CHUKA UNIVERSITY

Knowledge is Wealth/Akili ni Mali (*Sapientia divitia est*)

9th International Research Conference

Theme: "Exploring new frontiers in education, research and innovation for economic recovery"



Proceedings

Published in 2023

Chuka University is …. Inspiring Environmental Conservation for Better Life

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CHUKA UNIVERSITY FUNDAMENTAL STATEMENTS

Motto: Knowledge is wealth

Slogan: Inspiring Environmental Sustainability for Better Life

Philosophy: Quality education, training, research, extension, environmental sustainability, and entrepreneurship lead to social cohesion, human integrity and economic development

Vision: A Premier University for the provision of quality education, training and research for sustainable national and global development

Mission: To provide access, generate, preserve and share knowledge for quality effective and ethical leadership in higher education, training, research and outreach through nurturing an intellectual culture that integrates theory with practice, innovation and entrepreneurship.

Core Values

1) Customer Value and Focus
2) Diversity and Social Fairness
3) Environmental Consciousness
4) Fidelity to the Law
5) Innovation
6) Integrity
7) Passion for Excellence
8) Peaceful Co-Existence
9) Professionalism and Confidentiality
10) Prudent Utilisation of Resources
11) Teamwork
12) Timeliness and Devotion to Duty

DISCLAIMER

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PREFACE

Chuka University was the 9th Public University to be chartered in Kenya on 7th January 2013. This happened in fulfilment of a prophecy in 1951 by seer Jerusha Kanyua, when she proclaimed that: "a great mountain shall rise at Ndagani-Chuka, where birds from all over the world shall be coming to perch and then fly away happy after a while." Subsequently, the Chuka community built a Craft Centre in 1956 at Ndagani-Chuka. The Centre was upgraded to a Youth Polytechnic in 1969. In 2003, the community members felt that they needed an institution that could provide higher education and training access. They approached Egerton University to open a Campus in the Centre. Egerton University found Chuka to be centrally placed in eastern Kenya and hence suitable for establishment of a university campus.

On 21st August, 2004, when President Mwai Kibaki visited Chuka area and held a meeting at Ndagani, the Chuka community through their leaders informed him of their desire to establish a university in the area. Among the dignitaries who attended the meeting were Members of Parliament from the Greater Meru and Senior Government officials. The President supported the aspirations of the people of Chuka and Meru and pledged Government's support to establish a university at the site. Due to the goodwill of the Government, Egerton University Council approved establishment of a Campus at Ndagani in Chuka area.

The Campus was launched on 1st August, 2005 and the Youth Polytechnic in its place was re-located to another site. On 23rd August, 2007, President Mwai Kibaki elevated the Egerton University Eastern Campus to Chuka University College through Legal Notice Number 161. On 10th October, 2007, President Mwai Kibaki visited and inaugurated Chuka University College. After about five years, H.E. President Mwai Kibaki visited again and chartered Chuka University on 8th January, 2013, making it the 2nd public university to be chartered and the 9th full-fledged public university in Kenya.

The University is located at 186 km from Nairobi City, along the Nairobi-Meru Highway on the slopes of the snow-capped Mt. Kenya, and altitude of 1,500 m above sea level. The University's academic character is Environmental Conservation and Renewable Energy Studies, which is actualized through provision of higher education, training and research from Certificate to Doctorate levels in Agriculture & Environmental Studies; Humanities & Social Sciences; Business Studies; Education & Resources Development; Science, Engineering & Technology; Nursing & Public Health; and Law. This year, its alumni surpassed **26,754,** and are cherished for helping the University to realise its Mission through various initiatives.

In 2022, it entered the 9th cycle of holding Annual International Research Conferences. The theme of the 9th International Research Conference was: "**Exploring new frontiers in education, research and innovation for economic recovery**". Innovative research plays a pivotal role in promoting quality of life for humanity. The 9th Chuka University Conference aimed at fostering transformation of innovative research into enterprise outputs to meet contemporary nutritional, health and socio-economic societal needs. The conference was organized to contribute to the realization of the Kenya Vision 2030, UN Sustainable Development Goals and Global Economic Agenda blueprints such as Education for Sustainable Development, and Global Citizen Education.

Together with the subthemes, it aspired to link scholars, researchers, industrialists and policy-makers to establish firm partnerships for exponential development.

The Organizers set six subthemes to chart economic recovery. These were:
1. Frontiers in Agriculture and Environment Education, Research and Innovation
2. Frontiers in Humanities and Social Science Eduction, Research and Innovation
3. Frontiers in Education and Training, Research and Innovation
4. Frontiers in Science, Engineering & Technology Education, Research and Innovation
5. Frontiers in Hospitality and Business Education, Research and Innovation
6. Frontiers in Health and Affirmative Action Research and Innovation

The objectives were four:
1. To share new frontiers in education, research and innovation for economic recovery.
2. To revitalize policy through interrogation of contemporary and alternative knowledge.
3. To share research milestones to facilitate sustainable livelihoods.
4. To forge partnerships for collaborative education, research, innovations and entrepreneurship.

The Conference received over 150 abstracts from Kenya and beyond, comprising academicians, policy makers, researchers, industrialists, NGOs and CBOs, among others, from both public and private sectors. Many universities in Kenya were represented in the Conference either through direct entry or collaboration. Similarly, many allied institutions were also represented. We had a host of exhibitors participating through showcasing of their products, or presenting posters of their latest discoveries and works.

The organisers were truly grateful to all delegates who responded positively and immensely to our invitation. Delegates had a chance to listen to plenary sessions of their choice. Networking and exhibition sessions ran continuously and were scheduled during health breaks. The organizers invited several key lead speakers from pertinent industry sectors to curtain-raise the various breaker-out sections. The Conference ended with an excursion to some of the spectacular sites in the region.

The organizers packaged full manuscripts submitted into these proceedings and upgraded highest quality ones for review and publication in the Chuka University Journal for Environmental Sustainability Enhancement Research (JESAR) by January 2023.

Professor Dorcas K. Isutsa, Ph.D.
Ag. Vice-Chancellor/Deputy Vice-Chancellor (Academic, Research & Student Affairs)

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THE 9TH INTERNATIONAL RESEARCH CONFERENCE OFFICIAL OPENING SPEECH

Acknowledge: Chief Guest, lead speakers, collaborators, participants, staff, ladies & gentlemen, I warmly salute and welcome all of you to this 9th Annual IRC of Chuka University.

I am delighted by your attendance and patronage. I thank your host institutions for approving and facilitating you to grace our Conference.

Allow me to convey my gratitude to the local organizing board for a job well done in planning this Conference, whose theme is: **Exploring New Frontiers in Education, Research & Innovation for Economic Recovery.**

This theme has embodied various key-take-homes, including:

- **Exploring**, which refers to searching and finding.
- **Frontiers**, which refers to current/topical thrusts such as artificial intelligence, machine learning, robotics, e-learning, e-business, e-medicine and automation, just to name a few.
- **Recovery**, essentially from COVID-19 disruptions & poverty/dependency to achieving sustainable development of triple trajectories, namely social, economic & environmental.

Ladies and Gentlemen!

1. In this regard, we can contribute to achieving the call of this theme through clear understanding and application of the following aspects:

Education: *Albert Einstein* avowed that "Education is what remains after one has forgotten what one has learned in school". On the other hand, the great Nelson Mandela affirmed that "Education is the most powerful weapon that you can use to change the world". Education embodies both knowledge and skills. Therefore, there is need to equip oneself with the know-hows and then apply/practice them to make meaningful impact in economic recovery. This is in line with how learners go through theory and then practicals/participations to firmly concretize experiences, exposures, attendances and audiovisuals. Education is the foundation of everything we do in life to advance development. When not educated, what sets in is illiteracy, incompetence, ignorance, mediocrity, and analogue. Therefore, let us strive to embrace, share, disseminate and impart quality higher education in all our spheres of practice and operation.

Research: It points to generation of new knowledge, discoveries, creations, trends, policies etc. As higher education institutions, we are urged and encouraged to engage in research, extension and consultancy so as to differentiate ourselves from basic and tertiary institutions.

Innovation: This concept is equivalent to Intellectual Property (that is a creation of the mind). It generates the highest customer satisfaction and market value. Examples include: Originations; Revolutions; Inventions; Novelties; Modernizations; Improvements; Uniqueness; Modernisms; and Advances. In this connection, Chuka University has over 30 innovative products that are ready for commercialization. WE also urge and encourage you to aim at commercializing your innovations and intellectual property.

Commercialization: This is a process or method of introducing a new product onto the market.

- It does not necessarily need to have a monetary return, but it should be sustainable.

- Commercialization business model/strategy depends on evaluation of the innovation and inventor's aspirations, and includes:

1) Direct sale/transfer of common technologies
2) Assignment to another party
3) Collaboration/Contract research/Consultancy
4) Open innovation
5) Licensing
6) Spin-off company/Commercial exploitation

- **Commercialization challenges**, include the following:

1) Identifying correct partners
2) Lack of commercialization capital, leading to the death valley
3) Treatment as not the core business of universities
4) Low level of commercialization understanding
5) Not enough financial support
6) High cost of commercialization

- Nonetheless, university research outputs should be commercialized.
- "*The success of a particular research is not dependent on publication or recognition in a journal, but it is dependent on how far that research has been commercialized.*"

Thus, be ready to move from:



Ladies and Gentlemen!

2. Chuka University is ready to help you through the following:

a) Intellectual Property sensitization:

-Intellectual Property (IP) is a creation of the mind that can be protected by law. IP is an asset.

-IPRs include: Copy Rights, Industrial Property Rights (Patent, Utility Model, Industrial Designs eg pattern, Trade Marks eg words), Plant Breeder's Rights.

b) Technology and Innovation Support Centre (TISC) (CU launched it on 2nd March 2020)

1) TISC's are initiatives of the World Intellectual Property Organization (WIPO).
2) TISC's are established within a variety of host institutions, including patent offices, universities, research centres, and science and technology parks.
3) TISC's provide support services using trained local staff and promote effective use and access to valuable sources of technical and commercial information such as scientific and technical journals, patent, trade mark and industrial design information.

b) Journal of Environmental Sustainability Advancement Research (JESAR): It publishes high quality manuscripts. It is a web-based, open access journal. You are welcome to publish here free of charge once you submit through a Conference such as this one we are holding.

c) Proceedings: These are published using full papers presented in our Conferences. All full papers are accepted.

d) Internal Research Fund: It is seed money granted to Chuka University staff, students and their collaborators, whose projects are based in the University, for jump-starting research work. The fund can assist you get better prepared to apply for even bigger money from other donors.

e) Collaborations and Linkages: The University is regularly forging these with allied institutions to build teaching and research capacity, and for student and staff training and exchange. The University now has over 30 signed Memoranda of Understanding/Agreement with reputable institutions, located both nationally and internationally.

f) Conferences: They are organised annually to interrogate contemporary issues. Objectives are:

1) To share research milestones to contribute to economic recovery.
2) To forge partnerships and collaborations with industrialists and other stakeholders.

g) Open Research and Career Weeks: These are organized every three years to showcase, exhibit and uptake innovations. Staff, students and the general public are welcome to participate and attend. The next one will be held in March 2023. Therefore, start preparing to be part of it.

h) Short Courses, Workshops, Seminars etc: They are offered on need-basis or call-basis.

I, thus, hope you will find this Conference enriching and patronize future similar ones.

With these many remarks, I declare this Conference **officially opened**.

Thank you for listening and may God bless you all.

Subsequently, the Chief Guest, Prof. Walter Oyawa, Director General for the National Commission for Science, Technology and Innovation (NACOSTI) presented his keynote address.

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Professor Dorcas K. Isutsa, Ph.D.
Acting Vice-Chancellor/CEO

EVALUATION OF SEED QUALITY OF JUTE MALLOW (*CORCHORUS OLITORIUS*)

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ABSTRACT
Production of high quality seeds helps to increase crop yields. Currently, there are no high quality seeds of Jute mallow (*Corchorus olitorius*) from breeders to farmers, resulting in farmers using re-cycled planting seed whose quality is not assured. This has resulted in low yields due to many reasons, one of them being poor quality seeds. Yields of crop has remained low 2-4 tons/ha/annum compared to expected yield of 5-8 tons/ha/annum. Farmers use up to 7kg/ha seed instead of 5kg/ha, indicating 40% extra seeds used. Though Kenya Agriculture and Livestock Research Organization (KALRO) are focusing her efforts on generation of appropriate strains of the vegetable, little is being done to examine seed used by farmers for its quality. Objective was to examine seed quality of Jute mallow used by farmers at planting. A field survey was conducted using structured questionnaires in five Counties of Keiyo, Uasin Gishu, Nandi, Trans Nzoia, and West Pokot and Simlaw Seed Company. A sample size of 500 farmers were visited and interviewed by use of stratified random sampling method and seed simultaneously collected. Seed quality tests and data analysis on analytical purity, germination and seed vigor was done using ISTA (2004) procedures. Results showed high seed analytical purity of 99% from both Simlaw seeds and Uasin Gishu, indicating superior quality seed (above 98%). Lowest purity was from West Pokot (95%). Germination results showed Simlaw Seed (89%) was highest, while Nandi (37%) was lowest. Germination from three counties of Keiyo (57%), West Pokot (49%) and Nandi (37%) does not meet seed quality standard (above 60%). Electrical conductivity (E.C) results showed highest seed vigor was from Simlaw (2.3 $\mu Scm^{-1}g^{-1}$) and lowest from Nandi (8.2 $\mu Scm^{-1}g^{-1}$). It was concluded that planting seed used by farmers were of poor physiological quality and recommended they be trained on quality seed production.
Key words: Indigenous, Vegetable, Quality Seed.

INTRODUCTION
Jute mallow (*Corchorus olitorius*) is one among the African Leafy Vegetables (ALVs) consumed much worldwide (Abukutsa-Onyango, 2002). Governments worldwide have been advocating for its production and consumption in its strategy for food self sufficiency, though seed quality has been a hurdle in improving yields (MOA, 2019). Seed production is a biological industry and good agriculture depends upon good quality seed and one cannot develop or advance without affecting the other (Schippers, 2003). Agriculturally, seeds with assured quality can be expected to increase yields (Amarjit, 1995). Informal on-farm seed production systems are prevalent globally and are responsible for providing more than 90% of seed used in most countries, as well as being recognized as major system for seed supply (Adebooye *et al*., 2005). The challenge or gap in seed industry is that majority of small-scale farmers use on-farm produced and saved seed (Muliokela, 1999), but unfortunately available seed is usually of poor quality (Louwaars, 1994). It is surprising, though, how many farmers actually sell the best produce and keep the worst for seed, the exact opposite of what should be done. Such practice has lead to a rapid decline in seed quality and productivity, and therefore low profits (KALRO, 2019). The reason as to why most of the seed obtained from the informal sector is of low quality is that many farmers value the most 'adequate physical purity of seed' and reasonable germination percentages while other seed quality parameters are considered less important (Wright *et al.*, (1994) and K'Opondo *et al*., (2005).

The cost of seed is a small proportion of total growing costs, yet the final crop is as dependent on seed quality in terms of yield and product uniformity as on the cultural environment (Amarjit, 1995). The first step in crop improvement is a full assessment of the local material. More often than not, local seed materials are not of excellent quality and have led to non acceptance by farmers and consumers (George, 1999). During production, Jute mallow is mainly grown in kitchen gardens for home consumption and little for urban market (Abukutsa- Onyango, 2002). However, the problem is that they have been neglected in terms of research on agronomic aspects e.g. seed production and improvement (Ndinya, 2005). In most cases, they have been allowed to regenerate at onset of rains without serious efforts to plant new seed or even apply other cultural practices on them (Okongo, 2005). The local demand for the vegetables is still largely unmet and farmers have continued to use their own seed or purchase the scarce seed of unknown quality from the local market (K'Opondo *et al*., 2005) necessitating research on quality of seed used by farmers.

Seed quality test is science of evaluating seed potential for agricultural purposes. It is important in evaluation of the planting quality of field crop and vegetable seeds, and also in determining the quality of crop, flower, and tree seeds (Mc Donald, 1980, 1994). Seed quality is usually a composite of several factors, all of which contribute to the desirability or planting value of the seed. Each aspect of seed quality may be the result of different testing procedure (Ellis and Roberts 1980). The most direct method of testing the quality of seed is germination test, as it gives reliable counts of germination, judged by percentage emergence of healthy radicle in about 2-5 days. Other quick methods of testing seed quality include Tetrazolium tests for viability, electrical conductivity test, free fatty acid content test (Simmonds, 1976). A variety of tests of vegetable seed vigor have been suggested like Tetrazolium, Electrical conductivity and cool germination test which is similar to standard germination test except that temperature of 18^{o}C used and percentage of normal seedlings at 4 cm long is determined (Delouche, 1981). These simple tests show true germination capacity and vigor of stock and whether sowing rates need to be increased, so that correct plant populations are achieved.

There is little sense in sowing seed of low germination several times, in the hope that some miracle will overcome a basic seed fault. In practice, such marvels are rare and farming plans based on such hopes usually prove costly and frustrating. All seed should therefore be tested before planting, especially home-produced and stored over sometime, like over a year, which may have been kept in less than ideal condition. Seed rates and treatments can then be adjusted on the tangible facts of a properly executed and interpreted seed test. In countries where farmers produce their own seed and areas where seed testing services are absent, a farmer can test his/her own seed by placing seeds on a wet medium, such as cotton wool, newspaper or wet sand. In one or two weeks, depending on species he/she can obtain a reasonable estimate of percentage of normal plants growing also called seedling emergence which translates to field situation (Delouche, 1981).

Seedling emergence is the result of a large number of preceding processes, which occur against the often-hostile background of seedbed environment. Under these circumstances the chances of successful seedling emergence are greatly influenced by seed quality. If the quality of seed is low, then emergence will be low. Laboratory germination tests reveal differences in seed lot viability, which will inevitably result in differences in levels of seedling emergence (Benjamin, 1990). In general, poor quality seeds will have low viability, reduced germination and emergence rates, poor tolerance to sub-optimal conditions, and low seedling growth (Mc Donald, 1980). Physiological seed treatment on seeds generally act to improve seed performance directly by reducing the time to germination and seedling emergence, or indirectly by improving the seeds potential to cope with stresses such as limited water availability (George, 1985).

Seed vigor is sum of all those properties of seed that determine level of activity and performance of a non-dormant seed or seed lot during germination and seedling emergence (ISTA, 2004). A vigorous seed lot is one likely to succeed under a wide variety of field conditions, while non-vigorous ones are unlikely to produce a satisfactory stand under certain field conditions. A vigor test is however not a test for field response *per se* since field response of a particular seed lot may more closely correlate with vigor test or ordinary laboratory test, depending on nature of field conditions under which they are planted. A vigor test, therefore, is an examination under specific environmental conditions so as to provide means of detecting differences that are not discernible in an ordinary laboratory germination test (Perry, 1978). Direct vigor tests simulate pertinent unfavorable field conditions on a laboratory scale, and include: Brick Gravel, Paper Piercing and Accelerated Ageing tests. Indirect vigor tests measure certain physiological attributes of seeds and include: seedling growth rate (germination speed), Tetrazolium (TZ) test, Leaching/ Electrical Conductivity (E.C) test, Enzyme and Respiration test. In Electrical conductivity (E.C) test, measurement of electrical conductivity of leachates provides an assessment of extent of electrolyte leakage from plant tissues. Conductivity measurement is done on soak water in which bulk sample of seeds e.g. Pea, (*Pisum sativum)* seeds has been steeped gives an estimate of seed vigor. Seed lots that have high electrolyte leakage, that is, having high leachate conductivity, are considered as having low vigor, while those with low leakage (low conductivity) are considered high vigor. The conductivity test offers a vigor test for seeds (especially pea seeds), which relates to the field emergence potential of seed (ISTA, 2004).

Quality of seeds has profound influence on economic production of agricultural crops of all species, vegetables included, though there is limited good quality seed available of Jute mallow from breeders to farmers (Ndinya, 2005). This is because production of high quality seeds has not been practiced in many of the African leafy vegetables (Abukutsa-Onyango, 2002). Farmers have been getting re-cycled planting seed of *Corchorus olitorius* every season from the local markets and farms whose potential is not assured (Okongo, 2005). Yields of crop has remained low 2-4 tons/ha/annum compared to expected yield of 5-8 tons per ha per annum (KALRO, 2019), and the major constraints

has been use of poor quality seeds which forces farmers to use as much as 7kg/ha instead of 5kg/ha of seed required for a density of 250 000 plants/ha, which amounts to 40% extra seed (MOA, 2019). Seeds with assured quality can be expected to increase yields (Bhattacharjee *et al.,* 2000). Improved or quality seed for crop production of vegetable like Jute mallow can play an important role in improving food security, health and general rural livelihoods (Fondio and Grubben, 2004). Expansion of production of these vegetables continues to be hampered by lack of a reliable source of quality planting materials like seed and technical information (Ngoze and Okoko, 2005). This necessitated study to examine the seed quality of Jute mallow seed accessions used by farmers as planting material.

MATERIALS AND METHODS

Seed Material Sourcing for Research

Sourcing of seed was done from Keiyo, Uasin Gishu, Nandi, Trans Nzoia and West Pokot counties and Simlaw Seed where farmers were interviewed on agronomy of Jute mallow using a structured questionnaire and seed samples simultaneously collected. A sample size of 500 farmers was visited by use of stratified random sampling method. The seed samples collected were well-labeled and taken to University of Eldoret seed laboratory for seed quality tests of purity, germination and vigor as per ISTA, (2004) procedures and survey data analyzed using descriptive statistics and GENSTAT package.

Seed Testing as per ISTA, 2004

Analytical Purity Test

The objective of making a seed purity analysis was to determine mechanical quality of sample and percentage by weight of each component, and by inference composition of seed lot. In the test a seed sample which contained about 2500-3000 seeds was subjected to analytical purity and separated into three fractions of: pure seed, seed of other species, and inert matter. Quality seed is considered superior, if pure percentage of seed is above 98% and other species seeds are almost negligible or nil (below 0.1%) and inert matter percentage be as low as possible. From the sample submitted to laboratory, a working sample (weighed portion) was taken, by successive halving method, and moved to a dark smooth surface for ease of discerning. The analyst examined every seed of crop/others and inert matter, separating them into the said three fractions where each fraction was weighed and reported as a percentage of total weight.

Germination Test

In germination test, 400 seeds of Jute mallow were counted from pure seed fraction of purity test submitted-sample. The seeds receive no pre-treatment. The counting of seeds was done without discrimination as to size or appearance by hand and aid of counting board or vacuum counter. The seeds, arranged in four replicates of 100 seeds on Petri-dish, were placed in growth chamber and under favorable moisture conditions in accordance with methods prescribed by ISTA (2004). The replicates were examined and counts made of seedlings and seeds in the various categories required for reporting in ISTA (2004) protocol. Proper spacing of seeds was done to minimize contact of seedlings with each other during germination. The distance between seeds was not being less than 1 to 5 times the width or diameter of seed being tested. Normal seedling category showed capacity for continued development into normal plants and possessed all essential structures and included, well developed root system, intact hypocotyls and epicotyls. Abnormal seedlings included those damaged, deformed and decayed. Also checked was presence of hard, fresh ingeminated or dead seeds and reported.

Electrical Conductivity (Seed vigor) Test

Distilled water of 250 ml was measured and put in 24 well labeled flasks and covered with aluminum foil to control any contamination. Other 2 flasks of distilled water of 250 ml was each set aside as control and covered with aluminum foil. The flasks were put on bench for 24 hrs at room temperature (20-23^{o}C). Jute mallow seeds (50) were added to each flask and left to soak for 24 hours. The soaked seeds was then swirled gently for 10-15 seconds and conductivity (μ S $cm^{-1}g^{-1}$) of soak water was measured upon meter showing constant reading. Between measurements, dip cell was rinsed twice in distilled water and dried using clean dry paper towels. The conductivity per gram of seed weight for each replicate was calculated after accounting for the background conductivity of the original water and the average of the four replicates provided the seed lot result.

RESULTS

Analytical Purity Results of Jute Mallow Seeds

The highest seed purity percentage (99%) was from Simlaw Seed Company with 1% inert matter, while lowest (95%) was from West Pokot (95%) with impurities of 3% (other seeds) and 2% inert mater (table 1). Analysis showed only

Simlaw seeds and Uasin Gishu county seeds were of superior quality since their analytical purity percentages are above 98%. The quality of seed is considered superior if analytical purity percentage is above 98% (ISTA, 2004).
Table 1: Jute mallow seeds analytical Purity in percentage in nearest whole number.

County	% Pure Seed	% Other Seed	% Inert Matter
Keiyo	97	2	1
Uasin Gishu	99	1	0
Nandi	96	2	2
Trans Nzoia	98	0	1
West Pokot	95	3	2
Simlaw seed company	99	0	1

Seeds with highest impurities were from West Pokot (5%), Nandi (4%) and Keiyo (3%) and lowest were from Uasin Gishu, Trans Nzoia and Simlaw seeds each with 1% impurities.

Germination of Jute Mallow Seeds

The highest germination was from Simlaw Seed Company (89%), followed by Uasin Gishu (78%) and lowest was from Nandi County (37%), loosely next by West Pokot (49%) shown by table 2. The highest dead seed was Nandi County (56%) as well as West Pokot (45%) and lowest was from Simlaw Seed Company (9%) as well as Uasin Gishu (18%). The highest abnormal seedlings were from Nandi (7%), West Pokot (6) and Keiyo (5%) and least abnormal seedlings were from Simlaw seed (2%) and Trans Nzoia (3%).

Table 2: Germination and Emergence percentage of Jute mallow

County	Standard Germination test			% Emergence of radicle
	% Dead Seeds	% Abnormal seedlings	% Normal Seedlings	
Keiyo	38	5	57	62
Uasin Gishu	18	4	78	82
Nandi	56	7	37	44
Trans Nzoia	29	3	68	71
West Pokot	45	6	49	55
Simlaw seed company	9	2	89	91

Compared to ISTA (2004) minimum Jute mallow seed germination requirement of 60%, germination from three counties of Keiyo (57%), West Pokot (49%) and Nandi (37%) does not meet this minimum standard. The germination variation is eminent from comparisons in plate no. 1



A **B**

Plate 1: Germination comparison of seeds from Simlaw Seed Company (A) being higher than West Pokot (B)



Plate 2: Jute mallow seedlings; **(A)** Normal, (**B)** Abnormal having either shoot or root (**C)** Dead seeds - soft and rotten

Radicle Emergence (Emerged seedlings): This is all seeds that showed life (normal and abnormal seedlings) in the test (plate 2). Emerged seedling result showed Simlaw seed had highest seedling emergence of 91%, as opposed to counties' best being Uasin Gishu (82%) followed by Trans Nzoia (71%), (table 2). This shows Simlaw seed were best in terms of germination and emergence than the entire county's seeds. It was also observed that though seedling emergence of Trans Nzoia (71%) and Uasin Gishu (82%) was high, germination percentage were reduced to Trans Nzoia (68%) and Uasin Gishu (78%) by abnormal seedlings by 3% (Trans Nzoia) and 4% (Uasin Gishu). This trend was also observed in seed from other counties (Table 2).

Table 3: Cumulative seedling emergence in numbers on filter paper at growth chamber

County	Day 1	Day 3	Day 5
Keiyo	38	57	62
Uasin Gishu	66	73	82
Nandi	28	36	44
Trans Nzoia	41	60	71
West Pokot	31	44	55
Simlaw seed	72	81	91

Emergence results showed most of seeds germinated in all seed sources with Simlaw seed (72) being highest followed by Uasin Gishu (66) and lowest emergence from West Pokot (31) (table 3). This variation in seed emergence as seen also in plate 1 simulates the field if these seeds were planted actually on the soils in farm. On average over half of seed in the research germinated on the 1st day (Table 3).

Electrical Conductivity of Jute Mallow

The conductivity per gram of seed weight for each replicate was calculated after accounting for the background conductivity of the original water and the average of the four replicates provided the seed lot result (ISTA, 2004). From Electrical conductivity (E.C) analysis (table 4), there was significant variation in their readings and most were high but below 10 E.C, indicating that the seeds were of low vigor and poor physiological quality. The highest E.C/vigor was from Simlaw seed (2.33 $\mu Scm^{-1}g^{-1}$) as well as Uasin Gishu (3.12 $\mu Scm^{-1}g^{-1}$) and lowest E.C from Nandi County (8.27 $\mu Scm^{-1}g^{-1}$) as well as West Pokot County (6.71 $\mu Scm^{-1}g^{-1}$).

Table 4: Electrical conductivity reading in $\mu Scm^{-1}g^{-1}$ of seeds leachet from various sources

County	Mean E.C
Nandi	8.27±0.8
West Pokot	6.71±0.9
Keiyo	5.34±0.6
Uasin Gishu	3.12±0.4
Trans Nzoia	4.06±0.2
Simlaw seed company	2.33±0.3

The higher the readings of conductivity per gram of seed indicates low seed vigor /poor quality seed and readings above 10 $\mu Scm^{-1}g^{-1}$ such seed should not be used as planting material.

DISCUSSION

Analytical Purity of Jute Mallow Seeds

Analytical purity showed Simlaw Seed had highest purity percentage (99%) compared with seed from most of the counties except Uasin Gishu (99%) having equally high. West Pokot (95%) and Nandi (96%) had lowest purity. According to ISTA, (2004), quality seed is considered superior if purity percentage is above 98% meaning that apart from Simlaw seed, only two counties (Uasin Gishu (99%) and Trans Nzoia (98%) seed were of superior quality. Though so, Louwaars, (1994) observed that analytical purity *per se* is not gauge of good quality seed but a sum total of several seed attributes, needing more tests to ascertain seed quality, which the study also agree and outlaid.

Germination of Jute Mallow Seeds

Germination results show Simlaw seed Company (89%) was highest closely followed by Uasin Gishu (78%) and lowest germination was from Nandi (37%). This means that Simlaw Seed Company Jute mallow seed would do better in field than all of the seeds from Counties analyzed concurring with out-put of works by Ngoze and Okoko, (2005) and Bhattacharjee *et al.,* (2000). Equally good germinations were shown by Uasin Gishu (78%) and Trans Nzoia (68%). Compared to ISTA, (2004), which requires Jute mallow seeds germination to have minimum germination percentage of 60%, three counties of Keiyo (57%), West Pokot (49%) and Nandi (37%) did not meet required minimum standard for its accessions to be used as quality seed supporting similar studies by K`Opondo *et al*., (2005).

Simlaw seed had high seed vigor (91%), followed by Uasin Gishu (82%) and Trans Nzoia (71%) in terms of emergence as compared with low Jute mallow seed emergence analyzed from other counties including Keiyo (62%), West Pokot (55%) and Nandi (44%). This same trend could be expected to be performed in the field if these seeds were planted on the soils in farm concurring with research by Abukutsa-Onyango, (2002) and reports by KALRO, (2019), MOA, (2019). This low seedling emergence could contribute to low yields and supports what was observed by Mc Donald, (1980) and Benjamin, (1990) and was as result of abnormal seedlings or dead seeds. Such was evident in this research where the highest dead seed was Nandi County (56%) as well as West Pokot (45%) and lowest was from Simlaw Seed Company (9%) as well as Uasin Gishu (18%). Also contributing to low yields were high abnormal seedlings from Nandi (7%), West Pokot (6) and Keiyo (5%) and least abnormal seedling were from Simlaw seed (2%) and Trans Nzoia (3%). This concurred with results of other research including Amarjit, (1995), George, (1999) and Ndinya, (2005) on crop improvement and full assessment of local seeding material for quality aspect.

Electrical Conductivity (seed vigor) of Jute Mallow Seeds

Simlaw seed had the lower leachate conductivity of 2.33 $\mu Scm^{-1}g^{-1}$ as well as Uasin Gishu (3.12 $\mu Scm^{-1}g^{-1}$) meaning that the seeds were of high vigor and could be used for planting concurring with studies by Amarjit, (1995) and Schippers, (2003) indicating agricultural, seeds with assured quality can be expected to increase yields. Seeds from counties generally had high leachate conductivity with highest being Nandi (8.27 $\mu Scm^{-1}g^{-1}$) followed by West Pokot with Electrical conductivity of 6.71 $\mu Scm^{-1}g^{-1}$ as well as Keiyo (5.34 $\mu Scm^{-1}g^{-1}$) all the seeds were considered of poor quality. This means that though seeds from counties were of low physiological vigor, further tests on seeds needed to ascertain other reasons of why there was low quality concurring with research results of Louwaars, (1994) and Amarjit, (1995). Also studies by Wright *et al.*, (1994) and Okongo, (2005) recommend several seed tests needed to be done to find out why some seeds show poor performance in field yet laboratory results show high seed vigor.

CONCLUSIONS

It is concluded that Jute mallow seed grown by farmers though of high analytical purity is of poor physiological seed quality and low seed vigor as seen from the high percentage of dead seeds at germination and high leachet conductivity. The dead seeds could be result of immature harvested seed, diseased seeds, poor processing methods and storage conditions right from field to markets. It is recommended that breeders or seed companies avail new varieties or improved selections for farmers use as well farmers be trained on quality seed production and proper post harvest handling to improve seed quality.

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EFFECT OF NITROGEN FERTILIZER RATES ON THE ESTABLISHMENT AND YIELD OF NEW SUGARCANE CULTIVARS IN KIBOS, KISUMU COUNTY

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ABSTRACT
Sugar industry plays an important role in economic development of Kenya. Nitrogen is the primary nutrient limiting sugarcane production throughout the world. A study was conducted in Kibos during the year 2015-2018 on the effect of nitrogen fertilizer rates on the yield of new sugarcane. The aim was to determine the optimal nitrogen rates for the new sugarcane cultivars and to analysis the cost benefits of N fertilizer rates on new sugarcane yields. The treatments consisted of 11 cultivars KEN 98-367, KEN 98-530, KEN 98-533, KEN 98-551, KEN 00-13, KEN 00-3548, KEN 00-3811, EAK 73-335, KEN 82-121, KEN 82-601, KEN 82-493 and 3 levels of N fertilizer rates; 0kg Nha^{-1}, 80kg Nha^{-1} and 160 kg Nha^{-1} as top-dress at five months after planting. The experiment was laid out as 11 x 3 factorial in a randomized complete block design (RCBD) having three replications with a gross plot size of 5 rows 6m long and spaced at 1.2 m apart. Clean seedcane aged 10 months was used. The trial was harvested at 17 months for plant crop (PC) and 16 months for ratoon1 (R1). Data was analyzed by ANOVA. The results showed that significant differences were noticed in girth, stalk heights, R1sugarcane yields and nitrogen rates of R1. Stalk population, pol% juice and nitrogen rates of PC did no differ. KEN00-3811 out yielded all the other cultivars and EAK 73-335 was the worst performer. Therefore, there is a need for further evaluation on Kibos soil before appropriate nitrogen fertilizer rate is recommended. And the cultivar recommendation should be site specific.
Keywords: Sugarcane, cultivar, nitrogen and fertilizer rates

INTRODUCTION
Sugarcane (*Saccharum spp)* is the world's primary sugar crop and it is basically a tropical crop whose yield is significantly affected mostly by soil fertility. Sugar industry plays an important role in economic development of Kenya as it generates about KES 12 billion annually (KESREF 2014) and supports approximately 6 million Kenyans, (KSB, 2020). The increase in sugar production has largely come about as a result of breeding for high cane yield and sugar content. Currently there are many cultivars being planted in Kenya, some imported and others bred locally. Eight cultivars, KEN 98-367, KEN 98-530, KEN 98-533, KEN 98-551, KEN 00-13, KEN 00-3548, KEN 00-3811 and KEN 00-5873 were released in 2014 (Kenya Gazette June; July, 2014) and three cultivars KEN82-121, KEN82-493 and KEN82-601 were released in 2011. The time when the cultivars were released no appropriate nitrogen fertilizer rates accompanied them.

Nitrogen (N) is the primary nutrient limiting sugarcane production throughout the world (Wiedenfeld and Enciso, 2008). The large amounts of N fertilizer applied to most cropping systems support high yields (Robinson *et al.*, 2007). Early N fertilizer application results in lower cane yield, while the late fertilizer application results in lower sugar yield (Wiedenfeld, 1997). (Wood, 1990) reported that in most sugarcane producing countries of the world, NPK fertilizer ratios of 2:1:3 or 2:1:2 or 3:1:5 are commonly used.

Nitrogen use efficiency (NUE) has been well studied in many crop species, especially grain crops, where kernel N content is a key harvest index (Whan *et al.,* 2007). In contrast NUE in sugarcane has not been properly understood, since N is an insignificant component of the harvested product. However, increasing concerns about pollution from N run off due to excessive fertilization demand an improved understanding of NUE in sugarcane, so that applied N is effectively utilized (Whan *et al.,* 2007). Moreover, unlike in cereals, the longer span of sugarcane growth presents different challenges for efficient N use.

It has been reported that high Nitrogen supply can decrease the sucrose concentration in fresh millable stalks and consequently decrease the commercial value of the stalks (Grisham *et al*., 2005). Among the major nutrients, nitrogen plays a great role not only in increasing the yield but also in influencing juice-quality. High tissue nitrogen leads to continued vegetative growth and thus delays maturity; it produces late tillers and water shoots; it increases sheath moisture and soluble nitrogen content in the juice. Thus low sucrose, high reducing sugar contents and lower purities are common under excess nitrogen which ultimately leads to higher molasses (Grisham *et al*., 2005; Weidenfeld and Ensico, 2008). Gilbert *et al* (2008) reported that different N rates application influenced yield by either increasing or decreasing. Singels and Donaldson (2000) found that higher N fertilized cane showed higher cane yield. Therefore it

is important that at the time sugarcane cultivars are released recommended fertilizer rates for economic recovery of juice sucrose and good millable stalk is a requisite.

Economic feasibility of the fertilizer practices is an essential element of improving crop productivity (Kadian 0*et al*., 1981). Very often the farming is based on sound economics and the farmers generally adopt only those improved practices, which are more paying and easily workable. The studies done on the comparative economics of different fertilizer levels has shown that there is no additional income from the control plots, which did not receive any fertilizers. The calculated value cost ratio from different fertilizer applications varied between 5.78 and 10.36. (Khan *et al*., 2005) reported that sugarcane applied with 200 kgN ha^{-1} significantly out-yielded control and gave comparatively higher value cost ratio than the other treatments that had lower rates. However, they further demonstrated that all other fertilizer levels were found highly profitable over the control. This shows that the use of fertilizers in balanced amount will always remain profitable for the sugarcane growers.

Kenya Agricultural and Livestock Research organization (KALRO)-Sugar Research Institute (SRI) has the mandate to develop and release new sugarcane cultivars to the cane growers in Kenya (KESREF, 2001). When a new cultivar is released it has to be accompanied by agronomic packages so that its full potential is realized. In view of this, it was important to test the cultivars that were released in 2011 and 2014 using different N fertilizer rates to determine their nitrogen use efficient for optimal fertilizer use as this was not done at the time of release but blanket nitrogen rate of 100kgN ha^{-1} application was used. Currently the practice is, the time and method of applying as well as fertilizer doses given vary widely across the sugar zone and farmers apply anyhow during the year. Inadequate, imbalanced and untimely fertilizer application and anyhow planting date contribute to poor crop performance.

Limited work has been done to determine the optimal nitrogen fertilizer rate and nitrogen use efficiency of these new sugarcane cultivars. Determining appropriate N rates in the new sugarcane cultivars is important for effective use of fertilizer. Therefore, the objectives of the study were, 1) to determine the optimal nitrogen fertilizer rates for the eleven new released sugarcane cultivars, 2) to analysis the cost benefits of N rates on eleven new sugarcane yields.

MATERIALS AND METHODS

A field experiment was conducted in Kibos, during the short rain season of the year 2015-2018. Kibos is in humid area and is situated 16 km North-East of Kisumu City, latitude 0°2'N and longitude 34°48'E. The mean monthly maximum temperature is 31°C, and means monthly minimum temperature is 23°C. The mean annual rainfall is 1487 mm. The altitude is 1240 m above sea level (KESREF, 2001). The soil of the study area was mainly Nitisols (KESREF, 2001). Land preparation was done using a disc plough, and thereafter left to weather for 21 days before harrowing. Furrowing followed immediately.

Chemical analysis of experimental soil was conducted before planting the crop. The procedures used for chemical analysis of all the aforementioned soil are given in "Analysis manual of soil". The treatments consisted of 11 sugarcane cultivars KEN 98-367, KEN 98-530, KEN 98-533, KEN 98-551, KEN 00-13, KEN 00-3548, KEN 00-3811, EAK 73-335, KEN 82-121, KEN 82-601, KEN 82-493 and 3 levels of N fertilizer rates; 0kg Nha^{-1}, 80kg Nha^{-1} and 160 kg Nha^{-1} as top-dress at five months after planting.

The experiment was laid out as 11 x 3 factorial thus 11 sugarcane cultivars and three N rates as a top-dress in a randomized complete block design (RCBD) having three replications with a gross plot size of five rows 6m long and spaced at 1.2 m apart. Clean seedcane of the 11 cultivars aged 10 months was used and 24 of the three budded setts was planted in each furrow. Phosphorus (P) was applied at 80kgP ha^{-1} in furrows at the time of planting in the form of TSP (Tripple Supper Phosphate) and while N fertilizer was applied in the form of urea as per treatments. Confidor was applied @ 200 L ha^{-1} at planting to control the termites. Weeds in the crop were controlled manually. The crop was harvested at the age of 17 months and 16 months for plant and ratoon 1 crops respectively

Data Collected

Sugarcane Yield Components

Stalk Girth (cm)

Five cane stalks at harvest were measured by Vernier caliper from each treatment and averaged. Stalk girth is one of the determinants of cane yield.

Cane Length
Stalk length of ten canes randomly selected was measured (cm) from bottom to apices at the time of harvest and then averaged.

Stalk Population
The millable cane from the net plot of 21.6 m^2 from all treatments at harvest were counted and their number recorded.

Cane Yield at Harvest
The millable cane from 21.6m^2 of each plot were topped, striped and determined in kg by electronic balance then computed to Tons of Cane per Hectare (TCH).

Cane Quality (pol % juice) Determination
A sample of 6 millable cane stalks (representative sample) randomly taken from each treatment were collected immediately after harvest and cleaned. Two of the stalks for juice analysis were cut at a third top, next two at a third middle and last two a third bottom (Anonymous, 1970). These parts were mixed and crushed to determine pol% juice, which was determined by Saccharimeter

Economic Data
To assess the costs and benefits associated with different treatments the partial budget technique as described by CIMMYT (1988) was applied on the yield results. Economic analysis was done using the prevailing market prices for inputs at planting and for outputs at the time the crop was harvested. All costs and benefits were calculated on per hectare basis in Kenya shillings (KES ha^{-1}). The following concepts used in the partial budget analysis are defined as follows: Mean cane yield is the average yield (t ha^{-1}) of each treatment. The field price of cane yield is its point-of-sale which is calculated from tonnage price less harvesting cost per ton and the gross field benefit (GFB) ha^{-1} is the product of field price of cane and the mean yield for each treatment.

$$MRR\,(between treatment, a\ \&\ b) = \frac{Change in\ NB(NBb - NBa)}{Change in\ TCV\,(TCVb - TCVa)} \times 100$$

Data Analysis
Data was analyzed by analysis of variance (ANOVA) using GENSTAT vs 19 and means separated by least significance difference (LSD) at 0.05 level of significance

Table 1: Chemical soil analysis

Site- Kibos	P^H (H_2O)	Pppm	N%	Ca m.e	% C	Mg m.e	K m.e	CEC m.e
Field 13	5.3	14.3	0.22	3.4	1.5	1.31	0.3	9.4

RESULTS AND DISCUSSION
Sugarcane Yield Components
The sugarcane yield components consisted of, girth, stalk height and millable stalk population. The three components are the determinants of cane yield.

Girth
Significant differences were noticed in girth between the cultivars with KEN98-367 showing the highest thickness and KEN82-121 the lowest (Table 2). No significant differences were seen in nitrogen fertilizer rates and crop class (Table 1). The differences noticed in the cultivars girth might be attributed to varietal characteristics. There were no interactions between the treatments.

Stalk Height at Harvest
Stalk heights of crop class differed significantly (*P>0.05*) with ratoon 1 (R1) crop being taller than the plant crop (PC) (Table 2). The stalk heights of cultivars differed significantly (P>0.05). The cultivar KEN98-551 was significantly taller than other cultivars. Cultivar KEN82-493 was the shortest (Table 2). The nitrogen fertilizer rates did not influence the cane stalk heights. The differences observed in crop heights might be probably due to varietal differences and erratic rainfall experienced during the crop development period. No interactions of treatments were observed.

Millable Stalk Population
The millable stalk population of crop class, cultivars and nitrogen fertilizer rates did not show significant differences (Table 3).

Sugarcane Yield
There were significant differences in the yield among the cultivars only in Ratoon 1 (Table 4). On average cultivar KEN 00-3811 showed significantly superior stalk yield (tha^{-1}) than other cultivars. The cultivar EAK73-335 had the lowest yield. The cane yield of crop classes differed significantly with the yield of plant crop being superior to ratoon1 by 31% (Table 4). The nitrogen fertilizer rates influenced the cane yields in the first ratoon crop but not in the plant crop. This is in agreement with (Gilbert *et al*., 2008) who reported that different N rates application on sugarcane influenced yield by either increasing or decreasing. No interactions were seen between the treatments. It was expected that there will be differences in fertilizer rates for both plant and ratoon 1 crop, but this was contrary. The no response seen in the nitrogen fertilizer rates in the plant crop could be attributed to the imbalance of nutrients and nitrogen availability in the soil at planting time (Table 1). The response of fertilizer rates in ratoon 1 crop could be attributed to the depletion of initial nitrogen that was utilized by the plant crop.

Sugarcane pol% Juice
No significance differences were seen on sugarcane pol% juice between cultivars, crop class and nitrogen fertilizer rates. Similarly there were no interaction effects on the treatments (Table 5). This concurs with (Grisham *et al*., 2005) who reported that application of different nitrogen fertilizer rates can either decrease or has no effect on the sucrose concentration in fresh millable stalks of sugarcane.

Table 2; Girth and stalk height of the sugarcane cultivars as affected by nitrogen fertilizer rates

			Cultivar										
	CC	Rates	KEN98-367	KEN82-493	KEN82-601	KEN98-530	KEN98-551	KEN98-533	KEN00-13	KEN00-3548	KEN00-3811	EAK73-335	KEN82-121
Girth	PC	R1	2.6	2.43	2.57	2.6	2.55	2.6	2.47	2.6	2.6	2.53	2.57
		R2	2.63	2.57	2.67	2.57	2.6	2.53	2.67	2.53	2.57	2.57	2.5
		R3	2.63	2.53	2.53	2.57	2.65	2.57	2.6	2.5	2.53	2.53	2.57
	R1	R1	2.83	2.53	2.63	2.57	2.71	2.8	2.53	2.45	2.5	2.53	2.5
		R2	2.7	2.4	2.63	2.47	2.53	2.63	2.5	2.55	2.57	2.57	2.53
		R3	2.77	2.47	2.55	2.53	2.5	2.7	2.65	2.53	2.6	2.53	2.4
Stalk height	PC	R1	249.9	228.33	259.13	232	265.26	207.8	232.7	221.26	232.3	194.43	247.33
		R2	247.1	230.77	237.77	235.67	268.81	208.67	241.13	228	244.77	206.3	238.43
		R3	232.63	246	249.67	223.87	265.96	229.9	256.9	232.61	224	208	228.8
	R1	R1	289.2	237.73	275.53	279.3	298.27	293.06	274.27	293.78	291.17	260.07	288.23
		R2	280.53	259.83	282.63	279.07	290.87	300.3	274.73	245.28	294.43	248.53	280.53
		R3	301.3	236.73	292.56	273.6	275.63	279.21	286.13	238.53	291.37	282.53	267.7

Girth: CV%= 0.3and LSD $_{0.05}$=0.095, Stalk height: CV%= 3.3 and LSD $_{0.05}$=17.726.

Table 3: Millable stalk population of the sugarcane as affected by nitrogen fertilizer rates

		Cultivar										
	Rates	KEN98-367	KEN82-493	KEN82-601	KEN98-530	KEN98-551	KEN98-533	KEN00-13	KEN00-3548	KEN-00-3811	EAK73-335	KEN82-121
PC	R1	64,352	60,495	68,981	56,944	32,148	54,630	66,356	51,130	63,579	43,208	59,259
	R2	77,162	57,870	61,727	43,519	55,296	69,907	78,088	62,963	47,532	63,889	63,273
	R3	70,681	60,648	58,949	65,741	54,370	63,579	71,449	46,963	79,319	46,759	69,907
R1	R1	60,185	61,727	53,394	69,134	57,560	64,727	59,106	51,505	71,449	58,644	61,227
	R2	58,949	66,819	48,764	70,060	69,755	78,088	68,519	48,264	70,986	58,644	74,847
	R3	57,255	51,389	65,250	55,556	56,329	85,097	85,069	65,741	78,088	58,644	71,759

CV%= 24.8 and LSD $_{0.05}$=28.982.

Table 4: sugarcane yield of sugarcane cultivars as affected by nitrogen fertilizer rates

Variety	Yield (TCH)						
Fertilizer rate	**Fertilizer rate 0 kgN ha^{-1}**		**Fertilizer rate 80 kgN ha^{-1}**		**Fertilizer rate 160 kgN ha^{-1}**		**Mean**
Crop cycle	**Plant**	**Ratoon 1**	**Plant**	**Ratoon 1**	**Plant**	**Ratoon 1**	
KEN 98-367	99.91	66.59	114.74	62.04	98.65	61.27	83.86
KEN98-530	83.11	66.74	70.04	69.98	91.73	56.79	73.90
KEN98-551	89.83	61.02	89.27	71.53	82.54	61.27	77.51
KEN98-533	78.64	68.07	97.57	63.12	104.63	55.67	75.45
KEN00-13	89.63	62.19	100.47	69.21	100.20	84.44	82.73
KEN00-3548	81.03	53.07	74.07	59.51	86.29	65.20	66.76
KEN00-3811	94.75	72.26	76.28	74.00	75.68	81.22	84.95*
EAK73-335	64.33	58.72	78.63	61.11	62.36	60.41	64.27*
KEN82-121	87.88	60.37	93.04	74.00	98.13	45.29	75.93
KEN82-493	78.08	61.19	71.26	63.96	81.00	50.46	67.24
KEN82-601	97.68	58.33	87.68	49.92	88.09	68.33	72.87

CV%= 24.5 and LSD $_{0.05}$=14.930

Table 5: Sugarcane Pol% Juice of sugarcane as affected by nitrogen fertilizer rates

		Cultivar										
	Rates	KEN98-367	KEN82-493	KEN82-601	KEN98--530	KEN98-551	KEN98-533	KEN00-13	KEN00-3548	KEN00-3811	EAK73-335	KEN82-121
PC	R1	17.78	16.08	16.59	16.53	15.78	17.6	17.62	18.37	15.68	16.48	17.1
	R2	16.69	16.55	16.7	15.67	16.15	18.85	16.85	17.43	16.89	16.63	16.96
	R3	17.27	16.62	15.17	17.18	16.76	16.99	17.77	17.74	16.6	16.76	17.57
RI	R1	18.37	18.47	17.21	16.6	13.98	18.72	17.58	17.58	18.21	17.31	17.08
	R2	16.99	15.92	18.33	18.18	17.28	18.38	18.61	19.18	18.43	17.2	16.59
	R3	18.27	18.67	16.99	18.45	17.02	16.14	16.42	18.27	16.8	17.82	17.84

CV%= 1.9 and LSD $_{0.05}$=1.599

Economic Analysis

Marginal Rate of Return (MMR) for Cultivar and Nitrogen Fertilizer Rates

KEN98-551 at rate 0kgNha^{-1} had the best returns given the zero cost that varied and a return of 383,400 while KEN00-3548 at 80kgNha^{-1} was the worst in term of performance thus returns given a varying cost of 14,000. The marginal rate of return indicates the gains to the famer for adopting a certain cultivar with a specified nitrogen regime. In the table 6, moving from KEN00-3548 of 80kgNha^{-1} to KEN82-121 of 160kgNha^{-1}, the farmer will gain 9.76% in terms of net benefit and moving from to KEN82-121 of 160kgNha^{-1} to KEN98-533 of 160kgNha^{-1}, there will be 0% gain in net benefits and that's the trend as shown by the MRR% column in the table6

Table 6: Marginal Rate of Return for cultivar and nitrogen fertilizer rates

Variety	Rates	Tch	cost that vary	Marginal cost	Revenue	Net benefit	Marginal NB	MRR%
KEN00-3548	80kgNha^{-1}	10.3	14000		46350	32350		
KEN82-121	160kgNha^{-1}	45.3	28000	14000	203850	175850	143500	9.76
KEN98-533	160kgNha^{-1}	48.1	28000	0	216450	188450	12600	0.00
KEN00-3548	0kgNha^{-1}	43.9	0	28000	197550	197550	9100	307.69
KEN82-493	160kgNha^{-1}	50.5	28000	28000	227250	199250	1700	1647.06
KEN82-601	80kgNha^{-1}	49.9	14000	14000	224550	210550	11300	123.89
KEN82-601	160kgNha^{-1}	55.5	28000	14000	249750	221750	11200	125.00
KEN98-530	160kgNha^{-1}	56.8	28000	0	255600	227600	5850	0.00
EAK 73-335	160kgNha^{-1}	60.5	28000	0	272250	244250	16650	0.00
KEN98-367	160kgNha^{-1}	61.3	28000	0	275850	247850	3600	0.00
KEN98-551	160kgNha^{-1}	61.3	28000	0	275850	247850	0	0.00
KEN82-121	0kgNha^{-1}	57.2	0	28000	257400	257400	9550	293.19
KEN98-493	80kgNha^{-1}	61	14000	14000	274500	260500	3100	451.61

EAK73-335	80kgNha^{-1}	61.1	14000	0	274950	260950	450	0.00
KEN82-601	0kgNha^{-1}	58.3	0	14000	262350	262350	1400	1000.00
EAK73-335	0KgNha^{-1}	58.7	0	0	264150	264150	1800	0.00
KEN98-367	80kgNha^{-1}	62	14000	14000	279000	265000	850	1647.06
KEN00-3548	160kgNha^{-1}	65.2	28000	14000	293400	265400	400	3500.00
KEN98-533	80kgNha^{-1}	63.1	14000	14000	283950	269950	4550	307.69
KEN98-533	0kgNha^{-1}	60.6	0	14000	272700	272700	2750	509.09
KEN82-493	0kgNha^{-1}	61.2	0	0	275400	275400	2700	0.00
KEN00-13	0kgNha^{-1}	62.2	0	0	279900	279900	4500	0.00
KEN00-13	80kgNha^{-1}	69.2	14000	14000	311400	297400	17500	80.00
KEN98-367	0kgNha^{-1}	66.6	0	14000	299700	299700	2300	608.70
KEN98-530	0kgNha^{-1}	66.7	0	0	300150	300150	450	0.00
KEN98-530	80kgNha^{-1}	70	14000	14000	315000	301000	850	1647.06
KEN00-13	160kgNha^{-1}	73.2	28000	14000	329400	301400	400	3500.00
KEN98-551	80kgNha^{-1}	71.5	14000	14000	321750	307750	6350	220.47
KEN00-3811	80kgNha^{-1}	74	14000	0	333000	319000	11250	0.00
KEN82-121	80kgNha^{-1}	74	14000	0	333000	319000	0	0.00
KEN00-3811	0kgNha^{-1}	72.8	0	14000	327600	327600	8600	162.79
KEN98-3811	160kgNha^{-1}	81.2	28000	28000	365400	337400	9800	285.71
KE98-551	0kgNha^{-1}	85.2	0	28000	383400	383400	46000	60.87

CONCLUSIONS

The study has established that;

1) Application of nitrogen fertilizer on sugarcane cultivars plant crop showed no response. The response was noticed in cultivars ratoon 1. Therefore, no appropriate nitrogen fertilizer rate could be recommended.
2) The marginal rate of return indicated the gains to the famer by adopting a particular cultivar with a specified nitrogen regime

RECOMMENDATION

There is a need for further studies to be conducted on Kibos-SRI soil before appropriate nitrogen rates for the new sugarcane cultivars can be recommended

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RANKING INDIVIDUALS BASED ON PREDICTED PERFORMANCE USING MEAN NORMALIZED DISCOUNTED CUMULATIVE GAIN VALUE

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ABSTRACT
Accuracy of genomic prediction always relies on an appropriate choice of a statistical model to capture the relationship between the genetic architecture of a trait and the underlying marker calls in a panel of high-density marker data. However, the ranking problem has become an important subject in machine learning (ML) models, due to its widespread applications in many decision-making processes because the measures of rank quality are usually based on sorting, which is not directly optimizable. To counter this, mean normalized discounted cumulative gain value (MNDCGV), a standard quality measure in information retrieval with capabilities of ranking individuals according to breeding values has been proposed. Few studies have emphasized on the ranking of individuals based on predicted phenotypic values using MNDCGVs but none have been reported in animals. The focus of this study, therefore, was, to evaluate the prediction performance of DeepGS, RR-BLUP and Ensemble GS models using MNDCGV. The MNDCGV results showed the accuracy of GEBVs estimated using DeepGS was approximately equal to 0.75~0.78, RR-BLUP 0.66~0.76 and Ensemble 0.76~0.79 as a result of top-ranked alpha increasing from 10% to 70%. The Ensemble and DeepGS model outperformed the conventional RR-BLUP model by a significant margin (P<0.05), therefore they can be used as a supplement to RR-BLUP. Thus, Ensemble and DeepGS models can be given a top priority as GS model and as an alternative to conventional GS models in predicting the performance and ranking of individuals with high breeding values to be used for selection purposes in indigenous chicken breeding programs. Ensemble model performed very well in ranking individuals with better performance compared to DeepGS and RR-BLUP, with improvement values of 0.01 and 0.11, respectively. Thus, Ensemble model can be given a top priority as GS model for performance improvement.
Key words: Cross-validation, Genomic selection, Mean normalized discounted cumulative gain value

INTRODUCTION

Selection criteria based on phenotypes have led to substantial genetic improvement as a result of its ability to utilizes phenotypic or pedigree information in prediction of breeding values. However, with technological advances, there has been a growing interest in developing new statistical models and algorithms capable of predicting untested phenotypes in methods commonly used in genomic selection (Gonzalez-Camacho *et al*., 2018). This led to the development of genome-enabled prediction models in animal breeding (VanRaden *et al*., 2008) such as the Stepwise Regression, RR-BLUP and Bayesian Estimation. The conventional genomic prediction models predict phenotypes using all available single nucleotide polymorphism (SNP) marker data collected from a population using statistical models to predict the marker-trait associations (Meuwissen *et al*., 2001).

The accuracy of genomic prediction depends on an appropriate choice of statistical model. The model chosen should be able to capture the relationship between the genetic architecture of a trait and the underlying marker calls in a panel of high-density marker data (Mcdowel, 2016). Therefore, models such as DeepGS with ability of incorporating interactions between marker features have the capacity to achieve higher accuracy by capturing non-additive effects and noisy data. Ma *et al*. (2018) proposed an Ensemble model which intergrades DeepGS and RR-BLUP model where parameters are optimized using the particle swarm optimization (PSO) algorithm. This model was developed by inspiration from the social behaviour of bird flocking or fish schooling (Kennedy and Eberhart, 1995). Among many different statistical models developed, no much variation in accuracy of predicted has frequently been observed and reported (Roorkiwal *et al*., 2016).

Application of machine learning (ML) in genome-enabled predictions as a means of improving accuracy has been accelerated in recent years (Bellot *et al.,* 2018). The increased use of ML has been due to a growing interest in using semi- and non-parametric models such as, deep convolutional neural network, artificial neural network and ensemble model for genome-enabled prediction of quantitative traits to account for non-additive gene effects and higher non-linearities as well as genotype-environment interactions (Ehret *et al*., 2015). According to Blondel *et al*. (2015) predictive accuracy of most models are typically assessed using the Pearson's correlation coefficient (PCC) between observed trait values and the predicted trait values despite poor correlations with ranking accuracy.

In order to select the most favourable individuals to be used in genetic improvement programs, it is important to correctly rank individuals from the most favourable to least favourable based on accurately predicting breeding values (Blondel *et al*., 2015). The focus of this study therefore, was to evaluate the prediction performance of GS models using the mean normalized discounted cumulative gain value (MNDCGV) as described by (Blondel *et al*., 2015) which have been described as rewarding more strongly models which assign a high rank to individuals with high breeding value.

MATERIALS AND METHODS

Phenotypes and genotypes source

The phenotypes and genotypes data used for this study were obtained from a study done by Yuan *et al*. (2018) from Chinese indigenous chicken breeds. The study used 394 birds where hens and cocks of the different breeds were phenotyped for body weight (BW). Phenotyping for BW was measured at hatch and every week until 12 weeks of age. For genotypes, blood samples were collected for DNA extraction for all birds used in the study using phenol-chloroform method and diluted to 50 ng/ml. Genotyping was performed using Illumina 60K Chicken SNP BeadChip (Groenen *et al*., 2011). Quality control was done using customized scripts in R software version 3.3.0 (R Core Team, 2017).

Missing Markers and Coding

Imputation using A.mat function on the RR-BLUP package installed in R software (R Core team) were done to impute missing genotypes. This function takes care of markers with 50% missing genotypes. Genotypes were coded into {0 1 2} based on R code script.

Data Analysis

Cross-validation was used to evaluate the prediction performance of GS models as proposed by Crossa *et al*. (2016) and Gianola and Schon (2016). Five-fold cross-validation was used for this study, in which individuals in the dataset were randomly partitioned into five groups of approximately equal size. Using genotypic and phenotypic data, the GS models were trained and validated from four groups with 90% individuals for the training set and 10% for the validation set. The trained GS model was used to predict phenotypic trait of individuals from the remaining group using only genotypic data. This process was repeated five times until each group was used once for testing. The predicted phenotypic traits values were combined for performance evaluation. The entire five-fold cross-validation experiment was repeated ten times with different seeds used to shuffle the order of individuals in the original dataset. Therefore, for each given level of alpha, this procedure produced ten different mean normalized discounted cumulative gain values (MNCGVs), and the average was used as the final result.

The predicted performance for determining individuals with high phenotypic values to be used for selection for each GS model was assessed by measuring the MNDCGVs as described by Blondel *et al.* (2015). Given n individuals, the predicted and observed phenotypic values form a $n \times 2$ matrix of score pairs (X, Y). The MNDCGVs for selecting the top-ranked k^{th} individuals were calculated in an iterative manner as follows:

$$MNV(K, X, Y) = \frac{1}{K}((K-1)MNV(K-1, X, Y)) + \left(\frac{\sum_{i=1}^{k} y(i, X)d(i)}{\sum_{i=1}^{k} y(i, Y)d(i)}\right)$$

where, $d(i) = 1/(\log_2 i + 1)$ is a monotonically decreasing discount function at position i; $y(i,Y)$ is the i^{th} value of observed phenotypic values Y sorted in descending order, here $y(1,Y) \geq y(2,Y) \geq \ldots \geq y(n,Y)$; $y(i,X)$ is the corresponding value of Y in the score pairs (X, Y) for the i^{th} value of predicted scores X sorted in descending order; MNV is the mean normalized value of selecting the top individual. Thus, MNDCGV has a range of 0 to 1 when all the observed phenotypic values are larger than zero; a higher MNV (k, X, Y) indicate a better performance of the model to select the top-ranked k individuals with high phenotypic values.

Statistical analysis

The significance level of the difference between paired samples was examined using the student's t-test as implemented in R software. The mean separation was done to ascertain if the means for the top ranked individuals predicted by the three models were significantly different using least significant difference (LSD) at alpha=0.05.

RESULTS

The MNDCGV was used to evaluate the performance of DeepGS, RR-BLUP and Ensemble (integrated DeepGS and RR-BLUP) for selecting individuals with high phenotypic values for body weight. With top-ranked alpha increasing from 10% to 70%, the results showed that the MNDCGV for DeepGS was approximately equal to 0.75~0.78, RR-BLUP 0.66~0.76 and Ensemble 0.76~0.79 as shown in Figure 3. The top alpha for this work did not reach 100% because the number of individuals used was 394 and when subjected to fivefold cross-validation, 79 individuals remained for performance evaluation.

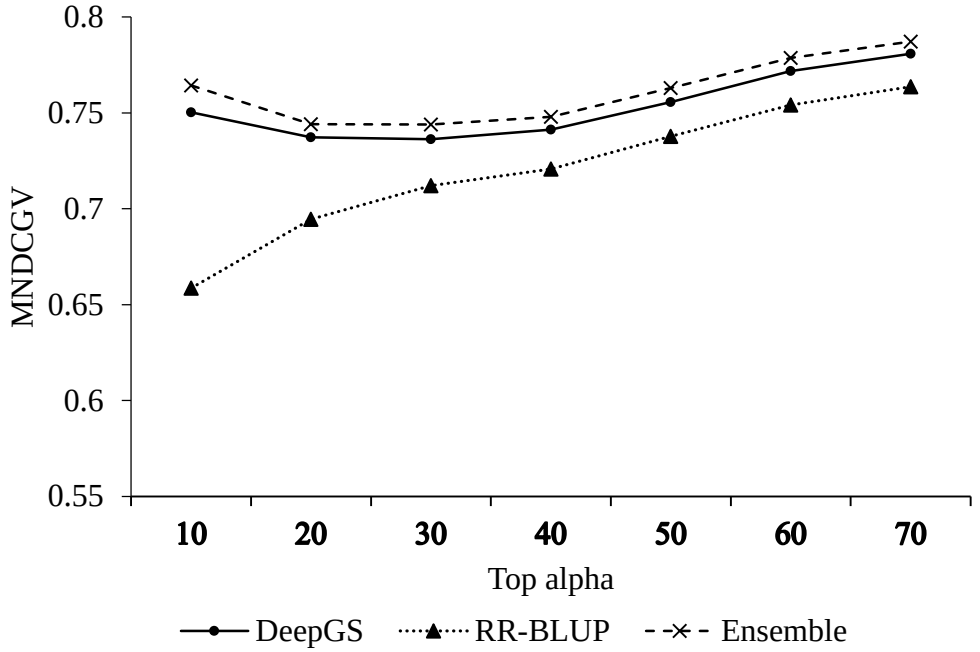


Figure 3: Mean normalized discounted cumulative gain values (MNDCGV) curves for DeepGS, RR-BLUP, and Ensemble model with top-ranked alpha increasing from 10% to 70%

The mean separation was done to using LSD at alpha=0.05 to ascertain if the means for the top ranked individuals predicted by the three models were significantly different. The results showed that MNDCGVs for DeepGS and Ensemble were significantly higher than those of RR-BLUP as shown in Table 3.

Table 3: Mean separation using least significant difference (LSD*) for GS models*

Model	Mean	N
Ensemble	0.76129[a]	7
DeepGS	0.75332[a]	7
RR-BLUP	0.72018[b]	7

Means with the same letter are not significantly different.

This study also aimed at investigating the performance improvement (absolute increment) for the three GS models. Integrated (Ensemble) model substantially improved the prediction performance over DeepGS and RR-BLUP. The absolute MNDCGV improvement (absolute increment) at the top-ranked level of alpha = 10% of Ensemble (0.76) over RR-BLUP (0.66) was 0.11 and for Ensemble (0.76) over DeepGS (0.75) was 0.01 shown in Table 4 and with P-values corresponding to 0.01 and 0.000107 respectively. Figure 4 shows the trend of the absolute increment of in MNDCGV of DeepGS and the ensemble GS models over RR-BLUP. When compared with RR-BLUP the median results showed that Ensemble model improved the MNDCGVVs by 0.03 and DeepGS improved by 0.02 corresponding to 3% and 2% respectively.

Table 4: Prediction performance based on MNDCGV for Ensemble, DeepGS and RR-BLUP with top-ranked alpha increasing from 10% to 70%

	MNV			Ensemble *vs* DeepGS	DeepGS *vs* RR-BLUP	Ensemble *vs* RR-BLUP
Top *α*	DeepGS	RR-BLUP	Ensemble	MNV improvement	MNV improvement	MNV improvement
10	0.75	0.66	0.76	0.01	0.09	0.11
20	0.74	0.69	0.74	0.01	0.04	0.05
30	0.74	0.71	0.74	0.01	0.02	0.03
40	0.74	0.72	0.75	0.01	0.02	0.03
50	0.76	0.73	0.76	0.01	0.02	0.03
60	0.77	0.75	0.78	0.01	0.02	0.02
70	0.78	0.76	0.79	0.01	0.02	0.02

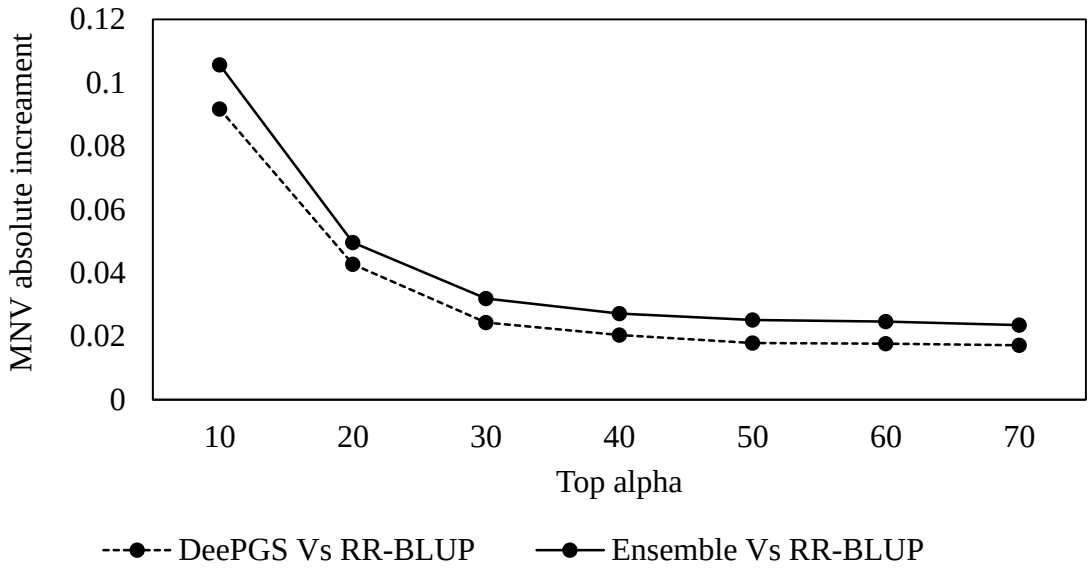


Figure 4: The absolute increase in MNDCGV of DeepGS and the ensemble GS models over RR-BLUP evaluated using fivefold cross-validation with five replicates

DISCUSSION

The ranking problem has become an important topic in machine learning, partly due to its widespread applications in many decision-making processes because the measures of rank quality are usually based on sorting, which is not directly optimizable. To counter this, mean normalized discounted cumulative gain value (MNDCGV), a standard quality measure in information retrieval with capabilities of ranking individuals according to breeding values (performance) has been proposed (Blondel *et al*., 2015). It has the ability of rewarding models which assign a high rank to individuals with high breeding values. It is also important to select a small number of individuals because selected individuals contribute their genetic materials to the next generation. If too many candidates are selected, selection intensity becomes low and it is not possible to obtain a good improvement of the target trait in the next generation (Blondel *et al*., 2015). The focus of this study, therefore, was, to evaluate the prediction performance of GS models using the MNDCGV.

The MNDCGV results showed that the DeepGS model was approximately equal to 0.75~0.78, RR-BLUP 0.65859~0.763621 Ensemble 0.764274~0.7871 with top-ranked alpha increasing from 10% to 70%. The Ensemble model and DeepGS model outperformed the conventional RR-BLUP model by a significant margin (P<0.05). The mean separation for MNDCGV results for the models showed that there was no significant difference between Ensemble and DeepGS model but RR-BLUP was significant different from the other two models. Therefore, Ensemble and DeepGS can be used as a supplement to RR-BLUP in predicting the performance of individuals with high phenotypes to be used for selection purposes in indigenous chicken breeding programs. A similar trend of results was reported in the phenotypic prediction of a wheat study done by Ma *et al*. (2018). The reason behind this difference in performance ranking is that both Ensemble, DeepGS and RR-BLUP models capture different aspects of the relationship between phenotypes and genotypes, this is attributed to the fact that the models used different algorithms to build regression-based models (Ma *et al*., 2018). Also, the integrated model (Ensemble) and DeepGS had an advantage over conventional models (RR-BLUP) because of their ability to handle categorical variables and missing values without prior imputation and estimate variable importance and interactions (Blondel *et al*., 2015).

The MNDCGV improvement at the top-ranked level of alpha = 10% results showed that integrated model (Ensemble) performed very well in ranking individuals with better performance compared to DeepGS and RR-BLUP, corresponding to 0.01 for DeepGS and 0.11 for RR-BLUP. This confirms a trend observed by Ma *et al*. (2018) and Blondel *et al*. (2015) in their study on wheat phenotypic prediction and a ranking approach to genomic selection respectively. This is attributed to the fact that ensemble model uses a particle swarm optimization (PSO) algorithm, which has the capability of parallel searching on very large spaces of candidate solutions, without making assumptions about the problem being optimized (Kennedy and Eberhart, 1995). This is also supported by Ma *et al*. (2018) argument on the combination of predictions of DeepGS and RR-BLUP to contribute to better performance.

Performance improvement was also evaluated by comparing the Ensemble and DeepGS model with respect to RR-BLUP. The median results showed that Ensemble model improved the MNDCGV over RR-BLUP by 0.03 and DeepGS improved by 0.02. This further affirms the fact that Ensemble model is superior and robust in performance improvement compared to DeepGS and RR-BLUP. Therefore, Ensemble model can be given a top priority as the GS model and as an alternative to conventional (ridged regression) GS models. The performance of ridge

regression model with respect to MNDCGV was not good for this study, these egos what Ma *et al*. (2018) reported but contradicts what Heslot *et al*. (2012) suggested on ridged regression model being the best models for ranking individuals.

CONCLUSION

The performance evaluation results for this study showed that the Ensemble and DeepGS model performed better than RR-BLUP. Therefore, for phenotypic ranking, this work advocates the application of Ensemble and DeepGS model to be used as a supplement to RR-BLUP in ranking of top performing individuals with high phenotypic values to be used for selection purposes. Also, for performance improvement this study suggests use of ensemble model because it has shown to be robust, powerful and effective in comparison to other GS models. Application of MNDCGVs in ranking top performing animals opens up a new avenue for selecting superior animals to be used for genetic improvement programs.

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INFLUENCE OF CONCENTRATES SUPPLEMENTATION ON MICROBIAL ACTIVITY OF MALE GOATS

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ABSTRACT
Ruminants have a unique characteristic to utilize fibrous fodder material through anaerobic fermentation. The rumen of a ruminant animal is a complex, open and self-contained ecosystem where nutrients consumed by the microorganisms such as bacteria, protozoa and fungi are digested anaerobically. The rumen located at the beginning of the gastro intestinal tract plays a major role because over 50% of the digestion takes place at the rumen. The feed consumed by ruminant animals is fermented by rumen microbes to volatile fatty acids and microbial biomass that serve as source of energy and protein for the host animal. Microbial activities in the rumen differ according to the type of roughages fed to the animals. Short- chain volatile fatty acids such as acetic, propionic, butyric acids, carbon dioxide, and methane and ammonia nitrogen are the products of fermentation in the rumen. Dry mature pastures provide unbalanced levels of nutrients and subsequently do not create the environment for efficient rumen metabolism and thus do not ensure an efficient utilization of absorbed nutrients. Feed intake and the nutrients absorbed from such diets are insufficient to meet the maintenance requirement of the animal and thus animals are bound to lose weight if they do not receive additional nitrogen and mineral supplements. Supplementation with crude protein, minerals, fermentable carbohydrates provide energy that enhances rumen microbial growth and improve voluntary feed intake despite being fed with low quality roughages. The addition of bypass protein such as sunflower seed cake results in a synergistic effect that could trigger considerable improvement on the average daily gain of ruminants and hence become more efficient in using available nutrients
Keywords: Ruminant animal's, volatile fatty acids, voluntary feed intake

INTRODUCTION
Feeding of high concentrate diet to high producing ruminants could cause a major negative consequence through the occurrence of subacute ruminal acidosis. Acidosis is defined as a decrease in rumen pH below a threshold value of 6. On a daily basis, goats adapt their feeding behaviour depending on the composition of the diet offered, especially in terms of the quality and quantity during the day. Small ruminants like goats might adapt to the diet offered depending on the percentage of concentrate in the diet. Ruminants have a unique characteristic to utilize fibrous fodder material through anaerobic fermentation (Kibria *et al*., 1991). The rumen of a ruminant animal is a complex, open and self-contained ecosystem where nutrients consumed by the microorganisms such as bacteria, protozoa and fungi are digested anaerobically. The rumen located at the beginning of the gastro intestinal tract plays a major role because over 50% of the digestion takes place at the rumen.

MATERIALS AND METHODS
Experimental Diets and Ration
The basal diet used in this experiment was wilted napier grass. The napier grass was harvested and delivered into the study area a day before the actual day of the experiment. The napier grass was properly chopped by a chaffcutter into 2- 3 inches' length and stored into gunny bags after chopping. The basal diet was offered to the experimental animals after the concentrate diet mixture was offered in the morning. A concentrate diet mixture constituting of ground maize flour (70%) and sunflower seed cake (30%) was offered before the basal diet was consumed by the goats. Clean and fresh water was provided in plastic containers firmly fixed in the metabolic crates. A mineral block was also provided in the feed trough. The concentrate dieters were offered 200 and 400 grammes per day while the control dieters were offered only chopped napier grass.

Experimental Animals
Twenty seven male goats tagged from three breeds, Toggenburg, Alpine and Small East Africa aged 16 months with an average weight of 20 kgs and dependent on their body condition and weight were used in the experiment. The goats were randomly selected from a population of 36 goats that had been kept at the experimental site for 11months. The animals were properly managed against endo-parasites and ecto-parasites through routine spraying, deworming and vaccinated against Contagious Caprine Pre- Pneumonia (CCPP). The animals were sprayed after every 3-4 weeks against ticks during the actual period of the experiment.

Animal Housing and Management
The experimental goats were housed individually in separate well ventilated pens measuring 4 feet's in Length by 3 feet's in width and 4 feet's in height. All the goats were housed in individual metabolic crate with free access to mineral salt block and fresh water provided in plastic containers. Four goats from each breed were randomly distributed to the three experimental treatment comprising control, low plane and high plane of nutrition.

Study Design
The design of the study was a 3×3 factorial experiment. The experimental animals were blocked into group of four animals per breed each based on their initial body weight determined before the experiment commenced. Each treatment diet was randomly assigned to each animal in the group within the block.

Analysis of Samples
pH Analysis
The pH of rumen liquor was analysed immediately after its collection from the rumen of twenty seven randomly selected goats (three per treatment) using a general purpose pH Meter.

Ammonia Nitrogen Determination
Fifty milliliters of rumen liquor well labeled and stored in a deep freezer was used to analyse for ammonia nitrogen concentration (Mingung *et al.,* 2019). The samples were filtered through three fold cheese cloth. From each sample the ammonia nitrogen concentration was evaluated according to the Kjeldahl method. Five milliliters of aliquots of a standard solution were poured into glass tubes that were coupled in a Kjeldahl distiller. Two milliliters of potassium hydroxide solution (KOH) was added and the material was distilled in a Bolic acid solution (40g/l). The solution obtained from the distillation approximately 100mls was titrated with hydrochloric acid (HCL, 0.02N). Methyl red and bromocresol green were added go boric acid solution and was used as indicators. The NH_3-N concentration was estimated as follows: -

$$N\text{-}NH_3 = Vx0.02xFx14x100/A$$

Where:- A=Aliquot Volume
$N\text{-}NH_3$=Ammonia nitrogen concentration (mg/dl)
V=Volume of hydrochloric acid (ml)- Titre volume
F=Correction factor of the hydrochloric acid after standardizing with 0.02 sodium carbonate
14=the atomic weight of nitrogen



Figure 1: Extraction of rumen liquor for pH and ammonia nitrogen analysis

Statistical Analysis
Data collected from each experimental animal for both ammonia nitrogen and pH was entered into the computer for later analysis. The data was subjected to a two-way analysis of variance (ANOVA) with the aid of the standard error test for the comparison of means (SPSS, 2008). Data was analysed using the GLM procedures of analysis of variance. Individual goats were the experimental unit for all measured variables.

RESULTS
Effect of Supplementation on Ruminal pH Levels
The mean of ruminal pH for the three breeds of goat is presented in Table (1). The ruminal pH for the three breeds Toggenburg, Alpine and Small East Africa was 6.76, 6.83 and 6.69 respectively. The mean of ruminal pH at different level of supplementation was 6.86 (Control), 6.65 (200gms) and 6.77 (400gms).

Table 1: Rumen fermentation parameters (Mean± SE) of goats fed diet at different levels of concentrate supplementation (Control, 200, 400 grammes per day).

Breed	**pH**	**Ammonia Nitrogen**
1	6.76^{bac}±0.04	5.83^{abc}±0.52
2	6.83^{ab}±0.04	5.69^{bac}±0.50
3	6.69^{cb}±0.04	5.29^{cab}±0.57
Levels	pH	Ammonia
0	6.86^{ab}±0.02	5.18^{cba}±0.42
200	6.65^{c}±0.04	5.76^{bca}±0.52
400	6.77^{ba}±0.05	5.89^{acb}±0.61
Hours		
	pH	Ammonia
0	6.93^{a}±0.041	5.38^{b}±0.34
3	6.75^{cd}±0.04	9.07^{a}±0.60
6	6.61^{d}±0.05	5.08^{cb}±0.46
12	6.77^{bd}±0.04	2.73^{d}±0.21

Breeds Ruminal Ammonia Nitrogen Levels
The ruminal ammonia nitrogen for three breeds was 5.83 (Toggenburg), 5.69 (Alpine) and 5.29 (SEA)(Table 1). The mean of ruminal ammonia nitrogen at different level of supplementation was 5.19 (Control), 5.76 (200gms) and 5.89 (400gms).

Effect of Sampling Hours on Ruminal pH and Ruminal Ammonia Nitrogen Levels
The pH of the ruminal liquor at four set of hours namely 0, 3, 6 and 12 hours was 6.93, 6.75, 6.61 and 6.77 respectively (Table 1). The ruminal ammonia nitrogen levels at the four set of hours, 0, 3, 6 and 12 hours was 5.38, 9.07, 5.08 and 2.73. 5.5.3 Effect of Sampling hours on ruminal pH and ruminal ammonia nitrogen levels

The highest level of ammonia nitrogen concentration in the rumen was after the concentrate diet was offered 3 hours. The ammonia nitrogen level decreased on a linear scale as the hours of sampling increased except after three hours. The lowest ammonia nitrogen level was recorded after 12 hours of rumen liqour collection. The ruminal pH and the ruminal ammonia nitrogen levels (Table 2) in this experiment for the three breeds was different and significant (Wanapat *et al*., 2007).

Table 2: Effect of breeds and plane of nutrition on level of significance

Parameter	**Level of Significance(pH)**
Breed	P<0.05
Level	P<0.05
Breedx Level	P>0.05
Parameter	Level of Significance (Ammonia nitrogen)
Breed	P<0.05
Level	P<0.05
Hours	P<0.05

DISCUSSIONS
Effect of Supplementation on Breed Ruminal pH Levels
The ruminal pH can vary depending on the diet and the time after feeding (Silveira *et al*., 2000). The high pH observed before feeding is related to the low amount of nutrients available to the rumen microbial metabolism and rumination activity of the animal. According to Orskov (1986) values above 6.2 ruminal fluid is considered as a minimum limit

for adequate fermentation of the fiber. The ruminal pH levels in this study were within the normal range of 6.0-7.0 for effective microbial rumen digestion.

Breed Ruminal Ammonia Nitrogen Levels

NH_{3-N} is regarded as the most important nitrogen source for microbial protein synthesis in the rumen (Puwadon *et al*., 2018) and the level in the rumen is usually high when feeds are more digestible (Erdmen *et al.*,1986). Kinyua, (2019), found that there was a significance difference ($p \leq 0.05$) in the rumen pH of the Kenyan Alpine and Toggenburg for the three trial diets fed at 6^{th} and 9^{th} hours post feeding. It was concluded that goats poses a unique characteristic of being able to maintain larger rumen ammonia nitrogen levels without noticeable rumen distension than sheep.

Diet Effect on Sampling Hours for pH and Ammonia Nitrogen

Goats utilizes most of their time ruminating than eating, regardless of the diet offered. This behaviour of goats is in accordance with study results obtained in lactating goats (Kawas *et al*., 1991) and cows (Maekawa *et al*., 2002). There was a significant difference observed by the interactions of treatments with the days of sampling. This suggests that ammonia levels in the rumen might be associated with the shift of the microbial population by time due to the addition of the concentrate mixture

CONCLUSION

This study demonstrates that supplementation of a basal diet with a concentrates diet improves rumen fermentation. Incorporation of a concentrates diet positively improved nutrient intake, digestibility, growth performance and feed conversion efficiency of growing meat goat (Chanjula *et al*., 2015).

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BLACK SOLDIER FLY (*Hermetia illucens*) LARVAE MEAL AS A SUBSTITUTE PROTEIN SOURCE IN FISH FEED

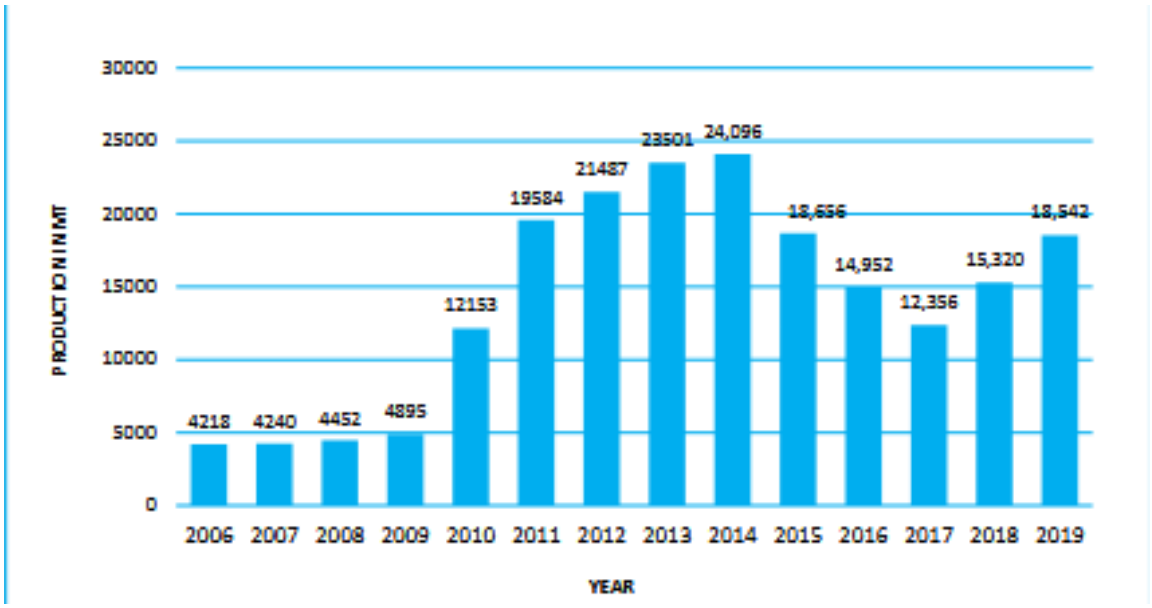
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ABSTRACT
The world fastest-growing industry for producing food is aquaculture contributing to food security. Aquaculture is currently thought to provide 50% of the food fish needs, and by 2030, it's anticipated that this percentage will increase to 60–70%. Due to the cost and food-feed competition, the use of fish meal in aquaculture is progressively becoming unsustainable; therefore, there is a need to look for an alternate protein sources. The scarcity and the prohibitive cost of the fish meal renders the fish feed expensive, halting the growth of the sector, therefore an alternative protein sources which is cheaper and sustainable to relief overreliance on fishmeal and insects such as the Black soldier fly (*Hermetia illucens).* The black soldier fly (BSF), *Hermetia illucens*, is one of these insects that has a high protein and fat content and the micronutrients increasing its potential for use in the formulation of aqua feed. Both the protein content and the amino acid composition in *H .Illucens* larvae are comparable to those found in numerous protein-rich foods including fish meal. BSF has the capacity to convert organic waste into a rich supply of nutrients, including proteins, lipids, micronutrients and chitin, helps to lessen the strain on the environment and the possibility for pollution resulting from the buildup of organic waste. This review shows black soldier fly larvae as a substitute protein source in fish feed. The study recommends the farmers to adopt the use of BSF larvae meal in poultry keeping.
Keywords: Aquaculture, Black soldier fly and Fish-feed

INTRODUCTION

The fastest-growing industry in the world for producing food is aquaculture. Nearly half of the world's seafood consumption comes from it. Aquaculture is currently thought to provide 50% of the food that fish needs, and by 2030, it's anticipated that this percentage will increase to 60–70% (Chanda et al., 2021). In recent decades, aquaculture has expanded, and farmed fish has seen an increase in global consumption (FAO, 2018). Global fisheries production increased by 174.0 Mt in total, of which 83.6 Mt came from aquaculture and 90.4 Mt from capture (FAO, 2022). The sector plays a significant role in the contribution to food and nutrition, which are increasing at an alarming rate due to the population increase, fostering food security and economic growth along the value chain. The aquaculture industry is expanding, mostly due to the feed industry. The world production of farmed fish climbed to 73.8 million tons in 2014 from 1.6 million tons in 1960 (Food and Agriculture Organization of the United Nations, 2017). Aquaculture's sustainability depends on affordable feed, which accounts for 60% of all operational expenses. Because of a variety of factors, including its high protein content, great amino acid profile, and outstanding digestibility and palatability, fish meal is an important part of every aqua-feed (Pereira et al., 2022). Kenya's fisheries industry plays a significant role in the nation's social and economic progress, even though it produces less than its potential (Kamau et al., 2021). The most important sources of fish include aquaculture (farmed fish) and ocean capture fisheries, with the latter having a considerably more significant role in the fish production systems in Kenya up to this point. Aquaculture has recently experienced significant growth. Kenya has made incredible strides toward promoting aquaculture. Kenya's Vision 2030, in addition to additional statutory, regulatory, and institutional frameworks, emphasizes the importance of aquaculture as a source of food security, the reduction of poverty, and the creation of jobs (Munguti et al., 2021). Through helpful government policies and significant government expenditure, aquaculture output in Kenya rose quickly from fewer than 1000 tons in 2006 to more than 24,000 tons by the middle of the 2010s (Obiero et al., 2019),) including in regions of the country where there is little historical production or consumption of fish (Ole-Moiyoi, 2017).

Between 150,000 and 300,000 metric tons (MT) of fish are estimated to be caught in Kenya's inland waters each year, mostly through commercial fishing. With a value of $237 million, overall fishery production in 2019 was 147,000 MT (KNBS, 2020). With the increasing adoption of semi-intensive and intensive fish production in the country, there has been an increase in demand for fish compound feeds to achieve optimal performance and profitability of the enterprise. The high cost of fish feed has been hampering the growth of the industry in Kenya (Munguti et al., 2021). Fish meal manufacturing is unpredictable and growing in demand, which raises market prices and the expense of production. Fish feed production costs should be reduced by replacing fish meal, either partially or entirely, with less expensive, protein-rich animal or plant sources (Hua et al., 2019). One interesting animal protein source that can be used in fish feed is insect meal, and in this case the black soldier fly, which has proven to be economically viable for mass production, sustainable, and environmentally friendly. As the largest class of species in the environment, insects are always available (Siva Raman et al., 2022).



Trends in aquaculture production in Kenya 2006-2019((Munguti et al., 2021)

A growing body of research and professionals have determined that incorporating insect meals in feed to increase feed and food security through formulation may be a creative strategy. Insects have been used as food for humans and are currently eaten as such in several regions of the globe (FAO, 2022b). However, using insect meal for fish feed is more popular with consumers since there is a degree of dislike for direct human ingestion in some communities rather than the ingestion of them. There has been a revival of interest in animal nutrition as a result of recent advancements, and the use of insects as animal feed ingredients is now widely recognized. Several studies have shown that edible insects are rich in protein and necessary amino acids, vitamins, and minerals. Insect meal can be used as feed for livestock and can also be used directly to treat organic waste-associated problems (Freccia et al., 2020), which is produced in large amounts and represents an environmental burden. The rearing of black soldier larvae leads to a significant reduction in waste moisture, waste volume, odor, and pollution potential. Insect meal from black soldier larvae (BSL) is included in the European Union Feed Material Register (Abd El-Hack et al., 2020). This study review aims to draw attention to the nutritional value of black soldier fly larvae (BSFL) and the feasibility of using it as a novel protein source in fish feed. It also highlights its contribution in terms of the bioconversion of organic waste into protein biomass by BSF.

Fish Feed Industry in Kenya and Its Challenges

Fish feeds is the most expensive animal feed in the Kenyan market today accounting for around 50%-70% of the total cost of production. Intensive and semi-intensive aquaculture systems which are being adopted by Kenyan farmers call for increased use of quality fish feed to achieve optimal performance (Munguti et al., 2021). Access to these quality and affordable fish feeds together with optimal utilization of the feed to maximize on profitability and viability of the enterprises. Most small-scale farmers fertilize their ponds with organic manure and locally available feed resources obtained from agro-processing. The high cost of the feed has led to low profitability of the fish enterprises (Okello et al., 2022). Fish meal has been used in fish diets because of its high protein content, and highly palatable and balanced amino acid composition but has been very expensive because of the overexploitation of fish in the natural sources (El-Sayed, 2020). In order to make the fish enterprise profitable for the farmers in Kenya to ensure accessibility of affordable quality feed to the farmers and the appropriate feeding management practices.

In Kenya, 90% of the cultured fish come from earthen ponds which are normally fertilized, and fish feed on agro-processing products. Before the inception of compounded feeds by the producers, they used to feed them on wheat bran, rice, cassava meal, and maize meal. These agro-processing products are low in protein, high in fiber, and not balanced with minerals and vitamins therefore less digestible, and less palatable resulting in low fish yield (Munguti et al., 2014). A study done at Sagana fish farm in Kenya on the growth performance of fish fed on different cereal bran showed that fish fed on maize bran had a better growth rate compared to those fed on rice and wheat bran thus the limitation of using brans in fish feed because of their high fiber content, low protein and less digestible (Munguti et al., 2021). The farmers have also tried to adopt homemade feed formulations using locally feed resources which have been faced with challenges because of the lack of understanding of the various nutrients requirements for various fish species and the nutritional limitations of various feed sources (Opiyo et al., 2018).

The increasing fish farming adoption in Kenya has been further boosted by the eight-year (2018-2025) Aquaculture Business Development USD 143.3 million funded by the International Fund, a program by the International Fund (IFAD) and the administration of Kenya (GoK). This project is currently promoting aquaculture among small-holders fish farmers and consolidating the fish production growth in aquaculture commerce and production (Munguti et al., 2022). The implementation of this program will ultimately result in higher demand for aqua-feeds, which calls for effective feeding management techniques. Additionally, increased production from aquaculture is associated with the

ongoing use of high-quality feeds that adhere to the nutritional needs of cultured fish, as well as the ideal feeding management techniques (Jennings et al., 2016).

This increase in fish farming has created an opportunity for demand for fish feed. There has been seen as an opportunity by the feed manufacturers who have gone to a point of manufacturing low-quality feed for farmers. This prompted the government to establish fish farming standards to curb this behavior. All stakeholders in aquaculture, including the Kenya Fisheries Service (KeFS), the Kenya Marine and Fisheries Research Institute (KMFRI), the State Department of Fisheries, Aquaculture and the Blue Economy (SDF&BE), and commercial fish feed, participated in a number of negotiations that culminated in the development of fish feed standards (Munguti, Odame, et al., 2021). The fish feeding standards established are to ensure the formulation of high-quality fish feed for farmers and to address the challenges of low protein levels, the presence of aflatoxins, and short shelf-life. The availability and cost of fish feed still remain a challenge to most of fish farmers. Feeding standards for Kenya tilapia, catfish and trout were created (Lall & Dumas, 2022).
Commercial fish feed in Kenya, for Nile tilapia (*Oreochromis niloticus*) and the African catfish (*Clarias gariepnus*) contains 245-34% and 30%-40% crude protein respectively. For most grow-out fish which are fed twice per day morning and evening their feed contains 25%-30% crude protein and fingerlings are fed 3 times per day at 3% of their body weight with 30%-40% crude protein. Compounded feed gives better results compared to feeding maize bran (Munguti, Odame, et al., 2021).

Kenya aquaculture is evolving from traditional to more modern aquaculture systems, the sector is faced with various constraints that are hampering its growth and the sector from meeting its full potential of the sectors. The various challenges include Inadequate readily available, cheap, and quality fish seeds(fingerlings), inadequate availability of high quality and affordable fish feed, inadequate supportive infrastructure for example fish propagation hatcheries, fish feed industries, fish marketing systems, especially for rural producers, Lack of enough budgetary allocation in the aquaculture sector. Additionally, the weak collaboration between researcher's farmers, and extension workers and linkages slow the adoption rate of fish farming technologies, innovations and management practices and lack of accessibilities to good credit facilities and schemes for fish farmers. Farmers are also facing the constraints of predators which invade the fish ponds and cages and thieves and poor record keeping (Munguti, Obiero, et al., 2021b).

The formulation of fish feed has a high protein level therefore it's dependent on high-protein feed resources such as fishmeal. Fish meal is used to formulate fish feed but has been scarce and very expensive and therefore looking for an alternative protein source that is economical, sustainable, and digestible with high crude protein will render the enterprise more profitable (Hoerterer et al., 2022). The insects have proven to have a high crude protein level, highly palatable, with a balanced amino acid profile for use as fish feed to replace fish meal.

Insect Meals as a Protein Source
Insects have for ages been used as human and animal feed for animals that scavenge on the environment. Insects have recently been given a lot of attention as potential protein sources as human food and animal protein source. With the increasing human population accelerating protein demand has to be addressed with sustainable meat production (Huis, 2022). In 2018, 1.1 billion tons of compounded animal feeds were produced and the demand is projected to keep increasing (Wilkinson & Lee, 2017). The prices of feeds have been increasing because of the increasing prices of fishmeal and soybean meal which calls for the world to look for an alternative protein source that is sustainable and economical (Karlsen & Skov, 2022).

Insects usually have a biological capacity to convert quality low-quality organic material into high-quality protein sources at a lower culturing cost of water, and land and less greenhouse gas emission (Derler et al., 2021). The most common insects or their larvae cultured as protein sources include yellow mealworm (*Tenebrio molitor*), house fly(*Musca domestica*), and the black soldier fly (*Hermetia illucens*) compared with soybean meal, fishmeal, and other plant protein sources insects are characterized by relatively high protein content, more balanced amino acids and highly palatable(Lange & Nakamura, 2021). Black soldier fly (BSF) has proven potential for mass production. It can be cultured on organic waste and produce larvae that are rich in protein of 37%-63% crude protein, fat (4.8%-38.7%), and well-balanced amino acid and fatty acids profile. It is also rich in minerals and vitamins. It also contains chitin which confers antimicrobial properties and is also less digestible (Li et al., 2022).

When BSF larvae meal replaced soybean meal and fishmeal in the proportion of 10 to 56% in broiler quails and chicks there was no adverse effect on growth performance, carcass characteristics, and meat composition (Cullere et al., 2016). When the diet of piglets was replaced with 5-10% of BSF larval meal to replace soybean demonstrated no adverse effect on growth performance (Veldkamp & Vernooij, 2021). The inclusion of BSF larval meal in layers meal has a shown satisfactory prolonged laying period, increased egg production, and yellow yolk (Abd El-Hack et al., 2020). BSFL has been found to the benefits growth performance of juvenile carp (*Cyprinus Carpio var.Jian*), shrimp, (*L.vannanzi)* and Atlantic Salmon (*Salmo salar*).

Black Soldier Fly Larvae

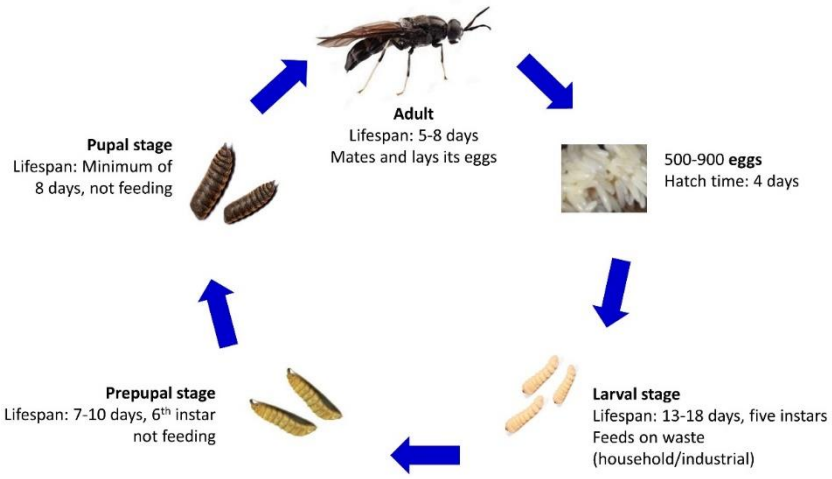
The black soldier fly (*Hermetia illucens*) belong to the Stratiomiydae family (Diptera) originated from South America and spread to temperate tropical and is now natural available within the environment and thrive in temperature of 25℃-30℃. An adult fly has a small and narrow head than the body with separated eyes in both sexes. The black soldier fly adults are sleek looking fly with a wasp like appearance and are black body with blue and green metallic reflection thorax and occasionally with a red-ended abdomen. They range between 15 and 22 mm in length (Miranda et al., 2019).The adults antennae are elongated with three segments head, thorax and abdomen and the legs are black with white coloration near the end of the legs, two wings which are membranous and folded horizontally in the abdomen and overlapped while resting and does not possess a stinger (Ushakova et al., 2016).

The male are longer than females but have smaller end genitals and wings and females have body lengths between 12-20mm and wings 8-14.8mm.There life cycle has five stages; egg, larvae, pupa, pre-pupae and adult which take about 22 days. The larvae and the pupal stage are the richest in nutrients which is also dependent on the rearing substrate with about 18-33% fats and 32-65.5% protein. The adults lack the mouthparts hence only take water, they are not involved in disease transmission (Lu et al., 2022).



Black Soldier Fly Life Cycle

The life cycle of the black soldier fly has five primary stages: the egg, larva, prepupal, pupal, and adult stages (Lu et al., 2022). The adult female fly lays between 500 and 900 eggs. The larval and pupal stages of the fly's life cycle last the longest, while the egg and adult stages are very brief. The eggs typically hatch in four days, though this depends on the season, location, and temperature. The larval phase lasts for six instars, with the largest instars measuring 20mm, and the smallest instars measuring 1.8mm (Liu et al., 2017). The larvae that hatch from the eggs begin feeding right away on a variety of organic materials, such as animal manure, rotting fruits and vegetables, and kitchen scraps (Purkayastha & Sarkar, 2021), with consumption rates rising significantly after the third instar . When the larvae reach the sixth instar, they undergo melanization, which gives them a darker cuticle and the insect stops eating during this stage and empties its digestive system. The pupal stage, during which larvae do not move or eat for at least 8 days, ends with the adult emergence. The adult fly feeds on water and relies on the fat reserves stored during the larval stage. The fly do not pollute the environment, harm to plants, homes, or restaurants instead (Mahmood et al., 2021) choosing to live in remote areas away from human habitat, mature, and mate. In 5-8 days, the fly mates, lays eggs, and shortly after ovipositing, the female dies (Ewusie et al., 2019).



Adopted : Rhuanito Ferrarezi

Nutritional Value of Black Soldier Fly Larval Meal

With great focus on the protein and fat content, the nutritional value of insects has been numerously researched. The protein and iron content of black soldier larvae diet are high. Its prospective use as animal feedstock is further supported by its fat content. The chemical composition of black soldier fly larvae (BSFL) meal will depend on the type of substrate diet and developmental stage can have an impact on its meals (Shumo et al., 2019). They can be utilized as either full-fat or defatted. Defatting removes fats and these increases the protein level of the meal (Heuel et al., 2021). The BSFL range from 35%-65.5% protein with an average protein level of 41% which is lower than that of soybean meal 45% crude protein and fishmeal 67.5% crude protein. Both full-fat and defatted BSFL has a good amino acid profile and considered more sustainable compared to soybean meal and fish meal (Esther, 2021). The most common essential amino acids were valine (average 40.1 g/kg, ranging from 28.2 g/kg to 67.9 g/kg), lysine (average 38.8 g/kg), and leucine (average 44.6 g/kg, from 27.8 g/kg to 78.3 g/kg). Even the valine content is larger than that of fish meal, and these three amino acid contents are higher than those of soybean meal. Methionine and tryptophan in the BSFL meal, are comparable to soybean meal and significantly less than fish meal, are the least abundant essential amino acids. Histidine and isoleucine contents are slightly greater than those of soybean meal and fish meal, ranging from 9.8 g/kg to 48 g/kg and 17.7 g/kg to 48 g/kg, respectively (Lu et al., 2022). Phenylalanine level varied from 16.4 g/kg to 77.6 g/kg, and threonine content varied from 16.2 g/kg to 45 g/kg, making them essentially identical to soybean meal and fish meal. Histidine and arginine levels are lower than those of soybean and fish meal (Lu et al., 2022; Ahiah, 2008).

The crude fat content of the full-fat BSFL meal range between 294g/kg-515.3g/kg which are comparably less than that of soybean (14g/kg and fish meal (103.6g/kg). For the defatted BSFL the crude fat decreased to an average of 69.2g/kg comparably less than soybean meal. They are rich in saturated and unsaturated fatty acids with the most abundant saturated fatty acids being the Lauric acid (C12:0) and the monounsaturated fatty acids the Oleic acid, linoleic acid and linolenic acids and palmitoleic acid. Lauric acid have antibacterial properties (Schiavone et al., 2017).

The ash content of the BSFL range from 27g/kg to 132g/kg with an average of 82.4g/kg which is relatively higher than that of soybean meal 71.9g/kg and lower than fish meal 171.5g/kg. BSFL are rich in calcium, copper, zinc, magnesium, iron etc. (Lu et al., 2022).

The Crude fiber content of the BSFL ranged from 41g/kg to 213g/kg with an average of 95.4g/kg which is slightly lower that of soybean meal 74.3g/kg and higher that of fishmeal 2.6g/kg (Lu et al., 2022).

The BSFL is made up of an exoskeleton which consists chitin whose active ingredient is chitosan which is about 61.7g/kg. Chitosan is a polysaccharide which confers immunological functions in the gut of the animal (Triunfo et al., 2022).

Table 1: Nutritional composition in g/kg dry matter

	BSFL MEAL								
TYPE	**DF**	**DF**	**DF**	**FF**	**FF**	**FF**	**FF**	**SBM**	**FM**
Crude protein	665.0	554.2	216.0	431.0	411.0	439.0	275.4	494.4	675.3
Crude fat	46.0	98.5	63.0	386.0	301.0	294.0	515.3	14	103.6
Crude fibre		74.0	70.0	41.0		213.0		74	2.6
Ash	93.0	81.0	93.0	27.0	93.0	132.0	65.9	71.9	171.5
Chitin	69.0	72.1	69.0	67.0					
	(Schiavone et al., 2017)	(N.V, 2021)	(Yildirim-Aksoy et al., 2020)	(Spranghers et al., 2016)	(Shumo et al., 2019)	(Onsongo et al., 2018)	(Tyshko, 2021)	(Council et al., 2012)	

DF-defatted meal FF-full-fat meal SBM-soybean meal FM-fish meal

Fig adopted: (Lu et al., 2022)

Black Soldier Fly Larvae Meal in Fish Feed

Black soldier larvae meal was approved for use in the fish feed in Aquaculture by the European countries (Oteri et al., 2021). The harvested pupae and pre-pupae can be fed to the fish, poultry and pigs (Holeh, 2022). They are also potential substitute of the fish meal and soybean bean meal in the fish diets of the Turbot, rainbow trout, Atlantic salmon, pacific white shrimp and Jian carp and *Oreochromis niloticus* (Zhang et al., 2022). Numerous studies have looked into the usage of black soldier fly larvae meal (BSFL) as a potential source of protein in tilapia diets. The findings of the current study further show that feeding fish up to 100% of the BSFLM inclusion level (complete replacement of fish meal (FM)) had no negative impacts on Nile tilapia growth performance, somatic indicators, or survival rate (Tippayadara et al., 2021). Mono-sex tilapia fed diets with BSFLM substituted with 50% of FM showed

comparable growth performance and feed utilization to the control group (Shati et al., 2022). Atlantic salmon (*Salmo salar*) also indicated good growth response when they were subjected to a BSF larvae meal where they showed good feed utilization, nutrient digestibility and the sensory qualities of the fillets when the fish meal in their diets was totally or partially replaced with the BSF larvae meal (Fisher et al., 2020). The weigh- gain of fish fed fish meal was comparable to that of fish fed BSF larval meal 80 g/kg in channel catfish (Tippayadara et al., 2021), 15% in rainbow trout (Caimi et al., 2021) 20% in brown trout (Mikołajczak et al., 2022), and 50-200 g/kg in Atlantic salmon (Lys and Met) (Fisher et al., 2020). Higher inclusion levels (120-300 g/kg) significantly reduced fish growth in channel catfish, rainbow trout, and turbot, and more than 330 g/kg inclusion levels would significantly reduce the palatability of the diet, protein digestibility, feed intake, and growth performance in turbot (Mohan et al., 2022). Increased chitin in higher inclusion levels of black soldier fly larvae or pre-pupae would impair the fish's ability to digest meals and thrive (Tran et al., 2022). Juvenile Japanese seabass (*Lateolabrax japonicus*) also showed good growth performance, good intestinal antioxidant activity and better immune response to 64% defatted black soldier fly larvae meal as a replacement for fish meal (Wang et al., 2019). The growth of yellowtail fish was reduced when 10%-30% of partially defatted black soldier fly meal replaced fish meal, the fat content in the black soldier fly may be causing the retardation yellowtail fish (Ido et al., 2021). To encourage excellent growth, black soldier fly prepupae raised on chicken waste and vegetable substrate can replace fish meal in rainbow trout (*Oncorhynchus mykiss*) diets up to 30% (Hoc et al., 2021). Black soldier can also be used as a substitute for up to 25–50% of the fish meal in the diets of ornamental fish, particularly for guppy *(Poecillia reticulate*) (Sanjaya, Y.; Suhara, Nurjhani, Mimin; Halimah, Mimi, 2014).When the black soldier fly meal level was limited to less than 29% and 15%, respectively, it was possible to achieve 95% maximum whole body protein and lipid content in pacific white shrimp (*Litopenaeus vannamel).* The Pacific white shrimp species, which have good weight gains, specific growth rates, and food conversion, substitute black soldier fly larvae meal for fishmeal to a lesser extent than 25% (He et al., 2022).

CONCLUSION

Fish farming is growing at high rate in the country and the increasing demand for fish meat calls for higher production and intensive production necessitate feeding with high quality feed and the use of black soldier fly larvae meal has proven a good replacement for expensive fish meal and soybean meal in fish feed.

I recommend the farmers to adopt the culturing black soldier fly as a cheap sustainable source of protein and environmentally friendly protein source reducing the reducing gas emission.

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EVALUATION OF TOMATO EARLY BLIGHT PATHOGENS' CHARACTERISTICS AND SUSCEPTIBILITY OF LOCALLY GROWN TOMATO VARIETIES TO EARLY BLIGHT INFECTION IN KIRINYAGA COUNTY, KENYA

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ABSTRACT
Tomato (*Lycopersicon esculentum* Mill) is a highly consumed and produced vegetable crop with an annual global production of over 185 million tonnes, due to its nutritional and health benefits. However, tomato production is characterized by inconsistent quality and yields partly emanating from biotic constraints attributed to fungal foliar diseases. In Kirinyaga County, where tomato production is a significant source of livelihoods, there exists knowledge gap on the identity of pathogens causing early blight in different Agro-ecological zones (AEZs) and on the susceptibility of locally grown tomato varieties to the infection. The objective of this study was to determine the characteristics of early blight pathogen isolated from tomato leaves collected from different AEZs and assess the susceptibility level of some tomato varieties grown in Kirinyaga County to the early blight pathogens isolates. Pathogen characterization was carried out using morphological and molecular approaches while susceptibility of tomato varieties to fungal pathogens was evaluated by artificial inoculation. Molecular characterization for fungal pathogen involved BLASTIN analysis of DNA amplicon Sanger sequenced nucleotides and use of NCBI databases. The susceptibility assay was carried out in the greenhouse using a completely randomised design (CRD). Data on the fungal conidia lengths (µm) were subjected to Analysis of Variance (ANOVA) and significant means separated by Least Significance Difference (LSD) at $\alpha = 0.05$. Data on the susceptibility (%) of tomato varieties to fungal pathogens isolates was subjected to ANOVA and significance means separated using LSD at $\alpha = 0.05$. Morphologies of early blight pathogen pathogens differed significantly ($p < 0.05$) with conidia lengths from 52.8 and 204.20µm. Molecular characterization of some selected culture implicated *Alternaria solani* and *A. alternate* involvement in causing early blight. Tomato varieties differed in their susceptibility to early blight pathogens ($p < 0.05$). Kilele F_1 was the most susceptible variety (73.84%) while Terminator F_1 was least susceptible (56.48%) to early blight pathogens. It can be concluded that Terminator F_1 was the least susceptible among tomato variety cultivated by farmers in Kirinyaga County and can serve as source for genetic improvement of tomato varieties for Kirinyaga pathosystem.
Keywords*:* AEZs, Early blight, characterization, tomato susceptibility, Kirinyaga County

INTRODUCTION
Early blight is a destructive and widely spread fungal diseases and may potentially causes tomato yield loses of up to 80% (Adhikari *et al*, 2017; Awan and Shoaib, 2019). Necrotrophic fungus in the genus Alternaria that include *Alternaria alternate, Alternaria solani* and *Alternaria tomatophila*, have been vindicated as the causative agent of early blight diseases (Awan and Shoaib, 2019; Wang *et al.,* 2022). Plants diseases limit chlorophyll levels and enhances build up injurious reactive oxygen species such as superoxide anion ($O2^-$), hydrogen peroxide (H_2O_2) which damage biomolecules such as lipids and nucleic acids (Sallam *et al*., 2021; Gulzar *et al.,* 2021). According to Sallam *et al*. (2021) The early blight pathogens further enhances ascorbic acid synthesis while limiting synthesis of antioxidant (Glutathione and soluble phenolic compounds), salicylic acid a stimulant, and catalysts such as polyphenol oxidase and phenylalanine ammonialyase which are necessary in plant protection in times of stress.

Tomato production is practised in different agro-ecological zones (AEZs) of Kirinyaga County ranging from zone LM4 to UM2 (Ogolla *et al.,* 2022a). These AEZs vary in climatic conditions (Jaetzold *et al.,* 2007) and tomato cultivation practices such as variety grown among other factors (Ogolla *et al.,* 2022b). Variations in microclimate i.e. humidity, temperature, light duration may influence pathogen selection, pathogen development and disease progress (Dillon and Meentemeyer, 2019; Gulzar *et al.,* 2021). Due to environment fluctuations which drives change in plant pathogen behaviour, adaptations and morphologies, the burden of disease control relies on positive and accurate identification of causing pathogen (Francisco *et al.,* 2019). According to Bhunjun *et al.* (2021), accurate pathogen identification is fundamental to farmers as it link the disease-causing pathogen with the already available information necessary for its management. Traditionally, identification of fungal pathogen entails an elaborate process that include pathogen isolation and characterization (Simmons 2007; Tan *et al.*, 2008; Sharma *et al.,* 2013; Lawrence *et al*., 2016). Phenotypic characterization has been predominantly used in identification of fungal pathogen include conidial shape, colour and septation (Meena *et al*., 2005; Kaur *et al*., 2007; Ramjegathesh and Ebenezar, 2012). However, phenotypic characterization provides variable results for different fungal phytopathogens. Kumar *et al*. (2008) evaluated characteristics of *Alternaria solani* from different agro-climatic conditions and observed yellow, brown, black, brown to greenish black pigments on potato dextrose agar medium. The conidiogenous hyphae varied in thickness from 1.17 to 9.56 µm. In the majority of the isolates, mycelial growth was smooth having circular or irregular margins that did not form concentric rings. Regarding cultural traits, variation in *Alternaria solani* strains from Jordan valley was reported with mycelial width range of 0.8 to 1.5 µm, conidia breadth of 35-75 µm, length of 10-20 µm, 2 to 7 transverse septa and 1 to 4 longitudinal septa (Alhussaen, 2012). In Limpopo, Mphahlele (2017) reported variability of *Alternaria solani* isolated from tomato leaves collected from four tomato production regions. Isolates were highly varied

phenotypically with reference to the pigmentation of mycelial, conidia length, septa number and diameter of the colonies. In Kenya, despite reported cases of tomato early blight in Mwea (Mugao *et al.*, 2021), little work has been done on characterization of the causative pathogens from different AEZs. Use of morphologies for identification of plant pathogens are tedious, require expertise and are hindered by fungal inconsistency and phenotypic plasticity (McCartney *et al.*, 2003; Toumatia *et al.*, 2015; Naroei and Salari, 2015; Luchi *et al.*, 2020). To resolve this inadequacy, there is need for development and use of advanced identification criteria, such as molecular techniques that allows comparative genome analyses to distinguish closely-related tomato pathogens is necessary (Adhikari *et al.*, 2017). A combination of phenotypic and molecular based identification approaches can provide more comprehensive knowledge of tomato foliar fungal pathogen in Kirinyaga County to facilitate management.

Improved tomato varieties such as Terminator F_1, Kilele F_1, Hansal F_1 and Riotinto F_1 have been introduced to farmers in Kirinyaga County. However, cases of early blight and other fungal diseases have persisted (Nuwamanya *et al*., 2021; Mugao *et al*, 2021; Ogolla *et al.*, 2022a). Success in breeding for the EB resistance have been slowed down by limited available effective genes for resistance particularly among the cultivated tomato (Chaerani, 2006). Therefore, ssusceptibility tests of tomato varieties to early blight disease may serve as guidelines for breeding of disease resistant cultivars, hence improving tomato production and income to farmers. According to Odilbekov (2015) and Adhikari *et al.* (2017), knowledge gap exists on the susceptibility of varieties of tomato grown by farmers to disease that include early blight among others. Thus, screening of local tomato varieties against early blight diseases in different pathosystems such as AEZ of Kirinyaga County is necessary to bridge the existing knowledge gap on their susceptibility to the pathogen in the area.

MATERIALS AND METHODS

Study Area

The fungal pathogen used in this study were isolated from diseased tomato leaves collected from farms in Kirinyaga County (Figure 2). Kirinyaga County is located in the Southern Mt. about 100 km North East of Nairobi (Serede *et al.*, 2015) at latitudes 0° 37'S and 0° 45'S, longitudes of between 37° 14'E and 37° 26'E with altitude ranges of 1,100 m to 1,200 m above sea level. The average annual rainfall is 940 mm with long and short rains occurring between April and May, and October to November, respectively (Jaetzold *et al*., 2007). Temperatures range from 12°C to 26°C with an average of 20°C. The AEZ in Kirinyaga County are grouped from Tea Dairy Zone LH 1 at the base of Mount Kenya National park, three coffee zones (UM 1, UM 2, UM 3), Marginal Cotton Zone in zones LM 3 and LM 4 [(Table 1) Jaetzold *et al*., 2007]. As shown in Table 1, soils types in Kirinyaga County differ within and across AEZs. For instance, whereas AEZ UM2 and UM3 comprises majorly of humic nitosols soil type, LM4 comprises of three soil types i.e. humic nitosols, eutric nitosols and pellic vertisols (Jaetzold *et al*., 2007). Preliminary studies carried out prior to actual study showed that tomato is grown in coffee zones, tea zones and largely in cotton zones through irrigation.

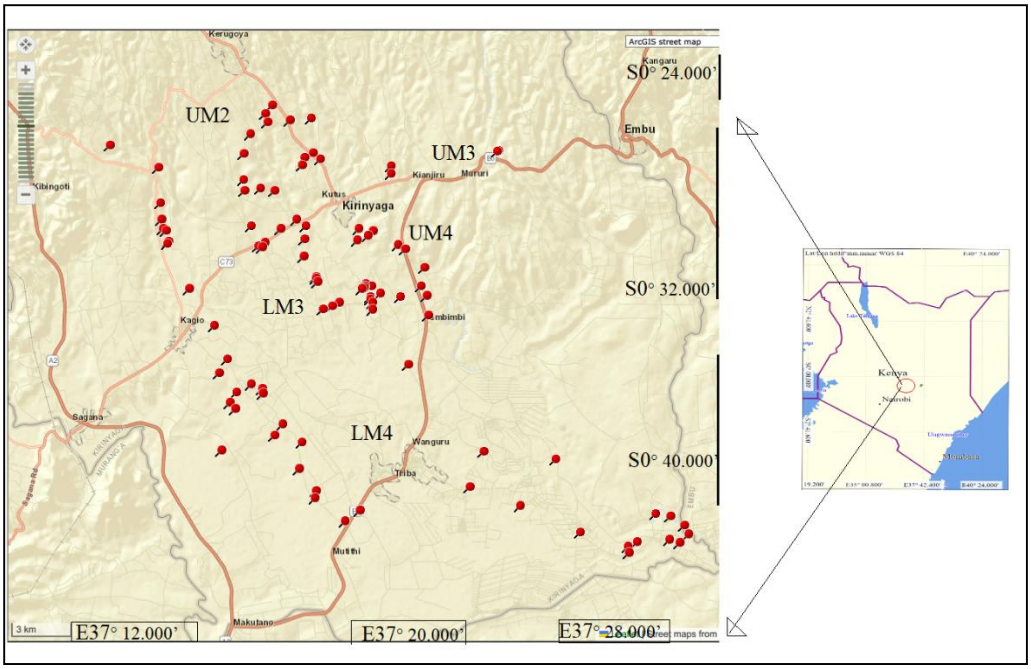


Figure 1: Map of Kirinyaga County showing agro-ecological zones (UM2, UM3, UM4, LM3 and LM4) surveyed for foliar diseases of tomato; where UM = Upper midland (1, 2 and 3), LM = Lower midland (3 and 4).

Specifically, the diseased tomato leaves used in this study were collected in five tomato growing AEZs of Kirinyaga namely LM 3, LM 4, UM 4, UM3 and UM 2 (Figure 2).

Table 1: Features of agro-ecological zones where diseased tomato leaves were collected in Kirinyaga County

*AEZs	Soil type	Altitude (m)	Temp (°C)	Subzone	Rainfall (mm)
UM2	Humic Nitosols	1400-1580	19.0-20.1	m/l + m/s	1220-1500
				m + s/m	1200-1250
UM3	Humic Nitosols	1340 - 1400	20.1-20.6	m/s + s	1100 - 1250
UM4	Humic Nitosols Eutric Nitosols	1280 - 1340	20.4-20.9	s/m + s	950 - 1200
				s + s	350 - 960
LM3	Humic Nitosols	1220 - 1280	20.9-21.2	s /m+ s	950 -1200
				s + s	350 -960
LM4	Humic Nitosols, Eutric Nitosols Pellic Vertisols	1090 - 1220	21.2-22.0	s + s/vs	850 - 950

*AEZ = agro-ecological zones, in the subzones, *m*= medium rainfall, *s*= short rainfall, l= long rainfall, *vs*= very short rainfall, UM = Upper midland (1, 2 and 3), LM = Lower midland (3 and 4) Jaetzold *et al.* (2007).

Experimental Designs

To determine the susceptibility of tomato varieties to foliar fungal pathogens 5 × 4 factorial experiment laid out in complete randomized design (CRD) and replicated 6 times was used under greenhouse conditions. There were two factors, i.e., tomato varieties 5 levels (Hansol F_1, Kilele F_1, Rambo F_1, Riotinto F_1 and Terminator F_1) and fungal isolates 2 levels (Early blight and control). Control treatment comprised of un-inoculated tomato plant for each treatment.

Isolation of Fungus Early Blight Leaf Spot Pathogen

A small piece of diseased leaf tissue (3 x 3 mm) at the margin of early blight lesion and healthy leaf part was cut using sterile blade. The cut lesion was surface disinfected with 0.3% sodium hypochlorite for 1 min, rinsed in 3 changes of distilled water to remove the detergent. The excisions were surface sterilized in 70% ethanol for 30 s, rinsed with sterile distilled water 3 times then blot dried using sterilized Whatman filter paper. Water free excised leaf parts were placed on PDA in the petri dishes and incubated for 1week at 25°C to realize optimal fungal growth. Upon growth of the colonies were viewed under the microscope and pure cultures prepared.

Purification and Identification of Fungus

Pure fungal pathogens were obtained by sub culturing in fresh PDA media. A flame sterilized scapel was used to cut the culture media with grown mycelia at the periphery and transferred in fresh media and were re-incubated for 2 weeks. After the pure mycelia had completely covered the plates, phenotypic characterization was done based on external cultural morphologies and by use of microscopy following scotch tape method (Kali *et al.*, 2014). In culture plates fungal phenotypic traits such as spore colour (SP), culture pigmentation, colour of colony margins (M-col), growth rate (GR) and Mycelial fluffiness [(MF) for late blight pathogen] were recorded during the growth phase of the fungal isolates to facilitate identification (Table 2).

Scotch tape method involved picking of the spore using transparent adhesive tape where the spores were picked from the plates using the adhesive side of the tape then placing the tape on the lactophenol cotton blue stain on the slide (Kali *et al.*, 2014). The slide was then observed under LCD phase contrast microscope light microscope (Model: OMAX 40X-400X) at × 40 objective lenses and microscopic details of the fungus observed, measured and the images photographed. Fungal characteristics assessed were; conidial length in µm, number of septa, and existence of beak and arrangement of conidia [(C-Arr) Table 2].

Table 2: Aspects of early blight pathogen isolates used for phenotypic characteristic

Cultural characteristic early blight pathogen isolates		
Growth rate (GR)	Colony margin (M-col)	Spore colour (SP)
1= Slow	1= Brownish	1= Greenish
2= Medium	2= Greyish	2= Greyish
3= Rapid	3= Whitish	3= Dark
Presence of Beak (PB)	No. transverse septor (T-Spt)	No. longitudinal septa (L-Spt)
1= Beak present		
2= Beak absent		
Conidia arrangement (C-Arr)	1=Single 2 = Chains	

The reference materials used for identification of early blight pathogen isolates included published material from related work (Kumar *et al.,* 2008; Loganathan *et al.,* 2016; Kaur *et al.,* 2020; Mugao *et al.,* 2021). Pathogenicity test was carried out for selected pathogen isolates for further identification and characterization. All the conidial measurements were taken in micro-meter (µm).

Pathogenicity Test and Aggressiveness of Early Blight Fungal Pathogen Isolates

Pathogenicity test was carried out as required by Koch's postulate (Agrios, 2005) on disease causing organism in a pot experiment in the greenhouse at Chuka University. Spore suspension (10^3 spores/ml) prepared from two weeks old pure cultures of early blight disease pathogen. The spores on the plates were scraped gently with an aid of scalpel and suspended in 100 ml distilled water then filtered through threefold cheese cloth. Haemocytometer (30 x 70 x 4mm) was used to standardize the inoculum to 10^3 spores/ml. Two-month old Terminator F_1 tomato variety was used in the pathogenicity test (Koch's postulate experiment). Terminator tomato variety was selected for pathogenicity test because it is grown in most areas where the pathogens were obtained. The leaves of tomato were sprayed with respective fungal pathogen isolates and were monitored for two weeks for the occurrence of early blight like disease symptoms.

To determine the aggressiveness of the early blight pathogens, detached leaf method described by Pryor and Michailides (2002) and Tymon *et al.* (2015) was used. Ten well developed mature and diseases free tomato leaves from Terminator F_1 were aseptically collected from green house. The leaves were transported to the laboratory in moist sterile zip lock bags. The leaves were rinsed under running tap water and surface sterilised with 70% alcohol for 5 seconds and rinsed again in three changes of sterile water to remove the alcohol. The water on leaf surface wiped using sterile blotting paper. Five sets leaves were pricked using sterile needle and inoculated with pathogen suspension (20 µl) of respective disease pathogens. The suspension was dropped at the point of the lesion and one leaf that served as the control was inoculated with 20 µl distilled water. Tomato leaves were then placed on sterile clean grid in a transparent glass desiccator (Diameter 300 mm height 240 mm). The desiccator had 250 ml of distilled water underneath to maintain humidity. The inoculated leaf area was monitored for seven days for development of lesion. The length (L) and width (l) of the lesion were measured for each leaflet inoculated. The lesion size (S in cm^2) was calculated using the formula below (Goufo *et al*., 2010).

$$S = \frac{\pi(L+1)^2}{4}$$

Molecular Identification of Selected Isolates

Molecular analysis of fungal pathogens isolated in this study was done at the University of Nairobi's Centre for Biotechnology and Bio-informatics. The DNA was extracted from 20 mg mycelia harvested by scraping the colony surface. The mycelia were ground into fine pieces using motor and pestle and placed into a 1.5 mL micro centrifuge tube containing 800 µL cetyltrimethyl-ammonium bromide (CTAB) extraction buffer (Final concentration: 2% (w/v) CTAB, 200 mMTris–HCl pH 8.0, 20 mMEDTA pH 8.0, 1.4 MNaCl, 1% (w/v) poly-vinylpyrrolidone, 1% (v/v) b-mercaptoethanol) (Lee and Taylor, 1990). The DNA extracts were dissolved in 50 µL of sterile distilled water and stored at 20°C for further use.

Polymerase chain reaction (PCR) was done using Thermocycler (Model C1000, Touch Biorad). Polymerase chain reaction was done in a 0.5 ml Eppendorf tube containing 10.5 µL ddH_2O, 12.5 µL Premix Ex Taq (Containing 0.625 U Taq DNA polymerase, 200 µM dNTP and 2 mM$MgCl_2$), 0.5 µL each of the two primers (10l M) and 1 µL DNA template (100 µgmL^{-1}). The internal transcribed spacer (ITS) region of ribosomal DNA (rDNA) of the isolates was amplified using primer set ITS1 [(50-TCCGTAGGTGAACCTGCGG-30) and ITS4 (50-TCCTCCGCTTATTGATATGC-30) White *et al.,* 1990; Lee and Taylor, 1990]. Amplification reactions was done with an initial denaturation at 94°C for 5 min; 35 cycles of denaturation at 94°C for 40 s, annealing at 58°C for 40 s, extension at 72°C for 1 min; and a final extension at 72°C for 10 min. Polymerase chain reaction products were checked using gel electrophoresis on 1% agar rose gel stained using ethidium bromide. The DNA amplicon (1µl) mixed with loading dye was assayed alongside 1kb 0 gene ruler plus ruler with initial reading at 75kb. The DNA loading bands were viewed on gel documenter imager (Bio- Rad). Positive DNA PCR products were cleaned using Quick cleaning kit supplied by Gene Script Company in readiness for senger sequencing. Sequencing of the DNA amplicons was done at the International Livestock Research Institute in Nairobi, Kenya using Sanger sequencer (Model: ABI 3730 genetic analyser) and The Big Dye Terminator v3.1.

The sequences (PCR fragment ITS rDNA) were compared with the record at the NCBI/Gene Bank database (www.ncbi.nlm.nih.gov/blast/). Multiple sequence alignment of fungal species obtained from the database were aligned using the Multiple Sequence Comparison by Log-Expectation program method in the Mega X version 11.0 (Tamura *et al.,* 2021). A phylogenetic tree of the pathogen sequences and those of related fungal species downloaded from the gene bank was generated using Neighbor-joining program and bootstrapping performed with 1000 replication to estimate the stability of branches (Saitou and Nei, 1987). Evolutionary distances of the species in the phylogenetic tree was computed using the p-distance method and output presented as the number of base substitutions per site (Tamura *et al*., 2018).

Susceptibility of Tomato Varieties to Different Fungal Pathogen Isolates

Five tomato varieties used for susceptibility screening were obtained from Kenya Seed Company in Nairobi. The nurseries of the 5 tomato varieties (Kilele F_1, Hansol F_1, Rambo F_1, Riotinto F_1 and Terminator F_1) were germinated separately in sterile germination trays in the greenhouse at Chuka University. The trays were watered every for three weeks before transplanting. Calcium Ammonium Nitrate (*CAN*) and Diammonium phosphate (*DAP*) was used to supplement the tomato growth. The growth bags used for growing tomatoes were 45 x 30 x 30 cm in size. The containers were filled with oven sterilized soil made up of sand, silt and compost (Ratio 3:1:1), respectively (Aslam *et al*., 2017). The three weeks old tomato seedlings were individually transferred to the plant growth bags (One plant per container) with each treatment being replicated six times. The distance between each tomato plant and the next was 0.5 meter. Watering was done by sprinkler every morning and evening to maintain humidity. Three weeks after transplantation, each variety was inoculated (By spraying) with 50 ml of respective fungi pathogen culture containing 10^3 CFU/ml determine by haemocytometer.

After inoculation, the tomato plants were watered at alternative days and plants inspected for the development of disease symptoms. At the end of 28 days after inoculation, the diseases symptoms were scored using the criteria and scale described in section 3.5.2 for individual diseases. The scores for different pathogens were used to calculate disease severity that represented the susceptibility of individual tomato variety used in the screening experiment. Susceptibility to *Septoria* leaf spot was categorised as resistant where the severity score ranged from 1 to 10%; Moderate resistant where severity ranged between 11 to 20%; Moderately susceptible where severity ranged between 21 to 40% and lastly, highly susceptible where severity score was above 40% (Raina and Razdan, 2010).

Data Analysis

Phenotypic Characterization of Fungal Pathogen Causing Tomato Foliar Diseases in Different Agro Ecological Regions of Kenya

Cluster analysis of data collected on the phenotypic traits was done using factoextra R package in R studio version 4.0.3. The normality test evaluated using Shapiro-Wilk test. Given that the normality test for conidial length and breadth gave non-significance ($p > 0.05$) Shapiro-Wilk test results, their means were subjected to the ANOVA using general linear model and significance means were separated using LSD in SAS version 9.4 at $\alpha = 0.05$.

Susceptibility Test of Tomato Varieties to Different Foliar Fungal Disease Pathogens

Data on the susceptibility based on percentages of severity of early blight had skewness value of 0.0119, Septoria leaf spot had skewness value of 0.003 and lastly late blight had skewness value of 0.210. Additionally, the normality test for all the tests had a $p > 0.05$ Shapiro-Wilk test result indicating that the data was normally distributed. Therefore, the data on susceptibility were subjected to the analysis of variance using the general linear model procedure in SAS version 9.4. Significant means were separated using least significant difference (LSD) at $\alpha = 0.05$ in SAS.

RESULTS

Phenotypic Characterization of Early Blight Pathogen

A total of 30 early blight pathogen isolates were obtained from diseases tomato leaves from different AEZ. Most on the isolates on potato dextrose agar were not different in terms of spore's colour on PDA. The isolates had green- dark grey spores and had dark pigmentation. The cultures had either regular or irregular margins (Table 3).

Table 3: Phenotypic characteristics of early blight pathogen isolated from different agro-ecological zones of Kirinyaga

AEZ [1]	Isolate	GR[2]	SP[3]	PB[4]	Mcol[5]	L-Spt[6]	T-Spt[7]	C-Arr[8]
LM4	EB _Gtg6	3	1	2	1	3	4	1
	EB _KBU3	2	3	1	2	0	1	1
	EB _ND1	2	2	1	1	0	5	2
	EB _ND4	3	3	1	1	2	4	2
	EB _ND7	2	3	1	2	0	3	1
	EB _WNG4	3	1	2	1	2	4	1
LM3	EB _KDG1	2	2	1	2	2	5	2
	EB _KDG9	3	1	2	1	1	4	1
	EB _KDO9	3	2	1	1	2	3	1
	EB _NYT4	2	3	1	2	0	6	1
	EB _NYT6	1	2	2	2	2	4	1
	EB _SRG2	1	2	2	2	1	5	1
UM4	EB _KGG1	2	2	1	1	2	3	2
	EB _KGG9	2	1	2	1	0	3	1
	EB _NDM3	3	3	1	3	3	5	1
	EB _NDM7	1	3	1	3	1	4	1
	EB _NJI2	2	1	2	1	1	4	2
	EB _NJI6	1	2	1	1	3	5	1
	EB _GTH3	1	1	2	2	2	4	1

UM3	EB _GTH5	1	2	2	2	2	3	1
	EB _KAM2	2	1	1	3	0	4	2
	EB _KAM3	2	1	1	3	0	4	2
	I EB _KAM8	3	2	1	1	1	4	2
	EB _THR9	1	2	2	2	2	3	1
UM2	EB _GEO3	2	2	1	3	0	3	2
	EB _GEO6	2	3	2	2	0	4	1
	EB _KER2	2	1	1	3	2	3	1
	EB _KER7	3	1	1	1	1	3	1
	EB _KRG1	1	2	2	3	0	4	1
	EB _KRG9	3	3	2	3	2	3	1

[1]Agro-ecological zones: UM = Upper midland, LM = Lower midland, [2]Growth rate (1= Slow, 2= Medium, 3 =Rapid), [3]Spore colour (1= Greenish, 2= Greyish, 3= Dark), [4]Presence of beak (1= Beak present, 2= Beak absent), [5] Margin colour (1= Brownish, 2= Greyish, 3= whitish), [6]Number of longitudinal septa, [7] Number of Transverse septa, [8] Conidia arrangement (1=Single, 2 = Chains),

Conidiophores of the *Alternaria* spp isolates were solitary or in groups and were either straight or flexuous. Morphologically, conidia differed in breath, length and presence of beak. The shape of conidia was straight or slightly curved muriform or ellipsoid. Conidia were tapering towards one end and were olivaceous brown in colour (Plate 1). The conidia's transverse and longitudinal septa varied ranging from 1 to 6 and from 0 to 2, respectively. The conidia appeared in chains or solely and some had beaks which were short, long or had no beak (Plate 1).

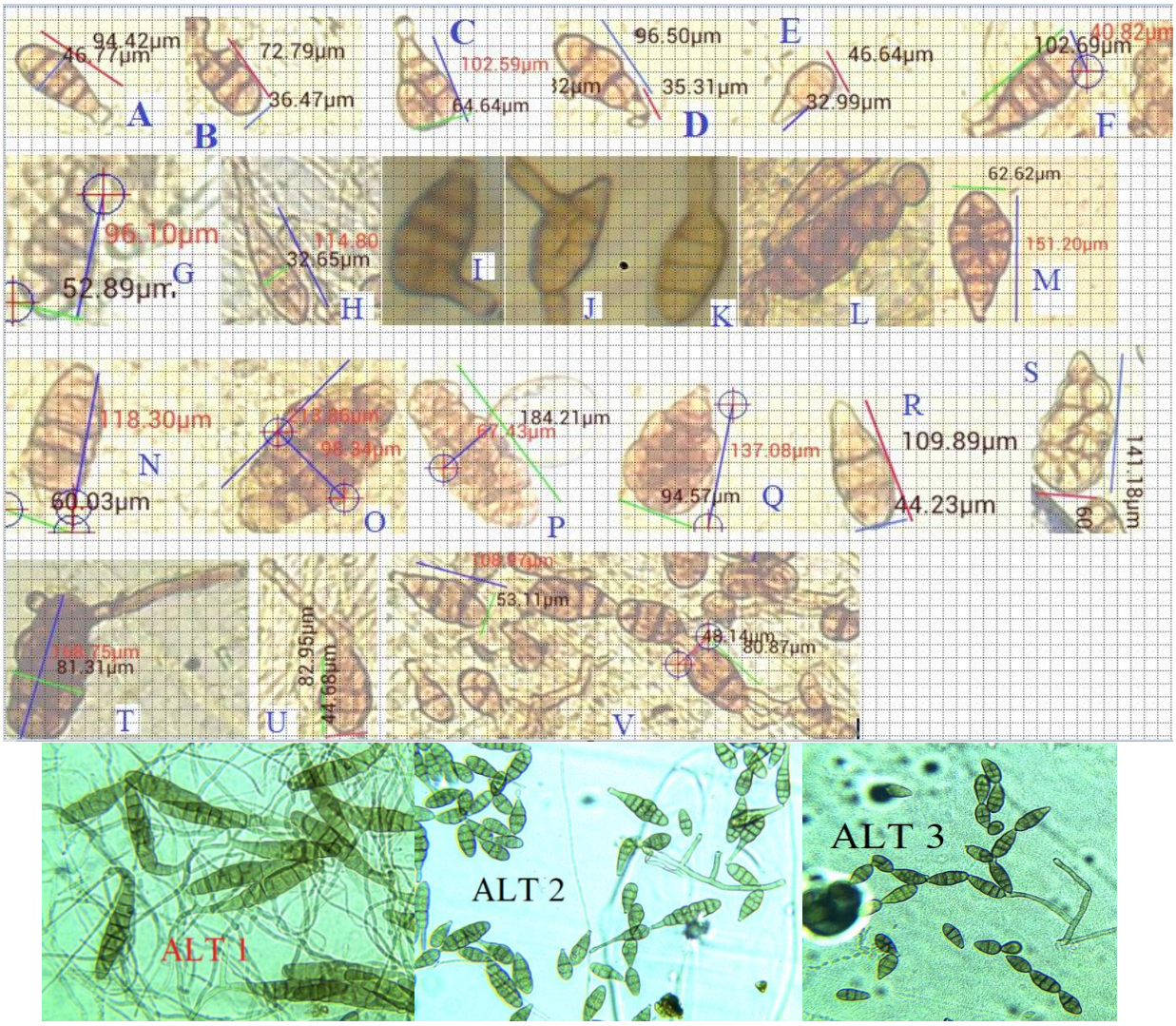


Plate 1: Selected conidia morphologies for the early blight pathogen (*Alternaria* spp) isolates from tomato leaves from Kirinyaga County, Kenya.

NOTE: Muriform shape (A, C, F, R, S), Pyriform (I, E, O, P), Cuneate shape (Q), Conidia with short beak (A, C, D, E), Medium curved beak (B and D), long beak (H and U) no beak (M, N, O, P, Q, R, S), ALT 1= Isolate EB-KAM8, ALT2= Isolate EB EB-NJ12-, ALT3= Isolate EB-ND4

Thirty early blight pathogen isolates from five AEZ (Table 3) were grouped in three clusters by euclidean distance constructed using phenotypic characteristics. The first and third clade comprised of 13 isolates each of which were further divided into two sub clades. The smallest clade comprised of isolates EB_KBU3 isolated from AEZ, isolates EB_LM4, EB_KD09 isolated from AEZ UM2 and isolate EB_KER2 and EB_KER7 both isolated from AEZ LM3 and AEZ LM4 and lastly, isolate NDM7 isolated from AEZ UM4 [(Table 3) Figure 2]. Isolate EB_KD09 and EB_KER7 had similar distance while EB_KBU3 formed a separate sub sub clade. Isolates EB_KD09 and EB_KER7 had similar growth rate, had beak, had similar colony margin, same conidia arrangement and number of transverse septa as outline in preceding Table 3.

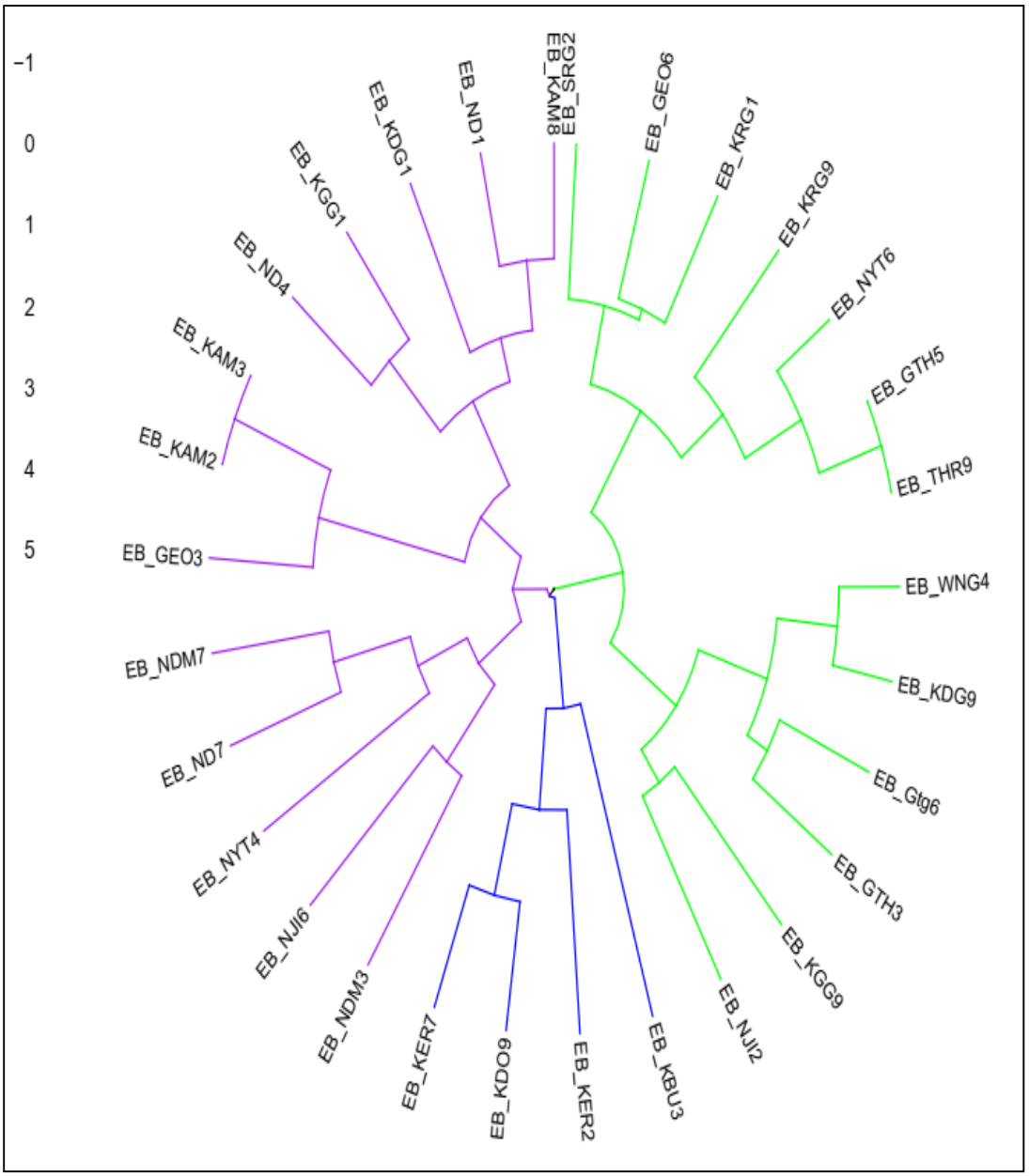


Figure 2: Cluster membership based on phenotypic traits of early blight pathogens isolated from tomato leaves from different agro-ecological zones of Kirinyaga County

There was a significant (F (29, 210) =8.25, p <0.0001) difference among the conidial lengths of early blight pathogen isolates from infected tomato leaves from different AEZ. In LM4, the lengths of early blight pathogen isolates were significantly (F (5, 42) =22.31, p <0.0001) different with the minimum and maximum conidial lengths measured being 52.8 and 194.2 µm, respectively (Table 4). Isolate EB_ND4 had longer conidia (148.37 µm) while isolate EB_KBU3 had smallest length of the conidia at 78.52 µm (Table 4).

In LM3, the lengths of the conidia of the early blight did not differ significantly (F (5, 42) =2.05, p <0.0909). However, conidia lengths ranged from 95.60µm to 204.6 µm, respectively.

In AEZ UM4, the lengths of the conidia of the early blight pathogen were significantly (F (5, 42) =3.93, p <0.0051) different where the minimum and maximum length of conidia lengths measured were 85.2 and 184.2 µm,

respectively. Isolate EB_NJI2 had longer conidial length (131.17 µm) while isolate EB_ NDM7 had short conidial length measuring 101.17 µm.

The length of conidia for early blight pathogen were significantly (F (5, 42) =5.30, p <0.0007) different in UM3 where the minimal and maximum conidia lengths measured were 64.2 and 159.4 µm, respectively. Isolate EB_KAM3 had longer conidial length (123.62 µm) while isolate EB_ GTH5 had short conidial length measuring 92.75 µm (Table 4).

Conidia lengths in AEZ UM2 differed significantly (F (5, 42) =2.59, p <0.0398) with the minimum and maximum lengths measured being 64.6 μm and 138.4 μm, respectively. Isolate EB_KER7 was significantly longer measuring 112.37 μm (Table 4).

There was a significant (F (4, 235) =8.25, p <0.0001) different in the length of conidia of the early blight pathogen isolated in the five AEZs. Conidia of the isolates in AEZ LM3 were significantly longer (130.5 µm) while those from AEZ UM2 were significantly shorter measuring 101 µm (Table 5).

Table 4: Conidia length and breadth of early blight pathogens isolated from diseased tomato leaves collected from different agro-ecological zones of Kirinyaga County

AEZ [a]	Isolate	N	Length (µm)	Breadth (µm)	Length (µm)		Length
					Min[b]	Max[c]	Anova
LM4	EB_Gtg6	8	123.72 ^{edf}	39 ^{h}	99.00	149.00	Cv = 17.86
	EB _KBU3	8	78.52 ^{m}	38.7 ^{h}	66.00	94.40	Mean= 115.71
	EB _ND1	8	83.95 ^{km}	48.83 ^{de}	52.80	109.00	p < 0.0001
	EB _ND4	8	148.37 ^{abc}	42.65 ^{efgh}	104.20	194.20	LSD = 20.85
	EB _ND7	8	97.97 ^{hijkl}	42.68 ^{efgh}	84.40	114.80	
	EB _WNG4	8	161.72 ^{a}	45.6 ^{efgh}	133.20	207.20	
LM3	EB _KDG1	8	139.85 ^{abcd}	41.1 ^{fgh}	104.80	180.40	Cv = 20.89
	EB _KDG9	8	138.50 ^{abcd}	41.77 ^{fgh}	108.40	174.60	Mean= 130.49
	EB _KDO9	8	150.3 ^{ab}	41.3 ^{fgh}	96.60	204.60	p = 0.0246
	EB _NYT4	8	124.5 ^{edf}	40.5 ^{fgh}	95.60	156.20	LSD = 27.52
	EB _NYT6	8	126.77 ^{cdef}	40.58 ^{fgh}	89.40	171.80	
	EB _SRG2	8	103.05 ^{ghijh}	44.15 ^{efgh}	81.60	137.80	
UM4	EB _KGG1	8	102.65 ^{ghij}	47.05 ^{def}	88.40	141.60	Cv = 17.33
	EB _KGG9	8	102.72 ^{ghij}	46.23 ^{efg}	85.20	130.20	Mean= 114.58
	EB _NDM3	8	121.8 ^{edfg}	62.43 ^{b}	89.80	161.00	p = 0.0051
	EB _NDM7	8	101.17 ^{hijk}	46.78 ^{edf}	89.80	112.60	LSD = 20.04
	EB _NJI2	8	131.17 ^{bcde}	71.1 ^{a}	91.80	184.20	
	EB _NJI6	8	128.0 ^{bcde}	58.75 ^{bc}	114.60	167.80	
UM3	EB _GTH3	8	99.2 ^{ijkl}	45.07 ^{efgh}	77.80	159.40	CV= 15.28
	EB _GTH5	8	92.75 ^{jklm}	40.65 ^{fgh}	64.20	111.00	Mean= 107.93
	EB _KAM2	8	107.0 ^{fghij}	45.43 ^{efgh}	95.80	125.20	p = 0.0007
	EB _KAM3	8	124.9 ^{bcdef}	60.58 ^{b}	109.40	158.20	LSD = 16.65
	EB _KAM8	8	123.62 ^{cdef}	69.97 ^{a}	113.20	152.80	
	EB _THR9	8	100.15 ^{hijk}	40.83 ^{fgh}	85.20	128.60	
UM2	EB _GEO3	8	100.07 ^{hijk}	44.58 ^{efgh}	80.80	138.40	CV= 14.93
	EB _GEO6	8	91.5 ^{klm}	39.43 ^{gh}	64.60	132.80	Mean= 101.16
	EB _KER2	8	94.0 ^{ijkl}	44.43 ^{efgh}	84.60	100.60	p = 0.0398
	EB _KER7	8	112.37 ^{efgh}	52.98 ^{cd}	93.20	126.40	LSD 15.24
	EB _KRG1	8	98.4 ^{hijk}	44.8 ^{efgh}	84.80	121.60	
	EB _KRG9	8	110.62 ^{efghi}	40.23 ^{fgh}	78.20	124.60	
Means (µm)			113.97	46.91			
LSD (p <0.05)			20.034	7.02			
Cv (%)			17.832	15.18			

[a]Agro-ecological zones: UM= Upper midland, LM = Lower midland, [b] Minimum and [c] Maximum conidia lengths,

[d] Means followed by the same letter in columns is not significantly different at α = 0.05

Table 5: Overall lengths of conidia of early blight pathogens isolated in different agro-ecological zones of Kirinyaga

AEZ [a]	N	Length (µm)	Minimum (µm)	Maximum (µm)
LM3	48	130.5 [a]	81.60	204.60
LM4	48	115.71 [b]	52.80	207.20
UM2	48	101.16 [c]	64.60	138.40
UM3	48	107.94 [bc]	64.20	159.40
UM4	48	114.59 [b]	85.20	184.20
Means (µm)		113.97		
LSD ($p < 0.05$)		10.59		
Cv (%)		23.11		

[a]Agro-ecological zones, UM = Upper midland, LM = Lower midland, N = Sample size,

[b] Mean followed by the same letter in columns is not significantly different at α = 0.05

Pathogenicity test using isolate EB_WNG4 (Fast growing isolate) produced symptoms identical to those observed in tomato leaves leaf samples from famers fields (Lesion with visible concentric rings) on the tomato inoculated with the pathogen isolates. The pathogens re-isolated from the lesion were phenotypically similar to the initial pathogen isolates in terms of spores' colour and conidia shape.

Inoculation of the tomato leaves under detached leaf experiment with selected 10 isolates showed that there was significantly (F (13, 36) =12.48, p <0.0001) differed in the lesion sizes formed by the isolates (Table 6). Isolate EB_KAM8 was highly aggressive with lesion size of 122.17cm^2 and was followed by isolate EB_NDM3 110.17cm^2. Isolate EB_KDG1 had smaller lesion size of 17.10 cm^2 and was followed by isolate EB_ND4 with lesion size 20.09 cm^2 (Table 6)**.**

Table 6: Aggressiveness of early blight pathogen isolates isolated from tomato leaves in Kirinyaga County

Isolate	N	Aggressiveness (cm^2)
EB-KAM8	5	12.27 [a]
EB_NDM3	5	110.17 [a]
EB_KER7	5	49.85 [b]
EB_WNG4	5	46.01 [b]
EB_KAM3	5	45.15 [b]
EB_KRG9	5	43.20 [b]
EB_KDO9	5	37.31 [b]
EB_NJI2	5	20.73 [c]
EB_ND4	5	20.09 [c]
EB_KDG1	5	17.10 [c]
Mean (cm^2)		41.27
LSD ($p < 0.05$)		1.67
Cv (%)		24.33

[a] Means followed by the same letters are not significantly different at α = 0.05

Molecular Characterization of Selected Early Blight Pathogen Isolates

The agar rose gel analysis of DNA amplicon PCR products (ITS rDNA) of tomato foliar pathogen isolates produced bands at different locations between 500 to 700 bp based on 1kb gene ruler plus ladder (Plate 2).

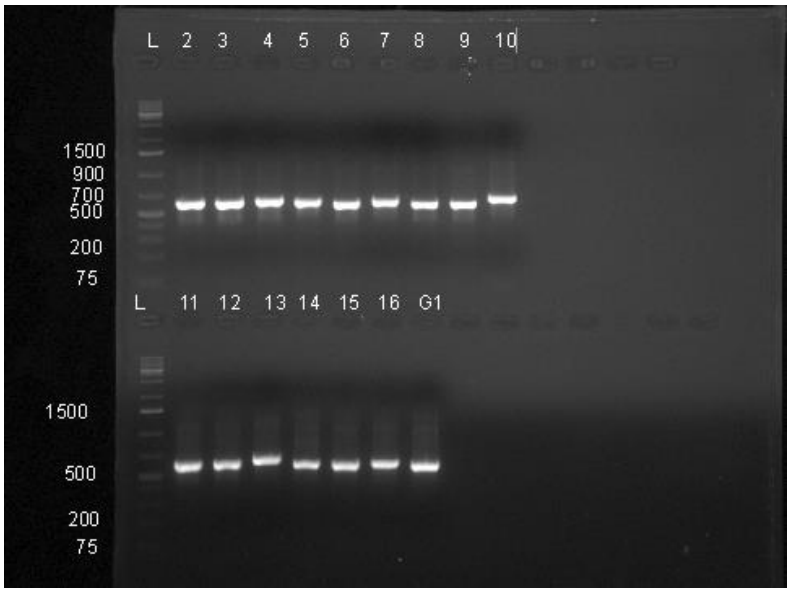


Plate 2: The agar rose gel analysis of DNA amplicon PCR products (ITS rDNA) of tomato foliar pathogen isolates isolated from diseases leaf samples from Kirinyaga County
where L= ladder (1kb gene ruler plus), 2= KRG-F02, 3= EB-KAM8., 4= EB-WNG4, 5= KRG-F05, 6= EB_NDM3., 7= KRG-F07, 8= KRG-F08, 9= EB-KD09, 10= KRG-F13, 11= EB-NJ12, G1= KRG-G01. 12= EB_KER7, 13= KRG-F06, 14= KRG-F08, 15= EB_KER7, 16= EB-KAM8; Isolates EB_KER7, EB-KAM8 were assayed twice

The blastin analysis of DNA amplicon Sanger sequenced nucleotides results (ITS rDNA sequences) revealed presence of different pathogens causing early blight like symptoms, which included *A. solani*, *A. altanata* and *Fusarium* spp (Table 7). The similarity identities of the nucleotide from pathogen isolates and fungal species in the gene bank ranged from 98 – 100% for *Alternaria* spp and for *Fusarium* spp. The phylogenetic tree of the sequenced nucleotides and their similar fungal species sequences available in the GenBank gave two main distinctive clades. Twelve isolates (HeB331-8, EB-KAM8, TgAa1, AC82, StrainL-2, EB-NDM3, EB-WNG4, EB-KER7, Strain AS-L-1, EB-ND4, NY003, EB-NJ12) comprising mainly of *Alternaria* spp were clustered together. On the other hand, fourteen isolates majorly *Fusarium* spp (10 isolates), two *Nigrospora* spp and *Pestalotiopsis* spp, respectively were clustered in a separate clade. All the species on the phylogenetic tree was rooted on *Rattus norvegicus* that served as an out group (Figure 3). The evolutionary distances matrix is shown in Table 8.

Table 7: Molecular identification of some tomato foliar pathogens using sequenced nucleotides and similar sequences in the gene bank

Isolate	Place of isolation	Close match	GenBank Accession No.	% Sim [a]	County	E values
KRG-F01	Gechenjo	[1]	MT035918	99.81	Egypt	0
KRG-F02	Kianganga	[2]	MT560323.1	100	China	0
EB-KAM8	Kiumbu	[3]	MG012289.1	99.82	China	0
EB-WNG4	Wanguru	[4]	OM980193.1	100.00	India	0
KRG-F05	Geotheri	[5]	MN898027.1	100.00	Israel	0
EB_NDM3	Thumaita	[6]	LC440583.1	99.64	Japan	0
KRG-F07	Chemise	[7]	MG664736.1	100	Uganda	0
KRG-F08	Kiangunga	[8]	NR_147556.1	91.33	Portugal	0
EB_KER7	Kidaruni	[9]	MK690429.1	99.33	China	0
KRG-F13	Kerigo	[10]	KY318497.1	91.22	South Africa	0
EB-NJ12	Thumaita	[11]	MN636300.1	99.82	Kenya	0
EB-ND4	Ndindiruki	[12]	MK656442.1	100	China	0
KRG-G01	Nguvaine	[13]	MH028084.1	100	Oman	0

[a] Percentage Similarity, [1]*Fusarium verticillioides*, [2]*Fusarium equiseti*, [3] *Alternaria solani*, [4]*Alternaria alternate*, [5]*Fusarium equiseti*, [6] *Alternaria alternata*, [7] *Fusarium equiseti*, [8] *Pestalotiopsis portugallica*, [9] *Alternaria alternata*, [10]*Fusarium equiseti*, [11] *Alternaria* sp, [12] *Alternaria alternata*, [13]*Nigrospora sphaerica*,

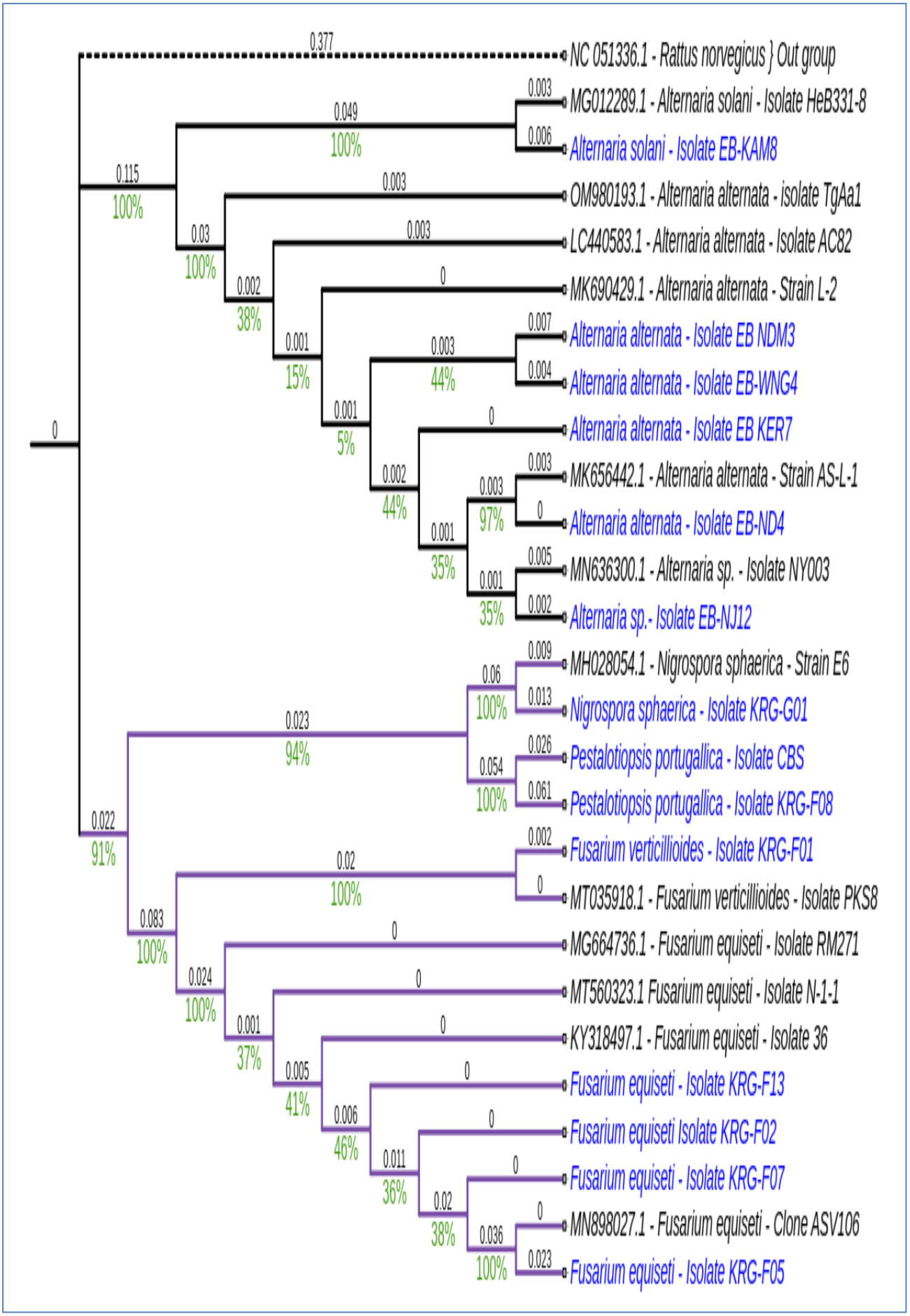


Figure 3: Phylogenetic analysis of sequences of some tomato foliar pathogens and similar sequences in the gene bank using MEGA X 11 software, neighbor-joining method and 1000 bootstrapped replications.
Where: The species in blue font are the fungal pathogens species isolated in the current study

Table 8: The evolutionary distances matrix of the fungal pathogens and fungal species from gene bank in the phylogenetic tree computed using the p-distance method

	Fungal species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	MT035918.1 – *F. verticillioides*	0																								
2	* *F. verticillioides*	0.00																								
3	* *F. equiseti*	0.05	0.05																							
4	MT560323.1 – *F. equiseti*	0.05	0.05	0.00																						
5	* *A. solani*	0.30	0.30	0.30	0.30																					
6	MG012289.1 – *A. solani*	0.29	0.30	0.30	0.28	0.01																				
7	* *A. alternata*	0.28	0.28	0.28	0.28	0.08	0.09																			
8	OM980193.1 – *A. alternata*	0.28	0.28	0.28	0.27	0.09	0.08	0.01																		
9	* *F. equiseti*	0.06	0.06	0.00	0.00	0.46	0.46	0.46	0.46																	
10	MN898027.1 – *F. equiseti*	0.06	0.06	0.00	0.00	0.39	0.38	0.37	0.36	0.00																
11	* *A. alternata*	0.29	0.29	0.29	0.30	0.09	0.10	0.01	0.02	0.48	0.37															
12	LC440583.1- *A. alternata*	0.27	0.27	0.28	0.26	0.09	0.08	0.01	0.01	0.46	0.36	0.02														
13	* *F. equiset*	0.05	0.05	0.00	0.00	0.30	0.30	0.28	0.28	0.00	0.00	0.29	0.28													
14	MG664736.1 – *F. equiseti*	0.04	0.04	0.00	0.00	0.30	0.29	0.28	0.27	0.00	0.00	0.29	0.26	0.00												
15	* *P. portugallica*	0.26	0.26	0.26	0.27	0.31	0.31	0.31	0.31	0.30	0.28	0.31	0.32	0.26	0.26											
16	NR_147556.1 – *P. portugallica*	0.21	0.21	0.22	0.21	0.29	0.28	0.28	0.28	0.25	0.25	0.29	0.27	0.22	0.21	0.09										
17	* *A. alternata*	0.28	0.28	0.29	0.29	0.09	0.08	0.01	0.00	0.46	0.37	0.01	0.00	0.29	0.29	0.31	0.29									
18	MK690429.1 – *A. alternata*	0.28	0.28	0.28	0.28	0.09	0.08	0.01	0.00	0.46	0.36	0.01	0.00	0.28	0.28	0.31	0.28	0.00								
19	* *F. equiseti*	0.05	0.05	0.00	0.01	0.31	0.30	0.29	0.29	0.01	0.01	0.29	0.29	0.00	0.00	0.26	0.22	0.29	0.29							
20	KY318497.1-*Fusarium equiseti*	0.05	0.05	0.01	0.01	0.30	0.29	0.28	0.27	0.01	0.01	0.30	0.28	0.01	0.01	0.26	0.22	0.29	0.28	0.01						
21	* *Alternaria* sp.	0.28	0.28	0.28	0.29	0.10	0.09	0.02	0.01	0.47	0.37	0.01	0.01	0.28	0.28	0.30	0.28	0.00	0.00	0.28	0.29					
22	MN636300.1 - *Alternaria* sp	0.27	0.27	0.28	0.29	0.10	0.10	0.01	0.02	0.47	0.37	0.02	0.01	0.28	0.29	0.31	0.29	0.00	0.01	0.29	0.29	0.01				
23	* *A. alternata*	0.28	0.28	0.28	0.29	0.10	0.09	0.02	0.01	0.46	0.37	0.01	0.00	0.28	0.28	0.31	0.28	0.00	0.00	0.29	0.29	0.01	0.01			
24	MK656442.1- *A. alternata*	0.27	0.28	0.28	0.30	0.10	0.10	0.02	0.02	0.46	0.36	0.01	0.02	0.28	0.29	0.31	0.29	0.00	0.01	0.29	0.29	0.01	0.01	0.00		
25	* *N. sphaerica*	0.19	0.19	0.18	0.20	0.29	0.29	0.27	0.27	0.22	0.21	0.27	0.27	0.18	0.20	0.20	0.15	0.27	0.27	0.18	0.19	0.27	0.27	0.26	0.26	
26	MH028054.1 – *N. sphaerica*	0.19	0.19	0.18	0.17	0.29	0.28	0.27	0.26	0.22	0.21	0.27	0.26	0.18	0.17	0.20	0.13	0.27	0.27	0.18	0.18	0.27	0.28	0.27	0.28	0.0
27	NC_051336.1 – *R. norvegicus*	0.49	0.49	0.50	0.50	0.55	0.55	0.53	0.53	0.54	0.53	0.53	0.53	0.50	0.50	0.52	0.52	0.53	0.53	0.50	0.50	0.53	0.53	0.53	0.53	0.5

Isolates marked with asterix are the pathogen isolated in the current study, and, A= Alternaria, F= Fusarium, N= Nigrospora, P = Pestalotiopsis

Susceptibility of Tomato Varieties grown in Kirinyaga to Early Blight Foliar Fungal Disease Pathogen Isolates
There was a significant [(F (19, 100) = 4.73, p <.0001] difference on the susceptibility of different tomato varieties to early blight pathogen isolates. Kilele F_1 variety expressed most severe symptoms of early blight (78.24%) to isolate EB-KAM8 followed by Riotinto F_1 (72.22 %) while Terminator F_1 had least (58.33%) severe symptoms (Table 9). Inoculation with isolate EB_KER7 triggered severe symptoms in Kilele F_1 variety (69.91%) followed by Rambo F_1 (67.59%) and the symptoms was less severe (54.17%) in Terminator F_1. Isolate EB_NDM3 caused severe symptoms in Kilele F_1 variety (70.83%) followed by Riotinto F_1 (68.06%) and least in Terminator F_1 (58.33%). Inoculation with isolate EB_WNG4 induced severe symptoms in Kilele F_1 variety (76.39 %) followed by Riotinto F_1 (62.2%) and the symptoms was less severe (58.33 %) in Hansol F_1 (Table 9).

Rambo F_1 tomato variety did not exhibit significantly [(F (3, 20) = 0.56, p = 0.649] difference susceptibility towards early blight pathogen isolates (Table 10). Riotinto F_1 tomato variety screened exhibited significantly [(F (3, 20) = 4.36, p = 0.0162] different susceptibility towards early blight pathogen isolates where isolate S_NDM7 had higher severity mean of 55.86 % and lower 50.31% in isolate S_KGG9 (Table 10). Hansol F_1 tomato variety screened did not exhibit significantly [(F (3, 20) = 1.57), p = 0.229] difference susceptibility towards early blight pathogen isolates. Kilele F_1 tomato variety screened did not exhibit significantly [(F (3, 20) = 2.16, p = 0.124] difference susceptibility towards early blight pathogen isolates (Table 10). Terminator F_1 tomato variety screened did not exhibit significantly [(F (3, 20) = 1.36, p = 0.283] difference susceptibility towards early blight pathogen isolates (Table 10).

Table 9: Susceptibility of selected tomato varieties to early blight pathogen isolated from tomato leaves in Kirinyaga

Isolates	Varieties	N	Severity (%)	Lsd (p < 0.05)	Cv (%)	Mean (%)
	Hansol F_1	6	64.81 [bc]			
	Kilele F_1	6	78.24 [a]			
EB-KAM8	Rambo F_1	6	66.20 [bc]	8.43	10.44	67.96
	Riotinto F_1	6	72.22 [ab]			
	Terminator F_1	6	58.33 [c]			
	Hansol F_1	6	64.81 a			
	Kilele F_1	6	69.91 [a]			
EB_KER7	Rambo F_1	6	67.59 [a]	8.57	11.18	64.44
	Riotinto F_1	6	65.74 [a]			
	Terminator F_1	6	54.17 [b]			
	Hansol F_1	6	61.11 [bc]			
	Kilele F_1	6	70.83 [a]			
EB_NDM3	Rambo F_1	6	66.67 [abc]	8.49	10.98	65
	Riotinto F_1	6	68.06 [ab]			
	Terminator F_1	6	58.33 [c]			
	Hansol F_1	6	58.33 [c]			
	Kilele F_1	6	76.39 [a]			
EB_WNG4	Rambo F_1	6	61.57 [bc]	7.57	9.83	64.72
	Riotinto F_1	6	66.20 [b]			
	Terminator F_1	6	61.11 [bc]			
Mean (%)			65.53			
LSD (p < 0.05)			3.99			
Cv (%)			10.62			

[a] Means followed by the same letters are not significantly different at α = 0.05

Table 10: Susceptibility of selected tomato varieties to different isolates of early blight pathogen isolated from tomato leaves in Kirinyaga County

Susceptibility level (%)					
Isolate	Riotinto F_1	Hansol F_1	Rambo F_1	Kilele F_1	Terminator F_1
EB-KAM8	51.23 [bc]	64.82	66.20	78.24	34.87
EB_WNG4	54.32 [ab]	58.33	61.57	76.39	37.96
EB_NDM3	55.86 [a]	61.11	66.67	70.83	40.12
EB_KER7	50.31 [c]	64.81	67.59	69.91	37.96
Mean (%)	68.06	62.26	65.51	73.84	57.98
LSD ($p < 0.05$)	3.67	7.43	10.60	8.22	7.23
Cv (%)	9.73	9.91	13.44	9.24	10.35

[a] Means followed by the same letters in column are not significantly different at $\alpha = 0.05$

DISCUSSION

Phenotypic Characterization of Early Blight Pathogen

Morphological, biochemistry and metabolites feature of fungal pathogens are useful in identification and diagnosis of disease pathogen (Simmons 2007; Sharma *et al.,* 2013; Lawrence *et al.,* 2016). Fungal pathogens' phenotypic traits predominantly used in pathogen identification are conidial shape, colour and septation (Meena *et al*., 2005; Kaur *et al*., 2007; Ramjegathesh and Ebenezar, 2012). The spores of early blight isolates were consistent with those reported by Mugao *et al.* (2021) in a study carried out in Mwea in Kirinyaga County in Kenya. As this study, Mugao *et al.* (2021) observed that the early blight pathogen isolates appeared greyish to greenish in colour and darkened as the culture aged, margins of the cultures were either regular or irregular pattern. Pigmentation and colony texture of early blight isolates in this study corroborated with other studies where greenish, dark and brownish pigmentation have been observed (Kumar *et al.,* 2008; Loganathan *et al.,* 2016; Mugao *et al.,* 2021). Surface texture of the colonies exhibited slight variations with zonation at margins observation which were similar to those observed in other studies involving early blight pathogens (Kumar *et al.,* 2008; Loganathan *et al.,* 2016; Kaur *et al.,* 2020).

Microscopic observation revealed variation of early blight isolates in their conidia morphology and concides with the findings of Mugao *et al.* (2021) where variability of tomato early blight pathogen in Mwea was reported. Further, morphological traits are in agreement with other studies carried out elsewhere where conidia have differed in breath, length and beak and have reported the conidia to be straight, slightly curved, muriform or ellipsoid (Rotem, 1994; Singh *et al.,* 2007; Blanchard, 2012; Ismael and Omer, 2018; Ragupathi *et al.,* 2020). The conidial transverse and longitudinal septa varied ranging from 1 to 6 and from 0 to 2, respectively which was in tandem with other studies (Rotem, 1994; Singh *et al.,* 2007; Blanchard, 2012; Ismael and Omer, 2018). The length of conidia of the early blight pathogen ranged from 78.52 µm to 161.72 µm. Conidia lengths observed in this study were within range of 105-220 µm reported earlier by Nolla (1927). However, conidia lengths were longer than those reported earlier by Neergaard (1945) and Abubakar and Ado (2009) ranging from 10.26 - 77.52 µm.

Molecular characterization of some of the early blight pathogen which showed variation in phenotypic traits revealed involvement of *Alternaria solani* and *A. alternate* spp. Some fungal species particularly *Fusarium equiseti* and *Fusarium verticillioides* were associated with leaf blight in this study. *Fusarium* spp isolated from this study have earlier been isolated from tomato leaves in various studies (Amini *et al.,* 2013; Micah *et al.,* 2018).

Evaluation of Aggressiveness of Early Blight Foliar Fungal Pathogens of Tomato

Knowledge on the aggressiveness level of different pathogen isolates in an area is useful for the evaluation on the magnitude of crop damage that can be caused by individual isolate (Bessadat *et al.,* 2014). Pathogens isolates differed significantly in their aggressiveness level. Differences observed in the aggressive level of early blight pathogen isolates may have been attributed to the effect of factors such as environmental conditions influenced by AEZs, variation in farming practices and a possible occurrence of different strains of pathogens. According to reports aggressiveness of early blight pathogens such as *Alternaria solani* is influenced by environmental conditions that include temperature stress and moisture and farm practices like the cropping system (Tsedaley 2014; Tymon *et al*., 2016; Hussain *et al.,* 2019). For instance, mono-cropping or mixed cropping

may influence pathogen aggressiveness due to impact on pathogen structure. Differences in the aggressiveness of the isolates may be an indication of existence of difference races of the pathogen. Occurrence of different races of pathogen may circumstantially cause synergistic interactions leading to elevated level of crop damage (Bonde 1929; Bessadat *et al.,* 2017). Variation in the level of aggressiveness of early blight pathogen isolates in this study is in tandem with the finding of van der Waals *et al*. (2004). Variation in aggressiveness of pathogen in an area influences the level of susceptibility of the crop varieties (Bessadat *et al.,* 2014).

Susceptibility of Tomato Varieties to Foliar Fungal Disease Pathogen Isolates from Kirinyaga County

Cultivation of disease tolerance/resistant crop varieties lowers cost of managing crop diseases in addition to protecting the environmentally against continuous use of harmful fungicides. Screening of tomatoes against disease pathogen in different niches may aid in identification and selection of varieties that may be explored in breeding for resistance and as well as adoption by farmers to lower mitigate high production cost associated with fungicide use.

The tomato varieties screened against various early blight pathogens in this study showed significant variation on their susceptibility to early blight. Kilele F_1 variety was found to be the most susceptible to early blight pathogens isolates (73.84%) while Terminator F_1 was least susceptible (57.99%). Difference in the susceptibility of tested tomato variety depicts variation in their genetical makeup. Varieties with high susceptibility rating may lack genes that confer resistant to early blight infection Chaerani *et al.,* 2006; Ramathani *et al.,* 2021). These results may be compared to the findings of Mphahlele *et al.* (2020) who observed variation in the susceptibility of Money-maker and Rodade tomato variety grown in South Africa to early blight isolates. The findings indicate that tomato varieties grown in different regions are susceptible to early blight infection.

There was no significant difference in the effect of isolates on the susceptibility in individual tomato varieties screened in this study. This may be attributed to the narrow genetic diversity of isolates used as they were selected on the basis of being the most aggressive during the detached leaf experiment. The findings of this study imply that tomato varieties screened do not have complete resistance towards early blight pathogens in Kirinyaga County. However, Terminator F_1 variety displayed reduced susceptibility when compared to the rest of varieties screened. The results deviate from the findings of Mphahlele *et al.* (2020) in Limpopo Province where a significance effect of early blight isolates on the susceptibility of individual tomato varieties was observed. Further the results of this study differed to those of Bessadat *et al*. (2014) and Ragupathi *et al.* (2020) which reported variation in the susceptibility of tomato variety to early blights in Algeria and India respectively.

CONCLUSION AND RECOMMENDATIONS

Early blight pathogen isolated from tomato leaves from different AEZ differs in their growth rate, aggressiveness and on the conidia aspects such as number of transverse and longitudinal septa. For instance, conidia lengths ranged from 52.8 µm for isolate EB_ND1 to 207.2 µm for isolate EB _WNG4 both isolated in AEZ in LM4. Further, morphological and molecular characterization confirmed the involvement of *Alternaria solanai* and *Alternaria alternata* as the causative agent of early blight in different AEZ of Kirinyaga County. The *Septoria* leaf spot pathogen isolated from tomato leaves different AEZ differed in their phenotypic characteristics such as rate of growth, number of transverse septa longitudinal septa and on conidia traits. Conidia lengths of the isolates ranged from 32.3 µm for isolate S_GEO6 in UM2 to 102.4 µm for isolate S_KDO9 in AEZ LM3. Late blight pathogen isolated from tomato leaves from different AEZ differs in their phenotypic characteristics that include conidia lengths and breadth. For instance, conidia lengths of these pathogens ranged from 25.5 µm for isolate L_KDG1 isolated from AEZ LM3 to 49.3 *µm* for isolate L_NDM7 in UM3. Molecular characterization revealed that other fungal pathogens such as *Fusarium verticillioides, Fusarium equiseti, Pestalotiopsis portugallica* and *Nigrospora sphaerica* also also asspociated with symptom that ressembles late blight in tomato leaves. Susceptibility screening showed that none of the tomato varieties screened was sufficiently resistant towards fungal pathogens under artificial inoculation in the greenhouse setup. However, Kilele F_1 and Terminator F_1 were found to be the most and least susceptible varieties, respectively to the early blight pathogens.

Thus, Terminator F_1 may be adopted by farmers in Kirinyaga County due to its low susceptibility to early blight infection.

Early blight fungal pathogen isolates differed on their phenotypic characteristics and on their aggressiveness, which may point at race variation thus, these isolates should further be assessed determine their races and the impact of environmental variation on their pathogenicity. Given that all the tomato varieties screened were susceptible to foliar fungal disease isolates at different levels, under artificial inoculation, further studies using varied concentration of pathogens is recommended. Further studies are

also necessary to determine physiological and biochemical response of tomato varieties towards different isolates of early blight fungal pathogens in Kirinyaga County.

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UTILIZATION AND PRESERVATION PRACTICES OF JUTE MALLOW (*Corchorus olitorius*) IN WESTERN KENYA

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ABSTRACT

Jute mallow (Corchorus olitorius) is a nutritious African leafy vegetable that is grown and consumed by local communities in Kenya. However, despite its nutritional superiority, its utilization is limited primarily due to its seasonality**.** This study sought to document the utilization and preservation practices of jute mallow in Western Kenya. A cross-sectional study, that involved a household survey (n=139), of jute mallow producers in Kakamega County of Western Kenya was conducted. Half (50.4%) of the households sourced their vegetables from their farms, while 37.4% sourced them from roadside vendors during the dry season. Jute mallow was mainly (57.6%) consumed as an accompaniment with other vegetables including African Nightshade and Amaranth. Approximately half (52.51%) of the households, employed a method of preservation. There was a significant association (P=0.01) between age and preservation practices, where middle-aged people (35-50 years) had a higher likelihood of employing a preservation method. Women were also significantly (P=0.024) more likely to preserve vegetables than men. Sun drying was practiced by 15.8% of the study population, 18.7% practiced fermentation, while 18% practiced both fermentation and sun-drying. The methods of sun-drying were well developed, where prior blanching, was incorporated by 33.3% of the participants. Sun-drying extended the shelf-life of jute mallow by 4.02 ± 3.151 months, while fermentation was 7 days. The leaves of both forms of preservation had relatively high acceptability ratios to the fresh forms at 40% and 48% for fermented and dried forms, respectively. There is a huge potential for low-cost preservation methods in ensuring the availability of jute mallow. However, it is necessary to investigate the viability of these methods on the nutritional quality and safety of jute mallow to improve food security.

Keywords: Jute mallow, Postharvest handling, Preservation practices, Food Security, Sun-drying, Fermentation

INTRODUCTION

Jute mallow *(Corchorus olitorius)* belongs to the family *Tiliaceae* and is of significant value in the rural parts of Kenya [1]. Like many African leafy vegetables including amaranth (*Amaranthus spp)*, spider plant (*Cleome gynadra*), and African nightshade (*Solanum spp),* jute mallow has been, in the past, referred to as a weed and wildly growing plant [2]. However, these vegetables have recently been domesticated and are now commercially available, although grown on a small scale.

Jute mallow has been identified as one of the key African leafy vegetables that have a role in biodiversity and food security in sub-Saharan Africa promoted due to its nutritional superiority [3]. Annual global production of Jute mallow in 2018 was 9.93 billion tonnes, where Africa contributed 29.4% of its production asserting the promising future of the crop [4]. In Kenya, jute mallow has gained particular acceptance in Western Kenya, where the local communities have adequately developed methods of preparing various cuisines from it [5]. The total annual production of jute mallow in Kenya increased by 15.26% between 2015-2016 [6]. Utilization of the leaves provides micronutrients such as vitamin C, beta-carotene, iron, and zinc, whose inadequacies contribute to hidden hunger in the region [7]. The vegetable is also rich in micronutrients, anti-inflammatory, and anti-tumor properties [8]. Therefore, consumption of African leafy vegetables including jute mallow, not only promotes nutrition and health but is also a possible avenue for income generate in Kenya [3].

Despite the knowledge of its nutritional vitality, the utilization of jute mallow in Kenya is still sub-optimal. Its consideration as a minor crop has limited its inclusion in research and developmental programs [9]. Notably, the production of jute mallow is usually seasonal where it grows profusely during the rainy season. However, due to its high perishable nature, its supply reduces significantly during the dry season [2]. Consequently, the local communities have developed various low-cost post-harvest handling and preservation practices, primarily sun-drying and fermentation [10]. However, the scope of the techniques and their possible effect on the nutritional quality and safety of the product has not been ascertained nor documented. Therefore, this study sought to avail this information to identify and replicate the good practices to promote the year-round availability of jute mallow, in order to contribute to food security.

METHODOLOGY

Study Design

A cross-sectional study design involving observational methods was used in this study. Randomly selected households in Kakamega County involved in the production of jute mallow were included in the study. A semi-structured questionnaire was administered to the participants during the survey

Study Setting

The study was conducted in Kakamega County, which is situated in the western part of Kenya. It is bordered by five counties, namely, Bungoma County, Nandi County, Vihiga County, Siaya County, and Busia County, as shown in Figure 1. In total, the County covers about 3224km^2, with a population of about 1,660,651. The County has an annual population growth rate of about 2.12%. The capital of the town is Kakamega Town. The County is divided into twelve sub-counties namely, Malava, Lugari, Lurambi and Shinyalu, Likuyani Navakholo, Matungu, and Butere, Mumias West, Khwisero, Ikolomani, and Mumias East which are further divided into 60 electoral wards. The County experiences an average temperature of about 20.5^{o}C. The main economic activities are agricultural activities and informal businesses. Rainfall received in the County is between 1,250 – 1,750 mm per annum. Likuyani County, which is the main focus of this study, has a population of 125,137 and has been divided into five wards, namely; Likuyani, Sango, Kongoni, Nzoia, and Sinoko [11].

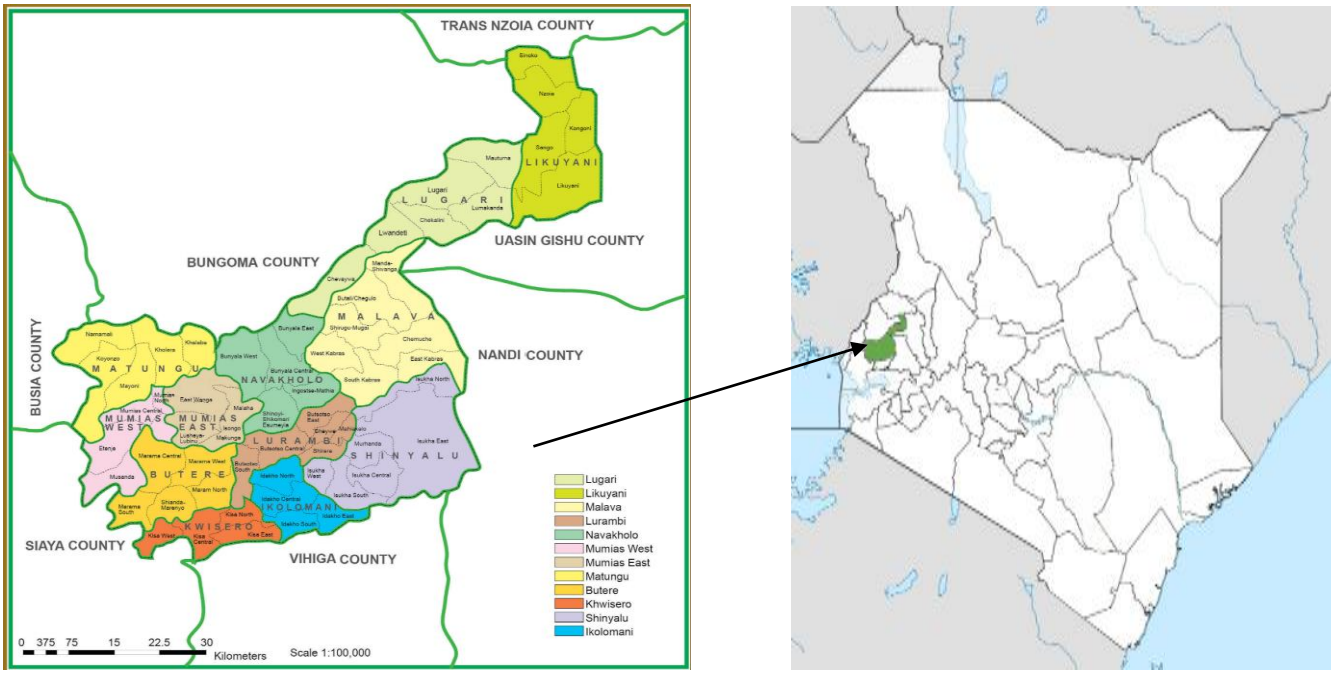


Figure 1: Map of Kakamega County, Kenya with its sub-counties and neighboring counties [11].

Sample Size Calculation

Fisher et al (1998) sample size calculation formula was used in the determination of the number of participants in the survey.

Therefore;

$$n = \frac{Z^2 pq}{d^2}$$

Where:
n = Desired sample Size [where population > 10,000]
Z = The desired confidence interval, taken at 95%
Z value at 95% is 1.96
p = Proportion of the population who process jute mallow leaves is 0.9 [16]

q = Proportion of the population who do not process jute mallow leaves is 0.1
d = Degree of precision; was taken to be 5 %, which is 0.05

$$n = \frac{1.96 \times 1.96(0.9 \times 0.1)}{(0.05)(0.05)} = 138.29$$

one (1) participant was added to cater to attrition
Therefore, 139 households were interviewed

Sampling Technique
Kakamega County was purposively sampled from Kenya due to the high production and consumption of jute mallow in this area. Likuyani Sub-County within Kakamega county was also purposively sampled from the country due to the high production of jute mallow. Sinoko, Nzoia, and Kongoni wards within the Likuyani sub-county were purposively selected in this study. The sample of 139 households was randomly selected across the three wards. A single respondent was drawn from each household.

Data Collection Tools and Methods
A semi-structured questionnaire was used to collect data on the respondent's biodata. The questionnaire captured information on demographic characteristics, sourcing, utilization, and preservation techniques of jute mallow. The demographic characteristics included age, sex, marital status, relationship to the household, and education level. The questionnaire was administered to the selected respondents during the interview period. Before the interview, the respondents were asked to provide their consent and asked to participate in the study voluntarily. Those who could read and write filled out the questionnaire on their own. At the same time, those who were unable were interviewed by well-trained enumerators. Enumerators translated the questions and filled the responses that were provided by the respondents.

Statistical Analysis
Data collected from the field survey were coded and entered into SPSS IBM version 23 and analyzed. Descriptive statistics namely, percentage and frequency were used to express the results of the socio-demographic characteristics of the study population, utilization of jute mallow, and different preservation techniques. A chi-square test of significance was used to test for any existing significant associations between the various variables studied with
p = 0.05 set as the level of significance.

RESULTS AND DISCUSSION

Socio-economic and Demographic Characteristics of the Households
The socio-demographic characteristics of included households are shown in Table 1. In this study, more than half (54%) of the household respondents were women. The majority of the household respondents (44.6%) were aged between 18-35 years, while the age group above 65 years had the least percentage of participants (3.6%). Age was an important demographic factor that helped the researcher determine which age groups took part in the farming and preservation of jute mallow. The largest percentage (41.7%) of household respondents had attained primary level education, while 28.8% of the population had attained secondary education. This data compares with that from the Kenya Demographic and Health Survey (KDHS), which reported that 55.2% of the population in Western Kenya had received some primary level education while 15.8% had attained secondary level education [12].
Most of the households were farmers by occupation (27.3%). The majority of the households (89.9%) agreed that women decided on the food to be bought for the family. This is because women are more involved in the cooking and preservation of food than men. Culturally, the role of food production and preparation is assigned to women [13]. This signifies the cultural role of women as the principal guarantors of nutrition, food safety, and quality at the household level [14].

Table 1: Socio-economic and demographic characteristics of Jute mallow-producing households in Kakamega County

Characteristics	Percentage (%)
Gender	
Female	54
Male	46
Age	
18-35	44.6
35-50	34.5

50-65	17.3
>65	3.6
Education Level	
Completed Primary	41.7
Completed Secondary	28.8
University	15.8
Never went to school	7.2
Tertiary	5.8
In Secondary	0.7
Marital Status	
Married	68.3
Unmarried	31.7
Occupation	
Farmer	27.3
Trading	23.7
Salaried Employment	20.1
Casual labor	11.5
Student	10.1
Unemployed	7.2
Who decides on Food to be bought	
Mother	51.8
Wife	38.1
Any other	5.8
Father	2.2
Husband	2.2

Sourcing and Utilization of Jute Mallow Leaves

Half (50.4%) of the households sourced jute mallow mainly from farms, where it grew freely as a weed as displayed in (Figure 2). Additionally, jute mallow was also sourced from roadside vegetable vendors and the market, especially during the dry season when it becomes scarce on the farms. Similarly, it has been reported that jute mallow is easily accessible from the local markets and at the household farm level in Western Kenya [15].

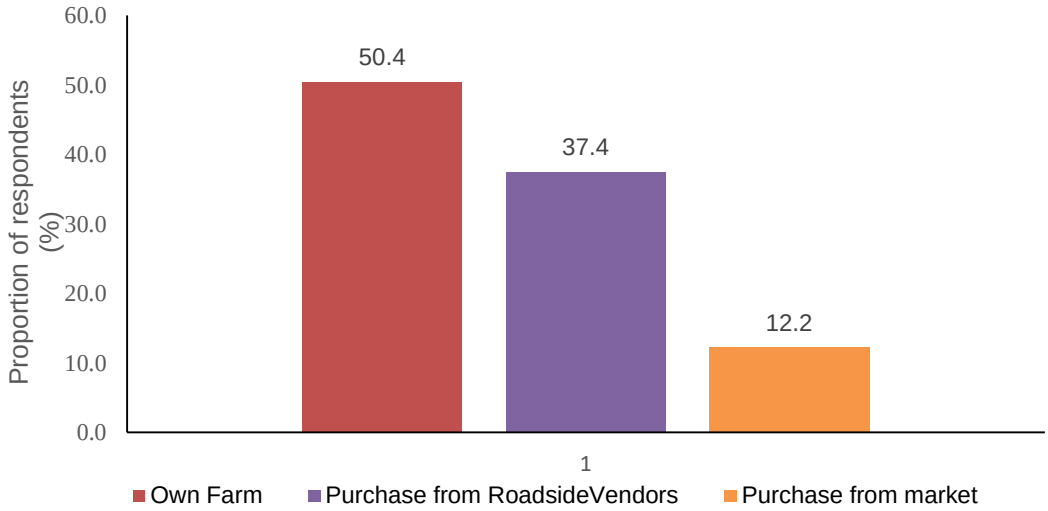


Figure 2: Sourcing of Jute Mallow Vegetables by Producing Households

The majority of the households (57.6%) reported incorporating jute mallow in the diet as a composite with other vegetables. Jute mallow was also consumed singly (26%) as a vegetable and mashed (16.4%) with other foods. As a composite, jute mallow was mixed with cowpea leaves (62.6%), and slender leaves (28.1%). This observation is in line with [16] who reported that jute mallow is blended with other local vegetables such as *Solanum nigrum*, *Crotalaria brevidens*, *Cleome gynandra*, and *Amaranthus spp*. The frequency of jute mallow consumption was 2.31± 0.82 days a week, with the whole family (69.8%) as the primary consumers although some respondents reported that the vegetable was mostly consumed by pregnant women and breastfeeding mothers. These findings are similar to those reported by Gido [16] where jute mallow is common amongst expectant and breastfeeding mothers since it is believed to stimulate the production of milk during the lactation period. Jute mallow was also reported to have medicinal uses by half (56.1%) of the respondents, mainly for treating constipation and anemia. Ali [17] reported the jute mallow in ethnobotanical medicine, where the leaves are used to treat ailments such as headache, influenza, fever, and pectoral pains as well as contains anti-inflammatory, gastroprotective, wound-healing, antiseptic, and anticancer properties. The by-products of jute mallow, more especially the stems, are used to feed chicken or livestock [18].

Preservation Practices of Jute Mallow in Producing Households

Half (52.51%) of the households in this study employed a method of preservation of jute mallow. The chi-square test indicated that age, gender, and occupation influenced the preservation technique as displayed in Table 2. Out of those who carried out preservation, 63% were women and 37% were men. According to Manuche [24] women are responsible for feeding the family and hence see the need to have vegetables during the dry season, which may account for the higher percentage. In this study, the preservation of vegetables was significantly associated with age ($\chi^2 = 17.250$, $p = 0.01$) as displayed in Table 2. Household respondents over the age of 35 years tended to preserve vegetables more than the younger respondents.

While Ayua & Omware [10] stipulated that the art of preservation of vegetables in Western Kenya is passed down to younger generations. This current study reveals that this knowledge is no longer being passed down and that with time traditional methods of preservation might cease. There was a significant association between the occupation and preservation of jute mallow ($\chi^2 = 19.212$, $p = 0.002$). Farmers made up the largest group of people who preserved jute mallow. This may be due to their easy access to jute mallow, especially during the rainy season [10].

Table 2: Association between preservation practices and socio-economic and demographic characteristics in jute mallow processing households

Socio-economic and Demographic factors		Households practicing preservation (%) n=139	Households not practicing preservation (%) (n=139)	***P***-value
Occupation	Farmer	20.9	79.1	
	Salaried Employment	11.5	88.5	0.002
	informal Businesses	10.8	89.2	
	Casual labor	4.3	95.7	
	Unemployed	3.6	96.4	
	Student	1.4	98.6	
Gender	Female	63.0	37.0	
	Male	37.0	63.0	0.024
Age	18-35	15.82	84.18	
	50-65	12.94	87.06	
	35-50	20.14	79.86	0.01
	>65	3.5	96.5	
Level of Education	Primary	23.74	76.53	
	Secondary	16.52	83.48	
	Never went to School	5.755	94.245	0.067
	University	4.32	95.68	
	Tertiary	2.8	97.2	
Name of the Ward	Nzoia	19.42	80.58	0.93
	Sinoko	17.26	82.74	
	Kongoni	15.8	84.2	

Distribution of Households by the Methods of Preserving Jute Mallow Processing Households

Out of the 139 households in this study, 15.8% practiced sun-drying exclusively, 18.7% fermentation, and 18% practiced both fermentation and sun drying. The techniques used for drying vegetables varied among the households. A majority (57.7%) of those who practiced sun-drying reported simply sorting and drying jute mallow. Blanching was practiced by 33.3% while washing the vegetables before drying was practiced by 42.2% of those who practiced sun drying. Blanching was conducted by boiling the water for an average of 20 ± 0.234 minutes, after which the leaves were drained of water and left to dry.

Washing helps in the reduction of dirt in the vegetables before drying, while blanching reduces the number of microorganisms present on the leaves and fixes the color of the vegetables prior to drying [19]. Shade drying was practiced by about 62.2% of the households, where the vegetables were placed under a shade during the drying process while the rest of the respondents dried the vegetables under direct sunlight. Shade drying allows for better retention of nutrients and minerals, such as vitamin C and iron which are easily degraded by solar energy [20]. On the other hand, direct sun drying reduces the amount of time required for drying vegetables [21].

Sixty-eight percent (68.1%) of the households reported placing the vegetables on the ground on a mat to allow them to dry (Figure 3). Other households used a raised platform and wire mesh structure to dry the vegetables. On average, the vegetables were dried 10.60 ± 0. 682 hours after being harvested. The facilities used for drying largely affect the quality and safety of the end product [22]. Placing the vegetables on a mat or wire mesh minimizes contamination from the soil that may occur during drying [22].

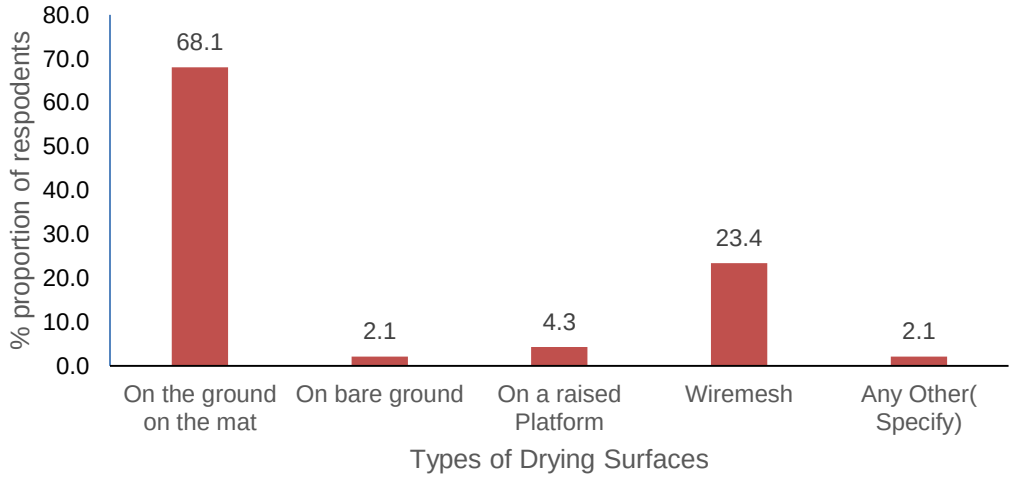


Figure 3: Types of drying surfaces in the study households

Storage of Dried Jute Mallow in the Study Households

The dried jute mallow was stored differently in different households (Figure 4). The majority of the households (80%) placed the dried product in gunny bags, which were stored in a granary together with other food products such as maize and beans. However, other households reported storing the vegetables in kraft paper, and clean plastic buckets while others placed them on an open mat. Since the majority used gunny bags, there is a likely occurrence of deterioration of product quality during storage as a result of rewetting of the product which might make the product susceptible to mold contamination [23].

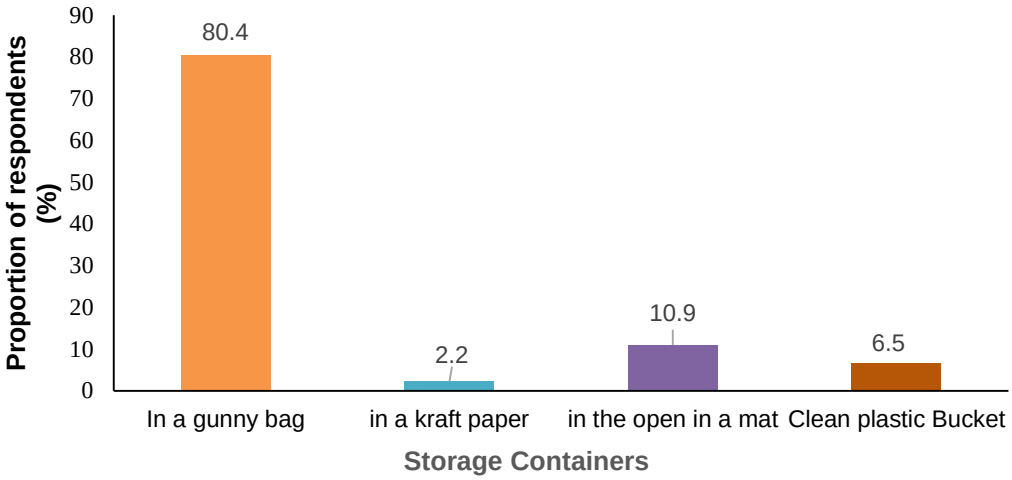


Figure 4: Types of storage containers of dried jute mallow in study households

The average period of storage of the dried jute mallow vegetables by the households was a period of 4.02 ± 3.151 months. This result is in line with that of Manuche [24] who reported that dried vegetables in Western Kenya were stored for an average period of three months. Usually, this period covers the dry season until the next rains [24]. During cooking, the dried vegetables are reconstituted by placing them in cold water for an average period of 26.90 ± 2.09 minutes. The water is then drained, and the vegetables are cooked in the same manner as cooking fresh vegetables. About 48% of the households reported that they would readily consume dried jute mallow as they would the fresh one, indicating the relatively high acceptability ratios of the dried product.

Traditional Fermentation by the Study Households

Traditionally, fermentation of jute mallow in the study households took place by following steps; the jute mallow leaves were boiled in water for an average period of 21.09 ± 0.345 minutes. The water is drained and then replaced with milk, which is added until the vegetables are soaked. The pot is then covered and stored in a dark place. The product is considered fermented after a period of two to three days. However, the process can go on for seven days. If further storage of the product is desired, the vegetables should be stored in a cool place, such as stored in an earthen pot or by refrigeration where applicable. The end product has a milky-like flavor. Before serving, the fermented product is usually sautéed with onions and tomatoes. Traditionally, the fermentation vessel was an earthen pot, however, currently, a stainless-steel pot (*sufuria*) is used. About 40% of the households consumed fermented jute mallow as they would the fresh one, indicating high acceptability of the product within the community, indicating the art of fermentation is practiced to improve the flavor and extend the shelf-life of jute mallow.

Several studies have recorded the traditional fermentation of African leafy vegetables. Manuche [24] reports that the black nightshade is fermented in Western Kenya by boiling the vegetable in water for about thirty minutes. The water is then replaced by milk, which is then boiled again for a shorter time. The product is then compressed and left to ferment for a few days until it solidifies till the color turns darker. The vegetable is then served with a starchy paste (*ugali)* [25]. A fermentation-like process for African kale that involves soaking the vegetables in milk to get rid of the bitter taste has also been reported [26].

CONCLUSION

Jute mallow is an important crop that has gained acceptance in Kenya, especially in Western counties. However, its utilization has been limited by the seasonality of the crop. Local communities have adopted low-cost methods to extend its shelf-life boosting its year-long availability. While the main methods of preservation; fermentation and sun drying have relatively high acceptability compared to the fresh forms, there is a need to investigate the effect preservation techniques have on the nutritional

quality and safety of jute mallow. This would allow the scaling and transference of these methods to other vegetables to improve food security in Kenya.

Competing Interests
Authors have declared that no competing interests exist.

Authors' Contributions
This work was carried out in collaboration between both authors. Author J.N. Muita designed the study, performed the analysis, and wrote the first draft of the manuscript. Author D.W.M Kaindi supervised the study and revised the manuscript. Both authors managed the literature search and writing of the final manuscript. The author wishes to thank the late Prof. J.K.imungi who designed and also supervised the study.

Ethical Approval
The study did not involve human subjects.

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BANANA VALUE CHAIN: CHALLENGES AND OPPORTUNITIES IN THARAKANITHI COUNTY

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ABSTRACT

Banana (*Musa acuminate* L) is one of the staple food predominantly grown by smallholder farmers for both home consumption and income generation in Tharakanithi County. Banana value chain was prioritized for upgrading under Kenya Climate Smart Agriculture Project (KCSAP).In order to establish constraints in the value chain to authenticate the interventions a baseline survey was undertaken in Mwimbi and Mariani wards in Mara and Igambangombe sub-counties selected purposively to establish the gaps by measuring key social economic indicators on household characteristics, agronomic practices, banana production practices, marketing and gender mainstreaming. Data was collected from a sample of farmers chosen using a combination of multi- stage purposive and systematic random sampling and analyzed using Statistical Package for Social Sciences (SPSS) version 25.0. According to the majority of the respondents, 70% of the households were male. The level literacy in the area was high as 99% of respondents had attained formal education. Farming was the main source of incomes and 69% of households had a member affiliated to a farmer groups'. The average farm size under banana production was 0.6 acres with a mean bunch weigh of 17 kg. Sources of banana planting materials were suckers from neighbors and friends. Soils testing for nutrients and diseases was minimal as 73% of the respondents had never had their soil analyzed. According to the respondents 58 % did not use fertilizer during planting and rarely top dressed their orchards. Bananas bunches were sold directly to brokers with limited use of cooperatives as marketing channels. There was no evidence of product development and processing. Major constraints included lack of planting materials for improved varieties, expensive inputs, pest and diseases, poor banana yields and inadequate rainfall. Apart from addressing the knowledge, skills and practices gaps, some new opportunities existed in marketing through improvements of transport and processing and increasing accessibility and availability of high quality planting materials.

Key words: Baseline survey, small holder farmers, banana value chain, climate Smart Agriculture, Household head, Knowledge, Skill and practices Gaps.

INTRODUCTION

Banana (*Musa* sp.) is the mostly cultivated horticultural crop in Kenya and in year 2018, it contributed 16.81 % of total value of horticultural produce with a total volume of 1,419,176 metric tons (MT) valued at slightly more than 22 million Kenya shilling (Kes). The area under cultivation was 68,248 Ha. Banana accounted for 35% of total value of the fruits produced (Agriculture Food Authority, Horticultural Crop Directorate, 2017-2018). The ability of banana to provide continued cycle of mature fruits all year round makes it a major multi-cycle food crop that enhances food security and sustains small holder farmer income (Sabiiti et al., 2016). Despite the banana value chain playing a crucial role in improvement of livelihoods in the rural areas, its productivity has progressively been declining over the years. Yields under Good Agricultural Practices (GAP) s range between 40 and 50 tons per hectare (t/ha), while Smallholder farmers realize between 4.5 to 10 t/ha **(**Muthee, Gichimu and Mthanio, 2019**).** The situation is aggravated by the prevailing climate variations and extremes that affect all ecosystems, including extreme rainfall (floods and droughts), hailstorms and high surface air temperatures leading emergence of new pests and diseases affecting banana productivity (Sabiiti et al., 2016;). Banana grows best in hot and humid zone ranging from 0 to 1,800m above sea level. The crop requires 1000 to 2000mm of well distributed rainfall per year and an optimal temperature of around 27^{o} c. The soil should be deep friable loam rich in organic matter with a PH range between6.0 and 7.5. Banana are sensitive to strong winds and wind break is necessary (Ministry of Agriculture livestock and Fisheries/Smallholder Horticulture Empowerment &promotion Project for local and Up scaling (MOALF/SHEP PLUS. 2019). In

Tharakanithi county banana is an important food and cash crop where 80% of the population depends on agriculture for their livelihoods. According to the county Agriculture Sector Transformation and Growth Strategy (ASTGS-2019-2029), Tharakanithi contributed 5.7% of the total value of banana in Kenya and was ranked eighth nationally. The annual turnover was 76,860 metric tonnes worth slightly more than one billion Kenya shillings. The County has a potential of about 4,200 hectares of land suitable for banana cultivation but only an estimated 3,742 hectares were utilized with an average yield of less than 15 tons per hectare. The average household land under banana was about 0.125 acres (50 banana stools. Due to its potential in increasing food security, household income and job creation the County government prioritized banana value chain for upgrading under the Kenya Climate Smart Agriculture Project (KCSAP). The project aim was to achieve the triple wins of increasing agricultural productivity, increasing adaptability to climate change and mitigation through reduction of greenhouse gases production in the atmosphere by validation and dissemination of climate smart Technologies, innovations, and management practices (TIMP)s. The purpose of the baseline study was therefore to identify the current status of banana value chain, identify social economic factors in the value chain limiting adoption of technologies to enable development of interventions strategies, generate data critical in developing Key performance indicators for monitoring and evaluation and eventually assessing the impact of the project. The study also aimed at identifying knowledge, skills and practices gaps among the value chain actors.

MATERIALS AND METHODS

The research was conducted in Mariani and Mwimbi Wards of Igambangombe and Mara Sub-Counties, respectively. The sites were selected purposively informed by the facts that both wards were among the county KCSAP project area The population consisted of all members of 22 banana Common Interest Groups (CIG)s comprising of 550 households. The CIGS nominated some members to attend the interview at the KCSAP adaptive research banana demonstration sites where a total of 119 farmers and agricultural service providers attended. During the interviews Utilization of a combination of multi-stage purposive and systematic random sampling strategies enabled the research team to draw three sample groups for key informant interview, Focus Group Discussions and Household questionnaire interviews. Whose sample size for was determined based on the following equation by Israel (2009): Data obtained was analyzed using Statistical Package for Social Sciences (SPSS) version 25.0 computer software in which descriptive analyses were carried out. Microsoft Excel program was used to generate tables, graphs and figures. The analysis formed the basis for findings discussion, conclusion and recommendation

RESULTS AND DISCUSSION

Household characterization

Among the respondents, males were the majority at 83 % compared to female at 17% (Table 1)

Table 1 Frequency statistics % of Household characteristics

Variable	Frequencies %				
Household heads among the respondents	Household head	Non household head			
	70	30			
Non House head Relation with household head	Spouse	children	Parent		
	24	4.2	1		
Sex of the respondents	Male	Female			
	83	17			
level of education	primary	secondary	certificate/diploma	university	non formal
	58	27	11	2.8	1
Household Main source of income	Farming	salaried employment	off-farm	Casual labor	Others
	86	13	21	1.4	1
Affiliation to farmers groups	self-help	producer	credit and saving	marketing	Non
	40	31	27	17	31
Benefits due to group affiliation	training	Grants	access to markets	access to irrigation	N/A
	61	51	18	3.6	31

On education 98 % of the respondents had formal education at 56, 27, 11 and 3% at primary, secondary, tertiary (diploma and certificate) and university respectively. 1% of the respondents gained formal education through adult learning program. The level of illiteracy in target area was very low at 2% of the respondents who had no formal education compared to County at 17% (County Integrated Development plan CIDP 2018-2022). Thuo (2018) noted that education helps in increasing adoption of TIMPs since farmers are able to receive decode and understand information relevant to making innovative decisions. The four Major sources of house hold income in descending importance were farming, self-employment, salary employment and casual labor at 86, 21, 13, and 1% respectively. This observation is supported by Government of Kenya, Tharakanithi County. Agricultural sector Development Support programmed II, (GOK, ASDSP. (2019) which indicated that more than 80 % of the county population depends on agriculture as source of income and therefore both National and County Government should allocate sufficient resource to agricultural sector in order improve livelihood and create jobs. On affiliation to famer's groups, 69% of the respondents were members of farmers group and the benefits included, training, grants, access to markets, better prices for their produce at 69, 51, 18, 4% respectively. Other benefit included access to water for irrigation 4% Nyakwara et al (2000) and Okuro et al (2000) in different studies observed that social factors including gender, culture, access and control of resources, education and age significantly influenced adoption. Opportunities of increasing banana productivity exist in gender targeting, increased affiliation of farmers to agricultural training and marketing platforms.

Banana Production

According to the respondents most banana growing household heads were aged with a mean age of 53 and 55 years among males and females respectively and the average farming experience of 22 years (table 2). The mean household size was 5 persons. The average household acreage under banana was 0.6 acres with the minimum of 0.1 and maximum of 3 acres amongst the respondents while the average number of banana stools was 120 with minimum of 5 and maximum of 700 stools.

Table 2: Farmers' respondents on mean and range of some household and agronomic practices statistics

Variable	unit/sex	mean	count	Minimum	maximum
Age of household head	male	53	59	24	92
	Female	55	12	25	79
Household size	Numbers	5	71	1	9
Farming experience	years	22	71	2	55
House hold banana acreage	acres	0.6	71	0.1	3
number of stools	stools	119.8	71	5	700
planting hole depth	cm	90	71	60	150
planting hole width	cm	90	71	60	180
Spacing of banana stools along rows	meters	2.4	71	1	6
spacing of banana stools between rows	meters	2.4	71	1	6
Application of fertilizer (DAP) during planting per hole	g	198.4	17	72	1000
Application of NPK: 17:17:0 during planting per hole	g	159.1	11	50	400
Application of NPK: 23:23:0 during planting per hole	g	87.8	6	12	200
House hold cost of DAP	Ksh	3176.5	17	1600	3500
Household cost NPK 17:17:0	Ksh	2581	11	500	3100
Household cost NPK 23:23:0	Ksh	2033.6	6	300	3000
Quantity of manure applied per hole at planting	kg	35	68	3	120
Addition manure applied during the season per stool	kg	28	49	5	80
cost of manure at planting	**KSH**	**5449**	**68**	**30**	**20000**

The agronomic data exposed relatively wide variation on application of technologies, innovations and managements practices among the respondents which was an indication of knowledge, skills and practices gaps. Example, the depth of banana planting holes ranged from 60 to 150 cm while that of the width was 60 to 180 cms. Fertilizer and manure application rate varied among the farmers. Diammoniam phosphate (DAP) fertilizer application rate at planting varied between 72 and 1000g per stool while organic manure ranged from 3 to 120 kg. There was evidence of improper use of fertilizers as some farmers 15% used Nitrogen: Phosphorous: potassium (NPK) 17:17:0 with low Phosphorous level compared with the recommended planting fertilizers (Diammoniam phosphate, Triple supper phosphate etc.) during planting. According to the respondents (Table 3), the most preferred banana varieties for cooking were Uganda green and Ngombe scored by 45 and 39% of the farmers respectively while the ripening varieties, sweet banana was more popular at 56% followed by William by 54% of the respondents.

Table 3. Frequency statistics % on response on banana production

Production variable	**Frequency %**				
Preferred cooking varieties	Uganda green	Ngombe	Nusu Ngombe	Mbokomboko	Non
	45.1	39.4	5.6	4.2	23.9
Preferred ripening varieties	Sweet banana	Williams	Muraru	Valery	
	56.3	53.5	15.5	11.3	
Preferred plantain varieties	non	Spambia	Goja horn plantain		
	95.8	2.8	1.4		
Type of planting material used	Suckers	Tissue culture plantlets			
	87.3	21.1			
sources of planting materials	community	own farm	Research institute	Training centre	
	67.6	66.2	9.9	7	
Soil analysis	Never	Frequently	Occasionally		
	73.2	15.5	11.3		
Fertilizer use during planting	No	yes			
	57.7	42.3			
Planting fertilizer used	DAP	NPK-17:17:0	NPK-23:23:0		
	56.7	36.7	20		
Organic manure during planting	yes	no			
	95.8	4.2			
Addition manure in the season	yes	no			
	69	31			
Orchard Topdressing (fertilizer)	yes	No			
	66.2	33.8			
Top dress fertilizer	CAN				
	91.7				
Methods of weeding the orchard	Manual	chemical			
	94.4	14.1			
De-sucking of banana	yes	no			
	60.6	39.4			
Timing of de-suckering	Mart turns busy	Any time	During weeding		
	55.8	16.3	11.6		
Follower sucker selection	strong and healthy				
	65.1				
pruning	yes				
	90.1				
pest encountered by farmers	Non	weevils	Nematodes	others	
	56.3	26.8	22..5	8.4	
Diseases encountered by farmers	non	Fusarium wilt	Yellow sigatoka	Cigar end rot	
	32.4	53.5	18.3	2.3	
Major constraints in banana production	Lack of Improved varieties	Expensive inputs	Diseases	Delayed rain set	
	33.8	29.6	14.7	14.1	

Majority of the participants indicated that 81% used the suckers as planting material compared to the recommended tissue culture plantlets at19%. The use of tissue culture banana as planting material not only hasten maturity but also has shown reduced infestation of pest and diseases in newly planted orchards thus contributing to high yield (Nguthi et al.). Plantain banana type was not known by 96% of the respondents despite it increasing popularity due to realization of its high nutritive value (Gitika, P.M. Chief Executive Officer. Forum for Agricultural Advisory Services Kenya. Direct communication, August 2021). The main sources of planting material were the neighboring community and own farm according to 68 and 66% of the respondents respectively. Majority of the farmers according to 73% of the respondents had never had their soil analyzed for nutrients and diseases while 58% did not use fertilizer at the time of planting bananas. As on agronomic practices, farmers had inadequate knowledge on banana pest and disease as 56 and 32% respectively did not identify any in their farms. Lack of improved varieties, expensive inputs, diseases and delayed rain on set were identified as the major constraints by 34, 30, 15 and 14% of the respondents' respectively. The study exposed technical and socio-economics gaps which lowers banana productivity in Tharakanithi County. The findings are confirmed by (Mbuthia, 2018 and Muthee et al., 2019) who attributed low banana productivity to poor husbandry practices, pest and diseases, lack of clean planting material and inadequate extension services in Embu and Meru counties.

Banana and Climate Change

The extent to which banana provides household with food security in the event of unfavorable weather was rated medium, highest and high by 31,27 and 20% of the respondents respectively (Table 4).

Table 4. Frequency statistics % of banana farmer' perception climate change

Please give a rank of 1-5 (lowest-1) to show the extent to which the banana enables the household to Become **Resilient** in the event of unfavorable weather condition such as drought.			
	lowest	7	9.9
	Low	4	5.6
	Medium	41	57.7
	High	18	25.4
	Highest extent	1	1.4
	Total	71	100.0
Food security	Lowest	4	5.6
	low	12	16.9
	Medium	22	31.0
	High	14	19.7
	Highest extent	19	26.8
	Total	71	100.0
Income	Lowest	5	7.0
	low	20	28.2
	Medium	25	35.2
	High	21	29.6
	Total	71	100.0

According to the study the respondents conceded that banana was moderately resilient in the event of unfavorable weather condition such as drought according to 58% respondents who rated it medium (Table 4). On the extent to which banana enables the household to become food secure in the event of unfavorable weather condition, the response; Medium, highest and high scored 31,29, 20% of the respondents respectively. The response according to income were medium, high, low scored by 35, 30, and 28% respectively. The result indicated that farmers were aware of the impacts of climate change and the importance of banana farming as an important coping strategy. Sabiiti et al., (2016.), in a study identified factors that may lead to the loss in yield in banana production in the event of extreme weather to include deteriorating soil fertility, drought occurrence, inadequate soil moisture and pest and diseases. The

study recommended that mainstreaming scientific climate change information in banana farming for effective coping and adaptation mechanism has the potential to promote banana production, food security, farmers' income and sustainable development.

Harvesting Postharvest Management and Marketing.

The bunch weight of banana were between 10 and 20 kg according to 60% of the respondents and majority were sold in ward markets (Table 4). There was little postharvest management as de-handing, sorting, grading, and cleaning and disinfection was not done according to 83, 79, 75, 79, and 94% of the respondents respectively.

Table 4: Frequency % statistics on Harvesting Postharvest Management and Marketing.

Variable	**Frequency**		
Bunch weight in KG	less 10	between 10-20	Over 20
	14.9	60	16.1
Disposal of harvested banana	Ward Markets	Outside county	Farm Gate
	50.7	21	14.7
Maturity index indicators	color change	Angularity	Other
	56.3	23.9	8.5
harvesting method	Two harvesters a cuter and supporter		
	91.5		
Time of harvesting	before 10 am	between 10 am and 4pm	
	38	29.6	
Harvested banana aggregation in the farm	Natural shade	open area	
	69	28.2	
Transport of harvested banana to homestead	Human labor		
	83.1		
De handing of banana	No	yes	
	78.9	21.1	
sorting of banana	No	yes	
	84.5	15.5	
Grading	No	yes	
	78.9	21.1	
Cleaning of banana after harvesting	No	yes	
	71.8	28.2	
Disinfection of harvested banana	No	Yes	
	94.4	5.6	
Holding harvested banana after harvest	less than a day	one to three days	
	49.1	36.5	
State at which banana are sold	unripe	both ripe and unripe	ripe
	64.8	26.8	5.6
packaging of banana	No	yes	
	83.1	16.9	
Transport of harvested banana to market	motorbikes	vehicles	human
	42.3	38	32.4

Unit of sale by farmers	KG	Bunches	fingers
	69	32.4	5.6
losses of banana-harvesting stage	not applicable	very low	
	69	29.6	
losses of banana-transport stage	Not applicable		
	84.5		
losses of banana-Marketing	Not applicable	fare	very low
	63.4	16.9	9.9
Marketing infrastructure available	Non	Aggregation centre	transport
	63.4	29.6	4.2
linking farmers with buyer/market	none	other farmer/referrals	mobile platform
	52.1	36.5	14.1

Most of the respondents (65%) sold their banana unripe and only 6 % ripen banana for sale. When respondents were asked to choose which marketing infrastructures were available to them 63% indicated none while 30% had banana aggregation centers. More than half of the respondents at 52% did not have formal linkage with banana buyers while 37 and 14% were linked to buyers by other farmers and through mobile platforms respectively. The banana losses along the value chain were low as at harvest, transport and marketing stages 69, 85 and 63% of the respondents respectively were not aware of any losses. This could be an indication that farmers had limited involvement in harvest, transport and marketing stages and middle persons or brokers were the main players. Apart from 6 % of the respondents who sold their banana when ripe there was no evidence of value addition and product development. In other studies (Mbuthia, 2018 and Muthee et al, 2019) identified socio-economic factors which contributed to low banana productivity included high cost of inputs, poor marketing channel, poor farmers organizations, poor infrastructure, minimal value addition and processing and inadequate government support.

Gender Mainstreaming

Most household tasks, in banana production were shared almost equally among male and female. Fathers had a slight lead (Table 5) in land preparation, planting, fertilizer/manure application, spaying and harvestings while the tasks of weeding, and ripening and selling were done by the wives.

Table 5. Frequency statistic % on gender activity profile in the house hold

Variable	**Frequency %**				
Household members who stay and work in the farm	Male adults	Female adults	youth	Children	
	82	82	24	23	
Gender activities profile in the household	**Male**	**Female**	**sons**	**Daughters**	**Hired labor**
Land preparation	69	56	9.9	1.4	46.5
Planting	63.4	59.2	14	1.4	40.8
Fertilizer/manure application	49.3	47.9	9.9	7	16.9
Weeding	56.3	60.6	21	8.5	35.2
Spraying	43.7	19.7	2.8	2.8	15.5
Harvesting	59.2	49.3	9.9	5.6	33.8
Ripening	35.2	71.8	0	7	4.2
Selling	62	71.8	7	4.2	2.8

The observation that children took a much lesser role even when compared to hired labor could partially explain the low youth involvement in banana production as observed in (Table 2) where the mean ages for the farmers was 53 and 55 years for men and women respectively.

CONCLUSIONS AND RECOMMENDATIONS

The banana yields in the study area by majority of the farmers (60%) had a bunch weight between 10 to 20 kg while research station achieves 40 to 50 kg. Increase in average bunch weight is a useful indicator in measuring the success of the project. The study identified gaps in knowledge, skills and practices in banana production, harvest and post-harvest managements and marketing which causes reduction in banana yields. KCSAP aims to address the technical constraints but most socio-economic constraints like poor infrastructure, strengthening farmers marketing bodies and creating conducive agribusiness environment will require both National and county government interventions. Opportunities exist in technical service delivery by both private and public sector, Value addition and product development, marketing, provision of inputs including availability of clean planting materials and soil analysis services among others. Governments and partners should offer enticements to make agriculture attractive to youths who are majority and more technology savvy and innovative than old farmers. Mechanization, cheap credits, agriculture friendly policies including on leasing land for farming and regular holding of competitive agricultural forums at ward and sub-county levels where winners segregated in terms of resources and gender are attractively awarded could be some of the incentives.

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RATIONALE BEHIND ROMAN CATHOLIC CHURCH'S TOLERATION OF MIRAA PRODUCTION AND CONSUMPTION IN IGEMBE DEANERY, MERU DIOCESE, KENYA.

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ABSTRACT
Drugs are a global phenomenon that has spread to all corners of the globe. The; Roman Catholic Church has been a leading voice in opposing the use of pharmaceuticals outside of medical necessity in every society it has encountered. Roman Catholic Church has taken a hard-line approach against any form of drugs legalization, including recreational drugs. On the contrary Igembe Deanery, Meru Diocese of the Roman Catholic Church, a contentious drug that many consider a drug, Khat (Miraa) production is tolerated. This; study is on the rationale behind Roman Catholic Church's toleration in Khat production and consumption, which is extensively grown in Igembe Deanery, Meru Diocese. Due; to Roman Catholic Church rules that prohibit the use of all narcotics except for therapeutic purposes and the variety of contradicting incidents seen by Khat farmers and merchants who are also members of the churches in the study area, this study was inspired. The study employed a descriptive research design. Data; was obtained from questionnaires, oral interviews, focus group discussion, participant observation and primary and secondary sources to ensure the validity and reliability of the study. The discussion starts with the various reasons for the Roman Catholic Church's toleration of Miraa. Structural-functionalism was used to establish the rationale behind the Roman Catholic Church's toleration in Miraa production and consumption of the study area. The findings of the study were that the economic, social, cultural, religious, and educational benefits of Miraa in Igembe Deanery are all the reasons for the Roman Catholic Church's in Igembe Deanery to tolerate Miraa farming, trade and consumption in the study area. This study has contributed to the church, particularly the African church, and to academicians studying religion and culture in higher education.
Keywords: Toleration, Miraa, Production, Consumption, Igembe Deanery, Meru Diocese.

INTRODUCTION
Drugs are phenomena that are invading all societies in the world. The fight against drug and alcohol misuse is being waged by many of international organizations and institutions. There are, several of these organizations, including the World Health Organization (WHO), INTERPOL, the UNODC, and the World Federation against Drugs (WFAD) (Nyamongo, 2014). Various churches are also engaged with multiple International Organizations, and Government Agencies in combating drugs and substance abuse and they have gone to the extent of developing multiple policies that are against drug use except on medical grounds only (Gorsuch, 1995). It is a significant violation, according to the RCC, to use medications other than for medical purposes (Pontifical Council for Pastoral Care, 2002) On contrary, Roman Catholic Church which is at the forefront in combating drug use except on therapeutic grounds tolerates Khat production and consumption in Igembe Deanery, Meru Diocese, which is a drug as affirmed by NACADA (2006&2007). Therefore, this study sought to establish the rationale behind the Roman Catholic Church's tolerating Miraa farming trade and consumption in Igembe Deanery, Meru Diocese.

Prominent religious leaders outside its home region have expressed their disapproval. Pentecostal; denominations in Kenya are among the most vocal critics of Miraa, and they're not the only ones (Carrier, 2006). Adherence; to total abstention from such substances by Pentecostal preachers and members of comparable denominations is required for salvation. At the same time, other denominations have a more relaxed stance concerning Miraa (Carrier, 2006). Despite Pentecostal churches' preaching abstinence on Miraa production and use, things are different in Igembe where similar denominations strongly support Miraa production and consumption. They mainly do so by quoting the Gospel of Matthew 15:11-17, saying that it is what you think or say that makes you unclean and not what you chew or eat (Carrier, 2006). It was thus necessary to establish in this study the rationale behind the Roman Catholic Church's toleration of Miraa farming and use in Igembe Deanery, Meru Diocese since the Roman Catholic Church, in general, condemns drugs' use except on therapeutic grounds, yet the same Church tolerates Miraa production and consumption in Igembe Deanery in Meru Diocese is an issue of concern.

LITERATURE REVIEW

There are various factors that led Churches, especially in Meru region to tolerate the production and use of Miraa. They include:

Socio-Cultural Significance of Miraa

Culture is a way of life for individuals, and it influences how people live in different groups. The people of Igembe Deanery, Meru Diocese Catholic Church, hold Khat in high regard. While it is a contentious chemical that many people consider being a narcotic (NACADA, 2008 & 2004), it is tolerated by some churches and elements of the RCC. For example, Igembe Deanery, Meru Diocese, is the most important Khat producing Deanery in Meru Catholic Diocese, and Christians there are quite proud of the product (Carrier, 2005). Christians in Igembe Deanery hold Miraa in high regard in their traditions. They underline Miraa's economic importance as well as its significance in Igembe traditions (Michella, 2005). However, while Carrier (2005) and Michella (2005) state that Miraa is ingrained in the people of Igembe's customs and culture, they do not explain the explanation for RCC's tolerance of Miraa production, which this study intended to determine.

Miraa is deeply associated with their forefathers, and it is thought that only the seniors consume it. It is, nevertheless, assimilated into the 'young mentality,' where it is seen 'poa' ('cool') (Carrier, 2005). The teenagers' Miraa validation as 'poa' promotes its worth as an item for identity by the youth, rather than leading to rejection owing to its adverse effects. Carrier (2005) stated that "Miraa is so culturally treasured and it forms part of the Igembe identity," but he did not state whether the RCC tolerates Miraa production and consumption because of its cultural worth and identity of the people of Igembe Deanery. Michella (2005) noted that a girl who wanted to marry would gift her father Miraa twigs in exchange for his acceptance of her desire. A suitor who is paying a first visit to his future in-laws is supposed to bring a bundle of Miraa as a present. Similarly, an offer of Miraa twigs is frequently made prior to the reconciliation process. The offended party's acceptance of Miraa twigs is a promising sign that the healing process will continue (NCST, 1996). This is significant for this study because it emphasized how Miraa is socially and culturally accepted in Igembe Deanery, allowing RCC to tolerate Miraa production and consumption, which this study aims to investigate.

Economic Significance of Miraa

Miraa is grown extensively by the people of Igembe Deanery, Meru Diocese. The monetary value of Miraa provided good economic grounds for the people of Igembe to support it, but there was more to their approval than that: Miraa was absorbed into their cultural heritage in Igembe (Kiunga, 2017). Miraa is highly regarded in the Meru Diocese's Igembe Deanery. This is due to Miraa's high economic worth, particularly Mbaine Miraa, also known as 'Colombo,' which is highly valued because it originates from such a culturally significant tree. Farmers with Mbaine plantings are regarded lucky because the returns from their Miraa are substantially higher than those from younger trees (Carrier, 2006). Miraa is known as the green Gold of Igembe by the inhabitants of Igembe Deanery, Meru Diocese. The trade has provided numerous jobs, not only for residents of the growing areas, but also for those who have relocated to the area because of the business's potential. By extension, trade generates revenue for the country (Goldsmith, 1998).

The money earned from the Miraa trade is used to build schools, churches, permanent housing, and other projects. As a result, this commerce is a significant economic contributor to the region's development (Goldsmith, 1998). Bururia and Nyaga (2014) argue that Miraa trading benefits Igembe society. The payment covers school fees, food, and other necessities for the family. As a result, Miraa farming enhances the family's living standard based on average monthly returns when compared to other crops cultivated in the area; Miraa generates more money than maize, beans, mangoes, pawpaw, and avocados (Bururia and Nyaga, 2014).However, Carrier (2006), Goldsmith (1998) and Bururia and Nyaga (2014) tell us about various economic reasons of Miraa farming and trade in Igembe Deanery, Meru Diocese that makes Miraa to be approved in Igembe society but they do not tell us the rationale behind RCC toleration of Miraa production and consumption in Igembe Deanery.

Religious Significance of Miraa

Miraa farming and trade has led to the growth of the religious sector in Igembe Deanery, Meru Diocese. Kiunga (2017) noted that some churches in Igembe region grew their own Miraa or had Miraa in their compounds. Through the capital raised from Miraa, Churches have been able to put up permanent structures, maintain their spiritual leaders such as ministers, pastors, bishops and other members of the clergy as well as the acquisition of worship instruments as the churches seems to be financially stable .However, Kiunga (2017) tells us that Miraa farming and trade has led to the grow of religious sector but he does not tell us why Roman Catholic Church tolerates Miraa production and consumption which this study established.

RESEARCH METHOD

This study employed a descriptive research design. The core concept underlying descriptive research is to collect data that depicts actual phenomena by asking people about their views, attitudes, and values (Mugenda&Mugenda, 1999). According to Kathuri (2000), the descriptive research design is employed when the topic is clearly defined and the researcher has a specific issue to describe. The Descriptive research design was used in this study as it enabled the researcher to collect, describe, record, analyze, report and present the rationale behind the Roman Catholic Church toleration of Miraa farming, trade and consumption in Igembe Deanery, Meru Diocese. In all this, there was no manipulation of the variables and the study reported the exact responses from the respondent's consent.

Data Analysis Procedures and Presentation

According to the stated aims and study questions, the acquired data was processed, sorted, structured, and summarized. To organize, summarize, evaluate, and present data or characterize the characteristics of the sample population, descriptive statistics such as frequency, percentages, and mean were utilized. The statistical package for social sciences [SPSS] version 27.0 for Windows. The researcher presented an introductory letter to the respondent and with the consent of the respondent, the interview was conducted. Research permit was obtained from the National Council for Science, Technology, and Innovation (NACOSTI)The researcher booked appointments with the respondent to conduct the interview before the discussion. The purpose of the discussion was explained to the interviewee who participated in the interviews willfully and where the interviewee sought to remain anonymous, the researcher respected the will of the respondent guided by Israel & Hay (2006).

Findings of the Study

This chapter presents discussion on why the Roman Catholic Church tolerates Miraa production and consumption in Igembe Deanery in Meru Diocese, yet, the policies of the general Catholic Church are against the use of any kind of drugs except on therapeutic grounds. The conversation is based on oral data received during the field research from respondents in Igembe Deanery. The structural functionalism theory, which views society as a complex system whose components work together to produce solidarity and stability, was utilized as the study instrument. This was done in the belief that it enabled the researcher to understand the main economic, social, education and religious reasons for the church's support of Miraa production and consumption in the study area. Respondents in this study were asked to give reasons for the Roman Catholic Church's tolerance of Miraa production and consumption in Igembe deanery, yet, the same Church is against all form's drugs except on therapeutic grounds. These reasons are discussed here.

Economic Reasons

This research established that Miraa is the backbone of the people's economy in Igembe. The production and consumption of Miraa in Igembe Deanery, Meru Diocese have been tolerated by the Church due to the enormous economic benefits it provides to the local people (Meeme, 2021, OI). All the informants affirmed that Miraa farming and trade is the main economic activity of Igembe region. For instance, all the priests interviewed, 10 (100%) confirmed that Miraa is the primary source of livelihood for the people of Igembe. They acknowledged that Miraa has the highest returns as compared to all other types of crops which have ever been grown in the region. All the priests, 10 (100%) and the catechists 8 (100%), who are the key religious leaders in Igembe Deanery affirmed that Miraa is the cash crop of Igembe region, just like tea, coffee, sisal, tobacco, and others are in other parts of Kenya. They elucidated that Miraa has acquired a new status in Igembe Deanery as 'Green Gold' of the people of Igembe region where Igembe Deanery falls. The researcher noted that all the economic developments in Igembe area traced their success and growth from Miraa farming and trade. Thus, the main reason as to why the Roman Catholic Church in Igembe Deanery, Meru Diocese has continued to tolerate this trend of Miraa farming and trade among its members and by extension the wider Miraa production and business is due to its huge economic benefits. The Church has therefore openly encouraged her followers to be involved in the Miraa activities (Muturia, 2021, OI) due to the following economic reasons raised by from the field research:

Miraa is the Main Cash Crop in Igembe Deanery

Miraa is the main source of income for the inhabitants of Igembe Deanery in Meru Diocese, according to all respondents (priests, catechists, elders, traders, and church members). This makes it the most treasured crop by the members of the Roman Catholic Church in Igembe Deanery, generating income which they, in turn, use for the purposes of the Church's development as well as for their own survival. During the field interview by the researcher, it was established that indeed this assertion was valid since the researcher, in his visits to the area, observed that most of the farms in the Igembe region, including those of the Churches had Miraa.

As the main cash crop in Igembe region, Miraa farming, trade and consumption are tolerated by the Roman Catholic Church in Igembe Deanery, Meru Diocese, because it is the primary source of livelihood for the people (Mwiti, 2021, OI)). It provides employment opportunities to the people of Igembe Deanery (Muturia, 2021, OI). Most people in Igembe have Miraa farms, and there are many vehicles for transporting Miraa produce to various markets throughout the country and business stalls of Miraa in Igembe region. This study established that Miraa is the primary source of income for the people of Igembe, which has led to tremendous development and growth in the religious, economic and education sectors as well as in various aspects of human life. Therefore, this study, established that the Roman Catholic Church in Igembe Deanery, Meru Diocese tolerates Miraa farming, trade and consumption because it is the primary source of income for the people of Igembe which has the highest income.

This study shows that all of the priests, 10(100%) affirmed that Miraa is good as it is the source of livelihood of the people of Igembe. In addition, the entire priest acknowledged that Miraa was good as it improved the living standards of the people in Igembe region. Further findings show that the most of the catechists 7(70%) said that Miraa is vital for cultural values. They also opined that Miraa is essential for religious significance. Just as the priests had affirmed, all the catechists 8(100%), said that Miraa is crucial because it is the source of livelihood. Also it is vital for its economic significance to the people and the church in Igembe region.

Supporting Evangelization

Data from various respondents showed that the Roman Catholic Church tolerates the production, trade and consumption of Miraa since it is used by the church to help in the spread the gospel. This could also explain to why most of the Roman Catholic Churches in Igembe region have Miraa farms in their compounds. The money got from the sale of Miraa once it is given by Christians as tithes and offerings helps the Church in evangelization (Kananu, 2021, OI).

The church members also reported that Miraa could be sold to help in purchasing church instruments. This was seen to be very crucial to the members since it took away the burden of contributing money to buy the items.

The catechists 6(80%) raised an issue where the Church in Igembe Deanery has suffered so much financially due to a fall in Miraa sales in recent years since it was banned in various countries. Miraa traders have faced the challenge of lack of markets which has affected the church's ministry because there is decrease in tithes and offerings as the churches mainly rely on contributions from Miraa income. The catechists, 7(90%) also said that the challenges facing Miraa production has led to a decline in members' support to the church. This has in turn affected the spread of the gospel which is supported by the income from Miraa.

On Miraa traders most of the respondents 8(80%) said that their churches owned Miraa plantations while the least group 2(20%) said that their churches did not own a Miraa plantation. This study further shows that most of the elders who accounted for 8(80%) owned Miraa plantations while a few of them 2(20%) did not own a Miraa plantation. I as the researcher agreed 100% that churches owned a Miraa plantation. The researcher noted that the Roman Catholic Church in Igembe Deanery, Meru Diocese tolerated Miraa farming, trade and consumption has various churches in the region have Miraa farms, which they sold and got money to enhance evangelisation through Igembe Deanery.

Construction of the Churches

It was observed that the church normally conducts fundraising to build infrastructures like the church buildings, priests' houses and even residential rented apartments as part of the income needed by the Roman Catholic Church in Igembe Deanery. Because of this, the church has always accepted Miraa in its funds-drive to raise money for undertaking such projects. Miraa could always be brought by church members and/or obtained from the church's Miraa farm.

In this study, most of the catechists 4(44.4%) responded by saying that Miraa fund was used in buying of more plots, while a few of them 2(22.2%) said that Miraa was used improving the living standards of the people in the society. In addition, another group that accounted for 3(33.3%) said that Miraa income was used in investing in other income generating projects that supported the construction of the various churches in the region.

The findings of this study showed that most of the elders8 (80%), said that Miraa farming and trading has enhanced the expansion of church, while the minority group 2(20%) responded by saying that expansion of the church is not as a result of Miraa farming and trading. Moreover, the study also showed that most of the priests 8(81.8%) said that

Miraa farming and trading has enhanced expansion of the church. However, a few of the priest 2(18.2%) said that Miraa consumption and production does not enhance expansion of the church.

Building Schools and Hospitals

Since the colonial times, the Roman Catholic Church has been at the forefront in construction of schools and hospitals to enhance the provision of social services to the people. The various respondents reported that Miraa is encouraged by the Roman Catholic Church in Igembe Deanery in Meru Diocese since the money obtained from its sales, is used to help in the construction of educational and health centers. The church has constructed many primary and secondary schools as well as various health mission hospitals through funds obtained from Miraa production in the deanery.

This study shows that most of the priests, 7(72.2%) said that Miraa enhances expansion of church economically, but a few of the priests 1(9.1%) said that Miraa enhances expansion of the church in other ways rather than economically and socially. However, some of them who accounted for 2(18.2%), said that Miraa enhanced expansion of church socially.

This study showed that most of the priests 8(81.8%) agreed that the church grows Miraa on its own while just a few number of them 2(18.2%) of them said that the church does not grow Miraa on its own.

This study shows that most of the church members 253(84.2%) strongly agreed that the church had put up permanent structures from Miraa income while a few of them 1(0.4%) just agreed on that. However, 1(0.4% just disagreed and said that the church had not put up permanent structures from Miraa income. It is evident from these findings that most of the church buildings in Igembe Deanery have been constructed using the proceeds from Miraa. It is because of this that the church has supported Miraa production and trade among its members.

Social Reasons

This section discusses the major social reason that has influenced the Roman Catholic Church to tolerate the production and consumption of Miraa in Igembe Deanery, Meru Diocese. The social reasons raised from the field were: reconciliation, marriage negotiations, social interaction, reference to the Ameru ancestors as well as closing of paths leading to a persons' homestead or farm. The majority of the respondents 289 (95.4%) raised social factors as one of the reasons as to why Miraa is tolerated by the church in Igembe Deanery. The social reason that has made Roman Catholic Church to tolerate Miraa production and consumption are discussed below.

Reconciliation

The data collected demonstrate that, Miraa is used by the residents of Igembe Deanery to reconcile people and solve emanating disputes within the region. The various respondents in this study reported that in the event that there was a conflict between two or more parties in the church, the offending party could bring Miraa to the offended party as a truce and a sign of peace. This means that Miraa is very crucial in solving disputes and promoting peace in the community as well among the adherents of the Roman Catholic Church in Igembe Deanery, Meru Diocese, hence the reason for its toleration by the church. For instance, most of Miraa farmers, 8(80%) said that they use Miraa to heal rifts with their friends while the minority group that accounted for 20% said that they do not use Miraa to heal rifts with their friends. Most of the priests 8(81.8%) said that the church solves disputes arising from Miraa farming and trade while a few of the priests 2(18.2%) said that churches do not solve conflicts arising from Miraa farming and trade. It is thus, evident that in Igembe region, Miraa plays a significant role in reconciliation as well as in the promotion of peace.

Marriage Negotiations

Among the Igembe people, marriage institution is essential just like in other African communities. Based on the African-Christian belief, it was reported that it was important for every Igembe man and woman to marry. This was marked by several preparations and ceremonies including negotiations. It was established that most of the members of the Catholic Church in Igembe Deanery, as other members of the community used Miraa as a form of negotiations when seeking a girls' hand in marriage.

This study finding showed that most of the priests 9(90.9%), said that use of Miraa in marriage negotiations, enabled the rich and the poor to get an opportunity to get married. Thus, marriage was the rhythm of life and the institution which was instituted by God. Therefore, Miraa (Ncolo) being used in marriage negotiations' stricked an equilibrium between the rich and the poor as all had equal opportunities to get married. This is because; if you gave the father of

the girl Miraa (Ncolo) you were allowed by her father to marry her even if you had nothing else. According to 10(100%) of the priests, the use of Miraa in marriage negotiations brought people together.

Social Interaction

Miraa is essential in bringing the Igembe people together. During the observation schedule by the researcher, it was established most of residents of the study area, usually interacted together while chewing Miraa at various Miraa joints in the deanery. Most of these people informed the researcher that just like any social activity, they chew Miraa together as form of their socialization and this helps to bring them together. While they do this, they noted that they normally discussed the social, economic and religious affairs of Igembe Deanery as Christians chew Miraa at their will. This study shows that most of the priests 6(60%) said that use of Miraa promotes social interaction because as people chew Miraa in groups, it brought them together while the minority 4(40%) said that as people chew Miraa they exchange ideas hence promoting social interaction.

Religious Reasons

During the field interviews, the researcher established that, Igembe people of the Roman Catholic Church used Miraa to remember or refer to their ancestors. For example, Muturia (2021, OI) one of the respondents, reported that, *Mbaine* was used to refer to the first Ameru ancestors, who planted Miraa in his homestead. It was also established that Mbaine is considered among the respondents as the best Miraa in the Igembe culture. This is because Mbaine Miraa is used for reverence to the Igembe ancestors that is Mbaine and Ntagi.

This study shows that most of the church members 253(83%) strongly agreed that the church tolerates use of Miraa because of the link between the ancestors and Miraa while a few of them 1(0.4) disagreed on that, a clear indication that Miraa used by the people of Igembe for religious reasons, symbolizing link to ancestor hood.

Other religious reasons raised mainly focused on the church members calling to support the church ministry. These included:

Offering Church Service through Offerings and Tithes

Most of the respondents reported that the church tolerates the production, trade and consumption of Miraa in Igembe Deanery, since Miraa is given by Christians to the church as offerings and tithes. For instance, 7(88.9%) of the catechists said that church members gave tithes and offerings from Miraa income while only 1(11.1%) catechist said that church members did not give tithes and offerings from Miraa income. 9(90.9%) priests aver that most of what the Church gets from Christians as tithes and offerings comes from Miraa sales. As such, the priests cannot condemn Miraa. Only 1(9.1%) said that he does not allow tithes and offerings from Miraa proceeds, something that was doubtable as the people of Igembe cannot allow any priest who is against Miraa to serve them as affirmed by Muturia (2021, OI). Further, the findings indicate that 8(80%) of the elders who formed the majority gave tithes to the church from Miraa income while 2(20%) of the elder respondents did not give tithes from the Miraa income to the church.8 (80%) of the Miraa farmers respondents affirmed that they gave tithes and offerings to the church from Miraa income while 2(20%) of them gave a contrary view. 254(99.6%) Christians said that they get the offerings and tithes which they give to the Church from Miraa income. This is a clear indication the Church in Igembe Deanery, gets its income from Miraa, and this explains why this Church has tolerated Miraa activities.

Supporting the Priesthood

Supporting of priesthood is one of the key responsibilities of a Roman Catholic Christians (Meeme, 2021, OI). The most of the Roman Catholic priests interviewed claimed that portion of the Deanery's maintenance costs, are covered by Miraa farming and trade. Most of the times members sold their Miraa and then gave the money obtained to the priests to get their basic upkeep items. To a greater extent, some of them got their vehicles purchased to them by the church members through the sales of Miraa (Kananu, 2021, OI). A big number of priests8(80%) said that Miraa proceeds are used for supporting church projects while the rest,2(20%) said that Miraa proceeds were used in building the church, maintaining the priests, facilitating the spread of the gospel and buying vehicles for the priests. 7(70%) Miraa farmers said that Miraa proceeds are used to support church projects and building churches. However, a few of them 3(30%) said that the proceeds are used in maintaining the priests. This indicates that income from Miraa plays a vital role when it comes to supporting the work of the priests. This explains why the Church in this region supports Miraa activities.

Supporting Seminars, Crusades and Youth Seminars

The data collected demonstrated that, the Roman Catholic Church's tolerated the use of Miraa in the Deanery, since the crop could be sold and the money obtained could be used to finance church programs like holding seminars, crusades and youth seminars.

The findings show that most of the catechists 7(88.9%) said that income from Miraa is used for buying music instrument as well as financing youth, Sunday School and women activities.

9(90.9%) priest agreed the income from Miraa is used for supporting church activities such as conferences, seminars and others. This explains why the Church in Igembe Deanery continues to tolerate Miraa production and trade.

CONCLUSION

From the above discussions, it can be concluded that Miraa is the main source of income of the people of Igembe, in Meru County. This makes it the most available, useful and reliable crop that is used by the Catholic Church to generates income, which is used for the purposes of mission work and the general church developments. It is for this reason that the Roman Catholic Church in Igembe Deanery tolerates Miraa production, trade and consumption. As the main cash crop in Igembe region Miraa forms the economic bases of the inhabitants of this area, and as a result it cannot be taken lightly by persons, institutions or organizations, and the Church included.

Therefore, the researcher can conclude that, Miraa production and consumption in Igembe Deanery, Meru Diocese is due to its enormous economic and social as well as religious benefits that it provides to the local people. This explains the reasons why the Roman Catholic Church in Igembe Deanery has continued to tolerate this trend among its members and by extension the wider population of Meru Diocese.

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EFFECTIVENESS OF PRISON DECONGESTION PROGRAMS IN SELECTED PRISONS IN KENYA: AN EMPIRICAL ANALYSIS

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ABSTRACT
This paper analyses prison decongestion programs in Kenya and their effects on prison populations in the country. The analysis is based on primary data collected from a sample of 266 prison officers and 16 probation officers. The analysis shows that overall, prison decongestion programs contribute to a reduction of prison population. Based on the evidence generated, the paper recommends adoption of community-based sentences especially on petty crime offenders to reduce overcrowding in prisons.
Keywords: Decongestion Programs, Prison, Population, Community Sentence

INTRODUCTION

Prison overcrowding is one of the major problems facing correctional institutions in Kenya today. This situation has been attributed to delays in the dispensation of the criminal justice, increased recidivism, overdependence by the courts on imprisonment as the primary punishment, longer prison term sentences, and insufficient prison capacity. The problem of prison overcrowding is also attributed to issues related to the roles of prison sentences in the system of criminal sanctions and criminal sentencing (Irungu & Muchori, 2018). Excessive use of prison sentences has been cited as the key contributor to the increasing population in prisons (Blumstein & Piquero, 2007). World Prison Brief Data (2018) suggests that there are 108 established penal institutions in Kenya with a cumulative accommodation capacity of 27,000 prisoners. Yet the average inmates' population is 56,000, of which 35,000 are convicted offenders and 21,000 are remandees. This shows that prisons in Kenya are too congested.

According to the Criminal Justice System in Kenya (2017), an estimation of more than four million people is arrested and detained every two years. Ochien'g (2018) posits that of the total arrests conducted, 32 percent are converted to charges in court, and 70 percent are sentenced to a prison term. Notable among the convicts is that most of the offenses committed are petty offenses that would otherwise attract a fine or be placed on probation.

Overcrowding compromises accommodation standards for inmates, healthcare, and rehabilitative services. Another consequence of prison overcrowding is the budget constraints, which, in effect, affect the criminal policy that determines the course of criminal law and punishment. Prison overcrowding has led to poor health outcomes for inmates in prison. Drucker (2011); Rabe (2012) posits that due to the increasing number of incarcerated individuals, prisons are experiencing unprecedented and unanticipated problems, including the spread of communicable diseases such as tuberculosis and re-socialization of minor offenders by hard-core criminals. Problems posed by prison overcrowding have resulted in urgent calls for an effective solution, including proposals for alternatives to imprisonment to counter overcrowding in prisons (United Nations Office on Drugs and Crime, 2012). As a result, decongestion programs were institutionalized in the prisons to bring a worthwhile solution in managing the prison population.

It is against this background that the government of Kenya introduced programs aimed at decongesting prisons. According to the Kenya Crime & Safety Report (2008), the decongestion program aimed at reducing the number of petty convicted offenders and remand inmates by 20 percent from 3,816 to 3 053 by December 2008. To decongest the prisons, non-custodial sentences such as community services and committal to probation hostels were proposed as alternatives to prison terms. The program involves revision of sentences of prisoners by the High Court, and it only affects the convicted offenders and not those in custody awaiting trial. Offenders serving a sentence of three years or less are eligible for this program, as well as a person serving a less than three years' balance of a longer sentence.

LITERATURE REVIEW

Decongestion programs are programs designed to manage the prison population. They are all known as Community Corrections Services. Decongestion programs are alternative sentences enforced on guilty adults either by a court instead of imprisonment or by a parole board after offenders' release from penal institutions (Rhine, Petersilia, & Reitz, 2017). Community correctional service has been introduced in Eastern Europe, different countries of the former

Soviet Union, and Africa, and they are employed by courts to punish and rehabilitate non-serious offenders (PRI, 2015). Community service involves the lawbreaker working on an unpaid basis in the community as a way of retribution for the offenses committed. is aimed at profiting that community for a period equivalent to the imprisonment term an offender has been punished to serve (Community Service Orders Act, 1998). It involves implementing and managing non-custodial measures for offenders (Griffiths & Murdoch, 2009). Community correctional services provides a sentence outside the prison and the Community Service Orders Act, No. 10 of 1998 makes it possible for Courts to issue an order necessitating an offender to do some community service.

Community service was initially designed to reduce the excessive use of imprisonment and emphasize the application of non-custodial means or fines for offenders who had committed less serious offenses such as non-violent acts, petty theft, and traffic violations (Jeffrey & Lisa, 2007). The scheme has provided the court with the power to command offenders to perform some duties within the community for a given period. In some parts of the world, community service orders schemes have been developed as an alternative sanction. For instance, the USA in North America, Ireland in Western Europe, and New Zealand in Australia have incorporated the schemes in their sentencing (UNODC, 2012).

The community based sentence does not involve the denial of the offender's liberty, who need not be put in prison either due to the conditions surrounding their offense, situation, or personality (Rob, 2015). Instead, the community corrections programs have multiple objectives: ensuring good rehabilitation services, economic efficiency, surveillance, and ensuring that offenders are made accountable for their offenses (Rhine, Petersilia, & Reitz, 2017). Serving a non-custodial sentence can aid to manage the prison populations and ensure that offenders positively payback to the community for the acts committed to the community (PRI, 2015). More importantly, it ensures that the problems that might have led the offender to offend are well treated.

According to the Centre on Sentencing & Corrections (2013), Community-based corrections supervision is inexpensive as compared to imprisonment, and this can be a basis of positive reformation for communities. The programs should be well-sourced with staff to incorporate efficient supervisory practices and be supported entirely by the Government. By doing this, the safety of the public, which is mainly affected by the large numbers of people getting back to society from prison, can be improved, and criminals can be well prevented from reoffending in the neighborhoods.

Community-based correctional programs are expected to reduce the prison population, but this cannot occur instantly. The process can take a long time. American Academy of Paediatrics, (APP), (2008) points out that Community-based programs alongside community partners are more interested in evaluating the kind of work they do in their communities. Therefore, constant monitoring and evaluation are emphasized. Conducting a regular evaluation of the community-based supervision programs ensures that offenders are well-integrated into society, which is the crucial goal of entire supervision (American Legislative Exchange Council, 2015).

Rockville (2005) argues that regular evaluation of decongestion programs is essential in ensuring their suitability in meeting the wants of criminals serving a community-based sentence. The evaluation also ensures that maximum results are realized. However, the inadequacy of resources has amounted to the cancellation of the evaluation of the decongestion programs. APP (2008) alludes that the sustainability of the programs is propped up by a prudently planned and well-executed program evaluation. The study thus reveals that the programs have not been very efficient due to inadequacy in appraisal.

According to the Centre on Sentencing & Corrections (2013), supervising offenders in the community can be a sure way of responding to criminal behaviour for both communities, justice-involved and individuals. This can only be possible if the community correctional is adequately resourced and carefully planned. Therefore, the success of any community-based sentence as a non-custodial sentence depends on different efforts designed to reshape and meet the needs of the correctional programs. The expectations of success may not be felt if there are no resources needed to accomplish the task. Also, the program should not be geared towards redirecting more offenders into existing systems. It should aim at offender reformation and prison population management. This may not guarantee to save on the cost of imprisonment or the safety outcomes of the public.

Community Based Sentence remain one of the most extensively used sanctions in the United States, as revealed by recent U.S. national estimates (Brandon, Hayden, Alicia & Nicolette, 2009). It remains the most frequently used

service (American Correctional Association [A.C.A.], 2006). In 2006, the number of offenders serving a probation sentence throughout the U.S. was more than 4.2 million. This number increased to 5.1 million people in 2008, while 84 percent of the 5.1 million offenders were adults placed under community supervision. Glaze and Bonczar (2007) further posits that the totals of the offenders placed under probation supervision were slightly higher than double the number of criminals imprisoned in U.S. jails and prisons. The probation service is widely used in the U.S. as an alternative to imprisonment, which remarkably decongests the prisons and saves on the State's economic resources. This is shown by the highest number of offenders serving a probation order. From the literature, it is evident that offenders placed on probation were many and reduced prison overcrowding. Nevertheless, in Kenya, statistics indicate that prisons are overpopulated despite the program's applicability.

It is evident from this study that the U.S.A. widely embraces the use of CBS as an alternative to custodial sentences. According to the Bureau of Justice, in 2016, 4,537,100 offenders were placed on probation in the United States. This figure makes up 84 percent of the population supervised in the community (Archambeau, 2011). The number of inmates serving a non-custodial sentence is higher than those in prison, thus cutting the cost of prison sentences and reducing the population. This is an indication that if well utilized, the program can help manage the prison population. Despite its use in Kenya, the populations are high, which calls for the need to assess how they effectively reduce the prison population.

In Europe, non-custodial sentences such as community service orders as an alternative to the incarceration period are likely to be used (Muliluvuori, 2001). For instance, in Ireland, most offenders sent to prison are for short periods, and therefore, CBS programs are an effective measure to imprisonment. The prison population has reduced to a definite number. It is noted that in 2014, 90.2 % of offenders sentenced for imprisonment totaled 11,596 and were for less than twelve months (Irish Prison Service, 2015). Following this massive number of short-period sentences, the Criminal Justice Community Service Amendment Act 2011 was introduced in Ireland. This Act required courts to consider a committal of all petty offenders to serve Community Service Orders (CSOs). This seemed very appropriate for all offenders sentenced to an imprisonment of twelve months and below (O'Hara & Rogan 2015). The committals were supposed to work in the community unpaid instead of a prison term completing between 40 and 240 hours. Thus, from the past to almost current, the prison population has been reduced, thus addressing the overcrowding challenges as alluded in the literature. This is, however, contrary to Kenya, where the prisons are overpopulated despite the sentencing of the offenders to CSO.

Community correctional services is considered the main penalty in the penal code of Tunisia. This service can be obligated on all lawbreakers and misdemeanors punishable by incarceration of less than one year but not for recidivism cases (PRI, 2015). The offender has a right to be informed by the court that they have a right to either accept the community service or refuse it. The court should well record the offender's response. This measure is directed towards reducing clogging the prisons with inmates. Overcrowding the prisons with inmates undermines the rehabilitation programs. Therefore, petty offenders are sentenced to non-custodial sanctions, thus limiting competition of the rehabilitation facilities with those serving long-term sentences. However, in Kenya, there is scanty information on how the community correction services have helped reduce the overpopulated prisons despite its application, which informs this study.

Tanzania is cited as one of the countries that impose community service orders on offenders who had already served their prison term beforehand. Although the move to divert more offenders from prison to community services appears to decongest the prisons, the Tanzanian prisons prefer to retain those offenders eligible for a CS to provide labor in the prison farms (PRI 2015). Thus, they consider committals, irrespective of whether they meet the threshold for an alternative sentence or not, first to serve a prison term before they can finally allow them to serve community service. There is a likelihood of the offenders to experience the adverse impacts of imprisonment. It is further argued that the sentencing magistrates felt that the offenders must feel the pinch of prison as a deterrent and that they can appreciate the CS once there.

In practice, the Kenyan government observed that prison congestion did exist, and consequently, imposition of non-custodial sentences was recommended. The establishment of the community sentences was recommended by the commission as a more humanitarian measure and could address the prison overcrowding (Ndombi, 2014).
The emphasis on the CSO Program stems from its perceived benefits which involve rehabilitation of less severe offenders within the community they were drawn from. Most of these offenders are poor and marginalized and cannot afford imposed court fines (UNAFRI, 2011). The CSO Program has an economic benefit to the country since it saves

the taxpayers money spent on petty offenders in prisons (PRI & NCRC, 2015). The program, if well implemented, is advantageous in both social and economic benefits. The CSO projects have raised revenue for Kenya's Government. Despite these vast advantages of CSO and its applicability as an alternative sentence, it is not clear whether the courts decide to sentence the inmates to serve a custodial sentence for provisions of services in prisons that leads to overcrowding.

An overview of the Probation Services in Kenya conducted by Okech (2015) reveals that Kenya experiences a severe problem of prison congestion. The study suggests that the solution to decongesting prisons lies outside the prisons; thus, C.S.O. is emphasized. According to the World Prison Brief Data (2018), the records from Kenya Prison indicate that in 2000, the total number of prisoners on pre-trial and those convicted was 40,010 inmates, and in 2002, there were 35,157 inmates. In 2004, the total number of prisoners on pre-trial and those convicted were 52,000 inmates, and in 2006, the population was 47,036 inmates. In 2009, there were 19,936 inmates on pre-trial, 29,032 convicted, giving a total of 48,668 inmates. In 2008, there were a total of 46,150 inmates.

In 2010, there were 15,092 offenders on pre-trial, 33,259 convicted, giving 48,351 incarcerated populations. In 2012, there were 20,140 pre-trial, 36,040 convicted, giving a total of 53,000 incarcerated populations. In 2014, the total number of offenders on pre-trial and those convicted was 54 579 incarcerated populations. In 2016, the total number of prisoners on pre-trial and those convicted was 50,900, while in 2018, the number was 56,000. From these records, it is clear that the number of inmates in Kenyan prisons is still very high. Therefore, there is a need for alternatives to imprisonment to reduce prison congestion. This includes orders for probation and C.S.O

Ndombi (2014), argues that the CBS program has set itself to decongest the overcrowded Kenyan prisons. The program enables the offenders to do unpaid community work for the community's benefit to retribution for the crimes committed. The CBS aims to rehabilitate the offender and make him/her become a better person in the community. This ensures that the less-serious offenders are not taught how to commit more serious crimes. Literature shows that CSO alternatively decongests the overpopulated prisons if the concerned personnel well utilizes the program.

From the literature, it is evident that a large body of empirical research has focused on using the CSO program as non-custodial sentences with the objective of sentencing petty offenders to offer services to the community for the offenses committed. However, research on the extent to which these programs have helped to reduce the prison population has rarely been tested since it is widely used, particularly in Kenya. The prison population also still remains to be very high. No study has focused on whether the CSO is meeting the intended purpose of managing overcrowded prisons. This is by ensuring that the petty offenders are sentenced on a non-custodial basis, thus alleviating the wastage of rehabilitation resources on these offenders, which could otherwise be used on the offenders serving long-term sentences.

METHODOLOGY

The study adopted descriptive survey research design. Purposive sampling was used to sample three prisons from all the decongested prisons. The sample size was determined by Slovin's formulae at 95% confidence level and 0.05 population variable.

$$n = \frac{\mathrm{N}}{(1 + \mathrm{Ne}^2)}$$

$$n = \frac{800}{(1 + 800 \times 0.05^2)}$$

$$n = 266.67$$

$$n = 266$$

The three prison officers total sample was 266. Stratified sampling was used to classify the prison officers' population into Embu GK prison, Eldoret GK prison, and Kakamega GK prison. Using Kothari's formulae, proportionate sampling was used to sample 267 prison officers from the three prisons.

$$n_1 = n \times \frac{N_1}{N}$$

$$n_1 = 267 \times \frac{250}{800}$$

$$= 83.44$$

$$= 83$$

The sample size of Embu, Kakamega and Eldoret GK prison officers was 83, 100, and 83. Simple random sampling was then used to pick respondents from each of the three strata. Purposive sampling was used to select a sample of 16 probation officers. Closed ended questionnaire was used for data collection which was edited for completeness using SPSS prior to data analysis. Descriptive statistics and inferential linear regression analysis was used in data analysis.

RESULTS

Response Rate and Descriptive Analysis

There were 282 questionnaires administered to the respondents and 256 were successfully filled out and returned. Table 1 below presents the demographic characteristics of the respondents.

Table 1. Demographic Characteristics of Respondents

Variables		Frequency	Percentages
Respondent Categories	Eldoret officers	67	80.72
	Embu officers	65	65.0
	Kakamega Officers	61	73.50
	Probation officers	9	56.25
Age	18-25 Years	56	27.7
	26-35 Years	65	32.2
	36 -45 Years	61	30.2
	46 -55 Years	20	9.9
Level of Education	Secondary level	86	42.6
	Bachelors	108	53.5
	Master's degree	6	3.0
	Any other	2	1.0
Rank of Officers	Officer in charge	1	0.5
	Senior prison officer	62	30.7
	Prison warders	120	59.4
	Any other	19	9.4

From Table 1, the response of Eldoret, Embu, Kakamega officers was 80.72%, 65.0%, 73.50%, and 56.25%, respectively. This implies that the response level of 71.63% was appropriate and commendable for analysis, making deductions, and recommendations. From the results, there exist significant differences between the age profiles of respondents. As presented in Table 1 above, most of the respondents who provided information were of the age bracket of 26-45 years. While prison and probation officers of all ages are present in the prisons and probation department, youths continue to be over-represented.

Youths appear to be over-represented because they have completed secondary education, tertiary education, and some college education which is a minimum requirement for joining the prison and probation services. The study further established that the majority (53.5%) of the prison and probation officers had attained a bachelor's degree qualification, 38.1% of the officers had a secondary level of education. In comparison, only 3% of the sample population had a master's degree qualification.

FINDINGS

The study sought to investigate the extent to which the decongestion programs have helped reduced prison population. The responses were recorded in the table below.

Table 2: Prison and Probation Officers' Responses on the Extent to which the Decongestion Programs have helped Reduced Prison Population

Statement	S.A		A		N		D		SD	
	F	%	F	%	F	%	F	%	F	%
The prison population was high before introduction of the decongestion programs	35	17.0	103	50	42	20.4	22	10.7	0	0
Application of CBS reduces over use of the custodial sentences	67	32.5	116	56.3	14	6.8	3	1.5	1	0.5
The use of CBS is a rapid response to crime and social disorders.	47	22.8	104	50.5	39	18.9	12	5.8	0	0
The judicial services emphasizes on the application of the CBS programs.	57	27.7	121	58.7	21	10.2	3	1.5	0	0
The Government has reduced ambiguity on the decongestion programs provisions.	45	21.8	136	66	12	5.8	7	3.4	2	1.0
The programs have improved the rehabilitation process	77	37.4	111	53.9	10	4.9	2	1.0	1	0.5
There is reduced criminal resocialization	67	32.5	119	57.8	7	3.4	7	3.4	2	1.0
The restorative justice has been improved	56	27.2	108	52.4	24	11.7	12	5.8	2	1.0

The results indicate that majority (67.0%) of the prison officers strongly agreed and agreed that the prison population was high before the introduction of the decongestion programs, 20.4% of the prison officers were neutral, while 10.7% of the sample population disagreed.

The study sought to investigate on whether application of CBS reduces the overuse of the custodial sentences that undermine human rights. The result revealed that majority (90.6%) of the prison and probation officers strongly agreed and agreed that CBS reduces the overuse of the custodial sentences. In comparison, 6.9%, 1.5%, and 0.5% were neutral, disagreed, and strongly disagreed. On whether the CBS has been a rapid response to crime and social disorder, the majority of the sample population, (72.8%) agreed and strongly agreed while 18.9% and 5.8% were neutral and disagreed. The result in Table 1 above further indicates that 58.7% of the sample population agreed that the judicial services emphasize the application of the CBS programs. 10.2% were neutral while 1.5 disagreed. With regard to whether reduced ambiguity on decongestion program provisions by the government has been effective as a measure to reduce the prison population, (66.0%) of the sample population strongly agreed and agreed while 4.4% strongly disagreed and disagreed.

The results in Table 2 above also reveals that majority (65.5%) of the prison and probation officers also strongly agreed and agreed that an intensive order set by the court to meet offenders' needs has been effective as a measure to decongest prisons, 23.8% were neutral while 8.9% of the sample population disagreed. On whether an improved rehabilitation process has been effective as a measure to decongest prisons, most (91.3%) of the prison and probation officers strongly agreed and agreed, 4.9% were neutral while 1.5% of the sample population strongly disagreed and disagreed. From the results in Table 1, (90.3%) of sample population strongly agreed and agreed that decongestion programs have effectively reduced criminal re-socialization. 3.4% of the officers were neutral while 4.4% strongly disagreed and disagreed. With regard to whether the decongestion programs have improved restorative justice in the Criminal justice system, majority (79.6%) of the officers strongly agreed and agreed while 11.7% of the sample population were neutral. In comparison, 6.8% strongly disagreed and disagreed.

Inferential Analysis and Hypothesis Testing

To complement the descriptive results, the researcher conducted inferential analysis involving Karl Pearson Moment Correlation analysis, analysis of variance (ANOVA), and regression analysis. The researcher used a correlation matrix to test for the correlation between the variables. The dependent variable in this study was prison population while the independent variable was decongestion programs.

Karl Pearson Correlation Analysis

Karl Pearson Moment correlation helps test the relationship between the explanatory variable so that the strength of the variables can be determined. This test is essential because it informs which variable best explains the relationship between decongestion programs and prison population.

The respondents were asked to indicate the extent to which they agreed with statements about the extent to which the decongestion programs have helped reduce prison population. The findings are presented in Table 3.

Table 3: Correlations between prison population and Decongestion Program

Variables	Correlations	Prison Population	Decongestion Programs
Prison Population	Pearson Correlation	1	.837
	Sig. (2-tailed)	.	.020
Decongestion Programs	Pearson Correlation	.837	1
	Sig. (2-tailed)	.020	.

These results from Table 3 above show a significant relationship between Prison population and decongestion programs. The findings showed a positive correlation between the Prison population and Decongestion programs with a correlation coefficient of 0.837 (p-value 0.02 < 0.05), which is significant at a 5% significance level. These results imply that for every unit change in decongestion programs, there is a positive change in the prison population (decongestion). These results are presented in Table 3 below.

Coefficient of Determination

The model summary below portrays the coefficient of determination for the model. The coefficient of determination R-square measures the explanatory power of the model. It shows the degree of association between the explanatory and explained variables.

Table 4: Regression Model Summary

Model	R	R-Square	Std. Error of the estimate
1	.797	.835	.269

From the model summary in Table 4 above, the model had an R-square of 0.840, which implies that 84% of the changes in prison population can be explained by the changes in predictor variable; decongestion programs. This implies that the explanatory variable is a good predictor of the model since only 16% of the changes in prison population can be explained by other factors not captured in the model and are taken care of by the error term. This is also in agreement with a study by Simon (2009) that decongestion programs and prison reforms greatly influence the prison population.

Analysis of Variance

The Analysis of variance (ANOVA) was used to determine whether there was a regression relationship between decongestion programs, constraints to decongestion programs, prison reforms, and prison population. The F-ratio in the ANOVA table tested whether the overall regression model was significant and fit for inferences. The results obtained are presented below.

Table 511: ANOVA results

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	7.58	4	7.51	3.972	0.000
Residual	203.08	198	3.52		
Total	210.66	202			

Dependent variable: Prison Population. Independent variables: Decongestion Programs

The results indicate that F-statistics of 3.972 are significant since p-value 0.00< 0.05 at 5% significance level, implying that the overall model is significant for making inferences. This, therefore, shows that the model is fit for finding out the relationship between the dependent and independent variables.

Regression Coefficients

To assess the effect of decongestion programs on the prison population, an OLS linear regression model was run with decongestion programs as explanatory variable while prison population was included as the explained variable. The results are presented in Table 6.

Table 6: Regression Coefficients Table

Model	Unstandardized Coefficients		Standardized Coefficients	t-value	t-prob
	B	Std. Error	Beta		
(Constant)	.580	.189		3.079	.004
Decongestion Programs	.489	.093	.227	2.034	.000
F-statistics	2.912				[0.000]**

Table 5 presents the OLS regression results for the model. The F-statistic is 2.912 with a p-value of $0.000 < 0.05$ at 5% significance level, implying the overall significance of the model. This means that decongestion program significantly influences the prison population. The regression coefficient (β) value of the computed scores of effect of decongestion programs on the prison population was 0.227 (t-prob 0.004< 0.05). The results show that decongestion programs positively contribute to a unit change in the prison population (β= -0.227). This means that ceteris paribus, a unit increase in decongestion programs like maximum utilization of the decongestion programs, adequate financial allocations by government, human resources, reduced ambiguity on its provisions, leads to depreciation of prison population by 22.7%. Therefore, the null hypothesis that there is no significant effect of decongestion programs on the prison population in Kenya was rejected, and thus the alternative hypothesis was accepted.

SUMMARY AND CONCLUSION

The aim of this study was to determine the effect of decongestion programs on the prison population in Kenya. The null hypothesis was that there was no statistically significant relationship between prison population and decongestion programs. The study affirms a statistically significant effect of decongestion programs on the prison population. It is evidently confirmed that the decongestion programs not only reduce prison population but also improves on the human rights of the inmates. Moreover, the programs rapidly respond to crime and disorder, thus ensuring that there are no or lessened cases of recidivism cases.

RECOMMENDATIONS

Drawing from the study findings discussed herein, the following recommendations were made:

i. The judiciary should emphasize the application of community-based sentences to reduce clogging prisons with petty offenders.
ii. The government should allocate adequate finances to meet the decongested populations' needs; this lowers recidivism and cuts the cycle of prison overcrowding.
iii. The government should deploy more prison officers in proportion to Prison administrative & management needs with priority given to areas with high prison populace to ensure adequate rehabilitation of inmates and thereby the reinforcement of decongestion programs.

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MODES OF AGRICULTURAL PRACTICES EMBRACED BY THE PEOPLE OF ABOGETA SUB-COUNTY BEFORE 1937.

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ABSTRACT
Agricultural activities are a very crucial part of a people's economic engagements. This study is about the history of the transition from subsistence to cash crop farming in Abogeta Sub-County in Meru County, Kenya, from 1937-1980. The people in Abogeta Sub-County's economic activities were farming and keeping livestock. Farming practices were mainly for subsistence. Crops that were grown included millet, sorghum, peas, arrowroots, yams, beans, and cowpeas. Later Changes occurred in the agricultural sector by 1937. This research aimed to examine the transition from subsistence to cash crop farming and its effects on food production in Abogeta Sub County of Meru from 1937 to 1980. The study investigated modes of agricultural practices embraced by Abogeta Sub-County people from 1937-1980. The study employed a qualitative research design to describe the events as they occurred systematically. The target population was 179608 as per the 2019 census. A total of 30 respondents were randomly sampled and interviewed from Abogeta Sub County. Data collection instruments were interview schedules, focused group discussions, and observation. Study findings revealed that the people from Abogeta Sub County engaged in subsistence farming before 1937. The study established that the transition in agriculture occurred in Abogeta Sub-County due to the introduction of cash crops like coffee and tea. This study also noted that the transition positively and negatively impacted the people. Policymakers in the government may use the study investigations to find solutions to food insecurity in Abogeta Sub-County of Meru County.
Keywords: Agriculture, History, Food security, Farming, Food crops, Cash crops.

INTRODUCTION
The development of agriculture is associated with the nutritional, economic, and social gains it gives to a man. Agricultural products like millet and sorghum are used to provide food. Animals provide meat and milk, and the skin provides clothes and bedding. Early man was a hunter and a gatherer. He hunted animals for food and gathered wild fruits and roots. Factors that led to the development of agriculture included population increase, decreased wild animals due to overhunting, and the invention of tools. According to Mwaniki (2005), agriculture was well organized in Meru, Chuka, and More before the colonial period. The researcher has given examples of crops like millet, sorghum beans, cowpeas, finger millet, sweet potatoes, and bananas. Like all the other Mt Kenya Bantu, the Meru were farmers during the pre-colonial period. The people grew crops and kept livestock. Crops that are grown include yams, arrow roots, sorghum, bananas, and peas. Later crops like maize and beans were introduced by the early visitors to Kenya, like the Portuguese. European intervention in Kenya resulted in social and economic changes affecting indigenous agriculture beyond recognition. This background led to investigations on the modes of agricultural practices embraced by the people of Abogeta- Sub-County during the pre-colonial period.

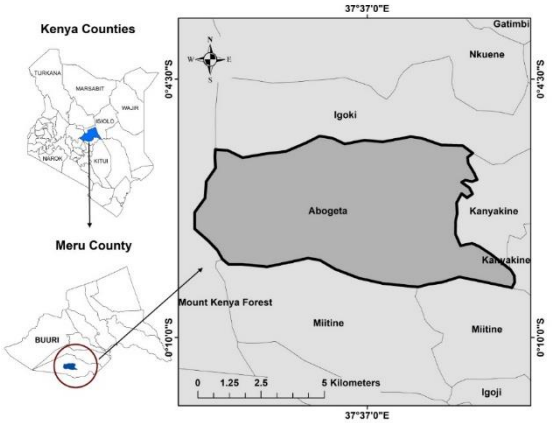


Figure 4: Map of Abogeta Sub County
Source: Meru County Development Plan 2008- 2012

RESEARCH METHOD

The study employed a descriptive research design. Mugenda and Mugenda (1999) note that Descriptive research is a process of collecting data to answer questions concerning the current status of the problem of the subjects in the study and that it determines and reports the study findings as they are. According to Kathuri and Pals (1993), descriptive research design ensures that the data collection and presentation process is systematic and the results obtained are valid and reliable. This design was used to investigate the modes of agriculture embraced by the people of Abogeta Sub County during 1937-1980. The study described, recorded, analysed, reported, and presented the study findings as they exist. Thus, a descriptive research design suited the study as it gave the researcher valid and reliable findings.

Data Analysis, Procedure and Presentation

The use of Qualitative Data Analyses analyzed data. Qualitative Data Analyses was used to describe the modes of agriculture in Abogeta Sub County, the transition from food crop to cash crop farming in Abogeta Sub County between 1937 and 1980and implications of the changes to food production. This data was merged and transcribed into written texts. Oral data was thematically analyzed and corroborated using secondary sources. Finally, data was merged from various data instruments to ensure consistency in data presentation. Data was collected using interview schedules, Focus Group Discussions (FDGs), and observation schedules. Interviews were conducted on a one-on-one basis. In focus discussion groups, six farmers gathered together to clarify information on agricultural practices before introducing cash crops. Open and closed-ended questions to obtain information. During the process, the researcher took notes and recorded important points from fourteen farmers.

FINDINGS OF THE STUDY

Imperialism scholars such as wringly (1965) and Ruthenburg (1971) generalize all pre-capitalist African land tenure systems as having been communally owned. According to the oral respondent, land in Abogeta belonged to the clan. According to Nkoroi (O.T 2020), The clan elders had the authority to allocate land to different households. Each clan had its plot of land that people could settle and use to cultivate and graze the animals. Portions of the land were set apart for communal activities like circumcision, dances, and circumcision rituals. Wells remained communal lands where all people were free to fetch water and water the animals. It was common for the elders to declare part of the land as arable for cultivation while the other was set free for grazing (*buuri*). According to Laughton William (1938), the people of Abogeta Sub County of Meru had a well-organized economy during the pre-colonial period. They had a group of professional hunters (Athi) who lived in the forest.

Hunters provided meat that supplemented meat from goats and sheep. Hides were used to make clothes and used by older adults as mats to prepare tobacco. They cultivated crops like sorghum, millet, yams, bananas, and arrowroots. Cattle were kept for milk and were slaughtered for meat during special occasions. After harvesting and threshing, food was safely stored in containers called˝muuru.''Only the mother could access the food store. Other members of the family practiced mixed farming. Stored food was used to feed the community members on different occasions. Harvesting feast was celebrated where a lot of brews called "marwa̋ was prepared and a lot of food was cooked to mark the occasion. After harvesting, the people of Abogeta-Sub-County had the festival prepared to thank God for a good harvest. A lot of food and drinks were prepared for the occasion. The agricultural practices in Abogeta Sub-County were for subsistence purposes. Agricultural activities ensured a regular supply of food.

Hunting and Gathering

In Kenya, the hunting and gathering system was practiced in Africa as early as late as the nineteenth century. According to Murithi (O.1 2020), the Meru practiced hunting and gathering to supplement the diet. Hunters used bows and poisoned arrows (*ubai*) which killed the animals after shooting with the poisoned arrows. Hunting was done by the young, energetic men and boys known as Athi. This was a group of talented men who could use bows and arrows to kill wild animals. The animals hunted included antelopes, deers, rabbits, rhinoceros, warthogs, gazelles, and leopards. Leopards were hunted for their skin which were used for ceremonial purpose. Various birds were trapped or killed with slingshots by young boys. These birds included *nkware, ncibi, ndungu, ndwigi, ncunguriku, and majia* Hunting was a group activity that involved two groups because animals are disturbed from their habitat; they move in different directions. According to Murithi, one group disturbed the animals while the other group waited on the other side. Different methods were used in hunting as some deep pits could be dug, animals could fall when running, and hunters could get them for meat. He informed me hunters could also chase the animals towards swampy areas where they got stuck in the mud. Hunters could use fire to chase the animals towards deep holes and swampy areas from where they were trapped.

Dogs were very important during hunting as hunters could use dogs to chase and catch animals during hunting. After hunting, the hunters slaughtered the animals and roasted some meat (*Nyama cia wathi*). The fire was made using two sticks rubbed against one another to produce fire. After the meat was roasted, not everybody was allowed to eat it as it was believed that if you ate, sours could develop in their bodies. After eating their share, the hunters carried the rest of the meat home to their families. Women gathered wild fruits and roots *mukuara, maungo, matuti, mpuru* collected insects like termites for food. Women could also move along the river valleys where they picked green edible vegetables *mwenjeu* for food. Women also dig some edible fruits from the ground (*ngatu*), which could be eaten raw by children. This is in line with the findings Abdul Sherriff (1985:4) that hunting and gathering were practiced in Africa as late as the 19th century.

Shifting Cultivation

This mode of production was common in Abogeta. According to Jones (1984), African agricultural systems were backward and static. Hopkins (1973) identified several types of shifting cultivation grouped under the rubric of shifting cultivation. He has shown that there exist various types of agricultural systems. In shifting cultivation, the land was tilled until its yields began to decrease. This piece of land was abandoned into fallow to the slow regenerative agencies of nature, and new fields were taken out of the surrounding waist.

According to Dionesio (2020), the people of Abogeta practiced shifting cultivation. He informed the respondents about how he left a portion of his land and moved with his family to a new area kibari, for four years, where they settled and cultivated but later returned to their original farm. Rotational bush fallow was suitable because the abandoned piece of land regained fertility, increasing food production, which helped cope with food shortage and crop failures. This form of cultivation also helped land to regain fertility and check soil erosion.

Intercropping

Zeleza (1986:174) calls intercropping the heart of African agriculture, which was common in Abogeta. Sorghum was intercropped with peas and black beans on the same farm. Cover crops like sweet potatoes were intercropped with peas and millet; trees were intercropped with bananas. In Abogeta, intercropping was also known as mixed farming. Mutiga (2020) gave information on how he intercropped sorghum with trees. When asked the reason, he told the researcher that trees acted as a wind break in the farm and that trees attracted rainfall. When the Portuguese introduced maize, the people of Abogeta intercropped it with peas on the farm. Wanja (2020) informed the researcher that not all crops were intercropped. He indicated that some crops like millet were grown separately to be able to scare birds during crop ripening. Millet was also not grown during the long rains because it matured before the dry period and thus could rot before being harvested. Intercropping crops suited the needs of the people of Abogeta because it ensured the supply of different food varieties. Root crops like sweet potatoes acted as cover crops and controlled soil erosion and adequate food supply. Food security was ensured by cultivating different food crops like arrowroots, yams, bananas, sorghum, and black beans Marieta (2020).

Livestock Keeping

Livestock keeping was a very important economic activity among the people of Abogeta during the pre-colonial period. Cattle, sheep, goats. Cattle were kept for milk and were slaughtered for meat on special occasions. One of the occasions when cattle were slaughtered was when an age group was about to retire from duty. The young generation slaughtered for the old generation to send them off duty. Mukura (2020) informed the researcher that milk from cows was important for children and women due to its nutritional value. Milk was also put in special guards ncengerio where it was fermented and taken as sour milk.

Cows were milked early in the morning, after which they were taken to communal grazing fields for grazing by men and boys. There was plenty of land; hence open field grazing method was practiced. Animals from different families in the village ntuura were gathered together for grazing, where duties were distributed to the men and boys who were to graze for a week, then another group could take over Muthuci (2020). According to Muthuci, cattle were a source of power and prestige, and the more cattle a man owned, the wealthier one was. Animals like cows and goats were used to pay dowry during the marriage. A young man had to pay *mwati na ruciu* (he-goat and a she-goat) to get a girl for marriage. Later, a *Mwari* (heifer) was to be paid to the girl's family.

Animals were also important trade items as families with surplus food production could exchange with livestock. The Abogeta could exchange the Tharaka grains with livestock of sheep, goats, or a cow. Animals were also used to pay fines in disputes (Mwenda, 2020). The people of Abogeta kept long-horned animals that were resistant to many

diseases. Sick animals were treated by herbalists who had acquired knowledge from their fathers. Raiding was a way of acquiring livestock where young men raided neighboring communities to get cows. Raiding involved fighting, and it was the duty of young, strong men who had to use spears and arrows to attack the enemies.

Crop Production

According to written sources, the Abogeta people grew varieties of crops like arrowroots, millet, yams, sorghum, maize, beans, bananas, and black beans for subsistence before 1938. Hopins (1973) identified several types of cultivation under shifting, fallow, and mixed farming rubrics. Fallow cultivation helped retain soil fertility by checking soil erosion to ensure high yields.

Kibaara (O.1, 2020), a respondent, narrated that when the people settled in the About area, they found bushes as they migrated from Mbwa, their original home. People cleared the bushes and planted crops. Broadcasting of crops was practiced when planting crops like millet.

Some fruits grew naturally, like *menyua, maungo, matuja*. Oral history was in line with Mwaniki's (1986) findings regarding planting indigenous crops of millet, sorghum, and peas. Later maize and beans were introduced by the Arabs and Portuguese. Maize and beans became the most consumed grains by the people of Abogeta. These findings can be compared to Maranga et al.'s (1988) history of agricultural practices during the Neolithic period domestication of plants and animals. He argues that agriculture evolved and developed independently and that only natural forces were at play.

Kiome (O.I,2020) noted that Farming methods and practices had remained unchanged by 1937. Plantation and estate farms were not practiced, and fertilizers, fungicides, and pesticides did not exist. Tractors and combine harvesters had not been invented. These findings are in line with the findings of Maranga et al. (1988) on agricultural practices in Britain before the agrarian revolution. According to him, Crops grown included corn, wheat, beans, peas, barley oats, and buckwheat. The land was divided into strips depending on the number of peasants. This encouraged soil erosion leading to low yields.

Respondents were also asked whether the foodstuffs they produced were for subsistence or sale. 80% of respondents said their production was mainly for subsistence, while 20% was exchanged in barter trade with their neighboring communities. Families grew foodstuff stored in granaries or exchanged during market days with products not made within their Sub County. Findings from this study agree with those of Mwaniki (2005), which found that the Meru people grew crops like millet, sorghum beans, cowpeas, finger millet, sweet potatoes, and banana subsistence.

According to Zeleza (1986), crops like millet, sorghum, arrowroots, and yams were grown to ensure enough food supply. The agrarian crisis-affected food crop production in East Africa, leading to food insecurity. According to Were & Wilson (1972), people of East Africa, 1000-1880, practiced cultivation. They grew crops and kept livestock for subsistence purposes.

KNA/PDA/EMBU/1/32/1963 Sources confirmed that Meru is a potential agricultural area with three different zones where different crops can be grown. The climate is suitable with an annual range of temperatures averaging between 17- 24 and receives rainfall of 1000-2000mm throughout the year.

CONCLUSIONS OF THE STUDY

The study concluded that the main economic activities in Abogeta Sub County were agricultural activities. People grew crops like millet, sorghum, arrowroots, and yams and kept livestock, cows, goats, and sheep. Agricultural activities were mainly for subsistence and not for sale.

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ASSESSMENT OF RELEVANT THEOLOGICAL ISSUES WITH REGARD TO THE ENCOUNTER BETWEEN AFRICAN TRADITIONAL RELIGION AND CHRISTIANITY IN THE METHODIST CHURCH IN KENYA, MERU COUNTY

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ABSTRACT
The Methodist church in Kenya (MCK) has been in Meru County since 1912 and there is evidence to suggest that African Methodist converts have continued to stick to some African traditional religious beliefs. The main objective of this study was to address the relevant theological issues following the encounter between African Traditional Religion (ATR) and Christianity in the Methodist Church. The study was informed by Emile Durkheim's functionalism theory which is a sociological view of religion emphasizing its usefulness to society. The theory posits that what has no function ceases to exist yet some aspects of ATR have been integrated in worship among MCK adherents thereby posing relevant theological issues. Six churches were purposively selected to participate in the study. The data was collected using questionnaires, structured interviews, checklist and church observation schedules and it was analyzed qualitatively. On the basis of the findings, the study recommended that Christian life and doctrines should be reformulated in the patterns of each and every culture in order to make Christianity durable. The modern Christian leaders should strive to make Christianity strong and permanent by allowing African and Christian culture to blend so as to meet the spiritual needs of Christians and give solutions to some of their problems. The findings of the study will contribute to the current academic concern for evolving an African Christian theology.
Keywords: Theological issues, African traditional Religion, Christianity, Indigenization, incarnation, enculturation

INTRODUCTION

This paper is based on a study on integration of African traditional religion and culture in Christian worship in Africa with particular reference to the Methodist church in Kenya (MCK) in Meru County. The research was prompted by apparent divided loyalties between Christianity and African Traditional Religion (ATR) as evident in the religious beliefs and worship practices amongst most adherents of MCK. This trend has raised relevant theological issues which cannot be ignored. The data presented here was mainly collected through interview sessions with enlightened members of the clergy and the Laity. The questions were also translated into mother tongue to enable other church members and leaders to respond in their focus discussion groups. Theological issues are mainly indigenization, enculturation and incarnation.

Purpose

The purpose of this article is to share the findings of a study carried out in the MCK, Meru County. The church appears to have integrated aspects of ATR into its spiritual programs as a strategy to accommodate and integrate the Ameru MCK adherents fully. This blending of religious beliefs has raised theological issues that this study has attempted to discuss. The research findings also demonstrate that the Ameru converts are reluctant to abandon their African beliefs and practices in spite of accepting the Christian religion and this reluctance has necessited an understanding of the theological issues therein so as to fully accommodate all believers.

Justification

First, the place of ATR in Africa in the context of rapid expansion of Christianity on the continent is unclear. This paper attempts to show apparent blending between ATR and Christianity within a conventional Christian church. Secondly, religion is one of the strongest elements in the African traditional background and exerts probably the greatest influence upon the thoughts and lives of the people concerned. It is therefore imperative to assess the possible theological implications of the encounter between the two religious beliefs mainly ATR and Christianity. The Christian presence in Africa has not erased the deep rooted African traditional religion. On the basis of research findings, this paper argues that ATR is very much alive within conventional Christian establishments in Meru County.

Theory

This study was informed by the theory of social functionalism as understood by Durkheim (1915) and Merton (1957). The essence of this theory is that social institutions remain relevant to the society as long as they serve useful purposes such as maintenance and perpetuation of the social system. Those that no longer serve any purposes are discarded as

dysfunctional. With regard to this paper, the argument is that the persistence of beliefs in ATR among Meru Methodist adherents has been conditioned by the functional significance of the former in the life and thought of the Ameru.

METHODOLOGY

The discussions in this article are based on a field study in which sixty respondents, mainly African members of MCK were purposively sampled to participate. Account was taken of their age, religious faith and leadership roles, both in the community and in the church as well as their level of formal education. Data for analysis and discussion was collected using questionnaires, interview question guides, checklists and church observation schedules. The main limitations were the distance between Egerton University and Meru County and the limited financial resources. However, these did not in any way compromise the credibility of the findings.

LITERATURE REVIEW

There have been several studies on the question of interaction between ATR and Christianity especially after 1960 by a number of scholars, Mbiti (1969) has observed that the form of Christianity brought by the Western Missionaries made no attempts to incorporate the ancestors, medicine men, religious specialists, African music and dance into the Christian faith. He observed that worship in mission churches was boring for most Africans. The hymns were sung in foreign tunes with little rhythm and without bodily movements, like clapping the hands or twisting the Loins as a religious expression. According to Mbiti, the Christian missionaries did not allow Africans to relate their own cultural and religious heritage to Christianity. They made an African convert become a Christian by cleaving to the new order introduced by the missionaries rather than by working out his salvation within the traditional African set up.

Mbiti (1975) acknowledges that African religion is part of the Africans' heritage and it has influenced African cultures and given them their world view. Mbiti further observes that it is not possible for this African heritage to be completely wiped out even by modern changes. As long as there is trace of African culture, it will also have some aspects of African religion. Mbiti argues that the continuation of African rural life will ensure the survival of African religion. African religion will continue to exist among people whose life is still tied to the land and traditional culture. However, argues Mbiti, some aspects of African religion will die out partly through modern education and partly because of urban life. The gist of Mbiti's argument is that ATR is here to stay in spite of the onslaught by Christianity and western culture. This is the kind of argument that could trigger an assessment of theological issues with regard to the encounter between ATR and Christianity in MCK.

Shorter (1973) has observed that true religion is Man-centered. It does not alienate man from himself but fulfils him and directs him towards his right end. He says that true religion promotes brotherhood and cooperation. Advancing the argument that African Religion directs man in the community and harmonizes with the aims of African Socialism, this scholar advocates for a stable and homogenous church structure which accommodates both Christian and traditional values. Shorter warns that unless and until there is a place for an African theology in the universal church, African rites and church structures of African Inspiration, an African Christianity will never be a reality. Shorter's conclusions are very important as they are relevant in as far as assessment of theological issues between ATR and Christianity in MCK is concerned.

Waliggo (1986) has argued that the incarnation of Jesus which made him become a perfect God will always remain the dearest guiding principle for enculturation. If the only begotten son of God saw it fit to enter the reality of humanity in full in order to save mankind from sin, it is the more reason for his church to do the same in every culture so as to continue with that saving mission. For Waliggo, the failure to incarnate the church in Africa means failure to make Christ appear African in his entire splendor. If Christ divinized humanity, then Christianity should do the same to African cultural and religious beliefs. According to him, evangelization loses much of its force and effectiveness if it does not take into consideration the actual people to whom it is addressed. The author further argues that for the gospel to be effective, it must use the language, the signs and symbols of the people to whom it is addressed.

Waliggo contends that the gospel should be able to answer the questions that people ask and it should have an impact on their concept of life. The concept of enculturation as proposed by Waliggo is relevant to the present study in the sense it is perhaps what has not been addressed in the MCK in Meru County.

In their effort to introduce Christianity in Africa, the modern western missionary church has been unable to present to Africans more than a Western image of its faith. Mugambi (1989) faults the early western Christian missionaries for introducing Christianity to Africans alongside their western culture. He argues that a similar problem arose in the New

Testament period when the early church apostles, who were influenced by their Jewish culture on the issue of male circumcision as an outward sign for the descendants of Abraham wanted Gentile converts to be circumcised. This necessited convening of the first ecumenical council in Jerusalem (Acts 15:1 Galatians 2:3). The ecumenical councils agreed that faith in Jesus Christ was the qualifying factor and not circumcision.

Mugambi contends that one of the negative consequences of the above error in the theology of mission was that Christianity came to be viewed by most Africans as a European religion superimposed upon the African cultural and religious environment. Africans wanted to relate to Christianity within their cultural and religious milieu. If their Christian experience is to be meaningful and effective, they cannot afford to cut themselves off from their own cultural and religious past. Mugambi seems to be of the view that those converting Africans to Christianity should respect African culture and religious heritage. However, this is yet another generalized study. Hence the current study focused specifically on the African traditional religious beliefs and practices which have persisted in the Methodist church and the theological issues there in.

At the beginning of the missionary era in Meru region, there was the wild assumption that the Ameru did not have a deeply rooted world view. However, it is now apparent that missionary Christianity in the region did not fall into a religious vacuum. It found the Ameru well and deeply equipped with their cultural and religious experience which shaped their world-view. Christianity to them was not the first but the second religious experience to which they were exposed and continue to be.

According to Onyancha (1989) the African and Christian world-views contrasts so much that the African world view has made it difficult for Christianity to penetrate fully and shape the African personality since the African world view is deeply rooted as the first experience prior to Christianity. Onyancha further says that African converts in mission churches have found difficulties in reconciling the previous experience with their new faith. The writer argues that while the laws of science are universal, religious beliefs are not. He says that religion must take different forms in different world views. The author further points out that even the western society did not adopt all aspects of Jewish community. This is because the western world view was different from that in which Christianity was founded. Similarly, the western society could by no means expect the African Christians to accept Christianity together with the western world view since they had their own. Thus, at the Psychological level, it could be right to say that Christianity has remained peripheral to many Methodist converts in Meru. The current study was an attempt to understand the theological issues arising as a result of the encounter between the two world views.

There are a number of studies on Methodism in Meru region by various scholars. Nthamburi (1981) has concentrated on the history of the Methodist church in Kenya with particular references to Meru region, while Micheni (1988) has assessed the contribution of Methodist Missionaries to education in Meru region. Nki (2001) has examined the traditional and Christian interpretations of suffering and healing among the contemporary Ameru of Kenya. However, no study has been carried out on the persistence of some aspects of ATR and its theological implications in the MCK in Meru County, hence the findings of this study are expected to fill a very important gap in knowledge. It was partly the aim of the current study to contribute to the contemporary concern for evolving an African Christian theology.

FINDINGS

This section discusses the findings of the study based on its purpose and objective. The main objective was to assess the relevant theological issues with regard to the encounter between ATR and Christianity that need to be addressed. The data presented here was mainly collected through interview sessions with the enlightened members of the Clergy, Laity and church leaders. The question was also translated into mother tongue to enable even the illiterate and semi-illiterate respondents to respond in their focus group discussions. The analysis of their responses is presented below.

Theological issues	**No. of Respondents**	**%**
Indigenization	45	78
Enculturation	20	34
Incarnation	235	60

NB: Respondents indicated more than one theological issue.

Indigenization

According to Reverend Gakii, failure to indigenize Christianity in Africa is like dressing the universal God in the western garment only. Reverend Gakii contends that all cultures need the gospel and are judged by it. Similarly, Reverend Mbae stated that the gospel has a universally relevant and applicable message which cannot be reduced to

the demands and expectations of one culture. He added that each culture should be allowed to bring into being a community of believers which is in tune with the demands and needs of that particular society. Reverend Mbae noted that the first Methodist missionaries were wrong in the understanding of the term conversion. He says that on the scale of conversion, the foreign missionaries gave themselves one hundred percent while the prospective convert was supposed to start at zero. In contrast, the Methodist clergy suggests that in the process of evangelization there are no active senders and passive recipients. The missionaries ought to be learners as much as the prospective convert is a receiver because we are all equal in the eyes of God. Both Reverends, Gakii and Mbae were in agreement that Christianity has to look at the contemporary Meru situation in order to be relevant. The two reverends therefore agree with Waliggo (1986) who argues that for the gospel to be effective, it must use the language, the signs and the symbols of the people to whom it is addressed.

According to church elder Jacob Kaaria, indigenizing Christianity means the worship will be accommodative through the use of local and understandable language, songs and dressing that will not disrupt a weak brother in the worship service. The elder noted that the use of foreign languages has made some worshippers to feel out of place. The elder further observed that the dressing styles that some churches allow become disruptive in worship services. He said that the use of local language will be an effective tool in evangelism, and a milestone in achieving the process of indigenization. The use of local music and local names will make Methodists African Christians appreciate and own Christianity as it will no longer sound foreign religion to them. As a result, the gospel will find home in the hearts of many Africans because communication would have been made easy. This can be done without changing the teachings of the Bible.

The researcher observed that the Laity, leaders and the clergy are not ignorant of the constraints to effective indigenization of Christianity in the county. Most of the respondents were in agreement that indigenization is a controversial and greater task which demands a lot of planning as well as time. This is because of the diversity of cultures in Meru County through intermarriages and immigration. As a result, the younger generation is getting more used to foreign language especially English. Reverend Mbae said that the Methodist church is a universal church with members from different cultural dimensions and backgrounds. He further noted that the Ameru are living in a multi-cultural and multi – racial society from where future Methodist converts and leaders will come. The Methodist clergy therefore preferred to base their strategy of indigenization on the authority of the Bible other than focusing so much on western Christianity and culture.

Reverend Doris Wanja suggested that indigenization should include the removal of the term “traditional” which betrays Christian bias and is meant to portray African religiosity as old fashioned and outdated hence irrelevant. The reverend noted that the use of the term traditional makes some believers to view ATR as a phenomena only important to those interested in studying history of the past. She suggested that it should simply be referred to as African religion just as there is for instance Muslim religion or Hindu religion.

Enculturation

The researcher observed that the Methodist church adherents tend to view Christianity as foreign or alien, one that has come to challenge their traditional religious practices. It is for this reason that many respondents during the oral interviews concurred that efforts must be made to enculturate the church to the times and cultures of contemporary Meru people. Church leader James Mugambi observed that the modern MCK church traditions and doctrines are flexible enough to accommodate the African background. He cited examples from the Bible where God addressed himself to the day to day problems or situations of the Israelite community. The church elder argued that the church tradition must be relevant to African situation. Along the same line, Reverend Gakii said the church needs to be inserted into the Meru culture so that the Christians can express their Christian practices in the language of today. This is the only way God’s saving power through Jesus Christ can be understood by people of all cultures. Reverend Gakii’s view concurs with that of Waliggo (1986) that for the church to be truly the church of Jesus Christ, it must be both universal and particular, and also reflect the characteristic culture of its people.

From the oral interviews with the ordinary church members, it came out clearly that the Laity adapted to the way of thinking and acting of the Meru people. This, they argued will make Christians in the Meru culture to view Christianity as a religion that belongs to them and can offer solutions to their problems even in times of crisis instead of turning to African solutions. To the Methodist clergy, enculturation is the only way to make Christianity permanent in Meru by making it a peoples’ religion and a way of life.

The researcher observed that some church leaders and elders were opposed to the idea of enculturation. The researcher sought to establish why some respondents were opposed to enculturation. Their responses were captured and analyzed in table below.

Table 2: Reasons against enculturation

Responses	No. of Respondent	%
Did not understand its aims	10	17
Fear that it might create a faulty Christianity	5	14
Will lower Biblical Standards	5	9
Will create syncretism	5	9
Will contradict the teachings of Jesus Christ	15	26
Will bring division in the church	16	28
Will create unhealthy imbalance between local and universal church	15	16

Incarnation

Many respondents were in agreement that Christianity should cease to be a foreign religion and become part of African Life, more specifically part of the Ameru life. Their views concur with Mbiti (1969) that Christianity in Africa is so old that it can rightly be described as indigenous, traditional and African religion. Mbiti says that failure to incarnate Christianity into the African cultures had made the religion to remain foreign to the Africans.

According to reverend Mbae, MCK leaders must follow the example of Jesus Christ and make efforts to incarnate Christianity into the Meru culture. Mbae concurs with Waliggo (1986) who says that Jesus saw it fit to enter the reality of humanity in full and became man while remaining perfect God. Reverend Mbae argued that the Methodist church should incarnate Christians into the Meru culture so as to continue with that saving mission of Jesus. Similarly, Reverend Wanja affirmed that it is only the denominations that are ready to make efforts to deeply incarnate the church that have a bright future. She further observed that where the opposite is the case, the church will remain weak and will always be seeking ways and means of retaining their members. Her views concur with those of Waliggo (1986) that for the gospel to be effective, it must use the language, the signs and symbols of the people it is addressed to and this is only possible through incarnation. Reverend Wanja also asserted that it is the desire to incarnate Christianity into African culture that made African independent churches to secede from the mission churches during the colonial period.

Another ordained minister, Reverend Gakii added that incarnation is unavoidable if the MCK is to have a future among the Meru. The reverend argued that the immersion of Christianity into the Meru traditional set up must be a reality if the scripture "God with us" is to become practical. She further pointed out that the Meru religious beliefs are to stay especially with the current revival of *Njuri Ncheke* in Meru region. Her views agree with those of Emile Durkheim (1917) whose theory guided this study that the religious practices and beliefs that have a function in a society continue to exist while those that have no function cease to exist. Reverend Gakii faulted the missionaries for having ignored the attachment of the Meru Christians to their religious beliefs and practices.

Muturi Nkaabu, a youth leader argued that the younger Christian generation in the Methodist church is quick to sift the Meru religious and cultural practices to retain those that are advantageous to them and leave out those that are not useful and are in conflict with Biblical teachings. He further stated that ATR is still relevant to the contemporary Christians. He thus suggested that the MCK leaders should come up with a way of making Christians part and parcel of the Meru people. According to Muturi, ATR is complex and even if the younger generation of Christians has abandoned many ideas and practices, others have still persisted and even some old ones are still being revived. The youth leader added that the youth have already embraced the good in both ATR and Christianity hence the need for incarnation.

Culture

Data collected through oral interviews, with the respondents showed clearly that culture is an issue that needs to be addressed in order to make Christianity to be lived practically in MCK in Meru County. Elders Gerishon Gitonga noted that right from the beginning the African converts in the MCK were not able to distinguish between the missionary work and the western culture. The elder pointed out that instead of taking the gospel of Jesus Christ, the

early Methodist converts in the region were struggling to adopt western culture. The Christians were not able to distinguish between the culture of the missionaries and the gospel the same missionaries were preaching. As a result, some African Christians ended up moving to the African independent churches which accommodated the Meru cultural and religious practices. Elder Gitonga noted that culture is not static and therefore the church should not ignore the changes that occur but should keep on adjusting so as to accommodate all people.

CONCLUSION

Theologically, there is need to develop a theology that will accommodate African Christians the way they are. The clergy need to devise a new approach with a view to promoting an understanding between Methodist Christians and Ameru traditional religious inclinations, ideas, values and beliefs. The Bible does not disagree but enriches and fulfills traditional religious beliefs and practices. Both the old and new testament give testimony to this. Just as the Jewish traditions prepared the Jews for Christianity, Ameru traditions provided enough background for conversion to Christianity. The problem of alienating the Ameru in the Christian churches need to be alleviated, for example, by finding a place for Jesus in the Ameru traditional religious set up. He would be the greatest ancestor who would do for the Ameru all that the ancestors did for them and even more. The word of God is meant to be effective in Christian lives today and it is the task of modern preachers to make the faithfuls realize this fact. All cultures need the gospel and will be judged by it. The Meru people have retained their religious beliefs alongside Christian faith and this makes it necessary for the MCK to develop a theology that will recognize the centrality of Jesus Christ and at the same time express a genuine African apprehension of the Christian faith.

The MCK members have sifted both Christianity and ATR and have accepted what is advantageous to them and left out what is of no advantage. As a result, the type of Christianity that has emerged in the MCK in Meru County is one that is enriched by the traditions of the Meru people. It is Christianity with a human face that is no longer abstract or mere ideology, but a reality.

RECOMMENDATIONS

If Christianity is to be lived and not to be just a matter of assent, then it requires concerted efforts by the entire modern Christian community. In view of this, the researcher recommends the following:

i) Christian life and doctrines should be reformulated in the patterns of each and every culture. This is necessary if Christianity is to be durable among the Ameru. Otherwise it will remain a foreign religion while the Ameru continue with their traditional religious practices.

ii) The thought forms and world views of particular communities should be incorporated into Christianity so that Christianity can fulfil its mission of development and fulfilment of human beings. This will enable Christianity to build itself up within existing viable human communities.

iii) Leaders of all Christian denominations should strive to make Christianity strong and permanent. They should allow African culture and Christianity to blend one another so as to meet the needs of Christians and give solutions to their spiritual problems. This will make Christianity a people's religion.

iv) The modern Christian leaders should evaluate ATR and understand it in the light of God's word so that where truth is found, it is preserved, and where errors exist, they are exposed by the standard of the scripture.

v) The modern church should do whatever it takes to make Jesus Christ appear universal and truly local at the same time. This will make Christianity in all its totality accomplish its founder's mission to be all to all people and win all for God.

vi) All Christian denominations should design ways of accommodating ATR in their worship so that believers will not feel out of place.

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LES INTERVENTIONS POST-COVID-19 DE L'AMBASSADE DE FRANCE VERS LA RELANCE ÉCONOMIQUE DANS L'ENSEIGNEMENT DU FRANÇAIS LANGUE ÉTRANGÈRE (FLE) AU KENYA

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INTRODUCTION

The Covid-19 pandemic affected almost all the sectors of the Kenyan economy the education sector included. Educational institutions were shut down indefinitely in March 2020 due to Covid-19 including institutions where French is taught. This resulted in a backlog that the Education Ministry has tried to get rid of in the last 2 years or so, in order to resume normalcy in educational institutions by January 2023. This year alone (2022), in order to catch up there has been 4 academic terms for nursery, primary and secondary schools instead of the normal 3 terms. Here at Chuka University, we have had 3 semesters from January to the current semester in order to recover the time lost during the Covid-19 period. Even at Alliance Française, which is the French Embassy's teaching and learning institution in Kenya, steps were taken to recover the lost time including online and blended learning programmes.

In order to recover from the ravages of Covid-19 and to cushion players in the teaching and learning of French, the French Embassy in Kenya, in conjunction with educational organisations linked to it, as well as collaborating with the Ministry of Education, has tried to put in place interventions to help the teaching and learning of FLE (Français Langue Étrangère) translated into English as French as a Foreign Language (FFL) to recover from the aftermath of the Covid-19 pandemic.

This paper seeks to investigate the interventions that the French Embassy in Kenya has taken in order to help the teaching and learning of FLE to recover not only academically but economically too.
This study has been a library research and has used information gathered from personal experiences as well as documents provided in the form of emails and reports obtained from the French Embassy in Kenya.
One of the interventions put in place by the French Embassy during the Covid-19 period was working online from home (known as "télétravail" in French). This was implemented in the education sector too and affected the SCAC (Service de Coopération et d'Action Culturelle), an educational organ of the French Embassy, as well as Alliance Française hitherto mentioned as the Embassy's teaching institution. With the "télétravail" in the education sector, the French Embassy continued an intense support for the existing networks in place for assisting French teachers including, and not limited to, training and resources. This was done within the framework of the new FSPI (*"Fonds Solidaire de Projets Innovants"*) an organ for financing educational projects of the Embassy hence give economic respite to the education sector due to the effects of the pandemic. This fund supported a project called EFIP *« Enseignement du Français, Innovation et Plurilinguisme »* (roughly translated in English as *"French Teaching, Innovation and Multilingualism"*). This project's first steering committee meeting was held in June 2020. More specifically, the project saw the launch of IFProf as an intervention measure by the French Embassy (currently with more than 500 members) and the project also continued to support FLAAP ("*French Language As A Priority"*) the latter of which is a network of schools in Kenya that have partnered with the French Embassy to promote French in schools in the country.

Another intervention was a programme the French Embassy started that comprised of English language assistants where young Kenyans (mainly university students, or students at Alliance Française, who have excelled in the French language) would be employed to go and teach English in schools in France while they work on their skills in French. This has been an iconic project and as of 2021 a total of 390 students had left Kenya for France to carry out this project. However, due to the Covid-19 pandemic, this programme was hampered and made difficult by the crisis.

In a discussion paper commissioned by the government of Kenya (GoK) on economic recovery (*"Building Back Stronger: Transforming the Kenyan Economy Post-Covid-19"*), the Ministry of Education notes that this crisis has highlighted the need to offer more flexible educational services adapted to different types of audiences.

With the reopening of schools in January 2021, the Ministry of Education considered a catch-up plan (shortening of holidays and lengthening of school days) so that by January 2023 the academic year in schools will have normalised. In addition, the Ministry had a plan to invest more in educational technologies. In order to do this, the Ministry of

Education relies on Kenya Institute for Curriculum Development (*KICD*) and its educational service tools on the Internet, radio and television (*"Educhannel"*).

It is in this context of challenges and educational experimentation that the French Embassy supports Kenyan teachers of French as an intervention strategy. With the new FSPI EFIP, an extra injection into linguistic cooperation, the project will develop the skills of Kenyan teachers of French by long distance learning through but not limited to it. This will help develop their (that is teachers of French) network as well as the sharing of resources especially digital ones. The new FSPI also puts emphasis on strengthening of ties and more dialogue with the Ministry of Education and its agencies (regarding its programmes and also when it comes to evaluation) as demonstrated by the first steering committee of 22nd June 2020.

Strengthening the network of Kenyan teachers of French by numerous online training activities with more emphasis on digital resources.

In order to support and motivate the over 500 Kenyan teachers of French in the country, this project can fall back onto the structured networks of years of educational and linguistic cooperation thanks to FSP (Fonds de Solidarité Prioritaire) which is a predecessor of FSPI. This support has been to 20 Kenyan regional centres of French spread out in the country under the umbrella organisation known as CRKF (Centre de Ressources Kényans pour le Français). The latter refers to the name given to French media libraries that have been opened by the French Embassy in the last 10 years or so approximately numbering about 20 of them here in Kenya. Other stakeholders are like Kenya Association of Teachers of French (KATF), the school network known as FLAAP (French Language As A Priority), CFTD (Centre for Training and Documentation) located at Kenyatta University, the latter of which is a member of AUF (Agence Universitaire de la Francophonie). In addition, there is the two Alliance Française institutions in Nairobi (with the latter encompassing the Eldoret Annex) and the other in Mombasa.

Through the exclusive use of digital technologies, the ACPF [Attaché(e) de Coopération pour le Français] and the VI [Volontaire International(e)], who are the French Embassy's staff responsible for educational cooperation, saw both of them working online during the pandemic (what is known as "télétravail" in French). These two personnel (ACPF and VI) made their input at several levels during the pandemic by disseminating information and they helped in the organisation of trainings for teachers of French on one hand and on the other hand networking with and aiding in withdrawal from 'professional isolation' of the same teachers. To cushion the teachers from the economic after effects of Covid-19, the French Embassy ensured that the teachers of French get data bundles of KShs1000 every week in order to access the modules being taught online. In addition, the French training courses were offered free of charge by the French Embassy so that any teacher of French would be able to attend even if they did not have the money to pay. This was an economic intervention that was very welcome and highly appreciated. Better still, French teachers who registered to do the DALF level C1 (Diplôme Approfondi de la Langue Française level C1) obtained a fee waiver for the exam in March 2021. Then, for universities doing FOS (Français sur les Objectifs Spécifiques) the French Embassy offered free courses and paid the costs of exams taken by French teachers (B2 level) and their students (A2 level) for the DFP (Diplôme du Français Professionnel). All these interventions were means of helping teachers and students of French in order to cushion them above all from the negative economic effects of the post-Covid-19 period. It was a way to achieve economic recovery.

Regarding the trainings, it is worthy to mention the following interventions financed by the new FSPI EFIP project: -

a) In May 2020, a first online training module was organised by the French Embassy called "Concevoir et animer une formation en Français Langue Étrangère [FLE] en ligne". This roughly translates as "Creating and teaching an online lesson in French as a Foreign Language". This online training had about 12 trainees of teachers of French in schools as well as FOS (Français sur Objectifs Spécifiques), the latter of which roughly translates as "French for specific objectives" which can be referred to, in layman terms, as Professional French. The latter involves university lecturers of French teaching tourism and hotel management as well as international relations. This training was organised from France and was hosted by Adrien Payet who is a freelance trainer.
b) In May-June 2020, an educational training known as "Créer une Webradio" (roughly translated as "Creating a Webradio") was organised by the French Embassy for approximately 30 teachers of French at all levels. This training was hosted online from France by a journalist-cum-trainer known as Thierry Riera.
c) A linguistic training in April/May 2020 was organised by the Alliance Française Mombasa branch with the aim of enhancing and/or improving the skills of teachers of French in the FLAAP network.

d) In collaboration with CFTD, online courses were proposed for future teachers of French at primary school level in line with the back to school programme in January 2021. This was an important milestone as it marked the launching of French as an LVE (Langue Vivante Étrangère), roughly translated as French as a "Modern Foreign Language" (MFL) as an option in our primary schools.
e) From around November 2020 to date, CFTD has also been offering online trainings for teachers during their school holiday breaks. Prior to this, these courses were offered physically at Kenyatta University (KU) but since the emergence of Covid-19, the lessons have been (and still are) online.

In order to contribute to online hosting of French trainings, the SCAC linguistic team created several online groups:-

a) A general group for Kenyan teachers of French with approximately 500 members.
b) A second one for university lecturers.
c) A third one for FLAAP teachers.
d) Another one for teachers of professional French (FOS – Français sur les Objectifs Spécifiques).
e) Apart from these WhatsApp groups, a Facebook page was created which is updated daily with numerous resources easily accessible to teachers of French and for those who are francophone and francophile in general.(https://www.facebook.com/francophonieKE/)
f) A newsletter and a Padlet were also created to complete these information channels and to enable the reinforcement of educational material as well as availing accessible and adapted content.

After being renamed last year, (formerly known as "pilot schools"), the FLAAP network of schools, hitherto mentioned, consists on its own of about 70 teachers of French spread out in 40 partnering schools. During the covid-19 pandemic, the French Embassy reinforced its communication with the teachers by increasing the frequency of issuance of the newsletter mentioned above while at the same time adding educational material, advice, webinars as well as free MOOCs (Massive Open Online Courses). The WhatsApp group created for these participants allowed not only the participants but it also enabled the SCAC linguistic team to reunite and mobilise.

In addition, SCAC organised "educational cafés" (these were Zoom meetings held bi-weekly) destined for the general fraternity of teachers of French with the goal of accompanying the teachers during the covid-19 crisis. These meetings were well appreciated by the teachers and they served to stimulate teachers' efforts and forestalled what could be referred to as 'professional isolation'. Even Ministry of Education agents took part in these meetings. These meetings also served as a good precursor to the reopening of schools in January 2021.

Another significant milestone was the launch of the IFProf platform in Kenya in June 2020, whose implementation followed the training of three trainers of Kenyan origin (a teacher each from the two Alliance Française institutions in Nairobi and Mombasa respectively as well as the Coordinator of CRKF who is a lecturer at University of Nairobi). Even if the uptake has not been fast, it would be good to remain optimistic as far as its success is concerned, the current issue being appreciating the desire by the more motivated teachers to join the IFProf platform. This new educational tool, indeed a new technological innovation by the French educationists, will allow the alongside implementation of policies on digital material and to integrate digitalism in public policies of domains relevant to Francophonie, as is recommended by the OIF (l'Organisation Internationale de la Francophonie) translated into English as the International Organisation of the Francophonie.

Finally schools in CRKF, in conjunction with the French Embassy's partnership with **eKitabu** (a non-governmental organisation), will be connected in their learning institutions and they will also be able to have access to digital material via inclusive and innovative solutions.

Promising involvement of the French Embassy's partnering with Kenya in the implementation of the new FSPI and the promotion of Francophonie

For the French Embassy, the priority of FSPI EFIP is to revitalise the teaching of French (training, quality, innovation and multilingualism) in a sustainable manner as part of its partnership with the Kenyan government. It is a post-Covid-19 intervention to ensure French is still vibrant after the ravages of Covid-19 in order to recover both academically and economically and especially to help the teachers of French to emerge from 'professional isolation' after the closure of educational institutions due to covid-19.

The first meeting of the steering committee, prepared as a virtual meeting by the stakeholders, finally took place on 22nd June 2020. Present at the meeting were representatives of the Ministry of Education and its main institutions

KICD and KNEC (Kenya National Examinations Council) on the one hand and the Alliance Française on the other. This first steering committee allowed the participation of the French Embassy's partners in the implementation and adjustment of the Embassy's objectives.

The following pertinent issues came up:-

a) The introduction of French as an option at primary school – confirmed postponement to January 2021.
b) The revision of French tests in the final KCSE (Kenya Certificate of Secondary Education) examination. KNEC observed that the tests are too difficult vis-à-vis the required level in the Kenyan education system which leads to students rarely opting for French at KCSE level.
c) The encouragement to acquire certification in FLE (French as a Foreign Language).
d) The enhancement of francophonie – KATF expressed the desire to be more involved in the organisation of the next national francophonie day (the one slated for March 2020 did not take place because of Covid-19) on condition that the association benefits from the financial resources. The French Embassy intimated to its partners that it was going to revise its schedule of activities from June 2020 up to the end of 2020, (some of these events were cancelled in March 2020), with the aim of celebrating the 50th anniversary of the Francophonie. These activities included:-

(i) Francophone literary conferences in liaison with IFRA (Institut Français de Recherche en Afrique) known in English as the French Institute for Research in Africa.
(ii) The short films festival in partnership with Alliance Française.
(iii) The "Machine à Bulles" exhibition which was also scheduled during the "Novembre Numérique" occasion.

Besides the KATF, the Embassy has made promising ties with FNK, Francophone Network of Kenya, whose website address is https://francophonenetworkofkenya.org. This is a new Kenyan NGO based in Kiambu County and whose objective is the promotion of French teaching in Kenya. Its main proponent is Mr. Chris Mburu, who is of Kenyan nationality and who is the Resident Coordinator of UNO (United Nations Organisation) in Congo-Brazzaville. He was introduced to francophone ambassadors in Kenya, with the aim of having a discussion on the role of the Francophonie at the United Nations (notably the UN office in Nairobi – UNON) and Kenya's interests therein, the latter of which is a non-permanent member of the CSNU (Conseil de Sécurité des Nations Unies), known in English as the United Nations Security Council. The aim was in order to better understand the OIF.

The Language Assistant programme affirms its success with Kenyan youth amidst difficult and unsure conditions of Covid-19

In spite of the corona virus crisis in 2020, the Language Assistant programme, which was launched when President Emmanuel Macron, the President of France, visited Kenya in 2019, is still on-going. The programme is two-pronged. This is a chance for Kenyan youth who speak French to be able to be in a francophone environment in order to perfect their skills in the language. This is the linguistic objective. Secondly, the young Kenyans also get to earn a salary while teaching English to French youth in schools hence reap from the economic benefit of getting paid in order for them to make financial decisions. This is welcome especially in today's challenging world of securing a good job and more so after the economic aftermath of the post-Covid-19 period where numerous people lost their jobs and suffered economically. However, this is amidst a lot of uncertainty and the French Embassy is monitoring very closely administrative conditions and the personal situations of the Language Assistants in liaison with FEI (France Éducation Internationale) and its academies.

Being the maiden cohort that President Macron met in March 2019, 53 of the 59 assistants, who started their mission in October 2019, were still in France by the time this report was being released. With a regrettable near exception, (an affected assistant at the Guadeloupe Academy), the assistants had all their contracts with the MENJ (Ministère d'Éducation Nationale et de la Jeunesse), roughly translated into English as the "Ministry of National Education and Youth", extended from end of April 2020 to the end of June 2020 (indeed of July 2020 for two of them). These language assistants returned home to Kenya during summer. For the second group of the year 2020/2021, the French Embassy enlisted 70 Kenyans in February 2020. They were trained remotely in order to prepare for their departure and they also benefited from a preparation seminar at the French School in Nairobi. In 2021/2022 the French Embassy envisages 135 assistants and likewise too for the year 2022/2023. In reciprocation to this Language Assistants' project, two assistants of French nationality came to beef up French in 2021. They were attached to University of Nairobi and Technical University of Kenya in order to support the lecturers in those two universities.

Support for civil society via the association known as PISCCA (Projets Innovants de la Société Civile et Coalition d'Acteurs) roughly translated as the Innovative Projects between Civil Society and Coalition Stakeholders.

PISCCA is a French government financial sponsor of civil society. During the covid-19 pandemic, young girls were prone to the risk of leaving the school system completely due to early pregnancies. As a result of dropping out of school, girls are more exposed to gender-based violence notably of sexual nature. The number of young pregnancies increased further due to closure of schools as a result of the covid-19 crisis. This closure of schools prevented such young girls from continuing with their education. In addition, economic difficulties, which have increased in many homes due to the corona virus pandemic, have led also to the rise in child labour hence dropping out of school. In light of this desperate situation, the French Embassy in Kenya, proposed a project financed by MEAE (Ministère de l'Europe et des Affaires Étrangères) roughly translated into English as Ministry of European and Foreign Affairs. This project was entitled **"Ell'imu"** which is a mixture of the French word **"elle"** (meaning **"she"**) and the Swahili word **"elimu"** (meaning **"education"**). This project is dedicated to supporting Kenyan civil society projects that focus on the education of young girls and young women and it mainly revolves around the following four sections:-

a) Technical and professional training
b) Promotion of long distance learning
c) Health in education
d) Promotion of sports education

These are interventions to help young teenage mothers so that they can improve their academic levels as well as being economic solutions after the covid-19 crisis.

Le Partenariat Mondial pour l'Education, PME, (roughly translated into English as "The World Education Partnership"), of which France is the 4th most important contributor, has donated $11 million dollars and other financings are in the pipeline.

The $11million dollars financial aid is in response to the health crisis created by covid-19 and the money goes to support:-

a) The expansion of access to and supply of online content to all pupils who are in primary school via radio, TV, 'cloud' and mobile telephony.
b) The training of teachers and supervisors of programmes using the long distance method of teaching.
c) The installation of an integrated system of follow-up and evaluation of distance learning.
d) The involvement of parents and different stakeholders in the supervision of learning by pupils.
e) The implementation of protection and security measures for learners, especially girls, during the school holidays.
f) A gradual transition towards the return to normalcy has been evident thanks to school feeding programmes and mentoring for girls, online psychosocial support services, as well as information on prevention of gender-based violence targeting teachers, parents and pupils.
g) Strengthening of Ministry personnel capacities when it comes to organizing virtual meetings during the corona virus pandemic and indeed beyond that i.e., post Covid-19.

In conclusion, these are some of the interventions that have been implemented and the French Embassy and its organs have been instrumental in helping the Government of Kenya (GoK), through the Ministry of Education, to help deal with the effects of Covid-19. This has helped the teaching and learning of FLE to recover not only academically but economically too not only in the post-Covid19 period but also during the pandemic itself.

Hence, it is desirable that the GoK, through the Ministry of Education, maintains a good working relationship with the French Embassy as regards bilateral cooperation since the Embassy has proven to be a viable, reliable and committed partner for sustainable solutions and/or policies that have helped the Ministry circumvent challenges it faced in the French sub-sector during the Covid-19 pandemic as well as the post-Covid19 period too especially economically.

Keywords: Post-Covid19, economic recovery, French Embassy in Kenya, interventions, FLE, pandemic.

REFERENCE

Emails from the the ACPF [Attaché(e) de Coopération pour le Français] and the VI [Volontaire International(e)], who are the French Embassy's staff responsible for educational cooperation.

APPENDIX I - ABBREVIATIONS

1. **SCAC:** Service de Coopération et d'Action Culturelle
2. **FSPI EFIP:** Fonds Solidaire de Projets Innovants
3. **FLAAP:** French Language As A Priority
4. **FSP:** Fonds de Solidarité Prioritaire
5. **CRKF:** Centres de Ressources Kenyans pour le Français
6. **AUF:** Agence Universitaire de la Francophonie
7. **ACPF:** Attaché(e) de Coopération Pour le Français
8. **VI:** Volontaire Internationale
9. **LVE:** Langue Vivante Étrangère
10. **MOOC:** Massive Open Online Courses
11. **CSNU:** Conseil de Sécurité des Nations Unies
12. **L'OIF:** Organisation Internationale de la Francophonie
13. **FEI:** France Éducation Internationale
14. **MENJ:** Ministère de l'Éducation Nationale et de la Jeunesse (France)
15. **PISCCA:** Projets Innovants de la Société Civile et Coalitions d'Acteurs
16. **MEAE:** Ministère de l'Europe et des Affaires Étrangères
17. **PME:** Petites et Moyennes Entreprises
18. **ONG:** Organisation Non Gouvernmentale
19. **ONU:** Organisation des Nations Unies
20. **FLE:** Français Langue Étrangère
21. **FOS:** Français sur les Objectifs Spécifiques

FRENCH VERSION

LES INTERVENTIONS POST-COVID-19 DE L'AMBASSADE DE FRANCE VERS LA RELANCE ÉCONOMIQUE DANS L'ENSEIGNEMENT DU FRANÇAIS LANGUE ÉTRANGÈRE (FLE) AU KENYA

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ABSTRACT

La pandémie de Covid-19 a touché presque tous les secteurs de l'économie kenyane, y compris le secteur de l'éducation. Les établissements d'enseignement ont été fermés indéfiniment en mars 2020 en raison du Covid-19, y compris les établissements où on enseigne le français. Cela a entraîné un arriéré dont le ministère de l'Éducation a tenté de se débarrasser au cours des 2 dernières années environ, afin de reprendre la normalité dans les établissements d'enseignement d'ici janvier 2023.

Afin de se remettre des ravages du Covid-19 et d'amortir les acteurs de l'enseignement et de l'apprentissage du français, l'Ambassade de France au Kenya, en lien avec les organismes éducatifs qui sont liés à l'Ambassade, ainsi qu'en collaboration avec le ministère de l'Éducation nationale, a tenté mettre en place des interventions pour aider l'enseignement et l'apprentissage du FLE (Français Langue Étrangère) à se remettre, y compris économiquement, des conséquences de la pandémie de Covid-19.

Cet article cherche à enquêter sur les interventions que l'Ambassade de France au Kenya a prises afin d'aider l'enseignement et l'apprentissage du FLE à se redresser non seulement académiquement mais aussi économiquement. Cette étude a été une recherche en bibliothèque et a utilisé des informations recueillies à partir d'expériences personnelles ainsi que des documents fournis sous forme de courriels et de rapports obtenus auprès de l'ambassade de France au Kenya.

En conclusion, l'ambassade de France et ses organes ont contribué à aider le gouvernement du Kenya (GoK), par l'intermédiaire du ministère de l'Éducation, à faire face aux effets du Covid-19. Cela a aidé l'enseignement et l'apprentissage du FLE à se redresser non seulement académiquement mais aussi économiquement non seulement dans la période post-Covid19 mais aussi pendant la pandémie elle-même.

Par conséquent, il est souhaitable que le GoK, par l'intermédiaire du ministère de l'Éducation, entretienne de bonnes relations de travail avec l'ambassade de France en ce qui concerne la coopération bilatérale puisque l'ambassade s'est avérée d'être un partenaire viable, fiable et engagé pour des solutions et/ou des politiques durables qui ont aidé le

ministère à contourner les défis auxquels il était confronté dans le sous-secteur français pendant la pandémie de Covid-19 ainsi que la période post-Covid19.
Mots clés: Post-Covid19, relance économique, Ambassade de France au Kenya, interventions, FLE, pandémie.

La pandémie de Covid-19 a touché presque tous les secteurs de l'économie kenyane, y compris le secteur de l'éducation. Les établissements d'enseignement ont été fermés indéfiniment en mars 2020 en raison du Covid-19, y compris les établissements où le français est enseigné. Cela a entraîné un arriéré dont le ministère de l'Éducation a tenté de résoudre au cours des 2 dernières années environ, afin de reprendre la normalité dans les établissements d'enseignement d'ici janvier 2023. Cette année seulement (2022), afin de rattraper son retard, il y a eu 4 trimestres académiques pour les écoles maternelles, primaires et secondaires au lieu des 3 trimestres normaux. Ici à l'Université de Chuka, nous avons eu 3 semestres de janvier au semestre en cours afin de récupérer le temps perdu pendant la période Covid-19. Même à l'Alliance Française, qui est l'institution d'enseignement et d'apprentissage de l'Ambassade de France au Kenya, des mesures ont été prises pour récupérer le temps perdu, notamment des programmes d'apprentissage en ligne et mixtes.

Afin de se remettre des ravages du Covid-19 et d'amortir les acteurs de l'enseignement et de l'apprentissage du français, l'Ambassade de France au Kenya, en lien avec les organismes éducatifs qui sont liés à l'ambassade, ainsi qu'en collaboration avec le ministère de l'Éducation nationale, a tenté de mettre en place des interventions pour aider l'enseignement et l'apprentissage du FLE (Français Langue Étrangère) traduit en anglais comme French as a Foreign Language (FFL) à se remettre des séquelles de la pandémie de Covid-19.

Cet article cherche à enquêter sur les interventions que l'Ambassade de France au Kenya a prises afin d'aider l'enseignement et l'apprentissage du FLE à se redresser non seulement académiquement mais aussi économiquement. Cette étude a été une recherche en bibliothèque et a utilisé des informations recueillies à partir d'expériences personnelles ainsi que des documents fournis sous forme de courriels et de rapports obtenus auprès de l'ambassade de France au Kenya.

L'une des interventions mises en place par l'Ambassade de France pendant la période Covid-19 était le télétravail à domicile. Cela a également été mis en œuvre dans le secteur de l'éducation et a touché le SCAC (Service de Coopération et d'Action Culturelle), un organe éducatif de l'Ambassade de France, ainsi que l'Alliance Française mentionnée jusqu'alors comme l'institution d'enseignement de l'ambassade. Avec le télétravail dans le secteur de l'éducation, l'Ambassade de France a poursuivi un soutien intense aux réseaux existants en place pour aider les enseignants français, y compris, mais sans s'y limiter, la formation et les ressources. Cela a été fait dans le cadre du nouveau FSPI ("Fonds Solidaire de Projets Innovants"), un organe de financement des projets éducatifs de l'Ambassade, donnant ainsi un répit économique au secteur de l'éducation en raison des effets de la pandémie. Ce fonds a soutenu un projet appelé EFIP (Enseignement du Français, Innovation et Plurilinguisme). Le premier comité de pilotage de ce projet s'est tenu en juin 2020. Plus précisément, le projet a vu le lancement de l'IFProf comme mesure d'intervention de l'Ambassade de France (actuellement plus de 500 membres) et le projet a également continué à soutenir le FLAAP (« French Language As A Priority »), ce dernier étant un réseau d'écoles au Kenya qui se sont associées à l'Ambassade de France pour promouvoir le français dans les écoles du pays.

Une autre intervention a été un programme lancé par l'Ambassade de France qui comprenait des assistants de langue anglaise où de jeunes kényans (principalement des étudiants universitaires ou des étudiants de l'Alliance Française, qui ont bien réussi dans la langue française) seraient employés pour aller enseigner l'anglais dans des écoles en France tout en travaillant sur leurs compétences en français. Cela a été un projet emblématique et en 2021, un total de 390 étudiants avaient quitté le Kenya pour la France pour mener à bien ce projet. Cependant, en raison de la pandémie de Covid-19, ce programme a été freiné et rendu difficile par la crise.

Dans un document de travail commandé par le gouvernement du Kenya (GoK) sur la reprise économique ("Building Back Stronger: Transforming the Kenyan Economy Post-Covid-19"), le ministère de l'Éducation note que cette crise a mis en évidence la nécessité d'offrir des services éducatifs plus flexibles adaptés aux différents types de publics.

Avec la réouverture des écoles en janvier 2021, le ministère de l'Éducation a envisagé un plan de rattrapage (raccourcissement des vacances et allongement des journées scolaires) afin que d'ici janvier 2023 l'année scolaire dans les écoles soit normalisée. De plus, le ministère avait un plan d'investir plus dans les technologies éducatives. Par

conséquent, le ministère de l'Éducation s'appuie sur le Kenya Institute for Curriculum Development (KICD) et ses outils de services éducatifs sur Internet, la radio et la télévision (« Educhannel »).

C'est dans ce contexte d'enjeux et d'expérimentations pédagogiques que l'Ambassade de France soutient les enseignants kényans de français comme stratégie d'intervention. Avec le nouveau FSPI EFIP, une injection supplémentaire dans la coopération linguistique, le projet développera les compétences des enseignants kenyans de français par l'apprentissage à distance à travers mais sans s'y limiter. Cela contribuera à développer leur réseau (c'est-à-dire les professeurs de français) ainsi que le partage de ressources, notamment numériques. Le nouveau FSPI met également l'accent sur le renforcement des liens et plus de dialogue avec l'Éducation nationale et ses agences (sur ses programmes mais aussi en matière d'évaluation) comme démontre le premier comité de pilotage du 22 juin 2020.

Renforcement du réseau des professeurs de français kenyans par de nombreuses activités de formation en ligne mettant plus d'emphase sur les ressources numériques.

Afin de soutenir et motiver les plus de 500 enseignants kényans de français du pays, ce projet peut s'appuyer sur les réseaux structurés d'années de coopération pédagogique et linguistique grâce au FSP (Fonds de Solidarité Prioritaire) qui est le prédécesseur du FSPI. Ce soutien a été apporté à 20 centres régionaux kenyans de français répartis dans le pays sous l'organisation faîtière connue sous le nom de CRKF (Centre de Ressources Kényans pour le Français). Ce dernier fait référence au nom donné aux médiathèques françaises ouvertes par l'Ambassade de France depuis une dizaine d'années au nombre d'environ une vingtaine ici au Kenya. D'autres parties prenantes sont comme Kenya Association of Teachers of French (KATF), le réseau scolaire connu sous le nom de FLAAP (French Language As A Priority), CFTD (Centre de formation et de documentation) situé à l'Université de Kenyatta, ce dernier étant membre de l'AUF (Agence Universitaire de la Francophonie). En outre, il y a les deux institutions de l'Alliance Française à Nairobi (la dernière englobant l'annexe Eldoret) et l'autre à Mombasa. Grâce à l'utilisation exclusive des technologies numériques, l'ACPF [Attaché(e) de Coopération pour le Français] et le VI [Volontaire International(e)], qui sont le personnel de l'Ambassade de France chargé de la coopération éducative, se sont vus tous les deux travailler en ligne pendant la pandémie (ce qu'on appelle « télétravail » en français). Ces deux personnels (ACPF et VI) ont apporté leur contribution à plusieurs niveaux pendant la pandémie en diffusant des informations et elles ont aidé à l'organisation de formations pour les enseignants de français d'une part et d'autre part à la mise en réseau et à l'aide à la sortie de «l'isolement professionnel » des mêmes professeurs. Pour protéger les enseignants des séquelles économiques de Covid-19, l'Ambassade de France a veillé à ce que les enseignants de français reçoivent des forfaits de données mobiles de KShs 1000 chaque semaine afin d'accéder aux modules enseignés en ligne. De plus, les cours de français étaient offerts gratuitement par l'Ambassade de France afin que tout professeur de français puisse y assister même s'il n'avait pas les moyens de payer. Il s'agissait d'une intervention économique très bien accueillie et très appréciée. Même encore, les professeurs de français qui se sont inscrits à faire le DALF niveau C1 (Diplôme Approfondi de la Langue Française niveau C1) ont obtenu une renonciation des frais pour l'examen en mars 2021. Puis, pour les universités qui font le FOS (Français sur les Objectifs Spécifiques) l'Ambassade de France a offert des cours gratuits et a payé les frais des examens passés par les professeurs de français (niveau B2) ainsi que leurs étudiants (niveau A2) pour le DFP (Diplôme du Français Professionnel). Toutes ces interventions étaient des moyens d'aider les enseignants et les étudiants de français afin de les amortir surtout des effets économiques négatifs de la période post-Covid-19. C'était un moyen d'aboutir à la reprise économique.

En ce qui concerne les formations, il convient de mentionner les interventions suivantes financées par le nouveau projet FSPI EFIP :-

a) En mai 2020, un premier module de formation en ligne a été organisé par l'Ambassade de France intitulé « Concevoir et animer une formation en Français Langue Étrangère [FLE] en ligne ». Cela se traduit en gros par « Creating and teaching an online lesson in French as a Foreign Language». Cette formation en ligne comptait environ 12 stagiaires d'enseignants de français dans les écoles ainsi que de FOS (Français sur Objectifs Spécifiques), ce dernier se traduisant en gros comme « French for specific objectives » que l'on peut qualifier, en termes simples, de Français professionnel. Ce dernier implique des professeurs universitaires de français enseignant le tourisme et l'hôtellerie ainsi que les relations internationales. Cette formation a été organisée de la France et animée par Adrien Payet qui est formateur indépendant.

b) En mai-juin 2020, une formation pédagogique dénommée « Créer une Webradio » a été organisée par l'Ambassade de France pour environ 30 enseignants de français de tous niveaux. Cette formation a été animée en ligne de la France par un journaliste-formateur connu sous le nom de Thierry Riera.

c) Une formation linguistique en avril/mai 2020 a été organisée par l'antenne de l'Alliance Française de Mombasa dans le but de renforcer et/ou d'améliorer les compétences des enseignants de français du réseau FLAAP.

d) En collaboration avec le CFTD, des cours en ligne ont été proposés aux futurs enseignants de français du primaire dans le cadre de la rentrée scolaire de janvier 2021. Il s'agissait d'une étape importante car elle marquait le lancement du français LVE (Langue Vivante Étrangère), grossièrement traduit en anglais comme MFL (Modern Foreign Languages) en tant qu'option dans nos écoles primaires.
e) De novembre 2020 environ à ce jour, le CFTD propose également des formations en ligne pour les enseignants pendant leurs vacances scolaires. Avant cela, ces cours étaient offerts en présentiel à l'Université Kenyatta (KU) mais depuis la crise de Covid-19, les cours ont été (et sont toujours) en ligne.
Afin de contribuer à l'animation en ligne des formations en français, l'équipe linguistique du SCAC a créé plusieurs groupes virtuels :-
a) Un groupe général pour les professeurs de français du Kenya avec environ 500 membres.
b) Un deuxième pour les professeurs d'université.
c) Un troisième pour les enseignants FLAAP.
d) Un autre pour les professeurs de français professionnel (FOS – Français sur les Objectifs Spécifiques).
f) À part de ces groupes WhatsApp, une page Facebook a été créée qui est mise à jour quotidiennement avec de nombreuses ressources facilement accessibles aux enseignants de français et à ceux qui sont francophones et francophiles en général.(https://www.facebook.com/francophonieKE/).
g) Une newsletter et un Padlet ont également été créés pour compléter ces canaux d'information et permettre le renforcement du matériel pédagogique ainsi que la mise à disposition de contenus accessibles et adaptés.

Après avoir été renommé l'an dernier, (anciennement dénommées « écoles pilotes »), le réseau d'écoles FLAAP, déjà mentionné, est constitué d'environ 70 professeurs de français répartis dans 40 écoles partenaires. Pendant la pandémie de covid-19, l'Ambassade de France a renforcé sa communication avec les enseignants en augmentant la fréquence d'émission de la newsletter mentionnée ci-dessus tout en ajoutant du matériel pédagogique, des conseils, des webinaires ainsi que des MOOC (Massive Open Online Courses) gratuits. . Le groupe WhatsApp créé pour ces participants a non seulement permis aux participants mais aussi à l'équipe linguistique du SCAC de se réunir et de se mobiliser.

De plus, le SCAC a organisé des « cafés pédagogiques » (il s'agissait de réunions Zoom bihebdomadaires) destinés à la fraternité générale des enseignants de français dans le but d'accompagner les enseignants pendant la crise du covid-19. Ces rencontres ont été très appréciées par les enseignants et ont servi à stimuler les efforts des enseignants et à prévenir ce que l'on pourrait appeler «l'isolement professionnel». Même des agents du ministère de l'Éducation ont participé à ces réunions. Ces réunions ont également servi de bon précurseur à la réouverture des écoles en janvier 2021.

Une autre étape importante a été le lancement de la plateforme IFProf au Kenya en juin 2020, dont la mise en œuvre a suivi la formation de trois formateurs d'origine kenyane (un enseignant chacun des deux institutions de l'Alliance française de Nairobi et de Mombasa respectivement ainsi que le coordinateur du CRKF qui est chargé de cours à l'Université de Nairobi). Même si l'engouement n'a pas été rapide, il convient de rester optimiste quant à son succès, l'enjeu actuel étant d'apprécier l'envie des enseignants les plus motivés de rejoindre la plateforme IFProf. Ce nouvel outil pédagogique, voire une nouvelle innovation technologique des pédagogues français, permettra d'accompagner la mise en œuvre de politiques sur le numérique et d'intégrer le numérique dans les politiques publiques des domaines relevant de la francophonie, comme le recommande l'OIF (l'Organisation Internationale de la Francophonie) traduit en anglais par « International Organisation of the Francophonie ».

Enfin, les écoles du CRKF, dans le cadre du partenariat de l'Ambassade de France avec **eKitabu** (une organisation non gouvernementale), seront connectées dans leurs établissements d'enseignement et elles pourront également avoir accès à du matériel numérique via des solutions inclusives et innovantes.

Implication prometteuse du partenariat de l'Ambassade de France avec le Kenya dans la mise en place du nouveau FSPI et la promotion de la Francophonie

Pour l'Ambassade de France, la priorité du FSPI EFIP est de redynamiser durablement l'enseignement du français (formation, qualité, innovation et multilinguisme) dans le cadre de son partenariat avec le gouvernement kényan. Il s'agit d'une intervention post-Covid-19 pour s'assurer que le français est toujours vivant après les ravages de Covid-19 afin de se redresser à la fois académiquement et économiquement et surtout pour aider les enseignants de français à sortir de "l'isolement professionnel" après la fermeture des écoles établissements en raison du covid-19.

La première réunion du comité de pilotage, préparée comme une réunion virtuelle par les parties prenantes, a finalement eu lieu le 22 juin 2020. Étaient présents à la réunion c'était des représentants du ministère de l'Éducation et de ses principales institutions KICD et KNEC (Kenya National Examinations Council) d'une part et l'Alliance française de l'autre part. Ce premier comité de pilotage a permis la participation des partenaires de l'Ambassade de France à la mise en œuvre et à l'ajustement des objectifs de l'ambassade.

Les problèmes pertinents suivants ont été soulevés : -
a) L'introduction du français en option à l'école primaire – report confirmé à janvier 2021.
b) La révision des tests de français à l'examen final du KCSE (Kenya Certificate of Secondary Education). Le KNEC a observé que les tests sont trop difficiles par rapport au niveau réquis dans le système éducatif kényan, ce qui fait que les étudiants optent rarement pour le français au niveau du KCSE.
c) L'encouragement à acquérir des attestations en FLE (Français Langue Étrangère).
d) La valorisation de la francophonie – KATF a montré le souhait de s'impliquer plus dans l'organisation de la prochaine journée nationale de la francophonie (celle prévue en mars 2020 n'a pas eu lieu à cause du Covid-19) à condition que l'association bénéficie des ressources financières. L'Ambassade de France a promis à ses partenaires qu'elle allait revoir son calendrier d'activités de juin 2020 jusqu'à fin 2020, (certains de ces événements ont été annulés en mars 2020), dans le but de célébrer le 50e anniversaire de la Francophonie. Ces activités comprenaient : -
(i) Conférences littéraires francophones en liaison avec l'IFRA (Institut Français de Recherche en Afrique) connu en anglais sous le nom « French Institute for Research in Africa ».
(ii) Le festival des courts métrages en partenariat avec l'Alliance Française.
(iii) L'exposition « Machine à Bulles » qui était également programmée à l'occasion du « Novembre Numérique ».
À part du KATF, l'ambassade a noué des liens prometteurs avec le FNK, « Francophone Network of Kenya » dont l'adresse du site Web est https://francophonenetworkofkenya.org. Il s'agit d'une nouvelle ONG kényane basée dans le comté de Kiambu et dont l'objectif est la promotion de l'enseignement du français au Kenya. Son principal promoteur est M. Chris Mburu, qui est de nationalité kényane et qui est le Coordinateur Résident de l'ONU (Organisation des Nations Unies) au Congo-Brazzaville. Il a été présenté aux ambassadeurs francophones au Kenya, dans le but d'avoir une discussion sur le rôle de la francophonie aux Nations Unies (notamment le bureau de l'ONU à Nairobi - UNON) et les intérêts du Kenya dans ce dernier, ce dernier étant un membre non-permanent du CSNU (Conseil de Sécurité des Nations Unies), connu en anglais sous le nom de « United Nations Security Council ». L'objectif était de mieux comprendre l'OIF.

Le programme Language Assistant affirme son succès auprès de la jeunesse kényane dans les conditions difficiles et incertaines de Covid-19

Malgré la crise du virus corona en 2020, le programme Language Assistant, qui a été lancé lorsque le président Emmanuel Macron, président de la France, s'est rendu au Kenya en 2019, est toujours en cours. Le programme est à deux volets. C'est une opportunité pour les jeunes kenyans qui parlent français de pouvoir se retrouver dans un environnement francophone afin de perfectionner leurs compétences dans la langue. Cela c'est l'objectif linguistique. Deuxièmement, les jeunes Kenyans gagnent également un salaire tout en enseignant l'anglais aux jeunes français dans les écoles, ce qui leur permet de tirer parti de l'avantage économique d'être payé pour leur permettre de prendre des décisions financières. Ceci est un avantage, en particulier dans le monde difficile d'aujourd'hui de trouver un bon emploi, et surtout après les conséquences économiques de la période post-Covid-19 où de nombreuses personnes ont perdu leur emploi et ont souffert économiquement. Cependant, cela se passe dans de nombreuses incertitudes et l'Ambassade de France suit de très près les conditions administratives et les situations personnelles des assistants de langue en liaison avec FEI (France Éducation Internationale) et ses académies.

Étant la première cohorte que le président Macron a rencontré en mars 2019, 53 des 59 assistants, qui ont commencé leur mission en octobre 2019, étaient toujours en France au moment de la publication d'un rapport de l'ambassade française en ce qui concerne ce projet. À une regrettable quasi-exception, (un assistant affecté à l'Académie de Guadeloupe), les assistants avaient tous leurs contrats avec le MENJ (Ministère d'Éducation Nationale et de la Jeunesse), grossièrement traduit en anglais par « Ministry of National Education and Youth », prolongés de fin avril 2020 à fin juin 2020 (voire juillet 2020 pour deux d'entre eux). Ces assistants linguistiques sont rentrés au Kenya pendant l'été. Pour la deuxième promotion de l'année 2020/2021, l'Ambassade de France a inscrit 70 Kényans en février 2020. Ils ont été formés à distance afin de préparer leur départ et ils ont également bénéficié d'un séminaire de préparation au Lycée Français de Nairobi. En 2021/2022 l'Ambassade de France prévoit 135 assistants et de même pour l'année 2022/2023.

En contrepartie de ce projet d'assistants de langue, en 2021, deux assistants de nationalité française sont venus promouvoir le français. Ils ont été rattachés à l'Université de Nairobi et à l'Université Technique du Kenya afin de soutenir les enseignants de ces deux universités.

Le soutien à la société civile via l'association connue sous le nom de PISCCA (Projets Innovants de la Société Civile et Coalition d'Acteurs).
PISCCA est un sponsor financier de l'Etat français auprès de la société civile. Pendant la pandémie de covid-19, les jeunes filles étaient victimes au risque de quitter complètement le système scolaire en raison de grossesses précoces. Du fait de l'abandon scolaire, les filles sont plus exposées aux violences basées sur le genre notamment à caractère sexuel. Le nombre de jeunes grossesses a encore augmenté en raison de la fermeture des écoles à la suite de la crise du covid-19. Cette fermeture des écoles a empêché ces jeunes filles de poursuivre leur scolarité. En outre, les difficultés économiques, qui se sont aggravées dans de nombreux foyers en raison de la pandémie du virus corona, ont également entraîné une augmentation du travail des enfants, donc l'abandon scolaire. À l'aide de cette situation désespérée, l'Ambassade de France au Kenya, a proposé un projet financé par le MEAE (Ministère de l'Europe et des Affaires Étrangères) traduit grossièrement en anglais par « Ministry of European and Foreign Affairs ». Ce projet s'intitulait **"Ell'imu"** qui est un mélange du mot français **"elle"** (signifiant "she") et du mot swahili **"elimu"** (signifiant "éducation"). Ce projet est dédié à soutenir les projets de la société civile kenyane qui se concentrent sur l'éducation des jeunes filles et des jeunes femmes et il s'articule principalement autour des quatre sections suivantes :-
a) Formation technique et professionnelle
b) Promotion de l'enseignement à distance
c) La santé dans l'éducation
d) Promotion de l'éducation sportive

Ce sont des interventions d'aider les filles afin de relever leur vies académiques ainsi que d'être des solutions économiques après la crise de la pandémie du Covid-19.

Le Partenariat Mondial pour l'Education (PME), dont la France est le 4e contributeur le plus important, a fait un don de 11 millions de dollars et d'autres financements sont prévus.
L'aide financière de 11 millions de dollars est en réponse à la crise sanitaire créée par le covid-19 et l'argent sert à soutenir : -
a) L'élargissement de l'accès et de la fourniture de contenus en ligne à tous les élèves de l'école primaire via la radio, la télévision, le "cloud" et la téléphonie mobile.
b) La formation d'enseignants et de superviseurs de programmes utilisant la méthode d'enseignement à distance.
c) La mise en place d'un système intégré de suivi et d'évaluation de l'enseignement à distance.
d) L'implication des parents et des différents acteurs dans l'encadrement des apprentissages des élèves.
e) La mise en place de mesures de protection et de sécurité pour les apprenants, notamment les filles, pendant les vacances scolaires.
f) Une transition progressive vers le retour à la normale a été évidente grâce aux programmes d'alimentation scolaire et au mentorat pour les filles, aux services de soutien psychosocial en ligne, ainsi qu'aux informations sur la prévention de la violence sexiste dont les groupes ciblés sont les enseignants, les parents et les élèves.
g) Renforcement des capacités du personnel du ministère en ce qui concerne l'organisation de réunions virtuelles pendant la pandémie du virus corona et même au-delà, c'est-à-dire après le Covid-19.

En conclusion, voici quelques-unes des interventions qui ont été mises en œuvre et l'Ambassade de France et ses organes ont joué un rôle déterminant pour aider le gouvernement du Kenya (GoK), par l'intermédiaire du ministère de l'Éducation, à faire face aux effets du Covid-19. Cela a aidé l'enseignement et l'apprentissage du FLE à se redresser non seulement académiquement mais aussi économiquement non seulement dans la période post-Covid19 mais aussi pendant la pandémie elle-même.

Par conséquent, il est souhaitable que le GoK, par l'intermédiaire du ministère de l'Éducation, entretienne de bonnes relations de travail avec l'ambassade de France en ce qui concerne la coopération bilatérale puisque l'ambassade s'est avérée être un partenaire viable, fiable et engagé pour des solutions et/ou des politiques durables qui ont aidé le ministère à contourner les défis auxquels il a été confronté dans le sous-secteur français pendant la pandémie de Covid-19 ainsi que la période post-Covid19, notamment sur le plan économique.

Mots clés : Post-Covid19, relance économique, Ambassade de France au Kenya, interventions, FLE, pandémie.

RÉFÉRENCE

Courriels de l'ACPF [Attaché(e) de Coopération pour le Français] et du VI [Volontaire International(e)], qui sont le personnel de l'Ambassade de France chargé de la coopération éducative.

APPENDIX I - ABBRÉVIATIONS

1. **SCAC:** Service de Coopération et d'Action Culturelle
2. **FSPI EFIP:** Fonds Solidaire de Projets Innovants
3. **FLAAP:** French Language As A Priority
4. **FSP:** Fonds de Solidarité Prioritaire
5. **CRKF:** Centres de Ressources Kenyans pour le Français
6. **AUF:** Agence Universitaire de la Francophonie
7. **ACPF:** Attaché(e) de Coopération Pour le Français
8. **VI:** Volontaire Internationale
9. **LVE:** Langue Vivante Étrangère
10. **MOOC:** Massive Open Online Courses
11. **CSNU:** Conseil de Sécurité des Nations Unies
12. **L'OIF:** Organisation Internationale de la Francophonie
13. **FEI:** France Éducation Internationale
14. **MENJ:** Ministère de l'Éducation Nationale et de la Jeunesse (France)
15. **PISCCA:** Projets Innovants de la Société Civile et Coalitions d'Acteurs
16. **MEAE:** Ministère de l'Europe et des Affaires Étrangères
17. **PME:** Petites et Moyennes Entreprises
18. **ONG:** Organisation Non- Gouvernementale
19. **ONU:** Organisation Nationale Unie
20. **FLE:** Français Langue Étrangère
21. **FOS:** Français sur les Objectifs Spécifiques

EFFECT OF PUBLIC WAGES ON EXTERNAL DEBT IN KENYA

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ABSTRACT
Most developing Africa countries have a high need for capital projects that requires a lot of government spending and attention. However, it is unfortunate that in Kenya, borrowed cash intended for capital projects is diverted to recurrent requirements like payment of wages and salaries, and debt repayment, putting a damper on national investment in viable projects. This poses a significant threat to the economy's growth. The following goals served as a guideline for the study; to determine the influence of public wages on external borrowing debt in Kenya using both cointegration and error correction model. Causal research design was adopted to explain the influence of public wages, social expenditure and debt servicing on external borrowing in Kenya. The study period was from 1970 and 2019 from which a 50-year time series data was employed for analysis. The research relied on secondary data which was collected with the aid of a structured data collection checklist from Central Bank of Kenya, and Kenya National Bureau of Statistics, International Monetary Fund and World Bank websites. Data analysis was done with an aid of Stata, E-views and Ox-Metrics statistical software. Stationarity of variables was tested using PP unit root test where public wages was reported to be stationary at level form. The study employed use of Ordinary Least Square (OLS) technique, to empirically examine the influence of recurrent expenditure variable on external borrowing in Kenya. There was a significant negative association between public wages and external debt whereby a rise in public wage by 100% indicated decrease in external debt by 101.92%. . The overall model was found to be significant since the F-statistic value generated in the analysis was 124.664 with a p-value of $0.000 < 0.05$. Model was a good predictor of external borrowing, with an adjusted R^2 of 0.946 for public wages explaining foreign debt. This research recommends the study recommends that SRC should free up resources using the austerity measures which include wage reductions for government employees. Secondly, the government through the ministry of treasury should raise tax base to increase revenues. Finally, the results of this study may be valuable to government stakeholders who are charged with the responsibility of ensuring economic development through public sector financing, also it is expected to provide important information to policymakers in order to maintain external debt at manageable levels.
Keywords: Public Wages, Error Correction Model, Gross Domestic Product, Vector Autoregressive, External Debt, Recurrent Expenditure

INTRODUCTION

The term public debt means the entire of government obligations at both the local and national levels. It comes from either native or international sources. Domestic debt refers to money owing to citizens by the state from commercial banks and other monetary organizations in the state, whereas external debts is the amount of currency unsettled to other nations, banks, and financial organizations. Domestic borrowing simply moves resources within a country, whereas external borrowing can expand a country's resource pool (Muinga, 2014; Putunoi & Mutuku, 2013). The role of the government's debt is to finance the budget deficit and many countries have followed this strategy during economic downturns. Deficits occur when the government spends more as compared to the earnings it receives.

Following the global debt crisis that erupted in the early 1980s, Sub-Saharan Africa (SSA) countries' debt crises grew intensely. Most emerging African countries over borrowed due to the outcome of the crisis, which led to international banks boosting their credit, but at the same time there was a reduction in global product prices, especially those of petroleum, which worsened the loan obligations disaster in Africa (IMF, 2011).

From 1973 to 1979, oil price shocks worsened the financial crisis in these countries which induced spike in foreign borrowing. The oil price shock directed to severe and often these nations have macroeconomic imbalances that don't produce oil. Consequently, many countries have shifted their focus to foreign financing to assist them in dealing with the consequences of the international financial crisis on their balance of payments (Hartlyn, J. 2019). Krumma (1985) asserted that the external loan accessible boosts the borrowing country's capability for production. It is not necessary to obtain an additional loan from foreign nations to pay off the original debt. A study by Cline (1985) argued that borrowing from foreign countries will experience a beneficial outcome on the borrowing state's budget if each available overseas loan's marginal yield is equivalent to the principal and interest obligation. Nonetheless, it has been

suggested that if borrowing money is the primary funding source, then the private investment will be squeezed out, thus stifling economic progress (Muraya, 2013). Reasonable levels of debt can boost economic growth by increasing capital buildup and yield. Foreign borrowing towards Macroeconomic stability is maintained via investment spending, which further supplies an inflow of capital, this increases domestic savings and hence increases investment demand (Burnside, 2000). Large amounts of aggregated borrowing from abroad, whereby this might lead to a significant influence on the rate of investment and economic growth (Eaton, 1993).

In a study by Soludo (2003) there are two reasons that lead to massive borrowing by nations. The first one is to increase investment, and the other is to increase consumption (salaries and wages, debt servicing and social protection financing). Growing Economic expansion is aided by investments. Through obtaining external debt, a nation which borrows resources and have the potential to obtain international debt could provide a basis for critical imports commodities for investments, alleviating country of external borrowing and shortfall. Further, he emphasized that investment will result in increased economic growth and, as a result, a better economic situation for the country. It's worth noting that investment is associated to an economy's economic growth. High economic growth will improve a country's creditworthiness, which will help it attract additional capital inflows.

When foreign debt accumulates to severe levels, it slows economic growth by preventing investment, this occurs because the investment rate will be low. The negative association between foreign borrowing and economic growth can be explained by debt overhang hypothesis which asserts that excessive amounts of debt hinder investment because prospective taxes collected would be used to pay off the loans, it will have a detrimental influence on growth (Baum, 2013). Growing debt, on the contrary, indicates that in future a nation will devote a lot of its income collected on recompensing it, at the expense of critical resident ventures. Since debt service consumes a large portion of national budget, key investments, such as infrastructural projects, are foregone and this could have a detrimental impact on the levels of income result in more unemployment. In a study by Awiti (2015), it was noted that the country may not be able to adequately support crucial sectors of the economy that can promote improved growth and offer up additional opportunities to invest if more money is focused on debt servicing instead of economic and social sectors.

Foreign debt is very vital for developing countries and the reason is that it allows them to have access on foreign resources which enables them to finance imports (equipment and material) intended for development plans. Debt may be advantageous in the short term, but it has significant long-term repercussions: funds should first be gained via exporting and then utilized for refund or service the existing loan. All of this is contingent on the prudent and practical use of money borrowed. External debt is usually linked to vulnerabilities and debt crises because the central bank cannot print the hard money required to pay off external debt (Rais & Anwar, 2012). Kenya, like many developing countries has an increasing public debt. According to World Bank (2010) this raising debt has been used to make payments on debts and the remainder to fund development projects and recurrent expenditure.

The recurrent expenditure refers to the Payments made for anything other than capital assets. This type of spending has been on the rise in the emerging economies and states over time due to excessive spending, and this habit is also influenced by the availability of foreign help and the ease with which one might borrow (Shonchoy, 2010). However, reducing government recurrent expenditure is typically difficult due to the negative impact on welfare and employment, which has the potential to aggravate public outrage and political unrest in any nation. In the previous ten years, the cost of public wages has nearly tripled. For instance, it has increased from Sh. 173.5 billion in 2009/2010 financial year to Sh. 483.5 billion in the ending 2019/2020 fiscal year. To put it in perspective, the public salary bill amounted for 32.3 percent of overall recurrent expenditure and 29.6% for the over-all government revenues in the 2009/2010 fiscal year. According to forecasts for the 2019/2020 fiscal year, public wages will account for 27.5 percent of total recurrent expenditure and 23.2 percent of total government income, respectively.

Mahdavi (2004) examined the influence of obligation on various areas of government expenditure. Using a random effects model and a sample of 47 emerging states from 1972 to 2001, the research outcome was that, the foreign loan has an undesirable impression on both capital and recurrent expenditure if earnings and salaries are not included. When earnings and pays are added, however, the communal sector seems to be under protection (not harmed by foreign loans liabilities) because they account for a significant portion of social spending. However, the estimation focused on 47 developing economies from which the findings may be indifferent from the current study which focuses to one country in analyzing the effect of recurrent expenditure on external borrowing. In addition, the research was carried out over 17 years which may not be suitable for policy formulation. This survey is from 1970 to 2019.

Maingi (2013) researched on influence of state spending composition on economic development from 1964 to 2011 in Kenya using both the combination of cointegration and error correction model and it was reported that enhanced government spending on areas such as education and in infrastructural development increase GDP while spending in areas such as government consumption, foreign debts servicing, and payment of salaries and allowances (recurrent) were growth retarding. The research tended to concentrate impacts of public expenditure on the economy due to the increasing wage bill in the Kenyan economy (recurrent expenditure) and extreme rising of external borrowing in the country. The current employed research ordinary least squares model to determine the effect of each component of recurrent expenditure such as wages and salaries on external borrowing in Kenya from 1970 to 2019.

Holm-Hadulla (2010) examined the importance of government pay as a factor of economic steadiness and competitiveness in Europe. The data analysis showed that rise in government wages leads to decrease in monetary growth. According to the result of the research, governments should exercise caution when determining wages and implementing employment regulations to counter the negative economic and fiscal consequences. On the other hand, a study by Soest and Stancanelli (2010) showed that government salaries in Germany remained level between the year 2000 and 2008 though efficiency raised by 10% during tim-frame. The two studies were not carried out in Kenya and therefore the policy implications may not be applicable in Kenya. The current study used combination of cointegration and error correction model to model the outcome of recurrent expenditure on external borrowing from 1970 to 2019 in Kenya.

Done (2011) assessed the relationship between Romanian wages and labor productivity from 1999 to 2008 and the researcher came to the conclusion that the two variables had a favorable association. The study concluded that the share of labor income and other labour rights increased with labour productivity. The study suggested that there should be an organized system of wage determination so as to enhance productivity in an economy. Sharpe, Harrison & Arsenault, (2008) estimated the link between labour output and sectoral earnings in Canada with the use of Cobb-Douglas production spanning for the period 1980 and 2005 and the researchers finding was that between 1980 and 2005, the median wage in Canada scarcely changed, despite a significant growth in labor productivity. The sample size used was very small hence the findings of the studies cannot be relied upon, also the studies were not conducted in Kenya. The current study used the data that ranges from 1970 to 2019 and it focused on the effect of recurrent expenditure on external borrowing in Kenya.

Kenya's debt and, in particular, foreign currency have been on the rise since, the same case to recurrent expenditure, undermining the economy's momentum. Even though debt is good, the government is advised to borrow and invest in a wise manner, Wray (2009). Therefore, this proposed study sought to investigate the effect of public wages on external borrowing in Kenya.

METHODOLOGY

Research Design

Rahi (2017) described research design as the organization from which the study follows. It explains how the procedures and techniques used to solve the research problem were carried out. The main goal is to improve the research findings validity by removing potential sources of biasness that could skew the results. The researcher wanted to determine if there was a link connecting cause and effect on recurrent expenditure and external debt so the researcher used a causal research design with keen focus on determining the existence of cause-effect link between independent variables and the dependent variable. Causal research design is essential in pointing out how the variation of exogenous variables results into a change in the endogenous variable (Samii, 2016). In this case, the use of a causal study design aided in the explanation of how fluctuations in wages, social protection expenditure and debt servicing result in changes in external borrowing measured by external debt variable.

Data Collection

Data collection is the organized measurement and gathering of evidence on the particular variables that the study is interested in so as to test hypotheses, obtain answers for the study objectives and asses the outcome (Origlia, 2018). Quantitative data was used in this investigation. Yearly time series data for the period from 1970 to 2019 was employed. Data was obtained from Statistical reports; economic surveys of; Central Bank of Kenya, World Bank and IMF publication reports, International Monetary Fund (IMF), and Kenya National Bureau of Statistics (KNBS). The data was gathered by downloading it from the websites of the selected sources and then saving it in Microsoft Excel for analytical purposes.

Model Specification

The main aim of this study was to examine the effect of recurrent expenditure on external borrowing in Kenya for the period 1970 to 2019. In the study, the explained variable is external borrowing and the exogenous variables include; wages, social protection expenditure and debt servicing. In order to determine the effect of recurrent expenditure on external borrowing in Kenya, the study follows the argument of Sala-i-martin (1997) that Economic theories aren't good enough to explain the precise factors that influence growth. In accordance with previous research and in order to better test the effect of recurrent expenditure on external borrowing in Kenya, the multivariate statistical model specification in this study will use variables like wages, social expenditure, debt servicing and external debt. Based on the above information, we can specify the following empirical model.

$$lnEXT_t = \beta_0 + \beta_1 lnWGS_{t-1} + D_1 + D_2 + D_3 + \varepsilon_t \dots\dots\dots\

Table 2: Unit root at Level Form

Variable	PP-Statistic at Level Form	Stationary Status
External debt (lnEXT)	-1.200	Not stationary
Public sector wages (lnWGS)	-3.394	Stationary

MacKinnon Critical value at 5%=-2.9222449

The findings shown in Table 2 shows the Phillips Peron (PP) test statistic values of the variables under study. The PP test statistic value for External debt (lnEXT) data is -1.200 at level form. The MacKinnon critical value of -2.9222449 at significance level of 5% are used in the comparison. The value of the test statistic exceeds the MacKinnon critical value; hence the value lies in the acceptance region of the null hypothesis that the External debt (lnEXT) data is not stationary. Therefore, this implies that the data on External debt (lnEXT) was first differenced so as to make it stationary.

For the Public wages (lnWGS) data, the Phillips-Perron **(**PP**)** test statistic result is -3.394 at the level form. The MacKinnon critical values of -2.922 at a 5 percent significance level was used to do the comparison. The value of the test statistic is lower than the MacKinnon critical value, as a result, the number falls inside the rejection range of the null hypothesis**.** This implied that the data on public sector wages (lnWGS) is stationary.

Table 3: Unit Root at First Differencing

Variable	PP-Statistic at First Difference	Stationary Status
Eternal debt (DlnEXT)	-5.746	Stationary

MacKinnon Critical value at 5%=-2.923780

Table 3 shows that the data on External debt (DlnEXT) was found to be stationary at first difference since their PP statistical test values is -5.746 which was less than the MacKinnon critical value at 5% significance level (-2.923780). The rejection zone of the null hypothesis of non-stationarity includes all variables. Hence, this leads to the rejection of null hypothesis and it is concluded that external debt is stationary at first difference.

Test for Co-integration

When two or more non-stationary time series have the same order of integration and a linear combination of these series is stationary, co-integration is employed to find a long-run equilibrium. In order to ensure long-run relationships, tests are performed if the time series is non-stationary. Long-run equilibrium is a relationship that holds between variables that are not stationary individually. The Ordinary Least Square (OLS) approach was used to estimate the model when the parameters are integrated in the same order. If the parameters are integrated in different orders, the co-integrated vectors are estimated using the Engle granger 2-step technique

Table 4: Stationarity Test for Residuals

PP Test value	5%	Status
-6.647	-2.922449	Stationary

Table 4 shows stationarity test of the residuals from the estimated variables. The appropriate lag length was 1 for the estimation of dependent variable (external debt) and the independent variable which is public wage of the model because it minimizes the Akaike Information Criterion value. Phillips Perron (PP) test was used to test for the stationarity of the residuals. The computed PP test value for the endogenous variable, exogenous variable and the dummy was -6.647 which is less than the critical value at 5% (-2.922449) and therefore the residual was stationary. This showed that there was cointegration between dependent variable of external debt and independent variable of public wage.

Granger Causality Test

According to Granger (1964) there exist three types of causality between variables which include; neutral causality, unidirectional causality and bidirectional causality. Neutral causality exists if there is no relationship between two variables. Variables which have neutral causality are eliminated from the model. Unidirectional causality exists if only one variable influences the other. A p-value of less than 0.05 suggests that the variables are causally related, whereas a p-value of larger than 0.05 implies that they are not. Granger causality test results were shown in Table 5.

Table 5: Granger causality Test

Null Hypothesis:	Obs	F-Statistic	Prob.
lnWGS does not Granger Cause lnEXT	49	0.0803	0.778
lnEXT does not Granger Cause lnWGS		2.835	0.0990

The results in Table 5 indicate that *lnWGS* and *lnEXT* has neutral causality because their p values were greater than the critical value of 0.05 which implies that they are statistically independent.

Vector Autoregressive Analysis (VAR) Diagnostics

The VAR diagnostics involving lag order selection and the test for normality of the random variable were carried.

Lag Order Selection

The most appropriate lag length to be used in model estimation was determine by the Schwartz information criterion (SIC), and Akaike information criterion (AIC). Since the data was annual, different models were calculated with the maximum lag length of four. A lag length is favored if it minimizes the AIC value (Lee & Phillips, 2015).

Table 6: Lag Order selection Result

Lag	AIC	SIC
0	-0.705	-0.552
1	-1.148	-0.995

Table 6 indicates that the lag length that minimizes the AIC value is of lag 1. The lag length that minimizes the SIC value is also of lag 1. This implied that the model of the relationship between endogenous and exogenous variable were well estimated using a lag length 1.

Diagnostic Tests

Pre-estimation diagnostics on the presence of multicollinearity, autocorrelation, and heteroscedasticity were performed before reporting the findings of the model. Diagnostic tests were required to check that the OLS assumptions were met and that the models produced were trustworthy for forming inferences.

Autocorrelation Test

The OLS estimators are unbiased yet inefficient when autocorrelation is present. To determine if the error terms were serially autocorrelated, the Durbin Watson test was performed. Table 7 contains the results.

Table 7: Autocorrelation results

Model (OLS)	Durbin Watson (DW)
1	0.937

Table 7 shows the results of the model which indicated the DW statistic to be 0.937. This indicated the presence of both positive and negative autocorrelation in the model. This means that OLS estimates are unbiased and therefore reliable hypothesis test (t-statistics).

Heteroscedasticity Test

The Breusch-Pagan-Godfrey test was used to detect heteroscedasticity (Andriani, 2017). If the p-value of the test statistic is less than 0.05, the null hypothesis of homoscedasticity is rejected, and heteroscedasticity is assumed.

Table 8: Breusch-Pagan Test for Heteroscedasticity

Model	Chi-square	Prob>Chi-Square
1	4.983	0.173

Table 8 shows that p-values for Chi-square and F-statistics in the model were greater than 0.05 at the 5% level of significance (F-statistic 4.983, p-value 0.173 > 0.05), indicating that the null hypothesis of a constant variance which implied the absence of heteroscedasticity was accepted.

Multicollinearity Test

The independent variables in the regression must have no association for OLS estimation to work. When there is multicollinearity, the explanatory variables tend to have a close association, resulting in the estimation model being less sensitive. The absence of a multicollinearity problem will be assumed if the VIF score is less than ten (Jou & Cho, 2014).

Table **9**: Test for Multicollinearity

Variable	VIF
lnWGS	1.159

The VIF values for all of the variables in the model were less than 10, as shown in Table 9. This suggested that the explanatory variable is not multicollinear. This means that the coefficients and p- values will not be affected hence can be trusted in the interpretation of the results.

Error Correction Model

The macroeconomic variables were estimated using the error correction model. The model estimates variables that have a long-run equilibrium connection, according to (Guajarati, 2003). The results of co-integration tests revealed that the variables have a long-term link. This made it possible to estimate error correction models. The study was carried out in accordance with the assumptions, and a model was created to describe the relationship between the variables. T-ratios were used to examine the level of significance for the independent variables at a 5% level of significance. At a 5% significance level, adjusted R-square was used to calculate the percentage of the dependent variable that was explained by the independent variables.

To examine the effect of public wages on external debt in Kenya, the study evaluated a model with public wage, being the explanatory variable while external borrowing was included as explained variable. A dummy variable was used to represent the structural breaks in the economy caused by political factors.

Table 10: Vector Error Correction Model Results for External Debt Equation with Public Wage

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.193	0.166	1.158	0.0234
lnWGS	-1.0192	0.229	-4.450	0.0001
D1	-0.107	0.0659	-1.625	0.0117
D2	0.186	0.0767	2.423	0.0198
D3	-0.0883	0.0749	-1.179	0.0240
Residuals	0.115	0.144	5.656	0.000
R-squared	0.954			
Adjusted R-squared	0.946			
F-statistic	124.664			
Prob (F-statistic)	0.000			
Durbin-Watson stat	0.937			

The coefficient results in Table 10 can be represented using the OLS equation below.

$$\ln EXT = 0.193 - 1.0192\ln WGS - 0.107D1 + 0.186D2 - 0.0883D3 + 0.115$$

The regression results indicating the presence of a long run association between external debt and recurrent expenditure are presented in Table 13. The coefficient of constant, debt servicing, social protection expenditure, public wage and dummy variables representing structural breaks for the years 1982, 1992 and 2007 are 0.193, 0.480, -0.00299, -1.0192, -0.107, 0.186 and -0.0883 respectively. The model had a constant of 0.193 implying that external debt increases by 19% regardless of being affected by public wage, social protection expenditure and debt servicing. The model was found to be significant with F-statistic being positively infinite and the p-value of 0.000<0.05 implying that the model was significant. The Adjusted R-square (measure of goodness of fit) is 0.946 implies that the public wage account for 94.64% of the fluctuations in the external debt. As a result, public wage was an excellent predictor of external debt. At a 5% level of significance, all of the variable coefficients were found to be stationary because their values were smaller than the p-value of 0.05.

There was a negative association between public wages and external debt in Kenya. An increase in public wage by 100% leads to decrease in external debt by 101.920% holding other factors constant. The P- value of *lnWGS* was 0.0001 which was less than 5% significance level therefore the model is significant hence the null hypothesis was not supported and therefore concluded that *lnWGS* is linearly related to *lnEXT*

Normality test of the Residuals

The OLS requires that the disturbance term be normally distributed with zero mean, and constant variance for all variables. The Jarque-Bera and Kurtosis statistics were used to normality test of the data with null hypothesis showing absence of normal distribution for residual terms for all the values.

Table 13: Normality Test for Residuals

	Residual statistic
Jarque-Bera	1.367754
Kurtosis	3.126882
Prob-value 0.504657	

The result in Table 13 indicates that the probability (p-value 0.504657) for Jarque-Bera (1.367754) and Kurtosis (3.126882) statistics was larger than 0.05 at 5 percent significance level implying acceptance of the null hypothesis, that the residuals, were normally distributed for all values in the model.

Effect on Public Wages on External Borrowing in Kenya

There was a negative relationship between public wages and external debt in Kenya. An increase in public wage by 100% leads to decrease in external debt by 101.920% holding other factors constant. The finding of the study were contrary with the findings from Mahdavi (2004) who investigated the impact of debt on different categories of government spending, were (2011) investigated the impact of Kenya's recurrent expenditure and external debt servicing, Maingi (2013) carried out a study on impact of public expenditure composition on economic growth, and Holm-Hadulla (2010) addressed the importance of government pay as a factor of macroeconomic stability and competitiveness in Europe all found negative relationship between external debt and public wages. However, the findings were in line with the findings of Done (2011) examined the relationship between Romanian wages and labor productivity and found a positive relationship between wages and productivity which eventually lead to low external debt. Also, the findings were in line with the findings of Sharpe, Harrison & Arsenault, (2008) estimated the link between labour productivity and sectoral wages which found out that the despite the wages remaining unchanged, the productivity increased and this can lead to low level of external debt.

CONCLUSION

The research found that the Government spending on wages and salaries has the effect of crowding out private investment which has a detrimental effect on the growth of the economy. Although public wage is important, its return is low because insufficient attention is paid to efficiency and capital maintenance. Furthermore, public wage is created with the sole purpose of achieving the welfare of a country's population rather than making profits, therefore the public sector's contribution to economic growth is minimal yet significant to overall growth.

RECOMMENDATION

The following suggestions are offered based on the study's findings:

i. The government through Salaries and Remuneration Commission (SRC) should consider harmonizing the salaries and wages of the public workers so as to fall within the budget. This will go a long way to curtail the unnecessary borrowing for recurrent spending. The state institution in charge of setting the wage levels for public sector employees, should conduct reviews of government employee benefits.
ii. The government through its ministry of treasury should raise the tax base so as increase the tax revenues, which will enable the government to meet its budget. This will help in shielding the government from seeking for external borrowing to meet the increasing economic and population needs.

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NONCE FORMATIONS AS A CAMPAIGN TOOL IN THE 2022 GENERAL ELECTIONS IN KENYA

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ABSTRACT
Language is primarily a system that speakers use to make meaning. When there is no available term to refer to a new phenomenon or to communicate an idea then speakers use their linguistic creativity to create new terms. This is especially witnessed in the political arena during the campaign period. Using a multi-modal approach, this study analysed nonce formations that were used as a campaign tool during the 2022 general elections in Kenya. The nonce formations were purposively selected from WhatsApp platforms that supporters of the candidates were using to campaign for their candidates of choice or against the candidate they did not want to elect. Only words/phrases and images that were coined to campaign or communicate campaign ideals were selected. The data was analysed using a multi-modal approach and transitivity analysis based on Systemic Functional Grammar. The findings of this research indicate that nonce formations were a prominent campaign tool before the elections took place. This study contributes to the theory of nonce formations and neologisms and provides linguistic material for use in the study of political discourse and political register.
Keywords: Nonce Formation, Word-Formation Processes, Political Discourse, Multimodality, Political Campaigns

INTRODUCTION

The universality of language change is an undisputed fact. Changes at the lexical level of a language are the most noticeable to language users unlike changes at other levels. This is because a new word catches our attention. Nonce formations and neologisms provide a fertile ground for research. The difference between the two has not been clearly articulated in research as observed by Bauer (1983). Bauer defines nonce formations as a new complex word coined by a speaker on the spur of the moment to cover some immediate need. After the formation stage the nonce formation can then be institutionalized, that is, it starts being accepted by other speakers and to be known as a lexical item. In the third stage, the nonce formation is lexicalized and becomes part of lexicon of a language. Newmark (1988) defines neologisms are newly coined lexical units or existing lexical units that acquire a new sense. This perspective is the same as that of Crystal (2018) who defines neologisms as 'nonce words' in that many neologisms do not necessarily survive the test of time.

This study will adopt Bauers perspective and refer to word coinages that appeared during the 2022 campaigns in Kenya as nonces. It still remains to be seen whether these nonces will end up in the lexicon of any language, However, it is important to note that some of the nonces already exist as lexicalized words in well-known Kenyan languages but they acquired new meaning during the campaign period. This study analysed nonces in the campaigns leading to the 2022 general elections in Kenya using transitivity analysis and a multimodality approach for the visual images.

Several studies have been carried out on nonces and neologisms. Holumbygha et al (2020) identified 30 of David Trump's authorial neologisms by sampling 27 official speeches. 8 interviews, 500 publications of the 45th US President on Facebook and Twitter. Some of Trump's neologisms include: clicktivism, baterade, otherize, herd mentality, fake news, alternative facts and big league.

The COVID -19pandemic that spread across the world has left the world richer in terms of new vocabulary that were coined at the height of the pandemic. Apart from COVID 19 itself, others included mask lessness (no mask on), corona coma (period of shutdown), unlock down (opposite of lockdown), coronials (like millennials), PPE (Personal Protection Equipment) and WFH (working from Home) (Al-Salman and Haider (2021).

Word formation Processes

Quirk and Greenbaum (2004) identify three chief processes by which English words are formed. These are affixation, conversion and compounding. Other word formation processes that are also productive include reduplication, clipping, blending, back formation, and acronymy.

Affixation is the most productive word formation process in English. In involves prefixation and suffixation. Prefixation involves adding a prefix to the base. It may cause or not cause a change in the word class. There are a lot of prefixes to choose from to effect this process. For example, a negative prefix like -un is used to form words like

unfair, unassuming and unexpected. A pejorative prefix like MIS- is used to form words such as misinform, misconduct and misleading. Suffixation involves adding a suffix to the base with or without a change in word class. For example, the suffix -STER is used to form words like gangster and trickster. The suffix -Let is used as a diminutive to form such words as booklet and piglet, In other languages, affixation may also involve circumfixation and infixation such as is found in languages of south east Asia. In Tagalog, for example, 'kayu' is wood while 'kinayu' is gathered wood. This is an example of infixation.

Conversion is a derivation process whereby an item changes its word class without the addition of a suffix (Quirk &Greenbaum,2004)). For example, the word doubt can be used both as a verb or a noun. Compounding involves combining two or more bases to form a new lexical unit. They can be formed by combining subject and verb to form Noun compounds. For example, rattlesnake, bee-sting and firing squad. Verb and object compounds also generate new items, for example sight- seeing, brainwashing and songwriter. Compounds can also be in the form of verb and adverbial, for example swimming pool, daydreaming and baby-sitter. Verbless compounds are also attested, for example windmill, doorknob and ashtray. Recent examples include Obamacare and Brexit.

Reduplication involves compounding two identical items or compounding items that are only slightly different. Examples include goody-goody, walkie -talkie and tick-tick. Reduplicatives are highly informal and many imitate sounds (tick-tock), suggest alternating movements (seesaw), to intensify (tip-top) or to disparage (wishy-washy). Clipping denotes subtraction of one or more syllables from a word. It is a way of shortening a word. It may occur at the beginning of a word (phone from telephone), at the end of a word (photo from photograph) or at both ends of the word (flu from influenza).

In blending, parts of one or more different words join together. At least one of the elements is fragmentary when compared with its corresponding uncompounded form. The word *coronials* (Corona + millennials), referring to 'kids who were conceived by their parents during the quarantine that resulted from the coronavirus. Most of these babies are born post-December 2020. Another example is *coronacation* (Corona + vacation) which is defined as 'a vacation that takes place because of cheap flights and hotels that exist because of the 2020 coronavirus. The same applies to *quaranteens* (quarantine + teens), which refers to 'the generation who will become teenagers in 2033/2034'; and *Loxit* (lockdown + exit) 'the process of exiting from lockdown impositions.'

Acronyms are words formed from the initial letters of words. They can be pronounced as a series of letters, for example PPE (Personal Protection Equipment) or as words for example, COVID-19 pandemic. *Backformation* is the process of forming a new word by removing actual or supposed affixes from another word. An example is found in the verb *vaccinate,* a backformation from the noun 'vaccination,' and also in the verb *sedate* from the adjective 'sedative.'

In word formation, more than one process can be used to form a word in which case we have dual word formation processes also occurring. Compounding and affixation can be used to form a word. For example, the word lock downers. Two words lock +down are compounded to form lockdown and then there is the suffixation of -er and -s to refer to people who are self- isolating.

Political Discourse

Politics permeates every aspect of life and therefore every discourse can be said to be political. Fairclough (1995) and van Djik (1993b) limited the term political discourse to refer to discursive conditions and consequences of social and political inequality that results from power abuse or domination including forms of resistance to such power. Campaign rhetoric can also be said to be a type of political discourse because there are power relations being played out between the aspirants for various positions. Political discourse can be found in formal or informal political contexts involving political actors such as politicians, institutions, governments, media and political supporters.

Political communication is impact oriented. It uses an abundance of metaphors and aims to have an emotional impact in the recipient. It is focused on persuading people to take specified political actions or to make crucial political decisions. In a bid to convince the electorate to take specified actions, those aspiring for seats use language in creative ways such as catch phrases. Phrasal allusions, connotative meaning of words and a combination of language and visual imagery. They also create new terms to persuade their opponents to vote for their preferred candidate. In the 2022 general elections in Kenya, there were two strong presidential candidates and the nonce formations discussed in this chapter were about them.

The political discourse in Kenyan Politics that plays out at the national level is majorly on the presidential candidates. The media portrayed the presidential race as a two-horse race between Hon. William Ruto and Hon. Raila Odinga and this was also reflected in the social media. William Ruto was the presidential candidate for Kenya Kwanza Coalition and his running mate was Rigathi Gachagua. The main colours for this coalition were yellow and green. Hon Raila Odinga was the presidential candidate for Azimio la Umoja Coalition and his running mate was Martha Karua. The main colours for this coalition were blue and white. These colours play out in the visual images.

Political discourse in Kenya is also a reflection of Kenya's multilingual sociolinguistic profile. Kiswahili which is an official and national language and used by Kenyans as a lingua Franca, plays a key role in the formation of the nonces and social semiotics. Kenya is also home to 61 indigenous languages and the contact between them and Kiswahili has produced varieties of colloquial Kiswahili that Kenyans speak. This is also reflected in the nonce formations. English is also a principal language in Kenya usually learnt in school as a second language.

METHODOLOGY

The sample consisted of purposively selected items for analysis. The first criterion for inclusion of nonces was because they were nonce formations used as campaign tool during the 2022 general elections in Kenya. The second criterion was either because they were new words or words that were already lexicalized but acquired a new meaning during this period.

THEORETICAL FRAMEWORK

This study was informed by Multimodal Discourse Analysis (MMDA) approach. This approach is proposed by Kress and van Leeuwen (1996) who see discourse as multimodal if its meaning is realized in more than one semiotic mode. Language is one of the 'social semiotic' systems or modes of making meaning. Other social semiotic modes that also make meaning include visual design and music. In visual design several aspects can be analysed such as colour and print. They can be analysed for intensity, framing, foregrounding, highlighting, coherence and cohesion. Multi-modal analysis approach has its roots in Systemic Functional Linguistics (SFL). Kress and van Leeuwen utilize Halliday's (1978, 1985) theory of SFL to provide an analogy for the development of Visual Grammar (VG). The analogous relationship (Bi, 2019) between SFL and VG is seen in the explanation provided in the following paragraphs.

SFL proposes three kinds of meaning: ideational, interpersonal and textual. Ideational meaning is when language is used to talk about the world: the external world and the internal world. The external world addresses things, events and qualities while the internal world is about feelings, thoughts, beliefs perceptions and attitudes. Verbs are used to reflect the speaker's worldview on what is going on. Nouns reflect the things that are involved in what is going on. Adjectives are used to tell others about the attributes which these things may have and adverbials give background details of time, place and manner. Ideational meaning is expressed in terms of processes which are considered the core of the clause in meaning making. These processes can be material, mental, relational, verbal, existential or behavioural.

In VG, Kress and van Leeuwen use the term representational meaning in place of ideational meaning. They recognise two major processes: conceptual and narrative. Conceptual processes are classificational, analytic and symbolic. A classificational process describes visuals where the participants are related in some way. Analytical processes refer to processes that relate the participant in a visual in terms of part/whole relations. One participant referred to as the carrier and the others are parts(accessible). Symbolic processes are about what the participant means or is. Objects are made significant or prominent by such things as having exaggerated size, being well built, being well lit or containing strong colours.

Narrative processes deal with depicted actions and events, and their spatial arrangements. They comprise actional and relational processes. Actional processes involve some kind of physical action in the represented participants. They can be non-transactional where they involve only one participant or transactional where they involve more than one participant. Relational processes are processes in which the participants are characterized by a rection, which is realized by the direction of the glance of one of the participants-the reacters. The reacter is human or a human -like animal. The direction of the gaze follows the reacter in the receiving participant or whole process- termed the phenomenon. Three more processes (rare ones) are speech and mental, conversion and geometrical symbolism.

Speech and mental processes refer to vectors which can be drawn from speaker to thinker to their thought, for example, dialogue speaking balloons in comic strips or in computer display screens. Conversion processes are cycles of action. Geometrical processes occur in diagrams when there are no participants but the symbol in the diagram can be identified

as a vector, for example, an arrow which indicates direction. Secondary participants can be left out (circumstance) without affecting the basic proposition of the narrative pattern. The summary of SFL ideational meaning and processes and their correspondence to VG as representational meaning are presented in Table 1.

Table 1: Summary of SFL ideational Meaning and corresponding VG meaning

SFL Metafunction	VG Metafunction	SFL Processes	VG Processes
Ideational	Representational	Material Behavioural Mental Verbal	Actional Relational Speech and Mental Narrative Conversion Geometrical symbolism Classificational Analytic Symbolic

The interpersonal meaning in SFL is useful in enabling interaction which is meant to establish and maintain appropriate social links with other people. Grammatical aspects that enable speakers to make meaning in order to enhance relationships include such aspects as speech roles, mood and modality. In VG, this is referred to as the interactive meaning. Visual forms of communication maintain interaction between the producer(s) and the viewer(s) of a visual. There are two kinds of participants: interactive participants and represented participants. The former interacts with each other while the latter are depictions in a visual (people, places and things that are shown in the visual. There are four elements that are important for analysis in VG interactive meaning: contact, social distance, attitude and modality.

Contact refers to the ways in which images directly or indirectly address their viewers and what they require them to do. Image acts are of two types: demands and offers. One can offer or demand information. A demand is represented by a gaze in a visual image. The visual offer does not require the viewer to enter into a social relation with the represented participants. Social distance refers to the distance between the views and the represented participants. It is indicated by the size of the frame showing whether it is a close-up shot, medium or long-distance shot. These may indicate a social relation such as friendly, personal, social, familiar, general or public. Attitude refers to the point of view of the represented participants. Modality is a resource used to express the credibility of the proposition. A summary of the possible analysis tools in both SFL interpersonal meaning and VG interactive meaning is provided in Table 2.

Table 2: Summary of SFL Interpersonal Meaning and Corresponding VG Meaning

SFL Metafunction	VG Metafunction	SFL Participants	VG Participants
Interpersonal	Interactive	Speaker Writer Audience Mood	Interactive Represented • Contact • Social distance • Attitude • Modality

The textual meaning in SFL is what enables speakers to combine parts of a message in order to form a coherent whole. Messages are constructed in such a way in which they fit smoothly into the unfolding language event. Speakers and writers accomplish this by use of thematization techniques, referencing, ellipsis, conjunction and substitution. This is also accomplished through grammatical cohesion and lexical cohesion in a text. In VG this is referred to as compositional meaning. It is defined as the structure of a visual. In an image three are two integration codes: that of layout and that of rhythm. In layout texts whose elements are spatially co-extant but in a sense time frozen while in Rhythm texts develop over time such as in music or dance.

Compositional meaning is realized in three ways: Information value, salience and framing. Information value is the position that the symbol is placed in the image. The symbol can be in the left, right, upper or lower positions and all these positions have meaning. Salience is indicated by size, sharpness of colour, tonal contrasts, colour contrasts etc.

it refers to the ability of a viewer to make judgements about the importance of various elements in a visual, for example, if a symbol is placed at the centre, then that indicates that it is important refers to the intensity of the symbol in the image. An image can be foregrounded in which case it is significant or it can be in the background. The size of the image, colour and intensity of light also matters. Framing refers to the degrees of connectedness or boundedness provided by an actual frame or frame lines around the whole visual or around the elements in a visual. A summary of the SFL textual meaning and corresponding VG compositional meaning possible analysis is provided in Table 3.

Table 3: Summary of SFL Textual Meaning and Corresponding VG Meaning

SFL Metafunction	VG Metafunction	SFL Structure	VG Structure
Textual	Compositional	Thematic structure Thematization techniques Grammatical cohesion Lexical cohesion	Information value Salience Framing

In multi-modal analysis, it is postulated that any semiotic system will provide resources for making all three kinds of meaning analyzable. All the semiotic systems that make meaning have fundamental things in common with each other so the different modes can be analysed in similar way, that is, it is possible to describe the grammar of visual design. In this study, the various social -semiotic modes were analysed for meaning making based on the three metafunctions. However, it is important to note that nonces by their nature are ambiguous, making it possible to give multiple meanings. In the results and discussion, all nonce formations were analysed for word formation processes and were also analysed using SFL transitivity processes. Visual images were analysed using VG and the written texts in them were analysed as nonce formations

RESULTS AND DISCUSSION

The data collected was categorised into nonce formations (NF) and visual images (VI). NF were new words or phrases coined during the campaign period while the VI were visual images which also contained nonce formations.

NF1: TANGATANGA

The campaign period started as early as 2018.While addressing the public in Eastlands-Nairobi -sometime in 2018, The President, Uhuru Kenyatta, rebuked his Deputy President, William Ruto, for what he referred to as a behaviour of moving around the country instead of supporting him to accomplish the Big Four Agenda that his government was committed to implement. The President was upset with his deputy for starting to campaign very early and putting the country in a campaign mood (Kanyadudi, 2019).

The Kiswahili word 'Kutangatanga'is a verb meaning move around from place to place aimlessly. It can also mean 'to loiter'. The meaning has a connotation of lack of a goal and disturbing others. A number of politicians aligned themselves to the Deputy President and were referred to as the Tangatanga group. Towards the 2022 elections, this group formed the United Democratic Alliance (UDA) Party which they used as the vehicle to vie for seats at all levels of representation. It also became the Kenya Kwanza coalition. The word formation process involved is conversion. In the Kiswahili lexicon 'tangatanga 'is a verb but in this campaign context, it is a noun referring to the group that aligned itself with DP Ruto.

The word 'tangatanga' contains the following key morphemes: Ku- Nominal affix and tangatanga-root.

The deputy president and his allies took up the '*tangatanga'* concept which they rebranded to a progressive political initiative. According to the then deputy president's allies, the national tours and visits were aimed at inspecting the ongoing national development projects. After owning up the 'tangatanga' concept and giving it a positive outlook, the deputy president was able to draw likeminded politicians to his camp. The concept eventually evolved to a political ideology with a national outlook and support. It is interesting how a negative accusation against a politician evolved to become a national political movement representing social change and transformation. It can be argued that the wider social perception and loyalty overruled the negativity levelled against the deputy president in the phrase 'kutangatanga'.

NF2: KIELEWEKE

A number of politicians opposed to Ruto and aligned to Raila Odinga also came together and were given the name 'Kieleweke'. (Kanyadudi, 2019) notes that this came about because the opponents of DP vowed to expose his corrupt

dealings and claimed that the DP did not understand what he was up against by attempting to be President Uhuru's successor. They promised him that "Kitaeleweka' meaning 'it will be understood' and consequently they were referred to as the 'Kieleweke' group. The Kieleweke team comprised politicians closely associated with the President through history. party, government or the handshake. The group also had allegiance to the Orange Democratic Movement leader: Raila Amolo Odinga. Later it became the Azimio la Umoja Coalition. (Wangechi, 2018) listed this nonce formation as one of the most popular phrases in 2018.The meaning kept on changing and Kenyans used it to mean that one who is willing to take on a deal regardless of the risks involved. The word formation used here is conversion. As used in Kiswahili, the word 'Kitaeleweka' is a verb while in this campaign it is a noun.

NF3: BABA CARE

Babacare is a nonce formation borrowed from Obamacare. (Kenton, 2021) gives a summarized history of the legislation and enactment into law of the Affordable Care Act (ACA), nicknamed Obamacare. ACA, also known as the Patient Protection, was signed into law by President Barrack Obama on March 23rd 2020.It was considered the greatest overhaul of the US health care system providing coverage for over 94% of Americans. Its main aim was to make health care affordable for everyone by lowering costs for those who cannot afford them. It prevented insurance companies from denying coverage due to pre-existing conditions and low-income families qualify for coverage purchased through the created Health Insurance Marketplace (Babacare, Azimio la Umoja, 2021).

Raila Amolo Odinga promised the electorate that he would give those who were on the lower end of economic ladder six-thousand shillings as a way of social support. This was referred to as Baba Care. In the Azimio la Umoja manifesto, Raila affirmed his commitment to introducing "Baba care", which will include affordable, accessible, quality healthcare. "The Azimio commitment is to introduce Baba care which will invest in promotive and preventive health care and wellbeing, ensure that every Kenyan shall receive adequate primary healthcare services as per need and this shall be free at the point of delivery," reads the manifesto. The coalition said it will introduce emergency treatment in most hospitals and strengthen efforts in eradicating malaria by 2030. A Raila government would also seek to re-examine and improve the working conditions and remuneration of health professionals and establish a framework to monitor the safety and standards of products. (Kenton, 2021). In the formation of the word 'babacare' there is compounding of two words: baba +care. The word formation process used is therefore copounding.

The *babacare* initiative focused on social protection and transformation of universal health coverage to universal health care. According to Babacare-Azimio La Umoja (2022), all citizens are supposed to enjoy the rights to accessible quality and affordable health care. The programme also envisioned a social providence program to two million vulnerable households where each was to benefit with a pay out of Ksh 6000 per month.The choice of the lexical item 'baba' from Kiswahili blended with the abstract noun 'care' is deliberate. To begin with, the term 'baba' in Kenyan socio-political parlance has been in use for quite some time to refer to Hon Raila Odinga who was the Presidential candidate in the Azimio coalition. His political supporters fondly refer to him as 'baba' which in the Kenyan context signifies strength, provision, care and protection. In a bid to advance their political ideology and present Hon Raila Odinga as a caring and concerned individual, the Azimio team came up with the nonce 'babacare'. The concept was aimed to appeal to the needy and vulnerable members of the population who form a large percentage of voters. To the majority of the vulnerable voters, access to universal health and availability of a social protection stipend would go a long way to addressing the most pressing issues. The strategists for the Azimio coalition knew such an initiative would go a long way in winning votes for their candidates. The initiative was thus packaged in a relevant language, and using terms that were endearing, simple and familiar.

NF 4: KALONZO LEFT KALONZO ADDED



In NF5, the words left and added are used to communicate a campaign message that was completely different in meaning from the meanings that the words had previously. When a member of a WhatsApp platform leaves, it is usually indicated that the member left. Also, if a new member joins the platform, it is indicated that they were added. However, in this NF, the words are used to ridicule the behaviour of one of the key players in the General elections that is Kalonzo Musyoka. At the beginning of the campaign period, he made it clear that he would not join a coalition but would vie for the presidential seat. But this did not last and he joined the Azimio la Umoja coalition hoping that he would be given the running mate slot. This did not happen. Instead, the coalition picked Martha Karua as the running mate. He left the coalition and went ahead to pick a running mate with whom he was planning to vie for the presidency as a private candidate. Later he forfeited this strategy and rejoined Azimio la Umoja. This time since there were no obvious negotiations or being wooed to join the coalition, he had no choice but swallow the bitter bill and humble himself since going it alone would be mean that he was going to lose the election. This is why it is now indicated that he joined through the link, that is, of his own free will. Although this is not a visual, the arrangement of the clauses indicates the indecisiveness of the participant.

From an SFL analytical perspective, the material clause in NF4 has two constituents namely actor and goal. Material clauses are clauses of doing and happening. They denote change in the flow of events through input of energy (Halliday, 2014). The process 'joined' denotes deliberate decision to be part of a group, party or institution. In the context of heightened political activity, it can be inferred that the actor, Kalonzo, made a deliberate choice to be part of a political outfit, which he felt represented his political ideals and philosophy. Precisely, Hon. Kalonzo made a decision to join the Azimio coalition and this was motivated by the hope that he would be granted an opportunity for leadership and influence. To amplify the public perception, politicians always make their choices and actions as dramatic as possible through public statements and media briefings. The statement in NF4, is thus part of a media statement concerning the political manoeuvres by the subject. Politicians value such statements in the mainstream media as an avenue to gain popularity and relevance. The transitivity analysis is shown in T1.

T1

Kalonzo	joined
actor	*goal*

Politicians are known to shift their loyalty mostly in line with personal ambitions and aspirations. Any step that a politician makes is always documented and shared with the media for publicity and also to seek relevance. The other clause in NF4 is Kalonzo left which can be analysed as shown in T2

T2

Kalonzo	left
Actor	*process*

In transitivity analysis for material clauses, there are three key components which include the actor, the process and goal. The actor refers to the subject element in the clause whereas the process describes the action manifested by the subject. In T2, only two constituents of the clause are highlighted namely the actor and the process. The actor, Kalonzo, refers to the veteran Kenyan politician from Eastern Kenya. During the 2022, general elections, Hon. Kalonzo was allied to the Azimio coalition which was a brainchild of the ruling government. However, after some stalemate on the appointment of the presidential running mate, Kalonzo decided to quit the Azimio coalition though for a short time. The Process 'left' ideally denotes change in perspective and outlook. The actor is presumed to have a conscious and deliberate choice in relation to political orientation. He makes a decision to quit the political party as a sign of protest and discontent. The process 'left' is meant to communicate protest, dissent, divergence of opinion and the ultimate detachment by the actor/ subject.

NF5: RARUA

The word Rarua was first found in a song (Tibim, 2022). The song was released as soon as Raila Amolo Odinga announced his running mate-Martha Karua. The song 'RARUA' got the title through combing the first syllable in Raila's name to the last syllable in Martha Karua's name. The conjoining of -ra and -rua gave 'RARUA.' The word formation process is blending. The word 'RARUA' is lexicalised in the Kiswahili dictionary. Its denotative meaning is 'to tear apart.' However, the meaning of 'RARUA' in the song is connotative, it means to take the majority of the votes and to win the presidential race. It also has a connotation of ruthlessness in the way this win will take place so

that the opponents will not have a chance to come anywhere near the number of votes that Raila will garner because the gap between the two contestants will be quite big. The ruthlessness is further brought out through the beats and rhythm of the song. It has strong beats that make it easy to dance to. The dancing can also be said to show how they will 'RARUA' the votes on the day of elections. The word can be translated as 'take all the votes.' In this context. it carries an ideational meaning and depicts a material process. The derived word in NC5 underscores the adversarial nature of the Kenyan politics.

Political supporters allied to Hon Raila Odinga and Martha Karua used the term 'rarua' to imply defeat of their opponents. 'Rarua' is a strategic lexical formation that also highlights the political duel between Hon Raila Odinga's and Hon. William Ruto's factions. The lexeme also underscores the synergy between the two political vision bearers. Even if Hon Raila Odinga and Hon Martha Karua are endowed differently, their coming together is expected to yield transformative results. Hon Martha Karua is seasoned lawyer while Hon Raila Odinga political career spans several decades. The combination of the two is captured in the blending of their names to a formidable entity which is action packed. The 'nonce' is deliberately created to express a ruthless and deliberate defeat of the political opponents.

VI1: RA(U)KA



The word RAKA (with the sun in between) is the nonce formation of 'RAUKA', and the visual design on the right was one of the nonce formations during the campaign. The word is formed by combining the first two syllables of the names of the candidates, that is, **Ra**ila and **Ka**rua. The word formation process is therefore blending. It is important to notice that the symbol of the sun is placed between the two syllables; the colour used indicates that the sun is rising, which can be interpreted to mean early in the morning. Kenyans have a habit of going very early to the polling stations so that they are through with the business early. The word 'rauka' is a form of colloquial language used to mean 'very in the morning.'

The meaning intended from this lexical coinage and other social semiotic modes present is that supporters of the two candidates will wake up early in the morning and vote for their candidate. It can also have the meaning that the candidate will get a clear lead from the time the results start being released to the end. Their victory is assured and easy because the other side has nothing to offer. They are represented as two hyenas. In many Kenyan communities, the hyena is represented as a greedy animal in folktales. The other party is therefore brought out as greedy only interested to 'eat' tax payers' money without leaving any for the economic growth of the country.

The visual design (VI1) is divided into two parts to represent the two main competing coalitions; Kenya Kwanza on the left and Azimio on the right. On The left, the two hyenas act as participants representing William Ruto and his running mate-Rigathi Cachagua. The image is a major transactional, actional narrative process where the two participants (actors) exchange representational meaning between them and the viewer (voter). There is also a major reactional process in that the participants look directly at the viewer in a menacing gaze. Also, a conceptual symbolic attributive process is evident because the size of the participant has been exaggerated and therefore made prominent to the viewer. For the interactive meaning, contact is a demand for the votes and the look is unfriendly suggesting social evils such as corruption and greed. The image is demanding from the viewer loyalty and submission. The size of the frame shows full figure of one of the participants which is a medium long shot and the other participant is given a close shot which cuts the subject approximately at the waist which is an indication of a social relationship. In terms of attitude the visual is subjective in that thre is a clear attempt to emphasize the main features of the participants other than the background. In visual modality, the two participants are depicted as hyenas and therefore not credible leaders and the viewer should not even consider voting for them. For composition, the placement on the left indicates that is the given or known information. This is further emphasized by the capitalization of the word 'LEFT' in the written text. The written text is placed at the top of the visual indicating its great importance.

On the right, the visual is also representing a major narrative, actional transactional process because there are two participants: Raila Odinga and his running mate Martha Karua. There are also more than one minor actional processes going on in the image because in the image thre is the sun rising above the participants and figures below each participant indicating the number of votes that each will garner from various regions and groups in Kenya. Raila will get 90%from Nyanza, 80%from the elderly and 50% from the Youth. Karua will get 50% from Mt. Kenya region, 80% from women and 70% from women.

There is also a major reactional process because the aspirants look directly at voters. A major conceptual symbolic process is represented by the participants who are in a political relation to one another. For the interactive meaning, the interactive participants are the aspirants and the voter(s) and the represented participants are the voters from various parts of the country. In terms of contact, the presence of a gaze from the participants is an indication of a demand for votes and this look is conveyed through a smile which is suggestive of social affinity. The size of the frame is a close shot showing the head and shoulders of the aspirants indicating a friendly or personal social relationship with the voter. The attitude is subjective indicating that the aspirants are the two to vote for. In terms of modality, the visual presents the participants as credible.

Compositionally, three aspects that are relevant to this visual will be discussed. These are information value, salience and framing. The visual is a multiple mode composition in that it contains both image and written text. The placing on the right indicates that is the new information. The relatively big size of the aspirants and their being placed at the center points to them as the central message in the visual. The blue colour concentration also points the viewer to their party affiliation. The placement of the figures at the bottom of the visual shows that they are not of great importance. The line demarcating the two parts and the colour contrast from one to the other together with the lack of actual frame around the visual shows the disconnectedness between the two in terms of framing techniques.

Analysed from an SFL perspective, the verbal process 'afford' is regarded as a relational process in transitivity analysis. Relational clauses serve to characterize and to identify. Attributive relational processes attribute some quality to the key participant while identifying relational clauses help to assign some identity to the key clausal participant (Halliday, 2014) as illustrated in T3.

T3: Kenya cannot afford the mistake on the left.

Kenya	cannot afford	the mistake on the left
Identified	*process*	*identifier*

The Key participant in T3 is 'Kenya' which in the current analysis is referred to as 'identified' because it is the key constituent that the rest of the clause is built on. The 'Process' refers to the verbal group while the 'identifier' refers to circumstantial information that qualifies the subject of the clause. The meaning of the clause derives from the participants, the process, the circumstance and the context. In this regard, it is important to acknowledge the political background in relation to T3 above.

The clause T3 is situated in a political context whereby there was heightened political activities including campaigns and media statements. The politicians allied to both the Azimio and Kenya Kwanza coalitions articulated their convictions, loyalty and affiliation through political campaigns and media briefings. To appeal to the collective sentiments of patriotism and national identity, the media teams for the different parties make deliberate choices in the language used.

In the 'identified' slot in *T3,* the proper noun Kenya is used to appeal to the national psyche of patriotism and veil any partisan sentiments. By referring to the country 'Kenya' the political statement is elevated to a statement of national interest. This strategy is aimed to conceal any political interest and to make the voters belief that the politician is pursuing the common good of all citizens. The negated process/ verbal group '*cannot afford'* denotes rejection of extreme ideals that are likely to have negative impact on the nation.

In political parlance, *left* refers to radical as opposed to conservative position in relation socio-political views. Politicians aligned to the left profess views characterised by desire to reform or overthrow the established order (Left definition & meaning, 2022). The proposition evident in *T3* is made by the conservative politicians who advocate for minimal change in the socio-political system. These politicians present any possible change in negative light. The clause clearly invalidates the clamour for social change by the transformative politicians aligned to the 'left'. The conservatives present the impression that any campaign and initiative for reform is a mistake and should be avoided. From the clause, it is clear that some politicians advocate the status quo and delegitimize any aspect of change or social reform.

VI2: CHAGUA RUTO WACHA MARTHARAO



In VI3, two words were formed through compounding. Ruto's running mate was Rigathi Gachagua. The last portion of his name was combined with Ruto's Surname (CHAGUA +RUTO) to form CHAGUARUTO which means vote for Ruto. Chagua is a Kiswahili word that means 'choose' which in this context means vote for. The word MARTHARAO is formed by joining parts of the names of the Azimio la Umoja coalition. The first name of the running mate to Raila Amolo Odinga is Martha and this is joined to the acronym -RAO-which refers to Raila Amolo Odinga. RAO is also a fond name used by Raila's supporters to refer to him. The pronunciation of the coinage is similar to the Kiswahili word 'dharau' which can be used as a verb and as a noun. As a verb, it means to treat someone

with contempt, that is, by not voting for Kenya Kwanza whose presidential candidate was Hon Ruto, one would be showing contempt in the elections. The coinage is quite fascinating and this shows on the emoji. The use of the word actually means that there are no two ways about it, the vote is to be cast in favour of the Kenya Kwanza Coalition because the other choice will not work.VI3 would be translated Vote for Ruto and stop being contemptuous. The meme indicated that the choice is obviously in favour of the Kenya Kwanza Coalition and a combination of their names produced a word whose meaning was ' vote for Ruto' The texts are formed through two word formation processes, that is, blending(CHAGUA+RUTO) and (MARTHA+RAO) which is a combination of two processes: blending and acronymy.

The smiling emoji makes contact with the viewer making a demand from the viewer to come to the realization that the votes should be cast to the Ruto team and not to the Raila team. In terms of composition, the visual is multimode and the framing without is provided by the colour contrast showing some degree of connectedness. The most important parts of the visual are written in upper case (CHAGUARUTO and MARTHARAO) while the rest are written in lower case indicating they are of less importance. The position of the emoji at the top of the visual also makes its interactive meaning prominent.

The clause VI2 below can equally be examined through transitivity analysis. VI2 falls in the category of relational clauses which are used to characterise and identify. The clause is broken down to the following constituents: Identified, process and identifier. The 'identified' refers to the subject in the sentence while the 'process' refers to the verbal group. 'Identifier' refers to the clausal constituent which describes the subject.

T4: Actually, it is Chagua Ruto

Actually	It	is	chaguaruto
adjunct	*Identified*	*process*	*identifier*

The 'identified' in T4 is an impersonal pronoun 'it' used to introduce the primary lexical concept in the clause. The nonce 'chagua- Ruto' which is analysed as the 'idenifier' in T4 derives from the names of the presidential candidate and running mate for the Kenya Kwanza coalition. 'Chagua' is clipped from the name Gachagua and it also carries the meaning 'choose' in Kiswahili. When combined with the name 'Ruto' it creates the meaning 'choose Ruto' which was the clarion call for Hon. Ruto's campaign team. The sentential adverb 'actually' qualifies the entire clause. It is meant to emphasise the political inclination of the writer who is drumming support for Hon Gacahagua and Ruto's candidature. The clause in T4 precedes a contrasting statement made in relation to the opposing political faction. The clause that follows reads: '*Wacha martharao'* and when considered side by side, it is clear that the political statement in *T4* is meant to legitimize one of the political outfits and by extension invalidate the competing team. A further analysis of the adjoined clause '*Wacha martharao'* is presented in T5.

T5: *Wacha martharao*

Ø	*Wacha*	*martharao*
Actor	process	goal

The clause 'wacha martharao' loosely translates to stop 'contempt'. In T5, the actor slot is empty which is characteristic of imperative clauses. The process 'wacha' (stop) signifies a call to cessation and detachment. The goal slot is occupied by the nonce 'martharao' which is deliberate word play with the Kiswahili lexeme 'madharau' which translates to 'contempt' in English. The word 'martharao' is a blended lexeme formed from the names of the running mate and the presidential candidate for the Azimio coalition respectively. It derives from the lexeme 'Martha' and 'Raila'. The latter is usually shortened to 'Rao', which signifies affection, support and loyalty. Justice Martha Karua had been appointed as the running mate to Hon Raila Odinga in the 2022 presidential election. Formation of the nonce 'martharao' is deliberate with the intention of presenting the Azimio presidential candidature negatively.

According to linguistic relativity, the structure of a language affects speakers' worldview and cognition and people perceive issues on the basis of their spoken language (Sapir-whorf hypothesis, 2022). The word play between 'martharao' and 'madharau' is intended to give the Azimio candidates Hon Raila Odinga and Justice Martha Karua a negative identity associated with contempt. When this perception is created in the voters, it is meant to draw voters away from the Azimio candidates in favour of the Kenya Kwanza coalition who can be credited with creation of the nonce 'Martharao' with the intention of invalidating their political opponents.

VI4: **HAWASUBUANGI, SIPANGWNGWI, HATUPANWINGWI**



VI4 shows a visual of two of the key players in the 2022 elections, that is, Hon. Musalia Mudavadi and Hon.Wetangula. The two were members of Kenya Kwanza Coalition. In the two previous elections, the two had formed coalitions with Hon, Raila Amolo Odinga. However, during the 2022 elections, they joined the Kenya Kwanza coalition accusing Hon, Raila Odinga of betrayal. The picture is dedicated to Raila Amollo Odinga (RAO). The nonce formation -hawasumbuangi- was created in the same way as hatupangwingwi and sipangwingwi. Prior to the appearance of VI4, the Deputy President -William Ruto had released a music video of entitled Sipangwingi. This song was Remix of a previous song released by Kenyan artiste Exray Taniua featuring Trio Mio and Ssaru at their campaign rallies. (Citizen Digital, 2021).

The first song before the remix had nothing to do with political discourse but was meant to indicate a person's will to choose what is best for them without being coarsed into a decision. The word soon acquired a new meaning when it was used by Kenya Kwanza supporters to discredit the Azimio la Umoja Coalition as being a project of the incumbent government and therefore they were indirectly forcing the citizens to vote in the Azimio la Umoja coalition. The incumbent, President Uhuru Kenyatta, was campaigning for Azimio La Umoja. They were therefore persuading their supporters not to vote in Azimio la Umoja coalition which, according to them, would not be a reflection of the people but the will of the political elite so that they would entrench their monopoly on power and resources. The nonce formation was later banned by the National Cohesion and Integration Commission (NCIC) declared the phrase a hate speech.

The common pattern of inflecting verbs with -nga or -ngwi as in anachapangwa (he is usually beaten) to indicate tense (progressive and modality) is an indication of a variety of colloquial Kiswahili spoken by speakers whose first language is a Bantu language. The indigenous languages spoken in this region are Kimeru Dialects. The morphemes [-NGA] and [-NGWI] indicate habitual marker.

The second stage of analysis of VI4 using VG reveals that the two participants in the visual are Musalia Mudavadi and Moses Wetangula (members of The Kenya Kwanza Coalition). There is a major transactional, actional narrative process taking place in the visual between the two participants and the viewer. Both of the participants are looking away from the viewer which represents a reactional narrative process. There are also circumstantial participants represented by the two emojis. A major classificational process is indicated by the covert taxonomy where the two participants are placed side by side in the visual. The interactive participants are the aspirants and the viewer. The represented participant are the emojis. Sine the interactive participants are looking away from the viewer, thre is no social-relational call on the viewer. The visual is therefore an offer rather than a demand; the two participants are like

specimen on a display. In the post, the two politicians from western Kenya are presented as docile and non-confrontational as long as their basic demands are met.

For social distance, the visual is a medium long shot showing full figures of the participants and the social relation indicated is general. The attitude is subjective with a built-in point of view portraying the aspirants cannot be good leaders. They are also portrayed as not credible in terms of modality. The visual is composed as a multimodal text with a written text and therefore meaning cis embodied in more than one semiotic code. Being placed at the centre of the visual and given intensive colour intensity, which contrasts with the surroundings, the participants have been given high information value. Their relatively big size is a salient feature giving them prominence as well. Thre are frame lines at the top and bottom of the frame indicating a bit of connectedness between the participants.

Analysed from an SFL perspective, the word has four key morphemes as: Si- negation,Pang- root,w- case and i-ending.The doubling of the morpheme 'ngwi' is basically stylistic and signifies frequency. The song was a statement of independence and autonomy by the young artistes. The youthful population enthusiastically adopted the song and used it to make a statement to the effect that they should not be unduly pressured concerning making decisions about their lives. However, some social commentators felt that the 'sipangwingwi' phrase was an expression of rebellion against the set norms.

The political class took up the expression to articulate a collective resolve and autonomy. To this end, the phrase was modified to 'hatupangwingwi' as analysed below.

T7: 'Hatupangwingwi'
Ha – negation
tu- person
pangw- root
i-ending
end morpheme 'ngwi' –frequency.

Politicians picked up the phrase during the 2022 political campaigns to articulate political dominance and autonomy. To show the collective spirit, the negation morpheme 'si' changed to 'ha', with the later implying plurality. This is meant to index inclusion and present the listener as an insider in the socio-political strategies. The entire phrase '*hatupangwingwi'* is a statement of social resistance and eventual liberation. The choice of the expression in T7 is meant to endear the political class to the youthful voters and equally index freedom from any socio- political restrictions.

The other expression which was used in social media during the 2022 political campaigns with political insinuations is 'hawasubuangi'. The term is derived from Kiswahili slang and loosely means 'they are not bothersome'. The expression has four key morphemes as illustrated below.

T8: Hawasubuangi
Ha- negation
wa- person
sub- root
ang- aspect
i-ending

The verbal complex is used in social media in reference to two key supporters of the Kenya Kwanza Alliance, namely Musalia Mudavadi and Moses Wetangula.

T8: Hawasubuangi

They	are not	bothersome
identified	process	identifier

The participant 'they' refers to the two politicians who incidentally share a common political world view. Both of them are aligned to the Kenya Kwanza coalition and settled as staunch campaigners for their political party. The negated verbal process 'are not' is used to ascribe some traits to the cited politicians. In the final constituent of the

clause, the writer chooses to work with the negative complement in the identifier slot (bothersome), which is negated in the verbal process to avail the intended meaning. This implies that politics is adversarial by default and anything to the contrary is marked. It is expected that politicians are combative as they assert themselves but T8 is a deviation from the norm where the identified politicians are presented as calm and gentle.

CONCLUSION

This research examined different words/ lexical items used in the political statements and the functions realised. Compounding, blending and acronymy were the most frequent word formation processes used to form nonces in the 2022 general elections in Kenya. Multimodal analysis reveals that visual images were effectively used to persuade voters to vote for either of the two most popular coalitions. Transitivity analysis reveals the competitive nature of Kenyan politics.

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NARRATING THE ECONOMIC AND POLITICAL ENVIRONMENT: GHOST CHARACTERS IN BEN OKRI'S "THE FAMISHED ROAD"

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ABSTRACT
Since time immemorial, literature has played a pivotal role in mirroring the society. Literary authors in their endeavors to represent a lucid view of the state of things in the society have employed different types of characters to pass their messages. In Africa the use of humans, animals and objects feature in stories and have been studied and documented by various literary scholars. However, there have been little studies on the use of ghost characterization in prose. This paper has attempted to fill this gap by examining how ghost characterization reflects the economic and political environment in Nigeria. This paper has analyzed Ben Okri (1991) *The Famished Road.* The study has used Wendy (2004) magical realism strand as theoretical framework. Qualitative research design has been used where close textual analysis of the text has been carried out to show how the author has used ghost characters to reflect the economic and political environment in Nigeria. The study has established that ghost characters exceptional abilities enable them to pry into the oppressive, dilapidated, and impoverished Nigerian economic situation. In addition, ghost characters clairvoyant ability has enabled them to reveal the eerie political atmosphere that engulfed Nigeria during colonial and post-colonial period. The paper draws parallelism to the wobbly economic and political situation that overwhelmed the majority of African nations after the outbreak of Covid-19 in 2020.
Keywords: Magical realism, Economic environment, Clairvoyant, Material realm, Immaterial realm

INTRODUCTION

The novel is one of the literary genres that authors use to reflect a society. Okri set *The Famished Road* in a politically charged environment in Nigeria. The novel attempts to capture both colonial and post-colonial Nigerian Situation by use of ghost characters. It was written in 1991 as the first book in a trilogy that continued with *Songs of Enchantment* (1993) and *Infinite Riches* (1998). The book was published in London by Jonathan Cape. Okri is considered to have been influenced by the rich hero stories, spirits, and the chaos that sprung from Lagosian ghettos (O' Connor 2008).

Okri expresses the scars of colonial and postcolonial Nigeria using magical realism. Having been born in 1959 at a time when Nigeria was under transition from the British rule to self-governance he therefore witnessed the events of colonialism and post colonialism as a child before his parents relocated to London in 1962 and back to Nigeria in 1968. His text *The Famished Road* is seen as a recollection of his experiences in Nigeria. His first novel *Flowers and Shadows* 1980 and *The Landscapes Within* 1981 use surrealistic images to depict the corruption and lunacy of a politically scared country. The short-story collections *Incidents at the Shrine* 1988 and *Stars of the New Curfew* 1988 are viewed as the essential links in Nigeria culture, the physical, and the worlds of the spirit (O'Connor 2008).

Okri won the Booker Prize for his novel *The Famished Road* 1991. He has authored several other books, which have all made him as one of the world's prolific writer. His books covertly crusade for political and economic autonomy of Nigerians and Africans in general. The picture he gives about the Nigerian colonial and post-colonial can easily be paralleled with the crisis that broke in most of the African nations after the outbreak of covid-19.

Economic Situation in Nigeria from the lenses of Ghost Characters

Okri employs ghost characters to introspect the African economic situation using a third eye. He pries over the Africans state of poverty. He paints a horrifying image of unpalatable living conditions of the local Nigerians in ghettos. Azaro recounts how the single room they lived had several challenges.

He says:
The rain swept down so badly that I could no longer sleep on the floor and had to share the single bed with my parents. When more holes opened above us, we had to keep moving the bed round the room. It got so awful that we couldn't find a place that wasn't leaking. We ended up settling for having the water drip on our feet. Dad complained to the landlord, but he merely threatened to increase the rent further if he fixed the roof. We couldn't afford the rent as it stood so we had no choice but to settle for being soaked through at night (p.357).

The quote reveals the dire state of poverty in postcolonial Nigeria. It portrays poverty as a chronic and a constant phenomenon perpetuated by the rich political leaders who directly affects the less fortunate in the community (Guariso & Rogal, 2017). Okri mounts a critical eye on how poor people hurt under the watch of the rich. A family of three is so large as to spend in a single room that unfortunately leaks when it rains. He therefore roots for economic changes that would see every African benefit.

It is quite unlikely that even after the attainment of independence; the Nigerians continued to languish in pathetic poverty. This is portrayed by Okri through the ghost character. Azaro says the following, "Madame Koto turned her disquieting gaze on me. She studied my stomach. The merest hint of compassion crossed her face" (P. 423). The mention of the words "gazing at my stomach" and "she felt compassion" shows Azaro was malnourished. A state of poverty had reared its ugly head in Azaro's family, and it could clearly be seen in Azaro. He further uses other characters to analyze Azaro's health to unravel the level of poverty. Azaro exhibits the state of poverty state in African ghettos. In a conversation between Azaro's mother and Azaro, the following is revealed:

'Your father has gone mad,' she said. 'Why?' 'He is training to be a boxer, eh? We both watched him attacking the mosquitoes and the flying ants. He was sweating and his face was screwed up in absurd concentration. 'You see how poor we are,' mum said. 'How are we going to feed a boxer, eh? (P.362)

The quote depicts the state of poverty in Black Tyger's home. Gordon (1999) observes that characters in a text, either directly or indirectly, aid the writer in developing some aspect of plot through their manner of speaking or action. As they do this, they develop or strengthen some thematic concerns in the texts. Through Azaro's dialogue with his mother, the theme of poverty is brought out. They directly confess that they are poor. They grumble that they cannot afford to feed a boxer; an indication that the family is not able to cater for basic needs in their lives which Maslow (1943) states as food, clothing, and shelter. The illustration mimics the existing experiences that Nigeria and some other African state are undergoing in the process of sustaining their basic needs.

Azaro, the spirit narrator in *The Famished Road,* finds himself starved at school. His parents, being poor, struggle to pay his school fees. The narrator often contends with the challenge of going to school hungry. When he arrives at Madame Koto's bar, he relies on myths and superstations from his mother to suppress the hunger.

He says:
When I went to Madame Koto's bar after school, the place was empty. I was hungry. Sitting near the earthenware pot, I kept telling myself that I didn't have a stomach. I slept and woke up. Flies had come into the bar. I went to Madame Koto's room to ask for food (P.98)

It is quite disquieting for the child to go without food. Azaro's mother accepts her young son to serve in a club in return for basic needs such as food. This displays the glaring poverty that has handicapped the parents, and that there is little hope for solution. It takes the effort of Madame Koto to feed him in the afternoons after school when he arrives there very hungry. This is indicative of the suffering majority of the Africans went through after the independence.

Economic exploitation or oppression is the in thing in African communities. Okri interweaves magical realism and African myths to reveal the rot. Through Azaro, he manages to acquire a supernatural position, which elevates him to an inner position to see into all unimaginable human secrets. He creates an allegory of the road and the workers.

The narrator reports:
The road is their soul, the soul of their history. That is why when they have built a long section of it, they all forget the words of their prophet and begin to think they have completed it, land quakes happen, lightning strikes, invisible volcanoes erupt, rivers descend on them, hurricane tear up their earth, the road goes mad and twits and destroys itself, or people become distorted in spirit and start to turn the road into other things, or workers go insane, the people start wars, revolt cripple everything and thousand things distract them and wreck what they have built and a new generation comes along and begins again from the wreckage (P.378-379).

The road is used symbolically to represent African nation, particularly Nigeria. The workers are Nigerians while the prophets are the liberators. Okri alleges that Africans had a dream of building a free and economically secure nation, but unfortunately, the countries are faced with people who ruin others. They work but the same people misuse the

resources. The leaders watch Africans struggle to build a good nation, but they take all the resources. Okri is skeptical whether Africa would attain economic stability with the so many distractors that attack her.

In addition, Okri uses Azaro to convey the heartlessness and the cruelty of the rich. Azaro narrates the oppression mounted to his family by the landlord. This reveals that the landlord hiked the rent for his family as a way of evicting them from his house.

He reports that:
While we were eating, there was a knock at the door. 'Come in', Dad said. It was too early for visitors. We were struck by the sight of the man in ragged clothes who came in, looking around furtively his eyes yellow, his complexion pale, his mouth bitter. He was from the landlord. He was the bearer of a message. We were informed that our rent had been increased. Apparently, we were the only ones to suffer an increment in the compound. After he had delivered the message, which included an option to move out if we didn't like the new rent he was gone (p. 275).

Okri portrays a society that is occupied by indifferent people. He criticizes the rich in the society for continuing their mission of exploiting the poor. The text captures the real scene of Africa after independence. The rich grabbed land, constructed rental houses and charged hefty rents to the detrimental of the poor. This portrays a society that thinks less of the unfortunate.

Magical realism mode gives an author an opportunity to create a unique interphase where forces of class conflict in the society square it out. Okri in *The Famished Road* create such an in-between environment where the rich and the poor can muscle.

The boy narrator reveals that:
He came to a country full of palaces, a country of dreams, where the people are invisible, where wisdom and joy are in the air. He went to law courts of the spirit worlds. I heard him crying for answers. Then he came back and a war broke out and they shot him on the road that he had built (P.550).

The quote is an illustration of the reckonable force that Black Tyger fights. In the text, Okri has created a world that is neither spiritual nor physical, where Black Tyger is fighting for his liberation. The realm has the ancestors where the grandfather comes in aid of Black Tyger. The author emphasis the pain and struggle one has to go through in modern Nigeria to succeed in life. In the past, Nigerians struggled to attain independence from the whites, but after they left another struggle emerged, (Williams, 2017) refers to such struggle as the struggle for economic freedom, which now Black Tyger has to go through.

Okri gives the text a sense of human touch by withdrawing from the conflicts of the spirit world. He displays human conflict in the physical world. He attributes those conflicts to class discrimination. When Madame Koto hosts a party to celebrate her new economic class promotion, she leaves Black Tyger out among the invitees. This causes a kerfuffle to break out at her tents entrance when he is denied an entrance.

Azaro says:
He went to the bouncer and knocked him out with a single roundhouse punch. 'If its only gatecrashers you respect, then I am coming in,' Dad said. The thugs fell on him. He threw one of them on the bonnet of a car. He winded a second with a punch to the solar plexus. He was quivering with energy; his eyes had a manic glimmer. Someone screamed. Madame Koto came out, saw what was happening, told the thugs to stop fighting, and very politely asked Dad to come into the party (P.520).

This discrimination based on social class irritates the less fortunate in the society. Black Tyger is depicted fighting to overturn the status quo. In addressing the concept of class, Marx (1863) argues that a capitalist society is made up of two classes; namely, the bourgeoisie, or business owners, who control the means of production, and the proletariat, or workers, whose labor transforms raw commodities into valuable economic good. The two are always at conflict where the workers wish to overturn the business owners. Okri subtly portrays the conflict where Black Tyger is shown fighting for his recognition in a place where the rich only are welcome. He succeeds to be brought on board, demonstrating his future prospects in overturning the tables against the controllers of the resources.

The above illustration further portrays an emergence into power of a new class of individuals who took position of the white masters to control the country's resources. He uses Azaro, a spirit child endowed with some mysterious power beyond those of a normal omniscient narrator. Azaro reveals how Madame Koto rose into riches, dissociating herself with the poor such as Black Tyger's family. She hosts parties to celebrate her knew status. It is reported that, "outside, we heard rumors that the party was being thrown to celebrate Madame Koto's attainment of new powers, the installation of electricity, the consolidation of her party connections, and to widen the sphere of her influence in this and other realms" (P.516).

Koto's influence is felt after becoming a successful businessperson. She struggles and eventually attains considerable wealth that sets her apart from the other individuals. Koto represents the few Africans who managed to rise into richness after the white imperialists left. Okri intensifies her influence by showing how her influence was felt in the two realms: the physical and the spiritual realm. This is achieved through use of spirit characters.

Ghost characters are also used to develop the theme of unemployment. Majority of characters suffer due to inability to secure a reliable job. In *The Famished Road,* Azaro's family suffers because of lack of a reliable job. Black Tyger has to put up with weird jobs in order to sustain his family. He is hired to carry heavy loads of cement and salt every day, leaving his back peeling off.

The narrator reports that:
And then I saw Dad amongst the load-carriers. He looked completely different. His hair was white and his face was mask-like with engrained cement. He was almost naked except for a very disquieting pair of tattered shorts, which I had never seen before. They loaded two bags of salt on his head, he cried 'GOD, SAVE ME!' he wobbled, and the bag on top fell back into the lorry. The men loading him insulted his ancestry, wounding me, and Dad kept blinking as the sweat and salt poured into his eyes (P.174).

The pain he is undergoing makes him contemplate quitting his job, but he is unable because there are no jobs available. Azaro's mother warns him not to refuse schooling because after independence, educated Africans would probably secure good jobs while those who are not educated would find it hard to cope with the state of the economy. If not he would probably continue to suffer hard times and the unusual economic challenges just like his father.

The unreliability of making a fortune in business is revealed through Azaro the spirit narrator. His mother engages in unpromising business of selling provisions. The narrator recounts that most of the times her provisions would end up not having been bought.

The narrator says:
That morning she brought out her little table of provisions to the house front. She sat on a stool, with me beside her, and dispiritedly crooned out her wares. The dust blew into our eyes. The sun was merciless on our flesh. We didn't sell a single item (P.61). It is evident that majority of the Africans went through hard economic times after independence. Okri uses a spirit child character who tells the story naively. The innocence of a child makes the story acquire a sense of truth as children rarely tell lies. These economic challenges equate the contemporary phenomenon that the Africans are undergoing in the wake of covid-19

Telling the Uncanny Political Atmosphere in Nigeria using Ghost Characters
Okri skillfully uses myths that encompass reincarnation, as well as a biblical allusion of Lazarus (Azaro) to portray political realities in Nigeria during colonization and post-colonization. Nigeria, just like other African countries was engulfed with numerous political woes perpetuated by the ruling class. Just as Abiku child comes and goes, Nigeria is politically unstable.

The narrator says:
The spirit is unwilling adventurer into chaos and sunlight, into the dreams of the living and the dead. things that are not ready, not willing to be born or to become, things for which adequate preparations have not been made to sustain their momentous births, things that are not resolved, things bound up with failure and with fear of being, they all keep recurring, keep, coming back, and in themselves partake of the spirit-child's condition. They keep coming and going till their time is right (P.558).

The quote demonstrates that Nigeria is an Abiku country that keeps on going and coming. Oko (2020) buttresses that; Nigerians authentic independence, which is linked to Abiku', has not yet been achieved. He associates this instability with failure of Nigeria to be fully prepared for birth. He hints that the main problem that haunts African nations is that majority-attained independence when they had not matured enough to govern themselves. Thus, Nigeria leaders grapple with the monster of offering right leadership, which they have little knowledge on.

Ade, a living pessimistic Abiku, reasserts the above illustration when he says that, 'Our country is an Abiku country. Like the spirit-child, it keeps coming and going. One day it will decide to remain. It will become strong. I won't see it' (P.547). The quote reveals that Nigeria has hope of functioning as an independent, mature, and reliable country with robust systems and polices. However, Ade unfortunately will not be present to witness these changes. Ade represents the liberators who labored to see a free Nigeria but the jaws of death gnashed them before this realization. Nevertheless, he dreams of a better future where he says Nigeria will choose to stay.

Nonetheless, the Abiku argues that political stability will never be attained peacefully in Nigeria. Ade tells his friend Azaro that:
Suffering is coming. There will be wars and famine. Terrible things will happen. New diseases, hunger, the rich eating up the earth, people poisoning the sky and the waters, people going mad in the name of the history, the clouds will breath fire the spirits of things will dry up, laughter will become strange (P.547).

The quote above portends an oppressive atmosphere that will hover in Nigeria as the people fight to regain their second liberation. Okri intimates that the first liberation of Nigeria was from the chains of the white people; and therefore, he prophesies a second liberation, which will set people free from the chains of the black self-imposed masters.

The freedom above is achievable after the expulsion of the Abiku children. Nigeria as a country has to stop breeding and nurturing leaders who are incompetent, unreliable, and oppressive. The intimation by Ade that soon he is leaving indicates a possible new dawn for political atmosphere in Nigeria. He says, 'My time is coming. I have worn out my mother's womb and now she can't have any more children' (P.547). The illustration shows that no more bad leadership will be elected. The Nigerians will now understand themselves, and will chose good leaders and their country will become politically stable.

This is informed by the fact that the Abiku children are portrayed as bad and evil. They represent the forces detrimental to Nigerians. Madame Koto asks Azaro that, 'why were you staring at my stomach like that with your bad luck eyes' (P. 530). Madame Koto is aware that Azaro is a bad luck to her parents (Nigeria). Though narrated in a superstitious way, Okri tries to underscore the challenges facing Nigeria on persistence of people who are not willing to struggle to help Nigerian grow holistically. Oko (2020) observes that Azaro is likened to the echo of independence and its attendant's problems, and the embodiment of a Nigerian nation that has been born.

The description given about the three-spirit children Madame Koto is carrying has a great meaning about the future of Nigeria. Azaro's supersensory telepathic and clairvoyant power brings their nature to the reader's attention.

He says:
And I saw Madame Koto was pregnant with three strange children. Two of them sat upright and the third was upside down in her womb. One of them had a little beard, the second had fully formed teeth, and the third had a wicked eye. They were all mischievous, they kicked and tugged at their cords, they were the worst type of spirit children, and they had no intention of being born (P.530).

The three spirit children represent Nigeria. Their refusals to be born represent the inability of Nigeria to become an independent and autonomous country. Nigeria is not fully prepared for the monstrous birth. Their forced birth would result to an outbreak of a terrible war that Ade portends latter in the text when he says, 'Suffering is coming. There will be wars and famine.' (p.547). Therefore, Nigeria like other African countries is faced by eminent war in case they explore the route of seeking a second liberation.

Okri further presents a nation that is inhabited by self-fulfilling leaders. Through mystic sight of the herbalist, the following is revealed:

Too many roads! Things are CHANGING TOO FAST! No new WILL. COWARDICE everywhere! SELFISHNESS is EATING UP the WORLD. THEY ARE DESTROYING AFRICA! They are DESTROYING the WORLD and the HOME and the HOME and the SHRINES and the GODS! THEY are DESTROYING LOVE TOO.' (P.437)

Okri capitalizes some words in the lines above to reemphasize the meaning they carry. The words carry weight behind the rise of leaders in Nigeria who do not seek for her stability; rather they are interested in self-aggrandizement. They keep on acquiring wealth, which they cannot use after all. Okri's assertion is further buttressed by Achebe (1983) who notes that. "The trouble with Nigeria is simple and squarely a failure of leadership. There is nothing wrong with Nigeria land, climate, water, air, or anything else. The Nigerian problem is the unwillingness or inability of its leader to rise to the responsibility" (P.1). These arguments open a platform where a critical examination can be directed with the intent of unearthing the rot surrounding the Nigerian people. Both Achebe and Okri agree there is need for Nigeria's rebirth in which new leadership takes over and causes reforms.

Okri further spreads his tentacles by mocking the unprofessionalism of the police officers in post-colonial Nigeria. Generally, the autocratic governments in Africa have been known to use police officers as a weapon to propagate their despotic rule. In a minor conflict between the landlord and the tenants, the police officers are shown to take that chance as a golden opportunity to exercise their inhuman feats. The narrator reveals that, "The reinforcements meanwhile lashed out everything in sight, unleashing mayhem in a drunken fever. When they had finished 15 men, 3 children, 4 women, 2 goats and a dog lay wounded along the battleground by our area" (p.12). The horrific scene emblazoned in the mind of the reader exhumes the police officers as inconsiderate. Okri in this case uses a ghost young boy to divulge the crime in the crudest way conceivable because children are presumed innocent and free of biases and exaggeration.

The brutality of the police officers is further aggrandized by the beating of narrator's father. This is evidenced through this quote:
Dad was there, imprisoned for taking part in the riots. They managed to see him. He had been beaten by the police and there was an ugly cut on his forehead, bruises on his face, and his arm hung beside him like a diseased appendage. The next day, after much begging and some bribery, Dad was freed (p. 36).

Okri attacks police officers and the overall leadership. He depicts their naked truth through the ghost character that is able to have clairvoyant view of the happenings without his physical presence. The police officers are shown as corrupt and oppressive. They are the extension of the oppressive government. Black Tyger's remand is an exhibition of injustice. He was detained without a fair trial. Furthermore, it is ironical that the police officers come when the houses are burning and instead of helping people salvage their belongings from burning, they beat them up severely leaving many wounded. This subjugation is a representation of a tyrannical-sort-of leadership that Okri is shown to be against in contemporary post-colonial Nigeria.

Two political forces are shown to be antagonistic with each other: the party of the rich and the party of the poor. The spiritual, telepathic, clairvoyant eye of the Abiku child reveals the struggle for dominance that originates from the spiritual realm and cascades downwards to the material world. The narrator reveals that:
That was when I understood that conflicting forces were fighting for our future of our country in the air, at night, in our dreams, riding invisible white horses and whipping us, sapping our will while we slept. The political parties waged their battles in the spirit spaces, beyond the realm of our earthly worries. They fought and hurled counter-mythologies at one another. (P. 568).

The quote exhibits unpalatable thirst for leadership. This urge is aimed at ensuring they get power, which they would use against each other. The party of the rich wants to stamp its authority, while the poor wishes to overthrow the rich and distribute the resources to uplift themselves. This assertion is supported by Reno (2019) who avers that independence of African countries is a curse because it gives some people power to rule and oppress the rest. This can be deduced as the real phenomenon unfolding in Nigeria.

The political violence in Africa is a mechanism to disrupt the attempts to change the economic situation (Duursama, & Gebrehiwot, 2019). This assertion is evidenced in *The Famished Road*. Okri exhibits a society that is hit by turbulence of political turmoil. During the campaigns at the narrator's compound, several wars break up. The narrator reveals that:

The politician went on with his claim, and suddenly a stone smashed the vans window and undammed the furry of angry bodies. Several hands clawed at the vans; someone cracked the politician on the head and he screamed into the loudspeaker. The driver started the vehicle; it jerked forward and knocked a woman over. (P.181).

This is a representation of unstable political situation. There is mistrust between the poor and the rich which results to political turmoil in Nigeria. The author reveals that Nigeria is yet to achieve political stability after the attainment of independence.

The oppression minted by the rich to the poor is evident when the party of the rich feeds the poor with rotten milk. Azaro tells his parent that, "last night. Everyone was asleep. Then the insect flew out of the milk," (P.155). This irresponsibility of the rich to the poor worsens the already unstable situation in Nigeria. Azaro's third eye enables him to see into the cause of plight of the people in his village. The discovery by the villagers that they were poisoned by the party of the rich is received hilariously and revenge is organized. This makes the political mood in post independent Nigeria extremely tense.

Political deception and corruption in Africa is dominant. The political leaders make promises to the electorate but when elected they behave like others and fail to fulfill them (Mbandwa, 2020). Okri depicts Nigeria as a country that is ever deceived politically. When the party of the rich visits his village, Azaro says, "They only remember us when they want our votes" (p. 145). This shows disillusionment of the voters concerning the promises made by these political parties. The citizens are used to such promises, which are never fulfilled.

The two parties strive to woo the electorate to their sides using all manner of dubious methods. The party of the rich makes a myriad of promises to the crowd.

Azaro says:
The man in the van spoke for himself. VOTE FOR US. WE ARE THE PARTY OF THE RICH, FRIENDS OF THE POOR... 'The poor have no friends,' someone in the crowd said. 'Only rats.' 'IF YOU VOTE FOR US....' '…we are finished,' someone added. '….WE WILL FEED YOUR CHILDRE' 'lies' 'AND WE WILL BRING YOU GOOD ROADS '… which the rain will turn into gutters.' (P.145).

Okri skillfully uses capital letters for the lines said by the rich to show how important those words were sounding to the ears of the distance listener when uttered, and to let the audience know that those were the challenges the poor faced; yet they would never be fulfilled. He also uses the modal verb "will" as a subject rather than "shall" which lessens the possibility. In addition, they use the first person plural "we" rather than "I" which makes the responsibility of the commitment collective rather than individual. One would expect them to use first person "I" for the purposes of commitment. He also uses small letters to show the humbleness of the poor. It also represents how small those promises were sounding to the ears of the poor. This skeptical portrayal of the antagonism between the rich and the poor is captured by Marxist (1863) who introduced the concept of the class conflict and its implications.

Both the party of the rich and that of the poor are politically hypocritical. Okri uses the ghost character Azaro to exemplify their lies.

He reports:
The men of the compound talked about politics, about the party of the poor. They too had come with loudhailers and leaflets and had promised a lot of things and had won considerable support because they said they would never poison the people (p.177).

Okri is cynical about the promises that are made by these political parties. He reflects on the challenges facing the people in the compound and juxtaposes them with the promises that are made by the parties. When the two are analyzed, what comes out clearly is a complete ugly situation, which is a mockery to their promises. This is a confirmation that the two parties have been lying to the local Nigerians throughout their lives.

Black Tyger's dream foreshadows the future role he will play towards liberating the poor and the community at large. The following conversation with his son, Azaro, reveals this:
My son, I dreamt that I had set out to discover a new continent. What is it called? The continent of a hanging man 'What happened? 'When I landed with my boat, I saw mountains, rivers, and a desert. I wrote my name on a rock. I

went into the continent. I was alone. A strange thing happened. You're too young to understand this,' 'Tell me '…. I have just discovered this place. It is supposed to be a new continent. You are not supposed to be here.'' "We have been here since time immemorial, "he replied. 'And then I dreamt them away. And, then a shepherd came to me and said; "This continent has no name'' (p. 500).

Black Tyger's dream of a new continent is symbolic. It represents the critical role that he will play towards redeeming and restoring the lives of the poor. The poor in this case are represented by him and the beggars. In his dreams, the people who are not like him represent the whites. When he dreams them away, it signifies the end of their rule or leadership in the new continent. The new continent represents African continent that had no name before the coming of the Europeans. When the shepherds tell him that people do not name their own continent, it is symbolic of the authority that the white took to name African Continent. Ben Okri therefore uses the dream to show what was happening in Nigeria; more particularly, the Yoruba community.

Nigerians political liberation is shown to be going through intensive metamorphosis. Okri dexterously employs Black Tyger's rebirths to signify how Nigerians freedom movements are reborn. Black Tyger is engaged in three fatal fights. In each of those fights he wins but the aftermath of them is disastrous because he is left oscillating between the spirit world and the physical world.

He fights with the spirit of Yellow Jaguar, which he wins but after the war, the narrator tell us that:
We kept the business of our dad having fought a dead man to ourselves…dad was in his condition. If I had said that a fully-grown man, bearded and big chested, married and with a son, was being born as certain huge animals are born, I would probably have been chastised by all the grown-ups around (p. 411).

The quote is significant to Nigerian liberation movement. It reveals that Nigerian's are undergoing transformation politically. It is a rebirth of the second liberation. The narrator says an old man is being reborn to show that though Nigerians had gotten independence, there was need for the country to restart afresh by shedding off her old self.

The second fight between Green Leopard and Black Tyger metaphorically signifies the Nigerian awakening on matters of politics and finances. After black Tyger lingers between dead and the living for several days, he is reborn a second time. When he wakes up, he says he wants to become a politician. This is met with sharp criticism from his wife who tells him that, 'You used to hate politics,' Mum said. 'What has happened, eh? 'I have been thinking.' 'So it took Green Leopard to start you thinking, eh? 'Where there's politics, there's money,' Dad said (P. 471). This show that majority of Africans fought to liberate themselves from the jaws of poverty. The major motive for the fight was self-gain. This claim is buttressed by Boone (2017) who observes that the fight for leadership in Africa is ever targeted to control the countries existing resources and exploit the economy.

Black Tyger's last fight with the man in white suit is a climax of his political freedom and that of Nigeria. When he lastly wins the fight, his son Azaro (Nigeria) gets freedom.

Azaro says:
The air in the room was calm. There were no turbulences. His presence protected our night space. There were no forms invading our air, pressing down on our roof, walking through the objects. The air was clear and wide. In my sleep, I found open spaces where I floated without fear. The sky was serene. A good breeze blew over our road, cleaning away the strange excesses in the air. It was so silent and peaceful that after sometime I was a bit worried. I was not used to such a gift of quietude (P. 574).

This quote is a portrayal of a country's rebirth, which Black Tyger has been fighting to obtain. Okri uses the images of spiritual realm to signify how Nigeria had been in constant struggle to attain her liberty. Abiku children have been used to give the author the ability to pry into spiritual realms. The child character is used to give the crudest revelations of the happenings, devoid of exaggeration. Therefore, like an Abiku child whose existence is unreliable, Okri had been able to show the unreliability of Nigerian's independence.

CONCLUSION

This paper has shown that ghost characters are used by Okri to portray the economic and political environment in Nigeria. It has also revealed that those characters are endowed with extraordinary abilities, which enables them to give economic oppression, and a dire corruption, which impoverished many Nigerians. Through oscillation of the two

realms, they give a pleasing description of the immaterial realm while painting the material as full of economic exploitation thus leaving a reader with a clear picture of the extent in which African leaders have suppressed their subject.

The study finally concludes that ghost characters give an eerie political situation in Nigeria. It reveals political oppression, bad leadership, aristocratic leadership, and the effect of wars. They reincarnate from death and with the help of their telepathic abilities, they foresee the future of Nigerian people. Therefore, ghost characters have proved to be an effective tool to narrate the African postcolonial history, contemporary and the prospects of future in a magical realm. This reality was portrayed when many of the African countries experienced economic and political instability way earlier than other world countries during the covid-19 outbreak. This could be attributed to what Okri (1991) described as ailing economies and mangled political leadership. It is unfortunate that up to-date majority of African countries rely on grants and aids as a method of self-sustenance.

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INFLUENCE OF NON-TEACHING STAFF ON STUDENT DISCIPLINE IN PUBLIC SECONDARY SCHOOLS IN EMBU COUNTY, KENYA

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ABSTRACT
There is general outcry world over in relation to crime which has affected all sectors of development. Educational institutions especially secondary schools are best avenues where youth can be impacted with knowledge and competences for holistic character formation. The study objective was to examine the influence of non-teaching staff on the discipline of students in public secondary schools in Embu County, Kenya. Inculcating discipline among students requires a multi-dimensional approach incorporating other stakeholders. Non-teaching staff in secondary schools interact often with students. They directly or indirectly influence their behaviour. The study adopted Systems theory by Ludwig Von Bettalanffy (1950), as quoted by MacDonald (2019) and Institutional theory by Meyer and Rowan (1977). This study involved descriptive survey design and utilized qualitative research method. Stratified, purposive techniques were used to select the sample size. Data was collected by observation, open-ended questionnaires, and in-depth interview. Pretesting of instruments was done to determine validity and reliability. A sample size of 20% was used for population above 50, 30% for any category above 10 but not exceeding 50. Census was used for cases below 10. All principals, one student per school and all non-teaching staff in public secondary schools were targeted. The results were analysed through tables, pie charts and graphs. The findings indicated that non-teaching staff were indirectly involved in discipline issues pertaining the students. The research recommends that non-teaching staff should be trained and directly involved in handling students' discipline cases.
Keywords: Non-teaching staff, Students' discipline, Public Secondary Schools, Decision-making

INTRODUCTION
Educational institutions especially secondary schools are well placed to impact youth with knowledge and competences for holistic development and character building. Nevertheless, it is regrettable that there is moral decadency especially in public secondary schools. Mulwa (2015) recommended that principals in public secondary schools should use collaborative decision-making approach on students' discipline. Such an approach need to include members of support staff.

Objective
The study was carried out to examine the influence of non-teaching staff on the discipline of students in public secondary schools in Embu County, Kenya.

Statement of the Problem
In the 21st Century, there has been increase in moral decadency among the youth. Some of these cases are caused by the digital platforms such as internet and social media platforms. Most times when crimes are committed in the schools, the blame is mainly placed on the teachers. However, the non-teaching staff are not directly involved in management and administration of institutions but interact more often with the learners. Inculcating discipline among students requires a collaborative approach incorporating other stakeholders such as non-teaching staff members. The problem, therefore, is an investigation on influence of non-teaching staff on students' discipline in public secondary schools in Embu County, Kenya.

LITERATURE REVIEW
The study employed Systems theory by Ludwig Von Bettalanffy (1950), as quoted by MacDonald (2019), which states that any organization is a single, unified system of interrelated parts or subsystems. Each part of the overall system is dependent on the others and cannot function optimally without them. Behavior is influenced by a variety of factors that work together. Some of the factors that influence behavior are related to family, social friends, economic factors such as environment where one is living. These factors are interdependent and interrelated. An institution is influenced by both internal and external factors that determine the outcome. In the school setting, there are teachers, students and members of the non-teaching staff. Although teachers are charged with the responsibility of teaching and disciplining students, members of the non-teaching staff play a complimentary role that cannot be underrated. As per institution theory by Meyer and Rowan (1977), the environment within the organization has a direct impact on the development of formal organizational structures. Cultural elements, symbols, normative beliefs and other organizational

environment features shape institutional structure. This theory is popular in organisational management and was applied in various studies including Mohamed (2017), who argues that organizational formations depend on "rational myths" or shared beliefs. According to Scott (2004), in order to succeed, institutions should abide by the rules and belief of the systems that prevail in their environment. This idea was supported by Saqib, Allen and Wood (2021).

Theorists explain the rationale of organizational contexts and organizational factors through institutional theory and assert that by putting these norms into exercise, institutions become ideal and intensify their longevity to ensure the institution's existence. The theory supported the study because institutions have their own distinct culture and norms. Moreover, different categories of schools have varied number of support staff working in different sections. Every school has a unique culture which bind all members of support staff in that institution. Moreover, as these employees continue working together, they build a sense of belongingness to work as a team and promote education standards. It is through the performance of members of support staff, coupled with their care that the basic needs of students are addressed in schools.

The role of non-teaching staff in provision of quality education in secondary level is manifested directly and indirectly depending on the specific staff (Anietie, Kolubowei, & Idongesit, 2020). Although by virtue of their job placement, non-teaching staff are expected to play constructive roles in the school, sometimes this cadre may exhibit the potential for negative activities. Among the negative activities which can be perpetrated by non-teaching staff in educational institutions include intentional preparation of bad food, selling of drugs and cigarettes or pilfering of students' food to supplement their income. Indeed, students spend most of their time in school than at their homes and that many parents have little time with their children. Therefore, if careful measures are not taken the students are likely to go astray.

METHODOLOGY

Research Design

This study employed descriptive survey design since it allows the researcher to analyse the whole population using a sample as a representation. This design is considered appropriate since it allows the use of thematic methods to collect data such as questionnaires and interviews, observation, tape recording and document analysis. The design assists the researcher in obtaining a large number of respondents and inspect a wide range of policy implementation issues (Sharma, 2019; Kothari, 2014; Nworgu, 2015).

Target Population

The target population comprised of the principals, students' representatives and non-teaching staff in public secondary schools in Embu County. Each school is headed by one principal. Hence, all principals in public secondary schools were targeted.

Sampling Procedure and Sample Size

The quality of any research depends on the methodology, instrumentation, and the sampling strategy used in the study (Manion et al., 2001). For the purpose of this study, a sample size of 20 percent was used for population above 50 characters as proposed by Khan (2020) and Manion et al., (2001). The study also drew a sample of 30 percent from any category with the population above 10 but not exceeding 50 characters. Nevertheless, in the case of ssnational schools (two schools), census was used (Manion et al., 2001).

This study employed stratified and purposive sampling technique. All public schools were classified according to the categories and types; national boys' schools and national girls' schools, county boys' schools and for girls, and then sub-county schools for both boys and girls (mixed schools). Any school considered for sampling had done Kenya Certificate for Secondary Examination (KCSE) for at least five years. Depending on the numbers, a representative sample was selected to represent the target population. The sample sizes were drawn per category of schools depending on the number in that category.

Sampling of Schools

The researcher listed down all the schools according to their categories. More importantly, the representative sample percentage varied from 10 (census) for very small population to 30 percent for large population categories. Public secondary schools were classified as national, extra county, county and sub-county schools (Basic Education Act, 2013). This categorisation and establishment are both analysed in Table 1.

Table 1: Categories of Government Secondary Schools in Embu

Type of School	Number	Percentage	Sample
National	2	100	Census
Extra County	23	30	7
County	24	30	8
Sub-County	116	30	35
Total	165		60

Sampling of Principals

Table 2 shows sampling of principals of government secondary schools in Embu. Each school has one principal and hence their number is equal to the number of schools per each category. Sampling of principals was similar to that of school such that all principals of national schools were selected while those in county schools were sampled at thirty percent. Similarly, principals of sub-county schools were sampled at thirty percent.

Table 2: Sampling of Public Secondary School Principals

Category of school	Number of schools	Number of principals	Percentage	Sample
National	2	2	100	Census
Extra county	23	23	30	7
County	24	24	30	7
Sub-County	116	116	30	35
Total	165	165		51

Source: Researcher's conceptualisation and construction

Sampling of Students

For students' population, one senior student (mainly the president) was selected per category of schools through purposeful sampling. Thus, there were a total of 165 students selected through purposeful sampling. The researcher made a deliberate attempt to cover all sub-counties for fair representation and more accurate information.

Table 3: Sampling of Students of Public Secondary Schools

Category of School	Number of Schools	Number of Students
National	2	2
Extra County	23	23
County	24	24
Sub-county	116	116
Total	165	165

Source: Researcher's conceptualisation and construction.

Sampling of non-teaching staff by Category of Secondary Schools

Different categories of secondary schools have varying numbers of non-teaching staff depending on their establishments. In such a situation, schools were classified in accordance with the Basic Education Act, 2012. From this arrangement, a sample of schools was drawn from each category and then sampling of non-teaching staff was conducted per each category. In this case, schools were selected per category using random sampling.

Table 4: Sampling of non-teaching staff by Type of School

Type of School	Number in the Category	Non-teaching staff establishment per school Category	Total number of non-teaching in the school category	Sampling Percentage	Sample Size
National	2	28	12 (6x2)	30	4
Extra County	23	18	115 (5x23)	20	23
County	24	13	72 (3x24)	20	14
Sub-County	116	6	232 (2x116)	20	46
Total	**165**		**431**		**87**

Source: Researcher's conceptualisation and construction

The sampling of categories of non-teaching staff is analysed in Table 4. Here a sample of 30 percent of non-teaching staff was drawn from national schools. For county and sub-county schools sampling was done at 20 percent as supported by Gay and Airasian (2003) in Khan (2020) who claim perhaps the sample size for descriptive research ought to be approximately 10% to 20% of the population.

Instrumentation
Data was collected by using open-ended questionnaires and in-depth interviews. For school principals, data collection was done by use of in-depth interviews while questionnaires were administered to students and non-teaching staff.

Pretesting of research instruments
The study was carried out to assist in assessing the quality of data collection instruments in two public secondary schools.

Validity
Two experts who are the research supervisors from Kenya Methodist University School of Education were consulted to ensure the validity of the findings. In addition, the researcher ascertained that the items adequately covered the research objectives. The results of the pilot study were used to check for and correct any ambiguity.

Reliability
The term "reliability" refers to consistency and explainability over time, across instruments, and across groups of participants (Taherdoost, 2016). Tools were piloted in two schools to test their reliability. This process helped to address ambiguities, misunderstandings, or other shortcomings in the final instruments. The pilot study allowed for the pre-testing of research instruments in order to determine their reliability using the Cronbach (1951) coefficient for measuring internal consistency of research instruments. The research instruments were above 0.7 which is the accepted level based on Cronbach coefficient which is the recommended level for pilot study.

Data Collection Procedure
The researcher applied for a research permit from the NACOSTI after obtaining a letter of introduction from Kenya Methodist University. Permission was also sought from Embu County Commissioner, the County Director of Education, and principals of sampled schools to conduct research. The researcher informed the principals of the selected schools using mobile phone and booked appointments to deliver the questionnaires and conduct interviews. The researcher personally visited the selected schools in order to establish personal connection with the school authorities for the purpose of data collection. The researcher then distributed the questionnaires to the participants and once filled they were collected. Efforts were made not to interrupt the normal running of institutional programmes.

Data Analysis
The data collected was analysed in accordance to Taherdoost (2016), where the data was organized into patterns, categories and descriptive units in order to have relationships between them and conclusions were drawn.

Analysis of Qualitative Data
The data were entered into the computer using STATA version 17. The generated results were presented in tables, percentages, and graphs to facilitate interpretation of the findings. To depict the situation as it was on the ground, narrative and interpretive reports, as well as citations, were written down. All data were strictly interpreted in relation to the research questions, and conclusions were drawn from the findings in relation to the research objective.

Quantitative data analysis
Questionnaires were sorted out to ensure only the completed ones are analysed while incomplete ones were discarded. The study variables were assigned different codes and defined accordingly before formulating equations or models showing causal relationships between independent and dependent variables. Once coded, various diagnostic tests were conducted to eliminate any type of biasness. Such tests included normality, linearity, multicollinearity, heteroskedasticity and autocorrelation. These tests enabled the researcher to establish the suitability of the collected data in satisfying various assumptions. Once that is accomplished, hypothesis testing was done through regression analysis using Ordinary Least Square (OLS) Method. The model to be tested is formulated as follows:

$$QE = \alpha + \beta_1 INTS + \beta_2 ENTS + \beta_3 CCIS + \mu$$

Where: QE - Quality Education
α - Constant

$\beta_{1...4}$ - Coefficient
INTS - Involvement of non-teaching staff with students
ENTS - Effect of non-teaching staff on students
CCIS - Collaboration causes with indisciplined students
μ - Disturbance Term

The coded data inputs were fed into the computer statistical package using appropriate commands, and through this process, the output data was analysed and the results interpreted.

Ethical Consideration
The researcher strictly observed all legal and ethical considerations as expected in conducting research. The researcher sought permission to conduct study from NACOSTI and other relevant authorities.

FINDINGS AND DISCUSSION

Principals' Response

1. Effect of non-teaching staff contribution to students' discipline

Effect of non-teaching staff on interaction among students and administration	Freq.	Percent	Cum.
Weakest	4	6.67	6.67
Weak	13	21.67	28.33
Strong	35	58.33	86.67
Strongest	8	13.33	100.00
Total	60	100.00	

From the table above, about 71% of the principals show that non-teaching staff have a strong effect on interaction among the students and administration while about 29% indicated that non-teaching staff have a weak effect on the latter. From the findings, it is clear that there is need to involve non-teaching staff in administration and management of learners' discipline.

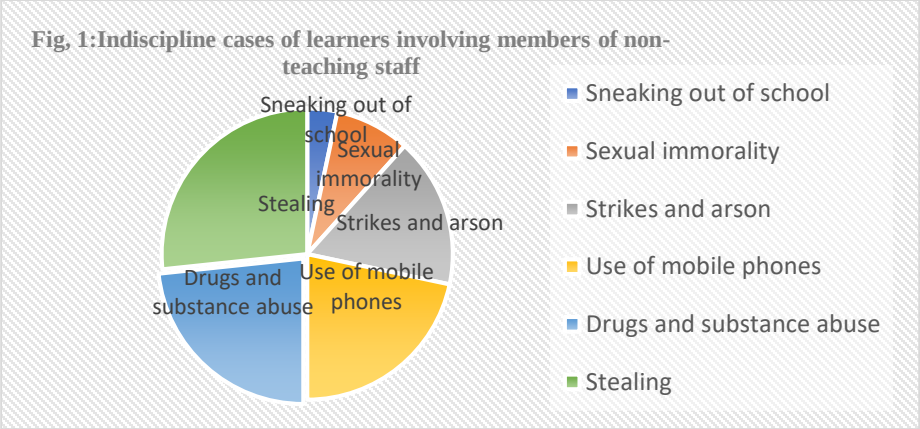
2. Knowledge on digital emergence issues

Knowledge on digital media platforms	Freq.	Percent	Cum.
Weakest	5	8.33	8.33
Weak	40	66.67	75.00
Strong	13	21.67	96.67
Strongest	2	3.33	100.00
Total	60	100.00	

Digitalization has become a daily indulgence in today's modern society. Most non-teaching staff members have little knowledge of the digital media programmes and use. About 67% of the non-teaching staff were found to have weak knowledge on the use of different digital media platforms as only about 22% had strong knowledge and about 8% had weakest knowledge on the digital media use. This shows that the rate of digital illiteracy among members of the non-teaching staff is high in the modern high digitalization era.

3. Indiscipline cases of learners involving members of non-teaching staff

Common indiscipline cases	Freq.	Percent	Pie chart ratio	Cum.
Sneaking out of school	2	3.33	12	3.33
Sexual immorality	5	8.33	30	11.66
Strikes and arson	10	16.67	60	28.33
Use of mobile phones	13	21.67	78	50.00
Drugs and substance abuse	14	23.33	84	73.33
Stealing	16	26.67	96	100.00
Total	60	100.00	360	



From the above Figure 1, the common cases of indiscipline among students such as drugs and substance abuse are high at 23%. Members of non-teaching staff, sometimes sneak-in drugs and allow students to peddle and use. Furthermore, some of the non-teaching employees use those drugs hence act as bad role models to the students.
The highest crime committed is stealing of items which is at 27% rate. From the interviews conducted, most items are sneaked out through mobile phone connections, which is also a school crime at 22%, with the knowledge of security guards and sometimes the guards assist in looking for market for such items. Commonly stolen items are bedcovers, calculators, dictionaries and shoes. In addition, use of mobile phones in schools is on rise because some members of support staff hide the gadgets for the students or assist the students with theirs.

Students' response

1. In your opinion, do you agree that non-teaching staff have influence in students' behaviour in school?

Do you agree that non-teaching staff have influence in student behaviour	Freq.	Percent	Cum.
Strongly disagree	11	5.64	5.64
Agree	90	46.15	51.79
Strongly agree	94	48.21	100.00
Total	195	100.00	

The most common mistakes by students is drug abuse. Others especially in boarding secondary schools are sexual immorality. From the findings above, it shows that 100% of non-teaching staff influence students' behaviour directly and indirectly.

2. How would you rate the contribution of the following categories of non-teaching staff to students' discipline in a rank of 5 where 1 is weak and 5 is the strongest

Account clerk on student discipline	Freq.	Percent	Cum.
Weakest	25	12.82	12.82
Weak	9	4.62	17.44
Strong	74	37.95	55.38
Strongest	87	44.62	100.00
Total	195	100.00	

3. How would you rate the contribution of the following categories of non-teaching staff to students' discipline in a rank of 5 where 1 is weak and 5 is the strongest

Secretaries on student discipline	Freq.	Percent	Cum.
Weakest	15	7.69	7.69
Weak	8	4.10	11.79
Strong	85	43.59	55.38
Strongest	87	44.62	100.00
Total	195	100.00	

4. How would you rate the contribution of the following categories of non-teaching staff to students' discipline in a rank of 5 where 1 is weak and 5 is the strongest

Librarians on student discipline	Freq.	Percent	Cum.
Weakest	61	31.28	31.28
Weak	9	4.62	35.90
Strong	53	27.18	63.08
Strongest	72	36.92	100.00
Total	195	100.00	

5. How would you rate the contribution of the following categories of non-teaching staff to students' discipline in a rank of 5 where 1 is weak and 5 is the strongest

Cooks on student discipline	Freq.	Percent	Cum.
Weakest	6	3.08	3.08
Weak	6	3.08	6.15
Strong	48	24.62	30.77
Strongest	135	69.23	100.00
Total	195	100.00	

6. How would you rate the contribution of the following categories of non-teaching staff to students' discipline in a rank of 5 where 1 is weak and 5 is the strongest

Lab tech on student discipline	Freq.	Percent	Cum.
Strong	84	43.08	43.08
Strongest	111	56.92	100.00
Total	195	100.00	

7. How would you rate the contribution of the following categories of non-teaching staff to students' discipline in a rank of 5 where 1 is weak and 5 is the strongest

Security officers on student discipline	Freq.	Percent	Cum.
Weak	18	9.23	9.23
Strong	60	30.77	40.00
Strongest	117	60.00	100.00
Total	195	100.00	

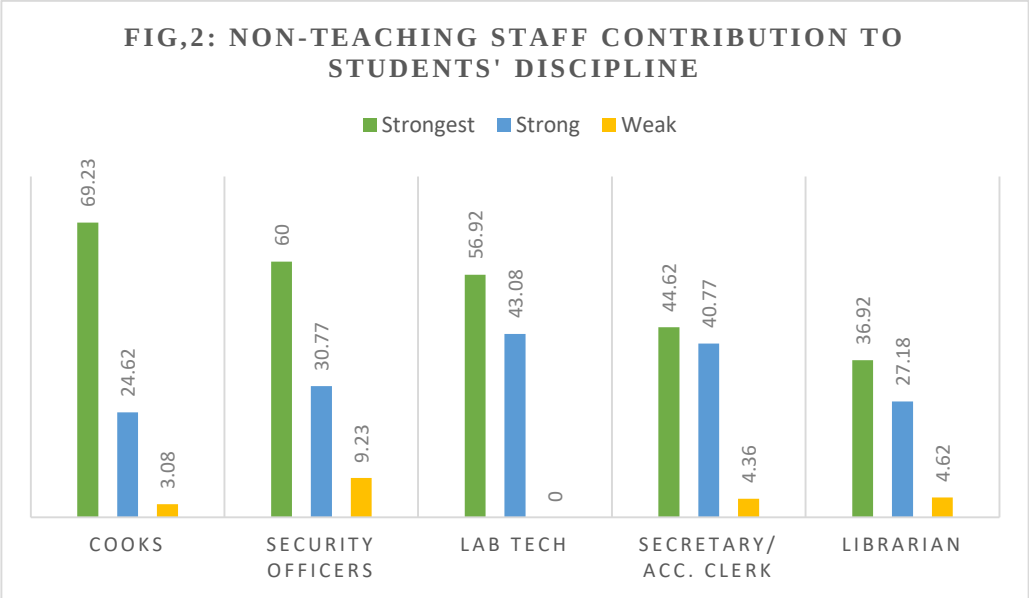
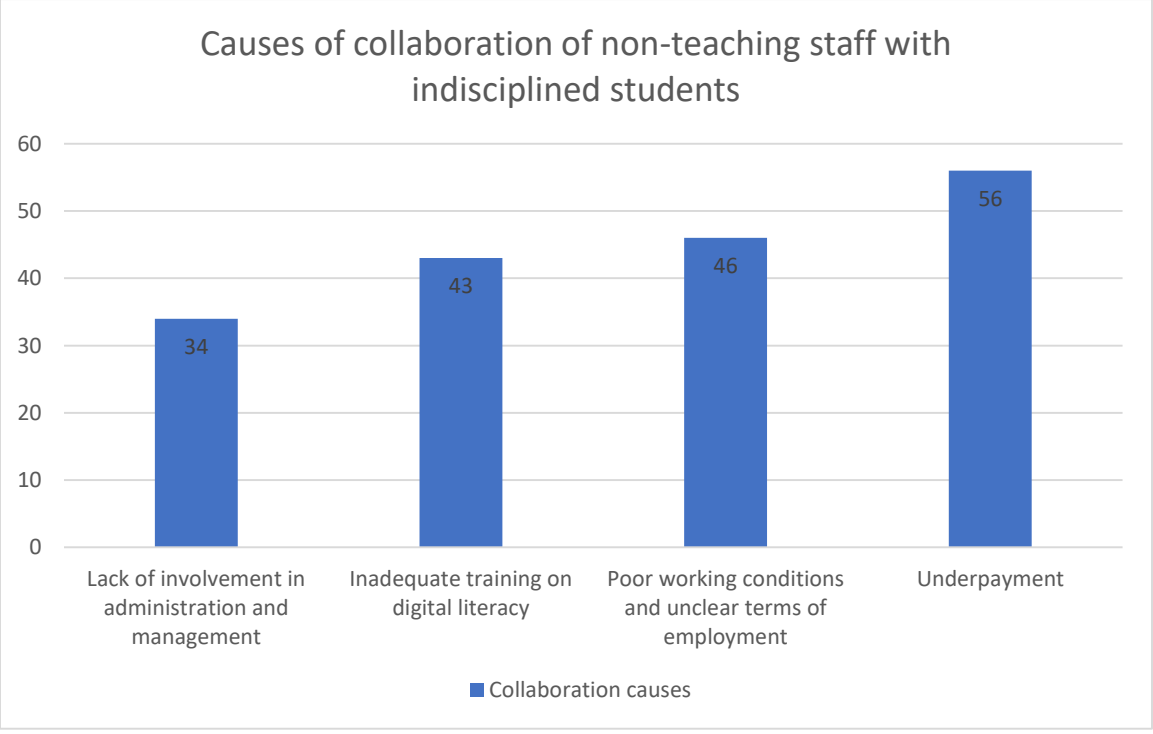


Figure 2 in reference to the foregoing frequency analysis reveals that the cooks with 69.23%, have the greatest influence followed by security officers, and laboratory technicians respectively. The secretary, accounts clerk and the librarian also influence students' behaviour at different levels. This scenario could be due to the fact that every school has cooks, be it national category or a day school he cooks interact often with the students and majority are drawn from the school surrounding locality. In most cases, cooks are least paid and therefore they could be trying to solicit for extra income and favours from the students. Security personnel are in charge of searching and keeping guard, they can therefore choose to reveal or hide the culprits, the laboratory technicians, with 56.92% contribution of students' discipline, can perpetuate the vices as they are the least suspected by the school management. They can hide drugs and mobile phones in the laboratories. Some laboratory technicians teach practical subjects hence they interact frequently with the students. The secretaries, in some schools, double as accounts clerks and are people who facilitate the illegal transactions in the schools. The librarians facilitate use of mobile phones and mobile communications as well as educating on use of internet and other digital media platforms to the students for harmful uses.

Non-Teaching Staff Response

Causes of collaboration of non-teaching staff with indisciplined students

Collaboration causes of non-teaching staff with indisciplined students	Freq.	Percent	Cum.
Lack of involvement in administration and management	34	19.00	19.00
Inadequate training on digital literacy	43	24.02	43.02
Poor working conditions and unclear terms of service	46	25.70	68.72
Underpayment	56	31.28	100.00
Total	179	100.00	



The above graph shows various causes of indulgence in indiscipline activities with the students. Non-teaching staff being the least paid cadre in public secondary schools with 31.28% followed by poor working conditions (25.7%), digital illiteracy (24.02%) and lack of involvement in school discipline management (19%) respectively, some result to illegal sources for extra income.

DISCUSSION

Common criminal activities that involve the students and non-teaching staff include; the use of mobile phones, sneaking in and use of drugs and substance, stealing and selling of stolen items from learners such as dictionaries, calculators and shoes, sexual immorality and sneaking in and out of school compound. Indiscipline in public secondary schools are not only perpetuated by the cooks and the security personnel as posed to be but also the laboratory technicians and librarians who are the least suspected. This corroborates with Anietie et al (2020), who argues that the non-teaching cadre can deviate from their expected duty performance to collaborating with learners to conduct immoral activities in schools such as smuggling of drugs. Unguided use of digital media and internet, coupled with the long period of interaction between support staff and students in school, has led to increase in cases of sexual immorality in secondary schools especially in boarding institutions. This includes emergence of immoral activities christened Truth-or-Dare (ToD) games which are played to promote irresponsible confidence by daring each other to engage in unhealthy activities for instance daring one to offer sexual favours to the other, promoting Lesbianism, Gayism, Bisexual, Trans-sexual, Quay behaviours (LGTBQ+) which is adversely affecting learners and academic performance as well as their behaviour morally, socially and emotionally. Other grounds for collaboration of non-teaching staff with indisciplined students cited were that this cadre is underpaid yet overworked. There are no clear terms of service and poor working conditions hence lack motivation and hence fall prey to students' enticements in collaboration to break the school rules. They lack adequate training on use of internet and social media platforms and hence do not understand when they are aiding these students in the vice. They are not directly involved in administration and management of learners' discipline issues and hence it is not their main concern.

CONCLUSION

From the findings it is evident that there is a lot of interaction between the members of the non-teaching staff and students. Non-teaching staff can prevent unrest in schools, if actively involved in the administration of the school.
Non-teaching staff can influence the discipline of the learner negatively if they are not motivated, recognized and appreciated by the employer, for instant if they are not well remunerated and trained in digital platforms.

RECOMMENDATIONS

The school board of management, county governments and ministry for education should review policies on terms and conditions of employment of non-teaching staff in order to recognize and appreciate their roles. The non- teaching staff should be trained on how to handle digital media in order to address digital emerging issues. The administration should identify areas where non-teaching staff can best be involved in discipline management and be held accountable. Moral education bodies should reinforce their efforts to ensure acceptable moral training is imparted to learners. Further studies should be carried out in relation to roles of non-teaching staff in schools

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CITIZENS' SATISFACTION WITH POLICE RECRUITMENT EXERCISE: A CASE STUDY OF BOMET COUNTY, KENYA

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ABSTRACT
Previous studies have examined citizens' perceptions of the police. However, studies on the citizens' perception of police recruitment are scarce. Thus, this study aimed at evaluating citizens' attitudes toward the recruitment of new police officers into the national police service. The study's objective was to determine citizens' satisfaction with the way police recruitment exercise is carried out in Bomet County, Kenya. The target population for the study was 875,689 citizens. This study used a descriptive research design. The simple random sampling method was used to pick three Sub-Counties in Bomet County and the respondents for the study from those selected sub-counties. A questionnaire with a series of statements on the Likert Scale was used to collect data. Analysis of the data was done through frequencies, percentages, and Chi-Square. The results were presented through frequency distribution tables. The study found that the respondents were not satisfied with the way police recruitment is done. The police recruitment exercise is still affected by police illegitimacy and other various vices such as bribery, nepotism, favoritism, and discrimination. The conclusion was that police the recruitment process is still below the recommended fairness, accountability, and transparency standards. These low standards during recruitment make citizens feel dissatisfied with police recruitment exercises.
Keywords: Citizens' satisfaction, police recruitment exercise

INTRODUCTION

Internationally, various studies are conducted on public attitudes toward the police (Gaarder, Rodriquez & Zarts, 2004; He, Ren, Zhao & Bills, 2017; Rosenbaum et al., 2005). The United States police departments have continuously used public surveys as an appropriate way to measure public perceptions toward the agents of law enforcement (Brown & Benedict, 2002). Several studies carried out in the United States (U.S), Europe, and Australia show that the public holds favorable attitudes toward the police (Benedict, Brown & Bower, 2000; Cao, Frank & Cullen, 1996; Reisig & Giacomazzi, 1998). However, it is becoming more apparent that the number of those with less favorable attitudes toward law enforcement is increasing (Yuksel & Tepe, 2013). This argument is corroborated by the GALL UP poll (2021) findings that, following public protest after the killing of George Floyd at his time of arrest in Minneapolis in late May 2020, citizens' confidence in the police reduced significantly in the U.S.

A large body of literature on how people feel about police officers and police satisfaction has reported findings on socio-demographic characteristics, safety, and police contact (Yuksel & Tepe, 2013). Other research has identified two aspects of police behavior that influence citizens' evaluations and opinions: acts about the process and actions about the result (Tyler, 2006). The degree to which police treat civilians in a procedurally just manner, regardless of whether the officers' acts are lawful or not, is one of the process-based elements that might influence citizens' satisfaction with police (Tankebe, 2009). The way police actions and their outcomes are viewed during police recruitment determines whether citizens will be satisfied or not. According to most studies, positive interaction with the police increases perceptions of the police, but harmful contact has the reverse impact (Worral, 1999; Tyler & Huo, 2002; Mbuba, 2010). The National Police Service (NPS) recruitment process involves actions and outcomes that determine citizens' evaluation of the police.

Each year, the National Police Service Commission (NPSC) in Kenya recruit new officers to increase their number in the National Police Service (NPS). This is done to both increase the number of officers, improve the police-citizen ratio, and replace those who have exited the service for various reasons (Mbuba, 2017). This shows that recruitment is critical in police organizations.

Some of the recruitment drives' challenges include corruption, patronage, nepotism, and favoritism (Gommans & Musumbu, 2014). Nevertheless, the NPS recruitment is portrayed as free, fair, transparent, and accountable. However, it has been reported that Kenyan police service has misplaced its glory in terms of performance through the years. The loss of glory is because their recruitment exercises are riddled with unethical practices, including bribery, nepotism, favoritism, and tribalism (Gommans & Musumbu, 2014). This finding is further corroborated by Githinji (2017), who

argued that the recruitment process, training, vetting, and promoting of law enforcement officials throughout the country of Kenya has continually been characterized by corruption amongst senior law enforcement officials. Tankebe (2009) opines that police misconduct is vital to comprehending satisfaction with the police because procedural injustice frequently witnessed in police service has the propensity to scale down citizens' ethical identification with the police.

No substantive studies focus on citizens' satisfaction with police recruitment in Kenya based on the available literature. The few studies available on NPS typically investigate other aspects of policing and their work (Hope 2018; Githinji, 2017; KNHCR, 2016). These studies leave a gap in attitudes toward recruiting new police officers into the police service. It is against this context that the study seeks to assess citizens' attitudes toward recruitment into the police service.

LITERATURE REVIEW

Sir Robert Peel in England championed the establishment of the first highly reorganized police department in 1829 (Balko, 2013). Balko (2013) reported that Peel changed the law enforcement organization by introducing uniforms and badges, stricter recruitment standards, a national headquarter, and a semi-militarized structure. Since that remarkable transformation in police departments, there has been much concern on how the police and public relate (Frank, Smith & Novak, 2005). Walker and Katz (2012) opined that police mostly interact with the public to execute their constitutional mandate. Their mandate mainly revolves around crime prevention, investigation, and preservation of public order in various communities inhabited by people who are targeted by those crime prevention measures.

There is a need to evaluate police services to determine how citizens rate them. This evaluation was coined by Bellman's (1935) "Police service rating scale." It was improved later by developing a survey instrument to gauge how citizens perceived the police (Parrat, 1938). Research on public perception has gained considerable attention (Brown & Benedict, 2002). Public opinions surveys are vital means to measure how the public feels about the police and have been used in the U.S. police department since the 1960s (Brown & Benedict, 2002). Public opinions are vital in enlightening the government on policy formulation and keeping government officials under control (He et al., 2017).

Recently, public opinions based on community policing have been sought regarding understanding public attitudes toward the police. Among the elemental constituents of community policing, the viewpoint is to extend the number and value of police-citizen interactions (Sherman, 1997). Community policing depends significantly on citizen participation to recognize and resolve the community's problems (Tebe & Yuksel, 2013). Therefore, it is imperative to establish and appreciate the public view of the police to create a mutually working relationship between the police and the community (Mbuba, 2010). Different aspects such as police officers' jobs, fear of crime, the effect of community policing on crime, and citizens' satisfaction, among others, have been put into consideration in understanding public perception (Yuksel & Tepe, 2013). There is a need to refocus the understanding of public perception on recruiting new police officers to the police service. It is hard to convince the public to trust the police if they have no trust in the police recruitment exercise. Citizens usually contact the police during the recruitment of new police officers, just as they do in community policing.

According to Rosenbaum, Schuck, Costello, Hawkins, and Ring (2005), interactions between members of the public and law enforcement officers usually lead to the formation of public attitudes. These interactions are evident by several pieces of literature which show that both direct and indirect negative police interactions lead to negative feelings and beliefs about the police (Charney & Robertson, 2013; Hinds, 2009; Longan, Greenfeld, Durose & Levin, 2001; Mazerolle et al., 2013; Miller & Davis, 2008; Rosenbaum et al., 2005). On the other hand, studies on community policing show that citizens' positive interactions with the police authorities will nurture positive public opinions toward the police (Gaarder, Rodriquez & Zarts, 2004). It is not only during community policing where citizens come in contact with police authorities but also during police recruitment exercise. Thus, fairness and accountability must be embraced by police bosses and their juniors to manage public perception of the exercise and to preserve positive sentiments about the police.

The way police officers come in contact with the citizens during recruitment determines how citizens will evaluate them. Law enforcement has to exercise fairness and favorable treatment when interacting with the public to be perceived as a legitimate force (Correia, Reisig & Lovrich, 1996). Legitimacy during police-citizen interactions is likely to determine citizens' decision on whether to welcome the police or not. The public encounter with the police determines whether policing is embraced or resisted by the community that the police serve (Mazerolle et al., 2013;

Mbuba, 2010; Webb & Marshal, 1995). Brown & Benedict (2002) opined that law enforcement officers' evaluations must be scrutinized on issues linked to the damaging evaluation of the law enforcement officers.

Job seekers are more inclined to be satisfied when treated professionally and positively, thus leaving them with a positive evaluation of the organization (National University of Ireland, 2006). Generally, according to Baumeister, Bratslavsky, Finkenauer and De Vohs (2001), they propose and substantiate that undesirable actions have more significant impacts on attitudes than desirable actions. These actions include those engaged in by police during the recruitment process. At best, the current police recruitment in the U.S. faces a lack of consistency, slight use of investigation to direct employment efforts, and fragmented approach to appreciating the crisis and planning a reaction to it (Orric, 2008; White & Ecobar, 2008).

The Commission on Accreditation for Law Enforcement Agencies (CALEA) in the U.S. recommended different ways for diversifying police personnel recruited to reflect the community (White & Escobar, 2008). Any police recruitment that gives equal chances to different ethnic groups of the community may satisfy citizens as it reflects the true representation of people. Thus, it is essential for police departments to have recruitment goals that reflect ethnic diversity (Mckay & Avery, 2005; Orick, 2008). Experience similarly reveals that a good employment practice can positively influence many other elements of an organization's functioning. In contrast, a wrong appointment can have damaging impacts far away from the organization in which it originated (Ekwoaba, Ikeife & Ufoma, 2015). In light of this, the mode of police recruitment is crucial in determining citizens' satisfaction. Nevertheless, there is scanty information concerning citizens' satisfaction with the police recruitment process. This study thus seeks to find more information as to whether citizens are satisfied with the mode of police recruitment.

Successful recruitment grounded on the set standards, the rule of law, reverence for human rights, and fairness may result in citizens' satisfaction. Conversely, whether real or perceived, unfairness may result in citizens' dissatisfaction with the mode of recruitment and the police service in general. Policymakers are more concerned with comprehending the determining factors of contentment with police to develop practical approaches to advance police-citizen relations (Nivette & Akoensi, 2017). Recruitment for diversity in a police organization that does not reflect authentic and credible organizational ideas might be perceived as dishonest and increase turnover (Mckay & Avery, 2005).

Due to rapid changes in community needs and demographics, it is not well known the kind of abilities departments should consider for choosing the candidates to be hired (Canadian Association of Chiefs of Police at al., 2000; Woksa, 2006). Organizations should comprehend the role of research and data gathering in the process of choosing personnel (Canadian Association of Chiefs of Police et al., 2000). Based on such research, recruitment and choosing of workers similarly offer a chance for the organization to show itself positively (National University of Ireland, 2006). If the organization fails to achieve that, the citizens will likely perceive them negatively and generally become dissatisfied with the way recruitment is done. Any form of unfairness, misconduct, or mistreatment during recruitment makes citizens feel dissatisfied.

Previous studies on citizens' satisfaction found that interpersonal treatment received when citizens encounter police determine citizens' contentment with the police and their lawfulness in a range of contexts (Tyler & Huo 2002, Sunshine & Tyler 2003; Hinds & Murphy 2007 & Reisig, Bratton & Gertz, 2007). Arguably, the recruitment of new officers into the police service provides grounds for interpersonal treatment.

To facilitate good human interaction between police and the public, policing requires a broad range of skills and attributes, rather than physical skills and performance (Miller, 2012). The police recruitment and selection process should consider soft skills and attributes such as people skills, computer skills, and problem-solving skills to improve police service. That kind of experience is likely to determine citizens' satisfaction with the mode of police recruitment. However, the issues and tendencies grounded in qualifications, generational preferences, and attrition affect police recruitment and transcend economic conditions (Wilson, 2014 p. 1).

Based on the literature reviewed so far, a lot of research has been done on how people selection and recruitment of police is done. There is scanty literature on citizens' attitudes toward police recruitment. These studies, therefore, leave a gap in attitudes toward the recruitment of new officers into the police service. This research aims to bridge that gap.

METHODOLOGY

This study employed a descriptive survey design. This design focuses on the description, collection, examination, and presentation of the circumstances of the study subjects. The sample size for this study was determined from the target population using Slovin's Formulae (2002),

$$n = \frac{N}{(1 + Ne^2)}$$

at a confidence level of 95% and a margin error of 0.05.

Where, n – Sample size

N – Target population

e – Margin error

$$n = \frac{875{,}689}{(1 + 875{,}689 \times 0.05^2)}$$

n = 400

Therefore, a sample size of 400 was obtained from the population target of 875, 689.

A stratified sampling method was used to group the population into five different strata based on geographical locations. These strata include Chabalungu, Sotik Bomet Central, Bomet East, and Konoin. Simple random sampling was used to pick three sub-counties including Bomet East with a population of 144, 275, Bomet Central with 175, 215, and Konoin with 163, 507 residents respectively. Therefore, to get respective sample sizes for the various selected sub-counties, Kothari's formula (2004) proportional allocation method was used

$$n1 = \frac{n1 * P}{N}$$

Where, n1 – Sample size of Bomet East

n – Sample size of the target population

N – Total population of the three sub-counties

P - Population of sub-county

Table 1: Sample Size

Location	Kothari's Formula	Sample size
Bomet east	$n1 = \frac{n1 * P}{N}$	120
Konoin	$n1 = \frac{n1 * P}{N}$	145
Bomet Central	$n1 = \frac{n1 * P}{N}$	135

The objective was to determine citizens' satisfaction with the way police recruitment is carried out. This objective was tested by administering 11 statements where respondents were asked on a five-point Likert Scale to rate the extent to which they agree or disagree with each statement. The data collected were analyzed and presented in Table 3 regarding frequencies and percentages and in Table 4 in Pearson's Chi-Square. Discussion of the results obtained was also done for every statement.

Table 3: Percentages and Frequencies of Citizens' Satisfaction with the Police Recruitment Exercise

Statement /Rating	**SA**		**A**		**U**		**D**		**SD**		**Total %**
	F	**%**	**F**	**%**	**F**	**%**	**F**	**%**	**F**	**%**	
Police are generally unfair in their recruitment exercise.	140	39.9	107	30.5	29	8.3	31	8.8	44	12.5	351 100
Police usually break the law during police recruitment exercises.	92	26.2	113	32.2	34	9.7	54	15.4	58	16.5	351 100
Police respect human rights during their recruitment exercise.	106	30.2	119	33.9	39	11.1	38	10.8	49	14.0	351 100
Police ask for bribes during police recruitment.	148	42.2	107	30.5	24	6.8	31	8.8	41	11.7	351 100

One must know someone in higher police rank to be recruited into national police service.	162 46.2	85 24.2	23 6.6	40 11.4	41 11.7	351 100
There is discrimination of people during police recruitment.	87 24.8	122 34.8	34 9.7	47 13.4	61 17.4	351 100
The manner in which police recruitment is done may be blamed for rising insecurity in the country.	89 25.4	94 26.8	53 15.1	57 16.2	58 16.5	351 100
Police recruitment exercise is stressful.	108 30.8	114 32.5	41 11.7	38 10.8	50 14.2	351 100
I would recommend someone to join the national police service.	102 29.1	112 31.9	37 10.5	42 12.0	58 16.5	351 100
Recruitment practices may be blamed for vices in NPS	92 26.2	106 30.2	48 13.7	39 11.1	66 18.8	351 100
I am satisfied with mode of police recruitment	131 13.1	103 12.8	26 7.4	45 29.3	46 37.3	351 100

KEY: SA – Strongly Agree, A – Agreed, U – Undecided, D – Disagree, SD – Strongly Disagree

Table 3: Pearson's Chi-Square Analysis of Citizens' Satisfaction with the Police Recruitment Exercise

Statement /Rating	***df***	**Pearson's Chi-Square Value**	**P – Value**
Police are generally unfair in their recruitment exercise.	16	195.08	0.00 0.00
Police usually break the law during police recruitment exercise.	16	113.682	0.00
Police respect human rights during their recruitment exercise.	16	139.207	0.00
Police ask for bribes during police recruitment.	16	196.856	0.00
One must know someone in higher police rank to be recruited into national police service.	16	1128.648	0.00
There is discrimination of people during police recruitment.	16	83.348	0.00
The manner in which police recruitment is done may be blamed for rising insecurity in the country.	16	119.530	0.00
Police recruitment exercise is stressful.	16	142.962	0.00
I would recommend someone to join the national police service.	16	52..541	0.00
Recruitment practices may be blamed for vices in NPS	16	146.014	0.00

The result in Table 3 show that respondents were generally dissatisfied with the mode of police recruitment, with an average of 37.3% of respondents strongly agreeing. That outcome resulted from irregularities, illegal activities, and other issues surrounding police recruitment. This is consistent with the findings of Tankebe (2009) that the form of misconduct among the police reduces the moral identification of citizens with law enforcement and is essential in comprehending contentment with the police. On the other hand, Chaney & Robert, (2013) & Mazerrole et al., (2013) negative police encounter usually leads to negative feelings about the law enforcement agency.

Among those determined to contribute to dissatisfaction with the recruitment exercise, where the police were unfair, 39.9% of respondents agreed, law-breaking with 32.2% agreeing, bribery with 42.2% strongly agreeing, nepotism during the police recruitment exercise with 46.2% strongly agreeing and discrimination with 34.8% agreeing. The results also showed that the mode of police recruitment is a stressful exercise and could be blamed for vices observed in NPS and for rising insecurity in the country, with 32.5% of respondents agreeing, 30.2% strongly agreeing, and 26.6% agreeing, respectively. In addition, Table 3 results show that there was a strong association for all other statements except two of them when Pearson's Chi-Square was used to determine the association between the statement, 'I am satisfied with the mode of police recruitment,' and the other 10 statements. The two statements that

seemed to show that the respondents were likely to be satisfied were 'police respect human rights,' and 'I would recommend someone join NPS.'

SUMMARY AND CONCLUSION

Inadequacy in police recruitment leads to other problems in policing as incompetent and non-committed officers may be recruited into NPS. The police recruitment process is still below the recommended fairness, accountability, and transparency standards. It is affected by police illegitimacy and various vices such as bribery, nepotism, favoritism, and discrimination. The respondents so far were not satisfied with the way police recruitment is done. This dissatisfaction is generally an indication of negative evaluation of the police recruitment process by the respondents, which translates to having negative attitudes toward the police recruitment exercises. It is, therefore, essential for the government and other stakeholders to reconsider how to eliminate such manifest vices and improve recruitment standards in all dimensions.

RECOMMENDATIONS

i. During the police recruitment process, the government of Kenya should deploy enough trustworthy IPOA officials and enlist support from non-governmental agencies to aid in monitoring police recruitment in all centers across the country.

ii. The government of Kenya needs to learn from and adopt recruitment standards from developed countries like the U.S and incorporate the same in police recruitment reforms. It will help the government to have a well-structured, systematic, and organized way of recruiting qualified and competent individuals to the NPS.

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WORLDVIEW CLASH: IMPACT OF PERSISTENCE OF THARAKA TRADITIONAL WORLDVIEW ON CHRISTIAN DISCIPLESHIP AMONG EVANGELICALS IN THARAKA

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ABSTRACT
Christian discipleship is recognized by evangelicals as playing a pivotal role in the life of an individual Christian as well as the congregation at large. This is because it promotes character transformation which in turn makes one handle life diverse challenges including economic spiritual and social challenges experienced in our day. Although this is so, this emphasis is actually not done in many congregations in Tharaka as evangelicals see recommended in the Bible. One thing that hampers Christian discipleship in Tharaka is that many evangelicals still revert to African traditional worldview in the times of crisis. This is despite the fact that at many points, there is a worldview clash between evangelical faith and Tharaka traditional worldview. This consequently impends Christian discipleship. The research design used in this study was descriptive survey, stratified random sampling was used to obtain a representative sample. Using face to face interviews, focus group discussions and interviews, the study revealed that persistent of Tharaka traditional worldview among evangelicals promotes nominal Christianity, produces inconsistent Christians, promotes syncretism, demeans the means of grace, leads to poor evangelism, undermines the role of Jesus Christ in redemption and produces imbalanced theology. Informed by the theory of the Flaw of the Excluded Middle, the paper argues that evangelicals need to take note of the fact that the persistence of Tharaka traditional worldview aspects condemned by evangelicals among them would imply that these evangelicals are finding relevance in these worldview aspects. Evangelicals hence need to present the gospel at worldview level to allow the gospel to speak to the African reality. Thus African church will yield its spiritual influence in world Christianity as was the case in the period of the early church fathers.
Keywords: Worldview, Persistence, Discipleship, Evangelicals, Tharaka, Christianity

INTRODUCTION
Christianity in Tharaka and indeed in Africa, as we know it today, was not introduced in a vacuum. Already, the Tharaka had their own religion that formed the basis of their worldview (Ndunjo, 2018, Gitonga,2008). The Western missionaries, who introduced this Christianity, demanded that any African who converted to this faith should totally abandon his or her beliefs and practices as a mark of genuine conversion (Mugambi, 1989)? This contrasted with the approach adopted Jesus since they did not demand wholesale was contrary to the proclamation of the apostles who did not demand wholesale abandonment of a convert's former culture but only aspects of the former culture which were the antithesis of the Christian faith. Accordingly, many continued to hold onto the Christian faith while secretly practicing their traditional faith. Some thus continued to keep protective medicine such as charms or have some incisions made on their body to safeguard themselves from malicious people such as witches and wizards. Others visit religious specialists such as diviners and medicine men especially during crisis in a bid to understand the source of their problem believed either to be caused by a human or divine agent. (Ndunjo 2018, Gitonga 2008).

The above situation prevails despite the fact that evangelicals in Tharaka oppose it? Informed by the Holy Scriptures, which evangelicals consider the infallible guide on matters of faith and conduct, evangelicals urge their members to reject any traditional worldview aspect that is out of sync with evangelical faith (Kirimi 2018). The supremacy of the Scripture comes in because for the evangelicals, "the Bible has stood the test of authoritativeness, reliability, inerrancy, non-contradiction and is universal" (Kigame, 2018). It can therefore speak to all cultures with authority.

The persistence of traditional worldview among evangelicals is well illustrated by evangelicals in Tharaka, Kenya. Many of them still hold on to the anthropocentric worldview as opposed to theocentric worldview (Ndunjo 2018). Similarly, they have a distinctive approach to suffering believing that suffering is always caused by a human agent such as a witch or a spirit agent such as an ancestor (Ndunjo 2018). Consequently, many visit divines and medicine men to find out the source of their problem and seek solutions (Ndunjo 2018). The fear of spirit beings, witches and sorcerers makes some evangelicals to look for protection in charms and other protective medicine. The fact that evangelicals in Tharaka and indeed in Africa hold on to these worldview aspects condemned by evangelicals impacts Christian discipleship. This study therefore sets out to discuss this impact.

Impact of Persistence of African Traditional Worldview on Christian Discipleship

From the aforementioned, we have noted that evangelicals in Tharaka, and by extension in Africa, continue to hold on to African traditional worldview considered incompatible with the biblical faith. This is in spite of evangelicals persistently condemning these practices. Below is a presentation of effects of holding on to some aspects of African traditional worldview considered unbiblical by evangelicals in so far as Christian discipleship is concerned.

Promotion of Nominal Christianity

When professing Christians continue holding on to aspects in the African traditional worldview considered unbiblical by evangelicals, nominal Christianity increases. The data from the questionnaires revealed that out of 321 respondents, 180 (56%) said that when professing Christians turn to diviners and medicine men for help, they with time no longer become serious in following Jesus. Similarly, 135 (42%) stated that the believers who turn to these religious specialists may eventually end up just becoming church goers without active involvement. Other respondents, 67 (21%), observed that those who turn to diviners and medicine men for help begin living their lives as they want. Also, 83 (26%) stated that such professing believers go to a Sunday service, listen to the pastor or the one sharing the gospel yet do not practice what they hear. Further, 116 (36%) stated that some walk in open rebellion while still professing to be Christians. In short, professing believers who continue visiting diviners and medicine men for help become a weak 'Christian' who can be described as a normal Christian. These is no visible distinction with unbeliever, his or her worldview is unchanged out unconverted.

Similar views were expressed in the focus group discussions and face-to-face interviews. Muthee (01:20:10:2017) reported that when believers reverted to seeking help from diviners and medicine men because of their view of causation, they displayed several characteristics: lose their sense of commitment to the things of God as they no longer get involved in the service of God; may come late for service or may not come at all; remain alone and take the back seat while in the service; become disinterested in the work of God; no longer interested in prayer; display lack of trust in God and become uncomfortable when in the company of believers. If the sin is not confessed, one loses relationship with Jesus Christ and merely becomes a Christian by name (Muthee 10:20:10:2017). Nominal Christians do not demonstrate that Christ is Lord or master of their live as they do not submit to his authority (Muthengi FGD: 20:08:2017).

As regards nominal Christianity (O'Donovan, 2000) notes that there are very many nominal Christians in the church of Africa today: these display an external change such as going for service on Sunday or having a Christian name but have no evidence of an internal transformation that affect their whole being (Kunhiyop, 2008). As a result, they resolutely hold on to deep-seated traditional beliefs and practices as their hearts are unconverted (Kunhiyop, 2008). Kunhiyop thus agrees with the respondents that when professing Christians continue sticking to worldview aspects which conflict with biblical Christianity, they demonstrate that they are nominal Christians.

Holding on to aspects of African traditional worldview which conflict with the Christian faith promotes nominal Christianity. Such individuals continue to profess to be Christians yet do not leave according to the Christian ideals required of a disciple of Jesus. Acts 19:19 indicates that at Ephesus, many who were involved in magic brought the things of their art to be burnt as a clear indication that they had repented and were willing to follow Jesus. Nominal Christians however have no evidence of repentance. The prevalence of nominal Christianity means that the quality of Christianity is weak, poor and below the standard brought out in the New Testament. It also means that this is the quality of Christianity that will be passed on to the subsequent generations (Ndunjo 2018). The church will continue expanding numerically but spiritually, it will be weak. There is need to arrest this situation. The way out is for all evangelical denominations in Africa to frequently preach and teach on how one becomes a disciple of Jesus Christ and what this means. This will mean that the place of repentance in personal conversation needs to be emphasized so that the people clearly understand who a disciple of Jesus Christ is and the marks of this disciple.

Normal Christianity has also implication for ministry. Christians are called to be the light and salt of the world (Matthew 5:13-16) this means they ought to have a positive impact wherever they are. This is possible if their worldview has been changed to re reflect the biblical view of reality. Normal Christians lacks this hence they cannot impact this space they are in with the gospel of Christ hence bring an impact. For institutions such as political, business, marriage. media and entertainment as well as education to continue flourishing the impact of gospel needs to be felt through Christians. One mark of Christian discipleship is abiding in Jesus Christ that is, maintaining a growing relationship with Jesus Christ as the true vine (John 15). This is a consistent relationship with Jesus Christ. Retreating to aspects of African traditional cosmology undermined by evangelicals does not produce such a relationship. On the

contrary, the life of that believer is characterized by an inconsistent walk with God. For example, when believers who still hold on to African view of causation go through periods of suffering, they may give up their faith in God especially when they pray to God and God does not respond; so they choose to visit a diviner who has a quick fix to their predicament. They may only come back to Jesus Christ when the dark cloud clears.

Mwangangi (FGD: 27:08:2017) stated that some believers who still hold that the ultimate cause of suffering is a spirit agent such as an ancestor or human agent such as a witch, many a times become inconsistent in following Jesus Christ. They follow Jesus when it is convenient. When all is well, they feel God is on their side and that they are loved by him. On account of this, they joyfully love and follow God. However, when the road becomes rough and challenges present themselves, they are not willing to hold on to the Christian faith. Some leave the faith and seek help elsewhere, for example, in diviners. Some evangelicals too turn to God when they are in need and when they get what they want, they cease seeking Him. They never long for an abiding relationship with God or daily pursuit of God in all seasons of their life (Ndunjo, 2018).

While it may be true that some professing Christians may fall away from the faith during times of suffering as a result of thinking God is not concerned, this is not necessarily the case. Sometimes, difficulties may cause people to seek God the more. Also, some people may follow God the more when they see Him responding to their needs. What stands out however is the fact that it is possible for those who maintain the African view of causation and the anthropocentric worldview to seek help from African religious specialist rather than wait for God. When they do that, they do not display a supreme love for Jesus Christ, demonstrate their unwillingness to carry the cross and fail to continue abiding in the Lord Jesus Christ: all requirements of Christian discipleship (Ndunjo, 2018).

The situation among some evangelicals in Africa may indicate a failure of the evangelicals to help believers firstly, embrace the biblical theodicy that recognizes that God, who is sovereign is with Christians even in suffering. Secondly, evangelicals seemingly have failed to help believers embrace a theocentric approach to God. The view of causation addresses itself to the present crisis of this life and when evangelicals in Africa at most do not give an answer to the cause of the present crisis, believers will thus continue reverting to aspects of African traditional worldview considered unbiblical from the perspective of evangelicals. This is in accordance with the theory of the flaw of the excluded middle which maintains that western missionaries tended to ignore the middle zone which comprises of sprit, demons and powers when preaching the gospel to cultures that turned to have an emphasis on these zones (Anyanwe, 2004, Hiebert, 1982). Biblical perspective on these issues needs to systematically be presented to bring renewal of the mind in the lives of people. This way, many will cease follow Christ only when it is convenient.

Syncretism

The persistence of African traditional worldview gives opportunity for syncretism to manifest. In syncretism, believers practice dual allegiance: practising the Christian faith alongside traditional African religion. The results from the questionnaires revealed that 241 (75.2%) of the participants for instance affirmed that the persistence of Tharaka traditional worldview promoted syncretism.

In syncretism, the practitioner seeks Jesus's help while at the same time, visits diviners or medicine men to try out which side yields results. This was the case with the children of Israel in 1 Kings 18 when Elijah challenged them to choose whom to worship – God or Baal – instead of practising double allegiance Mwenda (01:13:11:2017) remarked that some professing believers visit diviners and medicine men when they are sick and at the same time, come to their pastor for prayer. They try both ways so that whatever works, they will be okay. He added that when this divided attention is tolerated, there is no seriousness in the things of God. The same individuals keep charms to protect themselves from witches while at the same time pray to God for protection (Mwenda 10:13:11:2017).

Syncretism is not only found among the congregants but also the church leaders. Mutembei (FGD: 20:08:2018) commented that some ministers of the gospel such as pastors also visited religious specialists to seek power to draw crowds while at the same time call on the name of Jesus Christ. This power may enable these ministers to tell people what they are going through or even help them perform miracles (Mutembei: FGD:20:08: 2017). This way then, they become popular. Kiremu (2009) makes a similar observation when he notes that magical powers are used by some Christians in the healing ministry: these ministers do it by chanting magical powers through the help of the magicians. It is indisputable that some ministers can with the help of magical powers perform miracles. These incidents are recorded in the Bible, for example, Exodus 7:11-12, 22:8:7. Jesus likewise said that not all those who preach in his name and perform miracles are necessarily his disciples (Matthew 7:21-23). Evangelicals consequently do not support

use of magic as a way of accessing power. The Holy Spirit is legitimately the source of a minister's power: He enables the gospel to be preached with conviction and power (Acts 1:8). Depending on God while at the same time looking for help from magic is in itself an evidence of syncretism.

There is danger in syncretism. Gitonga (FGD: 27:08:2017) argued that disciples of Jesus Christ who for example entertain the belief that his or her ancestors can communicate to him or her through say a dream, and thus obliged to obey the message communicated, exposes himself or herself to deception. The reason is that it is impossible for the dead to appear to the living and communicate with them as they are not allowed to.

Commenting on this, O'Donovan (1992) notes that the dead are not free to leave their abode and visit the world of the living: communication between the dead and the living is cut. From the story of the rich man and Lazarus in Luke 16:19-31, it is alleged that verse 24-26 implies that the dead are restricted to the place assigned to them - Abraham tells the rich man that none can cross to where the rich man is and vice-versa even if one wanted (O'Donovan, 1992). Nevertheless, many evangelicals agree that it is only God alone who can permit the dead to leave their abode as it seemed likely with Samuel's appearance to Saul with a message of condemnation as is recorded in 1 Samuel 28:15-19 (Gehman, 1989). Similarly, Moses and Elijah appeared to Jesus and three of his disciples though in this case, Moses and Elijah speak to Jesus only in Matthew 19:1-19 (O'Donovan, 1992). and not to Moses or Elijah.

Evangelicals therefore note that since the devil is called a liar and a father of lies (John 8:44), as well as deceiver (Revelation 12:9), the devil and his agents are able to imitate the dead relatives as they can appear in any form to human beings even as angels of light (2 Corinthians 11:14). As such, one can be deceived easily, thinking that the message is from one's ancestor while actually, it is from the deceiver of brethren, Satan or his agents (Nkansah, 2006).

Syncretism no doubt affects one's relationship with Jesus Christ. Jesus Christ requires his disciples to love him supremely. In other words, there is no any other relationship that should supplant Christ's centrality in the life of believers. Since syncretism produces dual allegiance, this requirement of Christian discipleship lacks when one practices syncretism. Equally true, it is impossible to love God with the whole heart while at the same time, pay allegiance to what he hates, namely turning to diviners and medicine men in this context.

Syncretism too shows lack of trust in God's ability to help an individual which again shows that one is not willing to follow God whenever he leads, as a requirement of Christian discipleship. When divided loyalty exists, one fails to enjoy the fruit of abiding in Jesus Christ, one of which is answered prayer (John 15:16, James 1:5-6). Where syncretism exists, deception is not lacking as the sufficiency of Scriptures as a source of authority in matters of faith and conduct is ignored (2 Timothy 3:16-17). Evangelicals therefore need to help their members to accept the centrality of the Scriptures in guiding them in this pilgrimage and only embrace cultural beliefs and practices that do not contradict Scriptures.

Demeans the Means of Grace

Evangelicals see salvation as a means of grace. (Ephesians 2:5, 8-9). They too emphasize on the need of the believer to grow in the grace of God (2 Timothy 2:1). One way of growing in the grace of God is by utilizing the means of grace provided by God. These include prayer, fasting, reading and applying the word, fellowship and even worship. The responses from the questionnaires revealed that persistence of Tharaka traditional worldview demeans the means of grace provided by God to believers.

When evangelicals continue reverting to traditional religious specialists for help, they do not see the need for prayer as they see people such as diviners and medicine men as able to help them. Such people too tend to avoid fellowship with other believers as they think that believers know what they have done; they may have a sense of guilt which may keep them away (Ndunjo, 2018). In addition, these individuals may not have room for the word of God in their life. They may not depend on it for wise council and guidance as they have other sources of help. Therefore, believers who consult these specialists neglect prayer, Christian fellowship and the word of God, key means of grace for a disciple of Jesus Christ (Ndunjo, 2018).

The means of grace God has provided for believers are a means of deepening of a believer's relationship with Jesus Christ. Grudem (1994) too sees the means of grace provided by God as a way of helping a believer become more like Christ, a way of showing one's dependence on God and a means of allowing the Holy Spirit to take charge of one's life. Observing them then, discipleship is enhanced while neglecting them, discipleship is hindered. Coleman (1993)

too makes a wonderful observation about this subject. He asserts that Jesus Christ helped his disciples learn his way of living with God. This was through his personal prayer life as well as use of Holy Scriptures. His disciples caught up these godly habits and passed them to their converts (Acts 2:42). No wonder they were unwilling to give up the ministry of prayer and the word to serve tables (Acts 6:4): they understood that their power and strength came from God. Simpson and Willard (2005) also state that humanity first fell into sin because of allowing deception to penetrate their mind and hence influence them; the way back is to allow the mind to be renewed through knowing the word of God and obeying it.

Since these means of grace are central in helping a disciple of Jesus follow him and overcome temptation, neglecting them has consequences. When a disciple of Jesus Christ ignores God's guidance through prayer, the word, the community of believers and seeks help from diviners, one denies himself or herself an opportunity to nurture friendship with Jesus Christ, his teacher and guide. One also lacks spiritual strength to overcome temptation hence may not be able to be vibrant in his or her walk with God and influencing others around him or her for Jesus Christ as is expected. There is more need to help believers recognize the benefits of these means of grace which are underrated when professing Christians turn to diviners and medicine men for help.

Moreover, in focus group discussion, Muthuri (FGD: 27:08:2017) reported that, "the current teaching that all believers should prosper and not suffer at all is gaining popularity in Tharaka as it resonates with the tharaka view. Such teachings do not motivate believers to seek God at all times in order to deepen their fellowship with God. In a man-centered approach to God, one turns to God when there is need. One is not thus encouraged to follow Jesus closely when such a worldview persists:"

In order to respond to this assertion, it is good to note that Jesus Christ called his disciples so that he could have a relationship with them and secondly, send them to share the good news with others. (Mark 3:13-14). This underscores the fact that Jesus Christ's desire for his disciples is that he wants to have a personal and growing relationship with them. This should be key to anyone who would want to follow him. Since the underlying motive in a man-centered approach to God, as is the case with Tharaka Traditional Religion preachers in Tharaka, is what God gives not who he is, this relationship is hindered. Deepening one's relationship with Jesus Christ through the different means of grace is hence not pursued. The professing Christian therefore cannot follow Jesus Christ as is expected of a disciple of Jesus Christ for the motivation is not Jesus Christ but his gifts. Evangelicals in Africa hence have a task to present biblical truth to their congregations so that they can know the truth, hold on to it and share the truth with others.

Poor Evangelism

Christians have an obligation to pass on the Christian message to the next generation (2 Timothy 2:2). This implies that Christians as disciples of Jesus Christ should have thoroughly grasped and obeyed God's truth. It is in so doing that they can better prepare themselves to be effective ministers through words and deeds. However, many a time, this is not what happens among many evangelicals in Africa. Many first and second generation Christians are practising dual piety. They display outward religiosity on Sunday but in the rest of the week, they visit diviners, medicine men and even wear charms and other protective medicine – all condemned by evangelicals (Ndunjo, 2018). Young people therefore cannot see the older generation as good Christian models for they cannot see the Christian faith lived at home and in the society. So, the young become confused. Such may reject this poor quality Christianity being passed to them because there is no relationship between what is taught and what is practiced. These children may consequently rebel and indulge in antisocial behavior because of moral confusion. Some may also become agnostic or atheist, both growing worldview trends in Africa.

Secondly, individuals who continually turn to diviners, medicine men and other aspects of African traditional worldview condemned by evangelicals may eventually totally lose interest in their Christian faith and abandon it. This act may not be a good example to unbelievers, especially in circumstances where the person moving out was very influential and people looked to him or her for guidance (Ndunjo, 2018). In this case then, those that he or she was mentoring or those who considered the person a role model may be discouraged. The person who has fallen into this trap becomes a poor Christian witness. Again, believers who turned to medicine men and diviners lost their confidence in sharing the gospel. This may happen if the sin committed was unconfessed and has been known by the public. If the sin however is not confessed before God, one will not shy away from sharing the gospel.

A respondent in the face to face interviews noted,

When believers are not an example in the community they are living in, the proclamation of the gospel is largely affected: unbelievers view those people as practicing hypocrisy for while publicly condemning visiting diviners and medicine men, these people secretly go to these religious specialists they are condemning to solicit help for themselves and their businesses. While these professing believers visit these religious specialists, they may meet those unbelievers who eventually expose their hypocrisy to the public. When such a thing happens, the church's power to witness in the community is hindered (Nyaga: FGD:27:08:2017).

Indeed, the conduct of believers is crucial in so far as lifestyle evangelism is concerned. Matthew 5:13-16 and John 9:5 shows that disciples of Jesus Christ are the salt and the light of the world. They thus have a responsibility to impact the society positively through the way they live their life. Dual allegiance ruins this witness. Titus 2:10 indicates that through their lifestyle, disciples of Jesus Christ should endeavor to make the gospel of Jesus Christ attractive to those who are around them. Coleman (1993) and Olander (2013) agree that lifestyle evangelism is a strong method of evangelism as it involves living the Christian life in a fallen world which is waiting to see such a life lived.

To sum up, we note that the reverting of some evangelicals in Africa to African traditional worldview considered unbiblical by evangelicals implies that something ought to be done. The proclamation of the gospel should be presented with a view to address this challenge; this is by presenting the gospel at the philosophical level. This is by letting the gospel meet the needs that make people turn to medicine men, diviner or even carry charms and amulets. Jesus should be presented as able to meet human fear, uncertainty, anxiety and so on.

Undermines the Role of Jesus Christ in Redemption

Jesus Christ has a special role in redemption: salvation of humanity from sin. During the annunciation of Jesus' birth, an angel of the Lord tells Mary that the child she will bear would be called Jesus because he will save his people from their sin (Matthew 1:21). The message of the gospel therefore should centre around the salvation of humanity from sin. Nevertheless, this is not so in the message propagated by the prosperity gospel proponents.

Regarding this, Nyaga (FGD: 27:08:2017) noted,

Anthropocentric approach to God, common among evangelicals in Tharaka and Africa in general, undermines the place of Jesus Christ's sacrificial death in salvation by emphasizing that people need to come to Christ so that they may receive physicalblessing. Such a gospel has no place for the cross of Jesus and need for personal repentance, both of which are key in so far as following Jesus Christ is concerned.

Similarly, Adeleye (2011) and Musyimi (2016) state that the man-centered approach to God evident in the prosperity gospel misses out on the heart of the gospel: redeeming humanity from their sin. Likewise, this observation finds support from Allred (2003) who notes that Jesus Christ came to save humanity from state of lostness in sin (Matthew 1:21; Luke 19:10). This was accomplished by Christ when he died on the cross and his blood was shed for the redemption of humanity as captured in Mark 10:45, Ephesians 1:7 and 1 Peter 1:18-19 (Allred, 2003).

The anthropocentric worldview in the prosperity gospel resembles the man-centred approach to God found in the African cosmology. In both cases, God is approached in order that He may intervene in human situation. The motivation behind coming to Jesus is to get physical and material needs not necessarily because they are aware of their sins and need to change. Such an approach, therefore, reveals that most evangelicals may not be aware of the true meaning of the gospel which revolves around Jesus death, burial and resurrection to purchase those who will believe in him from their lostness (1 Corinthians 15:1-4, 1Peter 1:18-19). There is thus need for evangelicals in Africa to systematically and clearly preach and teach the true gospel, a gospel that is theocentric not anthropocentric.

On the other hand, evangelicals state that Jesus Christ is sufficient and well-able to address all areas of life: fears, anxiety, sickness, worries, deliverance and so on (Arnold, 1992). This is because Jesus Christ has been given a name greater than all other names and is seated at the place of honor and authority as high priest and mediator as brought out in Ephesians 1:20-23 and Philippians 2:9-11 (Arnold, 1992). To sum up then, when evangelicals continue fearing witches and seek personal protection outside God's will, visit diviners and medicine men, they undermine Christ's role in redemption. As a disciple of Jesus Christ, one should discover the liberating truth and significance of the cross of Jesus Christ for in doing so, one is able to have confidence and security. There is need for evangelicals to emphasize on Christ's role as a mediator and high Priest to help believers love and take in this truth.

Regarding the role of Christ in redemption, Kabuitu (FGD: 27:08:2017) underscored that Christ's role in redemption is important as he is also God's voice for the world today. So, believers who claim to have received a message from their ancestors which they or their family members ought to obey, belittle Jesus' ability to guide them in their pilgrimage (Kabuiti FGD: 27:08:2017). Indeed, Jesus is the one chosen by God as his voice today and believers ought to listen to him allowing him to direct their every step (Matthew 17:5, Hebrew 1:1-2). This is through the Holy Scriptures. Hearing God through God's word should therefore be encouraged in churches in Africa.

Imbalanced Theology

Evangelicals have a special emphasis on the need for believers to anchor their faith in God's word. In the proclamation of the gospel, they too seek to present the whole council of God so that no doctrine is emphasized at the expense of others; all doctrines should be emphasized to maintain good theological balance (2 Timothy 2:15). Through this then, the purity of doctrine is maintained and healthy growth of believers cultivated. This theological balance however is threatened when Tharaka traditional worldview that conflicts with biblical faith still continues to guide the life of many evangelicals in Tharaka.

In respect to this, Turaki (2006) notes, "Traditional Africans believe very strongly that their destiny and well-being are controlled and manipulated by supernatural or unseen mystical power. Thus, they embark on a quest for power to enable them to predict, control and manipulate the spirit-powers for their own benefit …. They can consult specialists who have special means of gaining access to the spirit-powers and may make use of rituals, divination, ceremonies, sacrifices, incantation, symbolism, witchcraft, sorcery, charms, fetishes and white and black magic." For this reason, Africans have a desire to be associated with people with power.

Turaki (2006) additionally notes,

It is believed that by keeping in close contact or touch with great men or women such as heroes, heroines, leaders and warriors, one may be able to absorb significant measure of life force …. One result of this belief is that men and women of stature, status and power usually attract a great following and many disciples. This also applies to great religious leaders in modern Africa and to some extent among certain Christian groups in their expressions of African Christianity. The followers and disciples are usually attracted by the unusual spiritual and mystical powers manifested by the religious leaders.

People in this case follow these leaders not because of the social teachings they receive from them, but because their ministry has evidence of power the very thing they are looking for. Instead of signs and wonders accompanying them, they are pursuing them irrespective of whether what the leaders teaches is true or not. Kigame (2008) too renders support to Turaki's assertion when he notes that "people who do or look like they can wield power are often elevated over the word of God, over Christ and God the Father." The words or messages of such people is often taken as gospel truth and the followers of such people do not exercise the wisdom exemplified by the Bereans who after listening to Paul and Silas consulted the Scriptures to find out if what Paul and Silas were preaching was true (Acts 17:10-11). Such 'powerful preachers' in Africa are often called the men of God or the anointed ones. They hold a special place in their followers, that of demi-gods. The result of such imbalance is that it may promote personality cults in Africa.

Even though this imbalance is a possibility on the account of Africans desire for power, Evangelicals should not be indifferent to the African interest in power. A biblical theology of power should be presented in a balanced way. Evangelicals should constantly teach their members to fully understand and appreciate that, God is the only source of legitimate power and He holds and sustains His creation under His providential and sustaining power. Any power obtained from sources other than Him are illegitimate and open to condemnation" (Turaki, 2006). A believer's source of power and security should thus be the omnipotent God who has revealed Himself to humanity through Christ Jesus; Christ whom even the winds and the waves obey him (Matthew 8:27). This Jesus lives in the heart of every believer and so a believer has all the power he or she needs to overcome every challenge in life; be it fear of witches, uncertainty about what the future holds or even going through a time of suffering. God is thus able to meet the deep longing among Africans that may lead them to desire power.

CONCLUSION

The effect of the continuity of evangelicals in Tharaka and other parts of Africa reverting to pre-Christian worldview aspects in conflict with scriptures especially during crisis is indeed enormous. This should not be taken lightly by evangelicals for this current condition is not working to strengthen the Christian faith in Africa but to weaken it. The weakening of the church in Africa not only affects Africa but also Christianity in the world. This is especially because Christianity is recording exponential growth in Africa than other parts of the world to the point that it has rightly been

argued that the numerical growth of the church worldwide tends to lean south of the Equator: in Africa, Asia and Latin America (Jenkins, 2002).

The critical concern here is the type of Christianity that is been embraced and practiced by these many converts in Africa. If Christians in Africa have to experience spiritual depth in faith in the face of great expansion of the faith as well as brave the challenge of Islam and other faiths, Christian discipleship must be practically emphasized by the evangelicals and the issue of evangelicals reverting to their pre-Christian worldview intentionally addressed. By so doing, the church in Africa will not only experience rapid growth numerically but also spiritually hence playing a key role in world Christianity as was of the case in the early church fathers such as St. Augustine and St. Athanasius.

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WORK ENVIRONMENT AND PUBLIC SERVICE DELIVERY OF HUDUMA CENTRES IN KENYA

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ABSTRACT
This study set out to investigate whether Huduma centres are a success in eliminating corruption, petty bureaucracy and inefficiency in public service delivery (PSD). The study focused on influence of work environment on PSD of Huduma centres in Kenya and the mediating variable of government policies on PSD. The study anchored on Hertzberg two-factor theory, SERVQUAL model and New Public Model. Descriptive research design was used. Target population was branch managers of 52 Huduma centres, 1456 supervisors and 1456 public customers from government ministries offering public services in huduma centre branches. Multi-stage probability sampling was used. Both primary and secondary data was used. Primary data used self-administered questionnaires and Secondary data from reviewing relevant literature and government statistics. Pilot study measured validity and Cronbach's alpha measured reliability. Inferential data analysis was used and it involved correlation coefficient (r) and linear regression analysis, which looked for strength and degree of relationship between variables. Hypothesis results show that work environment has no influence on PSD. Moreso, government policies don't mediate the relationship between work environment and PSD. The study recommends government to re-evaluate government policies to increase PSD. In addition, work environment practices to be given more attention and their impact on PSD reassessed often. Public organisations are urged to use guidelines of human resource strategy for the public service, to avoid every ministry, from using its own regulations and standards. Further research is recommended on more Human Resource practices in the public service.
Keywords: Work environment, Government policies, Hertzberg two-factor theory, SERVQUAL model, New public management and Public service delivery.

INTRODUCTION
Increasing global choices of human resource practices don't give much attention towards the ever changing trend of global competitiveness and modern advancements. Human resource practices are incomplete and are biased and in certain cases give wrong forecasts and understanding by assuming a general inclination to agree on certain types of human resource functions. Ignoring sustainability of HR management practices means to ignore opportunities and benefits of productivity in sustainability and losses are made when sustainability is disregarded (Kaufman, 2016).

In Africa, it is established that the ineffective application of management of human resource practices adversely influence the public delivery of services in the government. Employment in the public sector grew faster after independence making African governments bloated, inefficient and slowing down growth. In East Africa, late colonial and postcolonial era was characterised by lack of skilful African workers to take the place of the expats that were in the colonial government. The urge therefore was to build home-grown civil service for developments in nationalism that was managed by the government. (Simson, 2016)

Huduma centers were launched in 2014 to reform the public sector program. This was as a reaction to the 2010 Kenyan constitution, Huduma Kenya programs objective stands to renovate the Kenyans' satisfaction with the quality of public services. Huduma centers exist as one stop shops for the government where citizens have access to quality services that are offered using modern equipment, quality customer service with efficiency from professional employees.

In work environment, the majority of industrial relations problems around the world, including Kenya, can also be tracked back to the state of the workplace. Organizations that offer public services are required to provide appropriate working conditions and tools as well as standardization of operating facilities to ensure diversity and an enabling work climate, is a major problem in ensuring efficient human resource management and, as a result, improved service delivery. However, public-sector initiatives to create a more conducive work atmosphere are inadequate and inconsistent. The organizations that provide public services are also not adhering to the work environment guidelines. Furthermore, the majority of Kenyan public sector organizations have not prioritized the provision of appropriate working tools and a pleasant working climate (KPSC, 2019).

Government policy is the mediating variable in this study and it consists of legal frameworks made by the government and is helpful in controlling government situations in a country. These include politics, economic resources, government budgets and government laws. Government policies can bring development, successes and failures in organizations' practices. Organizational growth and performance is dependent on feasible government policies that are created by any institution. (Alex, 2020)

Human resource management continues to be a problem, undermining the government's efforts to improve service delivery in Kenya. The area in which this weakness has persisted is in the commitment to good governance and leadership, which includes discipline, observance of public service standards, transparency, and adherence to the legal system, as well as responsiveness to citizens' needs. This has remained a challenge up to today (GoK, 2017).

Purpose of the Study

1. To establish the effect of work environment on public service delivery of Huduma centres in Kenya.
2. To determine the mediating effect of government policies on public service delivery of Huduma centres in Kenya

LITERATURE REVIEW

SERVQUAL Model of Service Delivery

The SERVQUAL model explains dependent variable of public service delivery. It was created by Parasuraman, Zeithaml, and Berry as a service quality model metric for service organizations and retailers involved in understanding and assessing service quality. The focus was on the functionality of the product. The disparity between expectation and output is referred to as quality of service. Reliability, responsiveness, competency, accessibility, courteousness, communication, reputation, protection, understanding customer knowledge, and tangibles were defined as ten dimensions for measuring service quality. The ten elements were regrouped into five dimensions. These included reliability, assurance, tangibles, responsiveness as well as empathy. Tangibles include things like physical facilities, tools, and the appearance of employees. Reliability refers to a company's ability to deliver on its commitments correctly and consistently. Customer responsiveness refers to the firm's willingness to help customers as well as offer prompt service; assurance is understanding, knowledge, and also courtesy that employee has, as well as their ability to motivate faith as well as confidence. Empathy refers to company's helpful and individual attention given to customers. The SERVQUAL model considers service in a wider sense, going far beyond mere customer service (Parasuraman et al., 1988).

A criticism raised against SERVQUAL was that it used only 22 items and it may not apply in various contexts. There is, however, a gap in how to measure service quality in accordance with the realistic environment within which the problem is identified. There are currently no perfect models for assessing service quality in various cultures and economies. In addition, most current models have a Western origin, which is incongruous with developing countries' cultural and economic contexts. Quality service delivery and responsiveness means being conscious of customers' needs in a timely way. While prompt delivery has both an objective and a subjective component for the service provider and the service customer, the results of the study show that responsiveness is recognized as a different form of responsibility which is important for employees' in order to enhance efficiency of service delivery (Krishnamurthy et al., 2010).

Having a good public service process that perfectly represents the public service system is very important. This ensures that different employees involved in giving the service can comprehend and objectively handle it regardless of their roles or individual perspectives. Moreover, having a service plan also helps solve problems and create thought by identifying areas of potential failure and identifying possibilities for improving customer perception of service quality provision. The process is broken down into tasks, and each activity is a processing procedure, inspection, delay, movement or storage established on the current progression (Obeidat et al., 2019; Won & Lee, 2017).

According to Gronroos (1982) customers compare the service they expect with perceptions of received services in weighing quality of service. Gronroos identify the components of services as the functional, image and technical qualities. Therefore, it is the same as what was described by Lehtinen and Lehtinen (1991), where there are categories of service into three components of physical (technical) qualities, the interactive service (functional) and the corporate (image) quality.

Kiran and Singh (2016) posits that most of the service excellence models gauge quality of service by making a comparison with perception of the service that is excellent with expected quality of service that is delivered.

Nevertheless, none of the models of service quality is suitable in all situations and therefore, it gives the opportunities to the researcher to use the SERVQUAL model which is able to cut across a wider scope of the customer service expectations and public service delivery. In order for the customer to be satisfied, service quality is very important in service delivery.

Hertzberg Two-Factor Theory of Motivation

Hertzberg theory of motivation explains the independent variable of work environment. Work environment is an important factor in public service delivery of Huduma Centres in Kenya. A work environment is one in which the working experience is flexible pleasant and sufficient resources are available (Kossivi et al., 2016).

Fredrick Hertzberg developed this motivational model in 1959 from Abraham Maslow theory of hierarchy of needs for job satisfaction where he came up with two categories of work factors namely; hygiene factors which he referred to as 'dissatisfiers', and motivation factors which he referred to as satisfiers. Satisfiers brought about satisfaction and they included achievement, praise, the work itself, accountability and progression. Management style, Institutional politics, compensation, supervision, work relationships, and working conditions, on the other hand, all of these factors will demoralize employees, according to Herzberg. Hygiene factors do not cause happiness, but they can cause frustration or short-term motivation, whereas motivating factors have a longer-term impact by bringing good emotions into the workplace and converting dissatisfaction to satisfaction. If hygiene factors such as working conditions, supervision quality and degree, policy and administration, remuneration, personal relationships, and security of the job are lacking, the chances likelihood of dissatisfaction among the employees increase (Gawel, 1996).

Motivator-hygiene theory emphasizes on identifying the employees' individual needs, their strengths, and the determination of satisfying those needs. These motivators which include recognition, accomplishment, advancement, development, work, and obligation can contribute to employee satisfaction, but they do not reduce the degree of dissatisfaction. It's indeed important to meet hygiene requirements to minimize work dissatisfaction. More so, it's very important to focus on the motivational elements so as to boost and increase work satisfaction. Motivators are intrinsic factors which raise job satisfaction of employee, whereas hygiene factors represent extrinsic factors which dissatisfy workers. According to Herzberg, to have full stock of hygiene factors doesn't really guarantee satisfaction. Variables to motivation should be addressed so as to enhance staff performance and effectiveness. Aspect of working condition is the highest significant for job satisfaction. Employees value the working environment as most significant element that determines job happiness (Yusoff et al., 2013).

Satisfaction factors or motivation factors comprise characteristics based on the nature of the job itself, while hygiene considerations are related to the context in which the job is performed, such as management and company policy. These hygiene factors continue to be important in order to prevent negative feelings at the workplace. On the other hand motivators are also the compelling reasons that inspire workers at work. In short, hygiene considerations are elements of work that keep workers from being unhappy or prevent them from being dissatisfied. However, motivators identify work characteristics that give employees the feeling of being contented and satisfied (Alfayad & Arif, 2017). Organizations use Herzberg's motivator-hygiene concept so as to build possibilities for workers personal development, enrichment, and appreciation for employees. There is need for employees to be given promotion on finishing some levels in their career, be recognized, and be granted the authority to decide how to manage tasks related to their jobs. Hertzberg model is not able to give a difference related to physiological and psychological factors more so, fail to accurately clarify the concept of motivators and how they vary from hygiene factors. Motivator-hygiene notion fails to expound on degrees in satisfaction as well as dissatisfaction as an indicating measurement rather than the use of numbers. It creates assumptions that everyone in the organization will respond same way in a related situation (Badubi, 2017).

The biggest challenge in employee motivation is how appropriate the motivation technique implemented is. That which motivates one employee may not necessarily motivate another. For employee motivation to achieve its objectives, it requires a suitable work environment. Motivation approaches can vary depending on factors like the culture of the organization and the social environment. In different organizational cultural settings, a motivational strategy can lose or increase its motivational power. Therefore, every of each employee's needs and desires, which go hand in hand his or her social context, must be fulfilled (Can, 2018).

According to this study, the working environment in Huduma Centres is motivating and thus increases quality and effectiveness In terms of service delivery to Kenyan citizens. The working space and layout in Huduma Centre is

sufficient and convenient for public service delivery. In addition to that, integration of work activities within one building enhances service delivery and the study finally established that the work processes are quick and reliable. Lack of provision of working tools in Huduma Centres can be a potential de-motivator. The research findings depict that, there is no provision of enough working tools in Huduma Centres. However, the influence of work environment requires an in-depth evaluation as to whether indeed it provides the employee motivation required and the extent to which motivation is achieved.

New Public Management Model

The model of New Public Management (NPM) explains mediating variable of government policies. New public management entails techniques and practices of management derived from management of the private sector. New public management initiatives place a greater focus on public management rather than traditional government administration. New public management is characterised by decentralization of management of government services: the development of autonomous agencies as well as the devolved budgets and financial regulation, the increased use of markets and competitiveness in the public services provision, such as subcontract as well as other market systems, and a greater performance is emphasized, outputs, customer focus, technology advancement, and growing use of consultants of international management. In developing nations, main factors involve lending conditions and a growing focus on good leadership, as well as external influences and structural reform programs (Islam, 2015).

More so, Bouckaert (2018) postulates that New Public Management involves a significant change in the principles of the way public sector is managed in developed and developing countries in varying degrees. The new agenda for new public management reform is founded on improving public administration competencies in order to better monitor output based on outcomes. Islam (2015) states that changes in new public management have been impacted by external variables such as political, economic, social-cultural, and technological influences.

The impact of economic and fiscal crisis, which triggered a search for increased productivity and ways to minimize the cost of providing public services, has been a common feature of countries embarking on the modern public management route. In the 1990s, some developed and transitional economies used new public management approaches and methods. Nonetheless, the limited understanding of new public management in states with crisis implies that there are structural and other issues that exist and can impose implementation constraints. The ability to handle a network of contracts, the establishment of monitoring and evaluation mechanisms, and the challenging new governance climate are all factors that could hinder implementation capability and capacity concerns (Islam, 2015).

Adoption of NPM posted mixed results in terms of service delivery in diverse sectors of the European public sector. New Public Management got introduced in 1980s to deal with problems relating to a non-productive as well as bureaucratic public service in the United Kingdom (U.K). The result of the adoption of NPM brought about new standards in the public sector; political independence, professionalism and neutrality that informed both the management of human resources and enhanced public service delivery (Lapsley & Knutsson, 2016).

The success of NPM contributed towards the adoption of balanced score cards and annual star ratings in the delivery of services in public hospitals. New Public Management made a significant contribution in reducing levels of bureaucracy in public health sector under the management of Autonomous Communities in Spain. The adoption of New Public Management led to better management of Human Resources for Health in terms of developing staff capacity resulting to better provision of health services in public hospitals under autonomous communities (Alonso et al., 2014).

Failure to effectively implement new public management adversely influenced the management of personnel both in education and health public sectors ran by the provincial governments of Indonesia. Specifically, they contend that ineffective use of NPM resulted to the adverse prevalence of patronage in the human resources, recruitment and selection of which negatively influenced the quality and quantity of service delivery to the citizenry (Minogue et al., 1998).

The result of the taking on NPM led to a more effective approach into the management of human resources under provincial governments in South Korea. Additionally, they contend that the effective application of NPM in recruiting, selecting as well as training and developing civil servants, created a sense of accountability leading to an improved delivery of services in public sector at these levels of devolved governance units (Kim & Jae Moon, 2011).

Empirical Literature

Work Environment

Employee commitment to an organization, according to Sharma et al. (2016), affects the way employees act at work. This includes their level of motivation, innovative behavior, absenteeism, their interaction with their fellow colleagues and job retention. Purity et al. (2017) adds that employee productivity is of great interest in any organization and is reflected by the working environment. Moreover, Eberendu et al. (2018) agrees that other factors in the work environment involve design of the furniture, noise, ventilation, and lighting, support of the supervisor, safety measures, workplace space and communication.

Wangechi and Ndeto (2019) established that various working environment factors highly influenced their work productivity in a study done in Nairobi city council. Most of employees agree that the physical working environment aspects at the workplace, like office space and furniture for the workplace, appropriate equipment, reduced noise, illumination, and temperature, made a significant contribution to employee comfort and helped boost employee performance. Target population was 1872 and 320 respondents of employees of Nairobi city council as the sample arrived at through stratified simple random. Quantitative and qualitative data analysis was done. A good working environment ensures that employees achieve high productivity.

Usha et al. (2017) adds that work environment of employee enhances employee performance. Furthermore, physical workplace environment factors have an impact on employee productivity, employee fitness and safety, employees' wellbeing, employees job focus, job satisfaction and employee morale. The physical environment includes the layout of the office, the setup of the work station, the nature and quality of furniture and equipment, working space, vibration, temperature, air quality, illumination, noise, radiation, and ventilation. It's revealed that providing good working condition is one of important factor in influence the labour to retain in the job for a long period with satisfaction. Particularly the work station set-up, influence the laborers to be faithful, sincere and also influence a good industrial relation inside the organization. Descriptive research design was adopted and qualitative and quantitative data analysis was done. Data collection was done using questionnaires.

Government Policies

Adam (2020) believes that the African continent's legal, economic, and political system influence the practices of human resource management because African nations are undeveloped and rely on aid from international superpowers to thrive. As a result, numerous HRM variables and concepts are frequently misapplied or abused by employees or the company's personnel. Labor commissions try to resolve HRM issues so employers together with the government may address their grievances and meet their demands in the right way. However, politics in Africa is dominated by greed and corruption. Furthermore, Africans have a distinct approach to politics compared to developed nations. They have not been able to sustain constitutional legal rights that have been abused and misused to the greatest extent possible. Due to lack of integrity, Africa's politics suffocate any accurate HRM practice. Most governments make appointments based on political influence or political party connection rather than HRM recruitment methods.

Government policies help ensure there is strong and sustained collaboration between public servants, which is very important and this collaboration should remain for the entire term of the government. Public perception of the government towards delivery of public services is crucial for sustained general public confidence. There should Therefore, be high cohesiveness among the drivers of public policy that is, the ministers and the public servants. The constant changes in leadership have a positive or negative impact on performance of public service since every changes in leadership brings with it new approaches and strategies. These changes in approaches and strategies bring confusion, uncertainty and inconsistency in delivery of services when policies keep being changed (Nwasike & Maina, 2018).

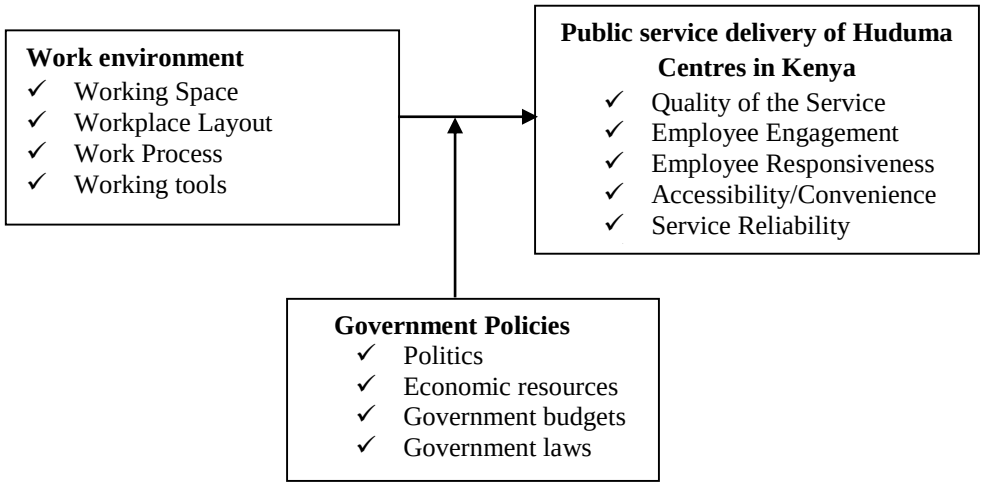
According to Maina (2016), political meddling is a key source of concern in county decision-making. As a result, professionals, not politicians, should be in charge of county affairs. Guidelines should always be implemented to establish the types of professionals who should serve in positions of county leadership. Complaint management mechanisms should be enhanced as well, so that customers have equal access to them. Furthermore, respondents believe that resources should be managed more carefully, as they believe that money given to counties was misappropriated to a moderate amount for the purposes for which they were intended. To further establish the e-government initiative in Kenya's public sector, a deliberate policy framework should be built. As a result, more services should be supplied in Huduma Centres, employees' capacity should be built, public awareness should be raised, more Huduma Centres should be established, and resources should be allocated to assist e-government in the Centers. To minimize complexity such as delays, there is a need to improve coordination between the back office

(mother departments) and Huduma Centres. It is proposed that a strategy be developed to decentralize Huduma services in the counties without referring them to Nairobi's headquarters and mother ministries, departments, or organizations. In accordance with Article 232 of Kenya's 2010 constitution, this will result in faster decision-making and consequently better service delivery.

Conceptual Frame Work

Figure 1

Independent Variable **Mediating Variable** **Dependent Variable**



METHODOLOGY

This study used descriptive research design. The study also used mixed method approach. The target population was all the 52 Huduma centres in Kenya with the 52 branch managers and 1456 supervisors from the Huduma centres in Kenya. A public customer was also included into the sample to rate public service delivery. Multistage sampling was used. Multistage sampling is commonly used when there is no sampling frame, and if the population is dispersed over a large area (Sedgwick, 2015). To collect data, the researcher used structured self-administered questionnaires Cronbarch's alpha was used to measure reliability. Data was analyzed using SPSS version 20 and presented through descriptive and inferential statistics.

Table 1: Reliability Analysis

Factors	Cronbach's Alpha	Comment
Work environment	0.959	Accepted
Public service delivery	0.880	Accepted
Government policies	0.729	Accepted

The results in table 1 reveal that work environment, public service delivery and the mediating variable of government policies (M) had coefficients above 0.70. Cronbach, (1951) indicated that 0.70 coefficient or higher indicates that the data is highly reliable.

Respondents Characteristics

There were more female managers and supervisors (57.9%), than male (42.1%) participated in the survey. Majority of the public customers that participated where male (50.4%) and the female were (49.6%). This shows there is a fairly balanced gender from the Huduma centers from which the information was obtained. From the results, it is found out that majority of those who seek the government services in Huduma centers are the youths and the middle aged. Majority of managers and supervisors were educated. Majority of the branch managers were found to earn a basic salary of Kshs. 60,000 and above on average as most have experience and higher education earning a considerable higher net salary as compared to the section supervisors a majority earned a net salary of Kshs. 20,000-39,000.

Table 2: The Influence of Work Environment on Public Service Delivery

Work environment	Strongly agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly Disagree (%)	Mean	Standard Deviation
The working space in Huduma Centre is sufficient for public service delivery	41.3	28.6	10.4	11.5	8.2	3.83	1.301
The workplace layout is convenient for public service delivery	41.3	37.2	9.3	6.7	5.6	4.02	1.131
Integration of work activities within one building enhance service delivery	58.2	33.2	6.0	2.2	0.4	4.47	0.741
The work processes are quick and reliable	52.2	38.8	5.6	3.0	0.4	4.40	0.759
There is respect for the rule of law in Huduma Centres	57.1	35.1	4.5	2.2	1.1	4.62	2.948
There is no provision of working tools in Huduma Centres	17.4	31.3	20.0	20.4	10.9	2.762	1.264
The working hours are efficient	36.8	41.7	10.2	6.4	4.9	3.99	1.081
Composite mean and standard deviation						4.0	1.3

In Table 2, the composite standard deviation is 1.3, and the aggregate mean value is 4.0. This implies that the respondents agreed that work environment influence public service delivery of Huduma centres in Kenya.

Table 3: The Mediating Effect of Government Policies on Public Service Delivery

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	Standard Deviation
	%	%	%	%	%		
Government policies influence public service delivery in Huduma centres	1.9	3.4	6.0	45.5	43.2	4.24	0.859
Priorities in political developments influence public service delivery in Huduma centres	5.3	17.4	20.0	35.5	21.9	3.51	1.165
Economic resources available influence public service delivery in Huduma centres	1.1	7.9	15.7	41.9	33.3	3.99	0.953
Government budgets influence public service delivery in Huduma centres	1.5	6.8	7.2	41.1	43.4	4.18	0.940
Laws that define institutional processes influence public service delivery in Huduma centres	1.5	6.8	12.9	45.8	33.0	4.02	0.933
Composite mean and standard deviation						**4.0**	**0.643**

Table 3 shows that on average, the respondents agreed that government policies had an influence on public service delivery (M=4.00, SD =0.643). This is a clear indication that government policies play a critical role in enhancing effectiveness of public service delivery.

Table 4: The Influence of Public Service Delivery in Huduma Centres in Kenya

Public Service Delivery	Strongly Agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly Disagree (%)	Mean	Standard Deviation
The services employees deliver in Huduma Centres are of good quality	39.5	48.2	7.6	4.7	0.0	4.22	0.782

Employees are highly engaged in their work of serving clients satisfactorily	40.6	47.1	7.2	4.7	0.4	4.23	0.806
There is quick response to clients' needs	37.6	39.4	15.3	6.2	1.5	4.05	0.953
The location of Huduma Centres is accessible, reliable and convenient to customers	39.9	35.1	13.8	10.1	1.1	4.03	1.021
The services offered in Huduma Centre are reliable	40.2	43.5	12.3	3.6	0.4	4.20	0.817
Huduma Centres fully conform to and fulfill the provisions of the constitution and expectations of the public.	42.5	46.2	8.0	2.9	0.4	4.29	0.762
There is responsiveness to citizens' needs in Huduma Centres	37.5	52.0	6.9	2.5	1.1	4.22	0.772
There is professionalism in Huduma Centres	46.0	41.2	8.4	3.6	0.7	4.28	0.824
There is respect for the rule of law in Huduma Centres	46.0	43.1	6.9	3.6	0.4	4.31	0.784
There is observance of public service values in Huduma Centres	42.5	45.1	8.4	3.3	0.7	4.25	0.803
Composite mean and standard deviation						4.2	0.8

Table 4 shows that on average, the respondents agreed that public service delivery has an influence in Huduma centres (M=4.2, SD =0.8). This is a clear indication that Public Service Delivery plays a critical role in the success of Huduma centres.

Table 5: Model Coefficients for Multi regression Model - Hypothesis results

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	2.207	.470		4.697	.000		
	WE	.129	.071	.109	1.820	.070	.908	1.101
2	(Constant)	2.061	.393		5.241	.000		
	WE	.051	.060	.043	.859	.391	.895	1.117
	M	.464	.043	.580	10.881	.000	.799	1.252

a. Dependent Variable: PSD

Table 5 shows that in the first model, work environment was insignificant (WE); $\beta = 0.129$, $p = 0.070$ ($p \leq 0.05$) at 95% confidence level. In the second model regression analysis was used to investigate the hypothesis that government policies mediate the relationship between employee training and public service delivery. Government policies had insignificant mediating effect on the relationship between work environment and PSD. As indicated by work environment (WE) and PSD ($\beta = 0.051$, $p = 0.391$). Therefore, it was concluded that work environment has no influence on public service delivery of Huduma centres in Kenya.

Summary of the Findings

From the results, it is found out that majority of those who seek government services in Huduma centers are the youths and the middle aged. From the findings, the public who were sampled were found to have the minimum education requirement to respond to public service delivery of Huduma centers in Kenya. Therefore, it is concluded that the respondents both the supervisors, branch managers and the public customers were well placed to give adequate and

reliable information. On the marital status of the Huduma centre managers and supervisors, majority were married, and the minority were single. This shows that there was employee diversity on marital status.

CONCLUSION

Work environment, was found to have a positive significant low linear relationship with a correlation coefficient of 0.183 (which statistically is significant $p = 0.002$ with $p \leq 0.01$) with public service delivery of Huduma Centres in Kenya.

Hypothesis results reveal that the p value on work environment was insignificant as it was more than 0.05 ($p = 0.070$ with $p \leq 0.05$). Hence, there was no rejection of the null hypothesis and concluded that work environment do not influence public service delivery of Huduma Centres in Kenya.

Further it was found that government policies did not have significant mediating effect between the relationship of work environment and PSD, as indicated by the p values of 0.391 for work environment

RECOMMENDATIONS

Huduma centre managers, who have not advanced in their studies, should be encouraged to further their education to at least a master's degree. This is to have more knowledge and skills, and to prepare them for succession to higher level roles and responsibilities.

Work environment practices should also be given more attention and their impact on public service delivery reassessed often to ensure the objective of influencing public service delivery is achieved. It's recommended that Huduma Centres should be expanded to give more space to the mass number of public customers that flock in daily. This should go hand in hand with the working layout which will facilitate more integration of work activities within one building. The work processes should also be assessed and ensure they are more quick and reliable, and rule of law is upheld. Working tools and hours should also be sufficient and provided in time to avoid delay of some services from their respective ministries.

Government policies that are not working should be removed, the policies that are working should be improved and government should also add to the policies that might enhance the working efficiency of strategic human resource practices to make them better and stronger. These can be policies on priorities in political developments which should be reexamined to identify those that influence at a greater extent so as to achieve maximum and timely productivity. In addition, political influences like corruption and petty bureaucracy that may hinder effectiveness of the strategic human resource practices should be avoided. Government budgets that take time to be decentralized especially in the counties can be reviewed. Government laws should also be upheld and closely monitored to ensure the right practices are observed.

Lastly there should be a robust monitoring and evaluation of policy implementation so that performance gaps can be identified early enough in order to advise policy change and help measure performance of the future process of policy making. There should be inclusive stakeholder participation during the process of making policies as well as putting the policies into practice to ensure they are inclusive and well crafted.

Lastly there should be a robust monitoring and evaluation of policy implementation so that performance gaps can be identified early enough in order to advise policy change and help measure performance for the future policy making process. There should also be inclusive stakeholder participation in the process of policy making and policy implementation to ensure that policies are inclusive and well crafted.

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SOCIAL NETWORKS INFLUENCING EFFECTIVE UTILIZATION OF YEDF IN ISIOLO COUNTY, KENYA

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ABSTRACT
The Youth Enterprise Development Fund (YEDF) was founded in the year 2006 with the aim of enhancing the wellbeing of youth in Kenya. Although Isiolo County is among the counties with the highest targeted number of youth beneficiaries (78,526), there is evidence of low levels of economic empowerment among them. The purpose of this study was to assess the social networks influencing effective utilization of YEDF in Isiolo. The study integrated correlational research and descriptive survey designs. The total study population was 9,602 people. This included a target population of 1,919 youths who have benefitted from YEDF in Isiolo County as at December 2021. These youths were obtained from the 288 youth groups whose members have benefited from YEDF. The population also included 7 YEDF officials in Isiolo and 7,676 community members. A sample of 384 respondents consisting of 277 youths who have benefitted from YEDF in Isiolo County and 100 community members was obtained proportionately and purposively respectively. All the 7 YEDF officials in Isiolo County participated in the study. Data collection was done using questionnaires and interview schedule. The questionnaires were self-administered. An interview schedule for the key informants was filled by the respondents. Research assistants were hired to assist in the process. The respondents were given time to respond to the questionnaires and those who were not able to read or write were be assisted. Piloting was carried out in Tharaka Nithi County to establish reliability of data collection instruments. Reliability of the instruments was estimated using Cronbach Alpha Coefficients. Descriptive statistics used included frequencies and percentages. The inferential statistics used in the study was linear regression. It was evident, from the study that social networks had significant effects on effective utilization of youth enterprise development fund. The study recommended the necessity of integrating YEDF entrepreneurship trainings with IT through inclusion of digital financial transaction technology experts in the training programmes such as M-pesa and the banking sector. Research findings and recommendations could be used to guide further research as well as policy makers in relation to YEDF
Keywords: Social Networks, Entrepreneurial Partnerships, Financial Training, Information Technology Training.

INTRODUCTION

Youth Enterprise Development Fund is an issue of concern in the modern society due to its pivotal role in stimulating economic development (World Bank, 2021). Governments have a major role in ensuring the success of this programme primarily by not only acting as the major donors, but also through enhancing such programmes that link the youth to employment. Governments worldwide strive to provide their youth the chances to reach their career potential while meeting the demands of the labour market in an effort to link them to employment. This effort, according to trends globally, has to be followed by proper utilization of any fund that may have been allocated to the youth in order to attain the set objectives (Omondi, 2013).

Effective utilization of YEDF enables the fund to achieve its main objective of youth empowerment. This utilization is, however, subject to some dynamics worldwide. In the United States of America (USA), for example, upon realization that formal jobs are not always available, the Federal government primarily focused on how to improve the chances of disadvantaged youth to start their businesses and organizations. In the mid-1970s, the rate of unemployment for the youths; especially coloured youths, was high. This factor motivated the Congress to pass the Youth Employment Demonstrations Projects Act (YEDPA).

In Sub-Saharan Africa, governments are concerned with enhancing effective utilization of youth funds to steer development. In different African countries, enhancement of youth entrepreneurship has been tackled in different combinations. These include through education, technical training, national youth service, youth entrepreneurship programmes and loans as well as informal sector development programmes. According to Kinyua and Kimando (2015) as well as Njogu and Kihoro (2012), African states should accord high priority to youth livelihoods by allocating significant budgets for youth funds due to their huge population. However, both Gachugia et al. (2013) and Kinyua (2015) attribute the contrary to the failure by many African governments to come up with comprehensive youth policies and institutional frameworks.

In Kenya, the Youth Enterprise Development Fund was established by the government in 2006 to provide an on-lending facility to the youth, with low interest rate and flexible to micro and small enterprises (NYP, 2006). Effective utilization of this fund by the beneficiaries was expected to create employment, which was in line with the government economic recovery strategy (ERS) for wealth and employment creation (2003-2007). The ERS estimated that, about 500,000 jobs needed to be created annually, of which 88 per cent were to come from the Micro and Small Enterprises sector. Data from the Federation of Kenyan Employers (FKE, 2016) indicated that youth represent 30% of the population and their unemployment rate is twice the country's average. Sixty-seven per cent (67%) of those unemployed are youths.

Isiolo County has benefited a lot (Kshs 30 million in National Budget of Kenya, 2022/2023) from the YEDF since it is among the counties in Kenya with the highest number of youth groups which have been formed and registered (1150 youth groups and over 23,000 youths). There have also been concerted efforts by the county government of Isiolo for instance through the enactment of the Isiolo County Youth Women and Persons with disabilities Enterprise Development Fund Act (2019). This has contributed to a lot of youths borrowing funds to start their own businesses. The youth groups funded have ventured into agribusinesses, financial businesses especially in the table banking, and hawking businesses. On the contrary, according to Isiolo County Development Plan (2018-2022), the wellbeing amongst the beneficiaries of the fund has been deteriorating despite increased funding (48.7%).

Independent assessment of the social networks influencing effective utilization of the Youth Enterprise Development Fund is unfortunately not readily available. Most researches done on YEDF have been limited to adequacy of the fund, evaluation of the impact, accessibility and effectiveness of the fund. Several scholars agree that most governments are guided by a vision that neither addresses the livelihoods needs nor meets the real expectations of youth (Catherine (2012), Orwa (2012) and Rajender (2012). However, Kisunza and Theuri (2014) as well as Wanjala (2014) focused on effective utilization of Youth Enterprise Development Fund and how this can affect Youth Empowerment in Kenya. None of the above studies, however, addresses the issue of social networks influencing effective utilization of such funds. Therefore, there existed a research gap on how social networks such as partnerships amongst youths as well as training programmes for the youth affect effective utilization of YEDF. In order to address this gap, the study sought to assess social networks influencing effective utilization of the Youth Enterprise Development Fund in Isiolo, Kenya.

Social Networks Affecting Utilization of YEDF

In his writings on the strength of weak ties, Granovetter (1982) argues that people are socially disadvantaged if they do not have weak tie networks and bridges out of their own strong tie network of close partnerships, associations, groupings, friends and family. In another study on social capital and resettlement of internally displaced persons in Molo district, Kenya, Kiboro (2009) opined that one form of social capital are networks of associations representing any social group which gather regularly for a common purpose. ILO (2012) report on global employment trends advanced entrepreneurial networking theory and concluded that an entrepreneur is an individual who innovates within the context of an uncertain environment. Given that characterization, they argued that key to entrepreneurial success is the ability of the entrepreneur to exploit social networks which Granovetter (1982) terms as weak ties. In a network, flows between objects and actors and exchanges, which might contain an advice, information, friendship, career or emotional support, motivation, and cooperation, can lead to very important ties. Akwalu (2014) affirmed this assertion by concluding that the main social networks affecting youth entrepreneurship include entrepreneurial partnerships and groups as well as training programmes.

Youth Entrepreneurial Partnerships and Groups.

In the worldwide business environment, a network is a group of two or more firms that have banded together to carry out some new business activity that the members of the network could not pursue independently. This finding is asserted by Irungu and Kamau (2015) in their study on the effect of YEDF on growth of new enterprise in Mathioya district, Kenya. The study by Irungu and Kamau (2015) explored the three constructs widely researched in entrepreneurial networking; first the content of the networks which should be viewed as the media through which actors gain access to a variety of resources held by other actors and secondly, the governance of these relationships. Trust between partners is often cited as a critical element that in turn enhances the quality of the resource flows (Irungu & Kamau, 2015).

In Europe and USA, according to OECD (2012) report on policy challenges for young entrepreneurship, partnerships in entrepreneurship have a number of contributions for youth. First of all, they create employment for the youth. Secondly, they provide valuable goods and services to society and lastly they promote innovation and resilience. In

Netherlands, for example, because youths are more likely than adults to be unemployed, partnerships in entrepreneurship gives them livelihood alternatives, economic independence, and positive psychological capital which will integrate them into the mainstream economy (OECD, 2012).

In Asia, World Bank (2011) report on doing business and making a difference for entrepreneurs support sentiments by Tsekoura (2016) by observing a positive relationship between networking and venture performance. In another study Wachilonga (2018) assessed the effect of finance determinants on loan repayment among YEDF board beneficiaries in Trans Nzoia County, Kenya and posited that through collaborations and strategic partnerships, business incubators can support the successful development of entrepreneurial projects of youth business ideas through an array of business support resources and services.

In Africa, the engagement of marginalized sections of the population in entrepreneurship can empower these people and subsequently contribute to economic growth (Gatimu & Wanyoike, 2014). Up to 84% of the youth population is resident in Africa and the developing world (UNECA, 2016). Along the same line of thought, supporting youth entrepreneurship in Africa is crucial in fostering the creation of sustainable livelihoods (Issa and Kiruthu, 2019). In Sub-Saharan Africa, it is estimated that by 2025, one in every four young people in the world will be from sub-Saharan Africa (World Bank, 2021), a region where most people are poor and live in rural areas.

In Kenya, findings by Muthee (2010) study on tackling the youth unemployment in Kenya revealed that YEDF was initiated with the core purpose of boosting youth entrepreneurship. This purpose, however, cannot be achieved without the target group having the requisite entrepreneurial partnerships. According to the same study, entrepreneurship training and provision of appropriate business development services are key to the fund's achievement of its mandate. The finding is in agreement with to KNBS (2016) basic report on wellbeing in Kenya that approximately 80% of the population in Kenya is youth and most of them are unemployed. The few who own businesses lack resources and start-up capital and thus operate small and micro enterprises (SMEs).

In Isiolo County, most youth employed in the informal sector are poorly paid thus continue living in poverty and cannot partner in groups (MIDP, 2018). Failure to engage the youth decently and productively has driven them to criminal activities. Fundamentally, without active youth participation in the economic sector, the region may never realize its full economic potential. Partnerships and creation of entrepreneurial activities for the youth was seen as the way out of the employment crisis. Despite this effort by the government, the entrepreneurial experience of youth in Isiolo County still remains wanting (MIDP, 2018).

Financial Training and Literacy

World Bank (2011) indicates that financial literacy has a relation with deposits, wealth creation and how business resources are managed. World Bank (2011) indicates that individuals who have financial skills and literacy participated more in financial markets. Muarya (2012) noted education levels contributed to financial literacy and thus affected individual level of income. In a related study by Mwangi and Ouma (2012) noted that low level of financial literacy affected economical transactions. The study also concluded that business growth is affected by financial knowledge of the entrepreneur.

In Asia and South America, one of the biggest challenges facing youth entrepreneurs is financial accounting. Klinger and Schundeln (2011) argue that most youth entrepreneurs' funds require that youth provide evidence that they have an understanding of financial management before funds or loans are advanced to them. This is a great challenge since most youth entrepreneurships start as sole proprietors, or partnerships, where personal funds are usually mixed with business funds, making it difficult to account for actual business funds and expenditures.

In Africa, Quaye (2011) reported that 38% of the MSEs surveyed in Ghana mention credit as a constraint, in the case of Malawi, it accounted for 17.5% of the total sample. This stems from the fact that MSEs have limited access to capital markets, locally and internationally, in part because of the perception of higher risk, informational barriers, and the higher costs of intermediation for smaller firms. As a result, SMEs often cannot obtain long-term finance in the form of debt and equity. Ott and Longenecker (2015) posited lack of planning, improper financing and poor management as the main causes of failure of small enterprises. Lack of credit has also been identified as one of the most serious constraints facing MSEs and hindering their development (Ott & Longnecker, 2015).

Mwangi and Kihiu (2012) observed that in Kenya, financial literacy needs to be enhanced so that individuals can make informed decisions when they evaluate products. According to women development fund report (2012), financial literacy equips individuals with skills necessary to make strategic business decisions. Rakodi (2016) in a study on the urban challenge in Africa and managing urban futures stated that in organizations providing financial education, participation rates is high for staff with skills, and that employer-based training on finance raises staff deposits. RoK (2014) report on YEDF also indicated that financial related seminars improved changes personal financial skills. Middle class staff preferred to be employed by employers who possess knowledge on financial plans as opposed to those who do not.

In Isiolo County, MIDP (2018) argue that in as much as it is necessary for youth to be trained on financial planning, applications for loans, management of loans, and business accounting, it is necessary also for government agencies to revamp their policies to make it easier for the youth to access funds. On the other hand, House, Ikiara, and McCormic (2011) argue that innovating delivery channels for youth entrepreneurship funds would eliminate the challenge youth have to utilize banking services even in places where there are no banking services. For instance, use of mobile money transfer services like M-Pesa makes it easier for youth to access funds and loans, than using bank accounts.

Training on Information Technology

In Europe and USA, Figura (2012) notes that youth venturing into entrepreneurship cannot avoid information technology. Most applications for entrepreneurship funds either from government agencies or the private sector are currently done via information technology platforms. Figura (2012) also argued that information technology eliminates the challenge of having to use bulky paper applications for youth entrepreneurship funds. In most cases where information technology is not being used, individuals applying for youth funds are required to submit paper applications that are accompanied with supporting documentation which takes more days to process compared to online applications that take minutes to file, and to be processed (Figura, 2012).

In Asia and South America, Sakyiamah (2015) in a study on an assessment of the effects of the Ghana Youth Employment and entrepreneurial development agency programme on beneficiaries contend that information technology training is important for youth entrepreneurs in helping them stay competitive and relevant in this digital era. Understanding how to utilize web platforms, navigate the internet and how to send online content is essential to business. However, the extent to which youth entrepreneurs are utilizing these platforms to access youth entrepreneurship funds is still nascent Sakyiamah (2015).

In rural Africa especially Sub-Saharan Africa, most youth entrepreneurs either do not have access to information technology, or when they do, they do not know how to use it (Rajendar, 2012). In a study done by World Bank (2021), 75% of youth entrepreneurs in rural areas of developing countries did not have access to information technology, while 64% did not know how to use online platforms to access financial services from government youth funds and other financial institutions.

In some East African countries like Kenya and Rwanda where youth entrepreneurship funding has moved online, there is a great challenge to youth in the rural areas who do not have access to information technology services. In Kenya, as much as Figura (2012) notes that youth venturing into entrepreneurship cannot avoid information technology, lack of training on information technology targeting youth entrepreneurs is also rampant. In most cases, youth entrepreneurs do incur extra costs by using cyber cafe attendants to help them do online loan applications (Figura, 2012). In these instances, accessing online application forms or scanning and attaching required documentation is a challenge to most youth entrepreneurs. Youth financial education is extremely significant in that it enables the youth to gain essential knowledge into the operations of business venture they are desirous to venture.

In Isiolo county, as stated by Kiyana (2018), as much as it is necessary for youth to be trained on financial planning, applications for loans, management of loans, and business accounting, it is also necessary and important for government agencies to revamp their policies to make it easier for the youth to access funds. To this end, information technology information is also important in making youth entrepreneurship ventures resilient and sustainable, and thus able to access funds due to track record of successful ventures. In other words, Kiyana (2018) revealed that with information technology, youth entrepreneurs are able to effectively keep proper records for their business transactions for a long time as well as retrieve the same when needed.

METHODOLOGY

The study was conducted in Isiolo County using correlational research and descriptive survey designs. The total study population was 9,602 people. This included a target population of 1,919 youths obtained from the 288 youth groups whose members have benefited from YEDF (Isiolo North-160 groups, Isiolo South-128 groups). The population also included 7 YEDF officials in Isiolo County and 7,676 community members directly affected by the programme (an average of 4 relatives per the 1,919 households of targeted YEDF beneficiaries). To constitute a sample of 384 respondents, 277 youths who have benefitted from YEDF were obtained proportionately from the 2 constituencies of Isiolo County (Isiolo North-177, Isiolo South-100). Each of the 277 youths was selected purposively to represent a youth group. All the 7 YEDF officials in Isiolo County participated in the study. The remaining 100 respondents were obtained purposively from community members targeted for the study specifically, mature relatives to the sampled beneficiaries of YEDF. Data was collected by use of questionnaires and interview schedule for the key informants. Quantitative data was analyzed using both descriptive and inferential statistics while qualitative data was analyzed thematically.

RESULTS AND DISCUSSION

The null hypothesis subjected to regression analysis test was that there is no statistically significant relationship between social networks and effective utilization of YEDF.

Hypothesis Testing

The Null hypothesis was rejected from statistical tests (Regression analysis) and therefore, there was a statistically significant relationship between social networks and effective utilization of YEDF as indicated in Table 1 and 2.

Table 1: Model Summary for Social Networks on Utilization of Youth Enterprise Development Fund for both Youths and Community Members

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.484[a]	0.234	0.232	0.51664

a. Predictors: (Constant), Social Networks

Table 1 above shows that from the findings, R was found out to be 0.484 which represented simple correlation. It indicated high degree of correlation between Social networks and effective Utilization of youth enterprise development fund. R Square is 0.234 which indicated that 23.4% of the variable Utilization of youth enterprise development fund can be explained by the variable Social networks while 76.6% of the variable Utilization of youth enterprise development fund can be explained by other factors such as social institutions, workplace values and cultural values as well as exchange programmes on entrepreneurship with foreigners and reading of business journal, books and magazines to borrow best practices among other factors.

Table 2: Regression Coefficients for Social Institutions on Utilization of Youth Enterprise Development Fund for Both the Youths and Community Members

	Unstandardized Coefficients		Standardized Coefficients		
Model	B	Std. Error	Beta	T	p-value
1 (Constant)	1.713	0.126		13.597	0.000
Social Networks	0.407	0.038	0.484	10.708	0.000

a. Dependent Variable: Utilization of Youth Enterprise Development Fund

Table 2 shows that P-value was 0.000 and thus P<0.05 implying that social networks had a significant effect on Utilization of youth enterprise development fund. The t value was 10.708 and thus t >2 further confirming significant effect of Social networks on Utilization of youth enterprise development fund. Therefore, the null hypothesis H_{02} (There is no significant relationship between social networks and utilization of YEDF in Isiolo, Kenya) was rejected.

The coefficient B, from table 3, was 0.407 which means that 1% increase in Social networks would increase Utilization of youth enterprise development fund by 0.407 % or 10% increase in Social networks would increase utilization of youth enterprise development fund by 4.07 %. In conclusion, there is a significant relationship between social networks and utilization of YEDF in Isiolo County. The simple regression equation to estimate the level of Utilization of Youth Enterprise Development Fund was as follows:

$y = a + bx$
Where,
y = dependent variable
= utilization of Youth Enterprise Development Fund (UYEDF)
a = constant
= 1.713
b = regression coefficient
= 0.407
x = independent variable
= Social Networks (SN)
Therefore,
UYEDF= 1.713+0.407(SN)
Where,
UYEDF= Utilization of Youth Enterprise Development Fund
SN= Social Networks

CONCLUSION

The study aimed at investigating social networks influencing effective utilization of YEDF in Isiolo County, Kenya. The study found that entrepreneurial experience, financial literacy for the youths, their economic independence, continuous entrepreneurship training, knowledge in online business and trainings on IT, entrepreneurship or financial literacy influences effective utilization of YEDF amongst the beneficiaries. Entrepreneurial experience and economic independence for the youths were found to greatly influence utilization of YEDF by the beneficiaries as compared to the other social networks. It was therefore concluded that there is a significant relationship between social networks and utilization of YEDF in Isiolo County.

R Square was 0.234 which indicated that 23.4% of the variable Utilization of youth enterprise development fund can be explained by the variable Social networks. The t value was 10.708 which was >2 (t=10.708>2) further confirming significant effect of Social networks on Utilization of youth enterprise development fund. P-value was 0.000 which was <0.05 (P=0.000<0.05) which implies that Social networks had a significant effect on Utilization of youth enterprise development fund. The coefficient B was 0.407 which means that 1% increase in the variable Social networks would increase effective utilization of youth enterprise development fund by 0.407 % or 10% increase in the variable Social networks would increase effective utilization of youth enterprise development fund by 4.07 %. Therefore, the null hypothesis was rejected.

RECOMMENDATIONS AND SUGESTION FOR FURTHER STUDIES

The study identified limitation in information technology as a significant social network challenge among the youth and other community members. The study therefore recommended the need to integrate YEDF entrepreneurship trainings with Information Technology through inclusion of digital financial transaction technology experts in the training programmes such as M-pesa and other banks. The study suggested further research on: Assessment of economic dynamics and effective utilization of YEDF.

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SOCIOLINGUISTIC COMPETENCE OF A TRILINGUAL AT AGE FIVE

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ABSTRACT
Being Trilingual is no longer a strange phenomenon as it may have been sometime back. In fact, in urban settings in Kenya, children are learning English as a third language (L3) rather than a second language (L2). Canale and Swain (1980), propose that communicative competence comprises four language competencies namely: linguistic, sociolinguistic, strategic and discourse competencies. Of concern in this study is sociolinguistic competence of trilingual children at age five. Purposive sampling and snowballing were used to select six children: three boys and three girls. Data was collected through conversational technique where the children were prompted to express themselves in three languages: English, Kiswahili and Mother Tongue. It was found out that the children exhibited three main sociolinguistic competencies: code-mixing, use of colloquial Kiswahili and use of politeness forms. Lexical code mixing was the commonest and the children code-mixed two languages in their utterances. The findings of this study reveal that Kenyan children are on the path of trilingualism at age five and it affirms the current language in education policy which encourages the use of three languages at different levels of education. These findings are relevant to language policy makers today and in the future.
Keywords: Sociolinguistic competence, Trilingualism, Code-mixing, Communicative competence, Age five

INTRODUCTION

A number of studies have been carried out on Bilingual first language acquisition but very few deal with trilingual first language acquisition (Hoffmann 1991; Genesse, 2000; Harmers and Blanc, 2000). Most studies involving trilingualism have been carried out within the frame work of bilingual research. (Hoffman, 2001). Chavalier (2015) notes that the number of children around the world being raised trilingually is increasing but research in the field is scarce.

Hoffman (2001) distinguishes five groups of trilinguals taking into account both the circumstances and the social context under which people become users of three languages. Firstly, there are trilingual children who are brought up with two home languages which are different from the one spoken in the wider community. Secondly, some children become trilingual because of growing up in a bilingual community and whose Mother Tongue (either that of one or both parents) is different from the community languages. Thirdly, there are those bilinguals who acquire a third language in the school context. Fourthly, there are those bilinguals who become trilingual through immigration. Finally, there are those children who are members of trilingual communities and so they end up being trilingual. This last group is the most numerous group and common in Asia and Africa. Most trilingual children in Kenya fall in this last category and also the third category is quickly becoming a reality in urban areas. Their trilingual acquisition is simultaneous rather than subsequent. It is also natural though aided by pre-school experiences.

Most of the studies available on trilingual acquisition are Eurocentric (Hoffman, 2001). One such study was carried out by Dewaele (2000). He followed the trilingual acquisition of his daughter Livia from birth to about (4;3). Livia was brought up in a multilingual environment. Her mother's native language was Dutch and her father's was French and they lived in an English environment. Her father addressed her in French, her mother in Dutch and her friends and neighbours spoke to her in English. From the age of 5 months to 2; 6 she went every afternoon to a Pakistan child – minder who spoke English and Urdu with the children. Livia started producing her first words at the age of one year and two months (1; 2). She had a good passive knowledge of about 150 French, Dutch, Urdu and English words by then. Her first English words were produced at the child minder's house. She never got past the word stage in Urdu but had a passive knowledge of the language. At age 2 she produced mixed utterances usually involving two languages. She used English to communicate to her dolls and with her friends.

Livia's utterances in the three languages were all generally well formed and with relatively few grammatical errors. The errors she made were comparable to those made by monolingual children at the same age. They included the omission of the personal pronoun subject position in French; errors with the past participate in Dutch and an occasional third person for a first-person verb form in English. Most of these errors disappeared by the time she turned four. Dewaele concluded from this case study that a trilingual child can grasp language and use it appropriately according

to the situation. The contextual factors in this study are different from the Kenyan context, Again, the researcher does not provide the communicative competence of the subject at age five.

A study by Njis (2021) investigated the development of a two-year-old American toddler who was growing up since birth in a trilingual language environment of Spanish, English and French. t was found out that the child was developing active trilingualism though the child seemed to favour English over French and Spanish for spontaneous language production. These results agree with the results of the current Study.

Hoffman (2001) gives an overview of Eurocentric studies involving individual trilingualism. He analyses these studies with a view to considering linguistic competence in trilingual children. Competence can be looked at in terms of how it manifests itself and how it might be explained.

According to him:
Trilingual language competence can be said to contain the linguistic aspects, that is, vocabulary and grammar, from the three language systems and also the pragmatic component, consisting of sociolinguistic, discourse and strategic competences pertaining to the three languages involved. In addition, it includes the ability to function in bilingual and trilingual contexts, which require decisions on code choice and code-switching. Trilingual competence enables speakers to create their own linguistic means in order to master particular communicative situations (Hoffmann, 2001:15).

Hoffman (2001) further points out that in young children; trilingual language acquisition largely follows the path of bilingual acquisition. He also notes that there is lack of sufficient numbers as well as a great variety of studies on trilingual acquisition, a gap which this Study aims to fill.

Factors that have been found to be important in trilingual language acquisition and active trilingualism in European settings include the use of the minority language at home (Arnaus Gil, Muller, Sette & Huppon, 2021), language exposure (Chavalier, 2015), parental language strategies and input load. Chavalier (2015) investigated two factors, that is, the role given to the societal language at home and the conversational style of the caregivers. These factors are present in the multilingual urban setting of the Kenyan society and they favour the development of trilingualism in children.

Sociolinguistic Profile: Domains and Concepts
Linguistic diversity is an inescapable fact in most African countries. Kenya is no exception and as a multilingual country, one is bound to face the usual issues associated with multilingual situations all over the world. These include such issues as the social situations of the different languages, the functions that these languages serve and their place in the education system (Whitely, 1974). Majority of Kenyans speak three languages, that is, English, Kiswahili and Mother Tongue.

On the whole, most Kenyans acquire a mother tongue as a first language at home and use it for day-to-day communication in the home setting. It is also used in the rural areas among homogeneous communities. It is also the recommended medium of instruction in lower primary in rural schools (Republic of Kenya, 1981).

Being an Anglophone country, Kenya inherited a colonial legacy of English as the dominant language in the education system. Kenyans learn English in school and can speak it though the degree of fluency depends on the education level and is perceived as the language of literacy and upward social mobility (Micheka, 2005). Kenyans use English as an official language. Educated parents may also use English especially through code-mixing. Children are exposed to English in school right from lower primary to the university. Learning English in Kenya is quickly becoming a practice of learning a third language (L_3) other than a second language as it has been in the past. English plays an important role as a language of instruction at all levels of education especially in the urban school setting (Michieka, 2005).

Kiswahili is widely spoken in its standard or colloquial form as a second language and lingua franca by Kenyans across different ethnic affiliations. In the new constitution it has been given the status of an official language to add to its role as the national language (New Constitution, 2010). It is a compulsory and examinable subject in schools (Republic of Kenya, 1981). In urban areas, some children acquire Kiswahili as their first language. An interesting aspect of Kiswahili language in Kenya is the existence of Regional varieties which are non- standard, for example, Luhya Kiswahili, Kikuyu Kiswahili, Kalenjin Kiswahili, Somali Kiswahili, Luo Kiswahili etcetera (Muhati, 2015).

These varieties are used in day-to-day interactions. Shinagawa (2007) identifies the Proto Bantu suffix morphemes [-AG] and [-NGO] that have their corresponding forms [-ANGA] and [-KO] in the present vernacular Bantu languages to denote functions such as habitual aspect, imperfective aspect and emphatic modality varying from language to language. The insertion of Bantu tense morphemes into Kiswahili words produces local varieties of Kiswahili which are non-standard.

The concept of domain in language behaviour was first elaborated on by the students of language maintenance and language shift among Auslends deutche in pre- World War II multilingual settings. Fishman (1972) has expounded on this. Fishman (1972) says that Schmidt- Rohr seems to have been the first to suggest that dominance configuration needed to be established to reveal the overall status of language choice in various domains of behaviour. Rohr suggested the following domains: the family, the church, literature, the press, the military, the courts and the government. In this study, three domains which are applicable to the children's choice of language. These are family, the peer group and school. Abdulaziz (1982) conducted research on language domains in both rural and urban Kenya. The urban location was Nairobi. He found out that there are two important factors that affect language acquisition and use. These are social-economic class cleavage and the ethnic group membership.

Gorman (1974) did a study on the patterns of language use among school children and their parents. His primary aim was to find out the pre-school knowledge of Kiswahili and English and the extent of the present use of the languages. He designed a questionnaire to find out what language the children spoke to various members of their families at home. He found out that mother tongue was used as language of communication with decreasing frequency. It was used in conversation with grandparents, parents, young brothers and sisters in that order. The children preferred to use English in certain speech interactions, for example, when talking to their closest friends about school.

Wangia (1991) did a study on language choice and use by lower primary school children in a multilingual urban setting. Her subjects were aged between 4 and 9 years. The aim was to find out how the three languages English, Kiswahili and Mother Tongue were used in different environments. She considered the three domains, that is, home, the school and the peer group. The research was conducted in nine schools selected on the basis of the social economic class. Three were from low-income areas such as Kibera and Line Saba. Three were from middle income areas such as Golf course and three from affluent areas like Lavington. The conclusion from the study was that of the three languages, Kiswahili appeared to be one used by most children in the different domains. Children from high income families tended to use English. It was also evident that there were children whose first language was either English or Kiswahili. Others were able to use the three languages fluently depending on how they had been exposed to them.

The home environment is a very important domain for language interaction. Language is first developed in the home. This is where children learn to talk. Interaction within the family involves parents, brothers and sisters, possibly uncles and aunties, grandparents, house helps and even visitors. In the school environment, the children interact with fellow children but from different backgrounds. In school they are also taught English and Kiswahili to add to their first language if it happens to be a different language. The peer group refers to the age group that generally fell within the prescribed ages in the study. Children assume special relationships when they are with their peers. It was not very easy to observe peer group relationships in the school compound because children tend to interact freely. In order to capture the peer group clearly, the researcher used school routes, bus stops and playgrounds in the estates.

The school language pattern seemed to be determined by the language behaviour of the home environment that the children came from. The schools were either Kiswahili or English speaking environment. The children's choice of language was influenced by the environment and by adults. For example, the children from the low income group spoke little English because their parents do not use English. In the current study, the researcher will capture children from the middle class who have been exposed to the three languages.

Given the above discussion, it is evident that either at home, in school or even in the peer group, there is use of code switching and code mixing. This can occur among the children or the adults and these are patterns of language that are likely to be used by children at age five. These two concepts will be discussed in Section 2.

Code-Mixing and Code -Switching

Though the two concepts are not clearly distinguished in sociolinguistic literature, they are different. Code mixing is the deliberate mixing of two languages without an associated topic change. Conversants use two languages together to an extent that they can change from one language to another in the course of single utterance (Wardhaugh, 2010).

This definition is similar to that given by Bhatia and Ritchie (2004). Wardhaugh notes that conversational code mixing is not just a haphazard mixing of two languages brought about by laziness or ignorance or some combination of these. Rather, it requires conversants to have sophisticated knowledge of both languages and to be accurately aware of community norms. It is a source of pride in bilingual and multilingual communities. The mixing occurs in form of morphemes, words, modifiers, phrases clauses and sentences. Utterances containing code-mixing have discourse unity just like those that are in the linguistic varieties.

Code switching is a shift from one language to another and this shift lasts for a long period. It is a conversational strategy used to establish, cross or destroy group boundaries. It is also used to create, evoke or change interpersonal relations with their rights and obligations. According to Myers Scotton (1995), code switching functions as a communicative strategy for facilitating communication by lowering language barriers as well as by consolidating cultural identity. It is a versatile strategy to meet the complex communicative demands placed on urban settings. Crystal (1997) gives three reasons why speakers switch from one language to another. If the speaker cannot express themselves adequately in one language, they switch to the other to make good the deficiency. Switching to a minority language is very common as a means of expressing solidarity with a social group. A switch between languages can also signal the speaker's attitude to the listener.

According to Savans and Muchnik (2008) there is a difference between switches and mixes effected by bilinguals and Trilinguals. For trilinguals there is a third language system involved making the switches/mixes more explicable as a universal multilingual processing rather than a language specific multilingual processing.

THEORETICAL FRAMEWORK

The communicative Model by Canale and Swain (1980.) informed the data analysis in this research. In this Model, Sociolinguistic competence is one of the competencies that show communicative competence. Sociolinguistic competence includes knowledge of rules and conventions which underlie the appropriate comprehension and language used in different sociolinguistic and sociocultural contexts. Sociolinguistic competence can be seen in the use of forms of politeness, change of register, change of style, code switching, code-mixing, use of correct dialect, idiomatic expressions

Sampling Procedure and Sample Size

Purposive sampling and snowballing were used to get a sample for this study. The subjects of the study were selected purposively so that they met the desired characteristics, that is, age and being multilingual. The researcher made contacts with parents whose children were aged between 4;5 and 5;5 and who used English, Kiswahili and Gichuka (or any other Kimeru dialect) in various domains in their interactions. The age was chosen because it is considered a frontier age in Child Language Research (Karmiloff-Smith ,1986). The first contact directed the researcher to other parents whose children were around the same age. Six children formed the sample size for this study; three boys and three girls.

Data Collection and Analysis

The children's utterances were analysed for the components of sociolinguistic competence as described in Canale and Swain's Model (1984). Sociolinguistic competence (SC) includes knowledge of rules and conventions which underlie the appropriate comprehension and language used in different sociolinguistic and sociocultural contexts. Sociolinguistic competence can be seen in the use of forms of politeness, change of register, change of style, codeswitching, code-mixing, use of correct dialect and use of idiomatic expressions.

RESULTS AND DISCUSSION

Three sociolinguistic competence components were found in the children's language: use of code -mixing, use of colloquial Kiswahili and use of forms of politeness.

Kiswahili /English Lexical Embedding

In the children's utterances extracted and presented in Table 1, Kiswahili is the matrix language and English is the embedded language. Free English translation is provided after the utterance and the lexical word that is embedded from English is indicated.

Table1: English Lexical Items Embedded in Kiswahili

Kiswahili Utterances	English Translation	Lexical Item(s)
Alafu siku hio ingine birthday ilikuwanga	Then the next day there was birthday	Birthday
Kirimi- nani wa **class seven**	Kirimi -and he is in class seven	
Eee- nilisikia kwa **TV**	Eee- I heard it on TV	Class seven
Anakuwanga na **muscle** mingi	He has a lot of muscle(body-buider)	TV
	The way it is blue	Muscle
Sii vile inakuwanga ya **blue**	Because you were in this class	
Juu ulikuanga hii **class**	Even a small monkey	Blue
Hasa **monkey** yenye kadogo	It has a lot of lace (material)	Class
Iko na **net** mingi	A very beautiful green trouser	Monkey
Mfuto yenye iko nzuri sana ya **green**	A good dress; another dress	Net
Dress nzuri, **dress** ingine	It is covered by a pillow	Green
Imefunikwa na **pillow**	Yesterday we went to the supermarket	Dress
Jana tulienda **supermarket**		Pillow
		Supermarket
Juu tulikula **glucose** bila maji tukagonjeka t**onsils**	Because we ate undiluted glucose and we got tonsilitis	Glucose
Niko na miaka **five**	Iam five years old	Five
Unaenda hivi **straight**	You go straight	Straight
Anaumba **boy**	He is modelling a boy	Boy
Nilicheza **game**	I played a game	Game
Nikaona **bus** imekuja	I saw the bus had come	Bus
Nitakaa tuu chini nichukue **modelling**	I will sit down and start modelling	Modelling
Na **brother** yangu	with my brother	Brother
Alafu unafungulia **gas**	then you start the gas (oven)	Gas
Ningeenda nifike **town**	I would go to town	Town
Alafu ningekuwa na **powers**	Then I would have powers	Powers
Alafu twende **home**	Then we go home	Home
Naonaga kwa **movie**	I see it in the movies	Movie
Alafu tunafunga **church** tunaenda **home**	Then we leave church and go home	Church
Huwa ananunua vitu analeta **home**	usually he buys things and brings home	
		Home
Alafu saduku ikawekwa flowers	then they put flowers on the coffin	Flowers
jeneza	We will go back to our home	
Tukarundi **home** kwetu	Because they are friends	Home
Juu wanakuanga **friends**	I usually do homework	Friends
Huwa nafanya **homework**	He dropped the dustbin	Homework
Akangusha **dustbin**	There is a beautiful gate there	Dustbin
Kuna gate poa hapo	And it had a swing	Gate
Na ilikuwa na **swing**	He said that and then the movie went on	Swing
Alisema hivyo, story ikaenda **break**	a commercial break	Break
Nikakunywa **breakfast**	I took breakfast	Breakfast
Nirudi tena kwa nyumba niambie Mum nimeona **ndongi**	I would go back and tell my MUM that I have seen a dog	Dog

The results of Kiswahili/English lexical embedding show that except for the verb 'modelling', all other embedded lexical items are nouns. The acquisition of English starts through exposure to a multilingual context where codemixing is the norm. The lexical items embedded were from very varied domains and the explanation for the embedding is that the children acquire the three languages simultaneously. In pre-school, they are taught to name items in English and at home their parents also refer to some items by their English names. It is a type of borrowing as well. The word birthday is always borrowed when speaking in MT or Kiswahili. Their mental lexicon has terms from all three languages and that is why they are able to use English lexical items in Kiswahili grammatical structure with ease.

Mother Tongue /English Lexical Embedding

In this type of code-mixing, Mother tongue provides the grammatical structure into which English lexical items are embedded. In the process of embedding, the embedded lexical items are pronounced with a mother tongue tonal inflection but they remain distinctly English.

Table 2: English Lexical Items embedded in Mother Tongue

Mother tongue	English	Lexical item
Nĩ biscuit, theremende na **roripop**	It is a biscuit, a sweet and a lollipop	Lollipop
Na b**alloon** mingi	And many balloons	Balloon
Tũgũraga **candle**	We buy a candle	Candle
Nĩ cietu cia **Kitchen**	They are for the kitchen	Kitchen
Ndethĩrire Kitchen indugure	I found the **Kitchen** door open	Kitchen
Agatũbe mabuku makwandĩka **date**	She gives us the books to write the date She gives us the Mathematics book	Date
Agatũbe **mathematics** book	We ate snacks	Mathematics
Twarĩa **snacks**	We drunk porridge	Snacks
Twanyua **porridge**	Mum went to work	Porridge
Mum athĩĩ **job**	We watched a music video	Job
Twona **Music**	We went for an outing	Music
Twathire-rĩ **outing**	He pressed one red button	Outing
Abinyire **button** ĩmwe ya **red**	The colour red appeared	Button. Red
Colour red yaũka	With my cousins	Colour red
Na **macousin** makwa	The mattress would get burned.	Cousin
Mattress ka ĩngĩbĩa		Mattress

Kiswahili/ Mother Tongue Lexical Embedding

Table 3: Mother Tongue Lexical Items in Kiswahili Grammatical Structure

Kiswahili	Mother tongue	Lexical item
Nikamtumia **kavideo**	I sent him a small video	**Kavideo**
Ananipikianga **githeri**	She cooks for me githeri	**Githeri**
Tunapanda **mbooco**	We plant beans	**Mbooco**
But siku hizi hanipikii **mukimo**	But these days she does not cook for me mukimo	**Mukimo**
Tunakula mchele tamu una **ndengu** tamu na **mbooco** tamu	We eat delicious rice, delicious greengrams and delicious beans	**Ndengu**
Ndarutha **makosa**	I did some mistakes	**makosa**

Embedding of English (ENGL) into Kiswahili (KISW) Grammatical Structure

The language structures presented in this section show the children's ability to combine morphemes from different grammatical structures and form novel utterances that are grammatically correct.

1. KISW: Huko tulienda **tukaswim**

ENGL: There we went and swam
tu-ka-swim
1PL-PRS-VERB
'We swam'

2. KISW: Alafu tukaenda **ku-swim** tena

ENGL:Then we went back to swim
Ku-swim
INF-VERB
'to swim'

3. KISW**: A-na-m-shout-ia**

ENGL: She shouts at her
A-na-m-shout-ia
3sing-PRS-OBJ-VERB-FV
'He shouts at her'

4. **KISW: Ni-ka-watch** cartoon
ENGL: I watched cartoon
Ni-ka -watch
1SING-PRS-VERB
'I watched"
5. **KISW: Ku-watch** TV
ENGL: Watching the TV
Ku-watch
INF-VERB
'to watch'
6. **KISW: A-na-ni-buy-ai-nga** sweet
ENGL: She buys sweets for me
A-na-ni-buy-ai-nga
1SING-PRS-OBJ-VERB-FV-PROG
'She buys me'
7. KISW: Alafu **a-na-tu-mark-ia** vitabu
ENGL: She marks our books
a-na-tu-mark-ia
3SING-PRS-OBJ-VERB-FV
8. KISW: Narundi **na-watch** cartoon
ENGL: I then watch cartoon
na-watch
1SING-VERB
'I watch'
9. KISW: Tuliambiwa **tu-make a line** turudi shule
ENGL: We were told to make a queue so that we could go back to school
tu-make
1PL-VERB-
'We make'
10. KISW: Aliniachia TV **ni-watch**
ENGL: He gave me a chance to watch TV
Ni-watch
1SING-VERB
'I watch'
11. KISW: Bangĩ **ba-kĩ-swing**
ENGL: Others were swinging
ba-kĩ-swing
3PL-PROG-VERB
'They swung'
12. KISW: Bangĩ **Ba-kĩ-slide**
ENGL: Others were sliding
Ba-kĩ-slide
3PL-PROG-VERB

This pattern of codemixing involves the Kiswahili verb. An English verb such as swing is embedded into Kiswahili grammatical structure to form the word 'anatumarkia' meaning 'she/he marks for us.' The subject, tense and final vowels are provided in Kiswahili. This is made possible because of the agglutinating morphological nature of Kiswahili grammatical structure. Similarly, the construction in Gichuka (which is also an agglutinating language) follows the same pattern as can be seen in N0. 11and 12 (bakĩswing and bakĩslide).

Use of Colloquial Kiswahili

Colloquial language is related to language that is most suited to informal conversation and a style that is informal. Kiswahili verb forms such as 'napikaanga, nilikuwanga, ananipiganga' were use very frequently by the children. The addition of -nga- to the verb form is a common practice in the colloquial Kiswahili spoken around the Mount Kenya region. Colloquial Kiswahili is considered wrong in formal contexts. Some examples of these utterances are the following:

1. KISW: Juu ulikuanga hii class

ENGL: Because you used to be in this class‿‿

Ulikuwanga should be ulikuwa

2. KISW: Kuku kwani zinakamuliangwa?

ENGL: Do you mean to tell me that chicken are milked?

Zinakamuliangwa should be zinakamuliwa

3. KISW: Tunakuanga na mnyama mkubwa

ENGL: We have a dog

Tunakuwanga should be tunakuwa

4. KISW: Mmm …kuku haikamuliangwi ni ng'ombe

ENGL: Yes, it is cows that are milked not chicken

Haikamuliangi should be haikamuliwi

5. KISW: Lakini ile yenye ilikuwanga hapa

ENGL: yes, the one that is usually here

Ilikuwanga should be ilikuwa

6. KISW: Ndio maana anachapangwa kila siku

ENGL: that is why she is disciplined everyday

Anachapangawa should be anachapwa

7. KISW: Mama yangu analalanga shule

ENGL: My mother spends the night in school compound.

Analalanga should be analala

8. KISW: Na ilikuanga ya mama yake

ENGL: It was for my mother

Ilikuanga should be ilikuwa

The common pattern of inflecting verbs with -nga or -ngwi as in anachapangwa (he is usually beaten) to indicate tense (progressive and modality) is an indication of a variety of colloquial Kiswahili spoken by ethnic groups residing around the location of the study, that is Chuka town and its environs. The indigenous languages spoken in this region are Kimeru Dialects. The morphemes [-NGA]and [-NGWI] indicate habitual marker. The above examples show that the children have acquired colloquial Kiswahili from the sociolinguistic context in which they are growing up in. This is a strong indication of sociolinguistic competence.

Use of Forms of Politeness

When asked how they would ask for items from their parents or teacher, the responses were as follows:

1. KISW: Nilimwambia **excuse me** mum, **may I borrow** na akaitikia

ENGL: I asked her politely to lend me and she agreed

2. **ENGL: Excuse me** mom, may I have a remote

ENGL: I politely asked her to give me the TV remote**.**

3. Excuse me, **may I** have a phone
4. **Excuse me**, I borrow a pen
5. Daddy **naomb**a unisaidie simu

Daddy…I kindly request that you help me with a pen

The terms excuse me, may I borrow, naomba (Kiswahili for please) are some of politeness forms that the children used. This is a sign of sociolinguistic competence. Again, the children showed their ability to use politeness forms from different languages.

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FLASH FICTION AS A NEW AVENUE TO ADDRESS SOCIAL VICES: A CASE STUDY OF VINCENT DE PAUL'S *FLASHES OF VICE*, VOLUME 1

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ABSTRACT
Advancement in technology and the internet age has given rise to new platforms of sharing ideas thus leading to the rise and development of flash fiction. This paper analyzes flash fiction as a new avenue for addressing social vices in the digital age. Some of the vices addressed in the selected mini-fictions resonate with the Sustainable Development Goals showing how writers rely on global trends in their creative processes. Marxist literary theory was adopted to examine the social vices that the selected texts address. The article argues that these exemplary flashes are used to develop and propagate complex themes with a long literary history and a wide contemporary relevance. It therefore avers that flash fictions of East Africa have a literary significance just like other genres of art. It is a new avenue to addressing human challenges with wide readership. Flash fiction and the new media are therefore seen as new frontiers in fostering education, research and economic recovery.
Keywords: flash fiction, social vices, short stories, readership, new media

INTRODUCTION

Flash fictions are very short stories which are complete in themselves thus contains all the features of conventional/traditional short stories. They contain the protagonist, conflict, obstacles or complications and resolution. In 1920's, the flash fiction in English flourished in the USA, under the umbrella-term of short-short story. Its popularity waned in the 1950s but resurrected from the mid-1970s. The first macro fiction anthology, edited by Robert Shapard and James Thomas, was published in 1986. The anthology defined sudden fiction to be of 1500 to 2000 words (Shapard et al., 2010). According to Thomas et al (1992) An Eponymous anthology later popularized the term "flash fiction" by setting a limit of 750 words. Today, flash fiction encompasses a wider variety of subgenres, with relatively lower word-limits of up to 750 words or 1000 words at most.

Flash fiction therefore is a short piece of creative work that can be read in less than 10 minutes. Vincent De Paul's "Flashes of Vice" Volume 1 is a collection of six flash fictions with an average of 400 words which depict how class differences in the society fuel social vices. Samuel Vincent De Paul is a Kenyan author, editor and creative writing tutor. In addition to his Bachelor of Science from Egerton University, he has a Diploma in Comprehensive Creative writing and a certificate in Copyediting & proofreading from The Writers Bureau, UK. Some of his works include *The Fundamentals of Strategic Writing*, *Twisted Times: The Phantom*, *Inevitable Desires*, *Flashes of Vices Volume I to III*, *Twisted Times: Son of man*, *Holy Crime: A collection of love poems* among others. This paper analyses the six mini-fictions in De Paul's first volume of Flashes of vices since the stories highlight social vices that ail contemporary Kenya. They are a representation of how the state apparatuses like the church and the justice system are used to champion the dominant bourgeoisie ideology. The selected flashes also highlight issues that resonate with the Sustainable Development Goals; a proof that the flash fiction writers are in touch with the societal needs and ailments.

The paper therefore strives to find out how flash fiction is creating a new avenue for addressing social vices. It aims at a closer examination of the emergent flash fiction. In doing so, topics such as genre definition, its development, its producers and consumers will be broached and, finally, its potential as an avenue to critique social vices will be discussed. The debate on the relationship between literature and the social media as literary space has been on the rise since late 1990s. The internet and social networks create imaginary spaces through WhatsApp, Facebook and twitter just to mention a few, which provide an avenue for literary interaction. Many authors like Vincent De Paul use the online platform to promote and publish their works.

The online platform has had noticeable influence on literature particularly on the short story and storytelling. Paolo Coelho – author of *The Alchemist* – when asked about his view on the internet and its effects, responded that "today everybody can tell a story. That is magical because everybody can express themselves" because of internet. Internet has given space for democratization of communication giving rise and development of the flash fiction sub-genre. Social networking has made flash fiction one of the most popular genres in the digital age. Flash fiction is also known as micro fiction, mini-fiction, nano-fiction, quick fiction, sudden fiction, smoke-long fiction, short short story, postcard fiction, and very short story (Botha,2016; Holdefer, 2014). Flash fiction fits the modern digital media because

they easily suit the specifications of tablet and mobile screens. According to Al-Sharqi & Abbasi (2015) and Levin (2020) mini-fiction and the digital media serves the needs of average reader and the "busy" audience who have to utilize the little time they have to read and retain despite a wide variety of texts with other attractive options. Through the communication channels – twitter, Facebook, blogs, YouTube, watt pad, drabble – people have the opportunity to record their experiences quickly and transmit to a wide audience at little or no cost.

Since flash fiction is one of the easily available genres, and easily accessible to the digital audience, it is one of the best tools to disseminate knowledge and to sensitize people to be on the fight against social vices. One can easily read a single story between breaks and still attend to their duties. This article examines how flash fiction uses the online platform to address social vices in the digital age where reading culture is said to be dwindling.

Background Information

In the study of Hyper-compressions: The rise of flash fiction in "post-transitional" South Africa, Blair (2020) states that each flash story under his study is rooted in the psychological and material legacies of apartheid, thus develops contemporary themes with a substantial literary history. He states that the flash fiction in a post transitional South Africa are of historical relevance since they address the historical peculiarities of the southern region of Africa. They highlight ethical complexities, racial segregation and evolving urban environment among other themes.

Lutch (2014) argues that flash fiction has found a platform in the internet. Through the new media; new digital devices such as smart phones, e-book readers or social networks, short and concise fictional texts can reach people anywhere anytime. Flash fiction literature can be read, consumed and enjoyed within a very short time span anywhere for instance when waiting for the doctor, shifting between chores, and still fulfil the traditional three main aims of literature; to inform, to persuade and to entertain. This volatile nature of flash fiction makes it ideal for the sensitization of the masses as it can be consumed without interfering with other duties.

According to Agbetuyi and Kolajo (2021) internet has contributed enormously to the achievement of education for all. However, the surge of its elements like social media has led to shift in concentration from the conventional reading pattern adapted from the spread of civilization to a society riddled with technological advancements. The two emphasize that the increase of internet use and proliferation of digital media have greatly transformed the reading habits in such a way that it is fast disappearing into the thin air.

Agbetuyi and Kolajo further portray how the internet seems to have reduced the public interest in reading of printed materials for vocabulary development, general knowledge and broadmindedness which individuals get from having good reading habits. This is an argument that the present paper refutes. The diminishing trend of reading printed materials does not mean that people do not read; they read through the online platform. The rise of digital media has given a wider space to propagate literature of every form that can still spread vocabulary, increase general knowledge and broaden minds of the masses. The digital media has by far made it cheaper to obtain these materials which could have otherwise been expensive in their printed forms.

Owing to technological innovation, internet use is threatening reading culture especially among the secondary school students (Akidi et al 2021). Akidi et al argue that most of the students spend a lot of their time in the internet browsing on matters of less importance rather than reading to acquire knowledge. Such students laze around, surfing the net, playing video games, listening to music with big headphones, chatting with friends instead of taking up some serious reading sessions. They consider sitting in a quiet corner of the library reading as some primitive practice thereby making reading a book or any other information resource a dying entity. The declining interest in reading among young people compared to increase in hours spent on the Internet has become a cause for alarm and a challenge to all and something needs to be done to change the scenario. The current paper argues that with the flash fiction, the time spent on internet can still be productive as the e-platform has provided a lot of information that can widen the knowledge of these internet users. Flash fiction comes in handy in that they are succinct, interesting and pass relevant values to the internet crazed lot without much expense in terms of money and time. The article therefore examines how the selected mini-fictions are of relevance to the contemporary society.

Marxist literary theory originated in the 19th C through the writings of German philosopher, Karl Marx (1818-1883). Bressler (2003) states that Marxist theory did not develop until 20th C when critics focused on the study of the relationship between literature and a society that consumes it. Marxism flourished as practical solution to the working class to better their world. It provided the society with a place of action that could help initiate change in the society.

Bressler argues further that Marxist literary theory made it easy to understand the political, social and the economic systems of a society. Marx and Engle argue that the elite use ideology to pass on beliefs and values that help them maintain power over the poor. In what they call false consciousness, Marx and Engles argue that the dominant social class uses this negative ideology to shape and control people's self-definition and class consciousness.

This study adopted Leninism strand of Marxist theory that championed social emancipation. As Alia (1970) puts it, Leninism advocates for the death of exploiters and oppressors in the community thus creating a world of social justice; a community where each member is treated equal. This theory guides this study to examine how flash fiction reveals the truth about human social interactions in an internet age.

Social Vices Through the Lens of Marxist Literary Theory

The old Marxist adage states that the society is divided into classes where the rich continue getting richer and the poor get poorer. The gap widens daily as the systems support the rich and impoverish the poor further. Vincent De Paul captures the injustices meted on the poor due to their status in the socio-economic ladder. According to Alia (1970), economic circumstances determine the value of human life. Every action one does or is involved in depends on his/her economic status or economic goal. Most of the stories in Vincent De Paul's anthology pass lessons to the reader on false consciousness of the masses that make them accept the dictates of the ruthless systems.

The stories further highlight lack of morality and common decency due to economic systems. Bressler (2003), states that the structure of the society is built on the conflicts between the different social classes. The main cause of these conflicts is the way members of the society use their economic power differently. The selected stories portray how gender and religion are used to segregate and subjugate the unsuspecting members of the society.

In "Guilty as Charged," and "Of Lovers and Cheaters," Vincent De Paul exposes how gender inequality contributes to gender based violence, rape, abortion and infidelity among other social vices. According to Heyman (2018) Marxist feminism is concerned with how the society praise masculinity and treats women as secondary beings geared towards sexual orientation. In "Guilty as Charged," the narrator kills her husband in cold blood for raping their teenage daughter. We are informed that the man has been sexually starved by the wife due to her nature of work and thus he rapes his daughter. This story portrays what results in a society where people give priority to their career progression at the expense of their families. Such violence as indicated in the story is on the rise as the narrator states: It was a high profile case with high-octane media frenzy. I was now part of statistics of rising cases of police officers killing their spouses. The only twist was that I did not end my life in the process of giving crime reporters a field day (p.1).

Domestic violence is one of the issues affecting the social well-being of the society. It can be deduced that these issues are caused by lack of self-control, prioritization of the careers and infidelity among the spouses. As reported by the K24 TV on July 2, 2022, a similar incident occurred in Migori, Kenya where a female cop was arrested after allegedly shooting and injuring her lover under unpublicized reasons. During covid-19 period, more of such cases were reported in Kenya and some of the reasons given for their rise is the poor mental health and harsh economic times.

The man in the story, "Guilty as Charged," is evil to the extent that he sees his only daughter as the only way to kill his sexual urge. Vincent De Paul's flash fiction is therefore a call for revolution. Men should stop giving women sexual orientation and women should stand strong against this vice irrespective of the price they have to pay. Family is a fundamental basic unit in the prosperity of a nation. A happy family creates a happy and prosperous nation. At a time when career progression is the main goal of many couples, they should ensure the wellbeing of their family is a priority. The raped girl has for long reported to her mother about the rape cases but she has been too busy to pay attention.

The story indicates that such deaths will continue to rise if things don't change. The narrator herself, admits that she is ready to do it again should anybody touch her daughter. On Thursday, December 10,2020, The Daily Nation reported that the UN's Covid-19 Gender Response Tracker indicated that there was an upsurge in domestic violence, sexual harassment and sexual violence globally and little was done to curtail their rise. It is with this fact that De Paul calls for drastic measures, sensitizing women to arise and take every possible step to fight these vices.

In the story, "Of Lovers and Cheaters," Rita lures Steve into infidelity because of material gain. Despite the fact that she knows that Steve is happily married with adorable family, she tries her best to take him to bed. She becomes pregnant for Steve and blackmails him to give her a few millions for the issue to remain a secret or continue being at

her service. Steve is thinking of running for governorship, so such a scandal is not healthy for him. He therefore gives in to Rita's demands. The need for material gain drives Rita into prostituting in the name of love. All these social vices happen in the society because of the need to climb the economic ladder. Rita does not want to be poor anymore and is using whatever she has to wring money from the unsuspecting rich Steve. Steve ends up giving in to Rita's demand just to maintain his status. As Rita does this sex game for money, Steve is a womanizer. Through their dialogue we realize that apart from Rita and Cecilia, Steve has another lady, Jacky. Apparently he is in this because of his socio-economic status.

"On Lovers and Cheaters" is also an indicator that De Paul is sensitive of the things happening around him and trying sensitize the society to fight for their betterment. The story resonates with an occurrence in Kenya where a governor was suspected to have killed a university student who used love to fleece money from him. As Kamau Muthoni reported on the Standard Newspaper on March 9th 2022 that details emerged linking the governor to the young girl's death. Sources indicated that the girl had pushed the governor to the corner with her incessant need for money.

According to Bressler (2003), Marx assumed that the experiences people go through such as their social interactions, employment and day-to-day activities directly shape the development of personal consciousness of an individual. It can therefore be noted that these personal experiences and contradictions in individual needs create conflict in the society. Rita ends up killing the unborn baby due to the circumstances in which it is conceived. Steve does not want the baby because it comes out of extramarital affair while Rita does not keep it maybe because it can harm her 'Miss independent' tag. De Paul thus creates scenarios that may lead to abortion as a social ill and a practice against the law that every being should strive to castigate.

Justice delivery is an issue of concern in many nations' judicial systems today. Corruption is a major impediment to achieving a fair judicial functions. To expose the rot in the judicial systems and land offices in Kenya, De Paul address the stories of land injustices in, 'Most wanted'. De Paul paints a picture of a judicial system that cares only for the haves. It takes care of the rich irrespective of their criminal records but hunts the poor for their felonies. John's family loses its ancestral land to the "owners" of the society. The justice system cannot protect them from losing their land because they are poor. John's father askes about how much a judge costs because he does not understand how he can lose a case involving his ancestral piece of land.

The killer of John' grandpa wins the case and takes the land because he has money. According to Boone (2017) few individuals who want to uninterruptedly control the resources cause the conflicts in Africa. John feels sad about their predicament and boasts about being the most wanted criminal globally because he is willing to kill any person who uses his wealth and power to oppress the poor. He tells his father: 'I have a bounty of over a billion shillings on my head. I rob, with violence, and kill the rich—government officials, media moguls, academicians, church leaders, bankers, police, judges, military gooks and all (n.p).' John thus becomes the judge and jury to fight for the common man. The story is sensitizing the common man to stand up and be ready to fight the status quo. De Paul seems to echo Bjelkendal (2020, p.22) that "Change will not come by remaining within the system, only by exiting it." The systems in place are structured in that they support the haves maintain their position as the poor remain below the economic ladder. As Bressler puts it, Marxists maintain that the bourgeoise control the economic base and establish structures and institutions that will help them maintain their dominance. As seen in this story, the justice system is well under the control of the haves in the society.

In the story "Church Hypocritical", De Paul uses Irony to expose the effects of religion on the economic well-being of the believers. The church is designed in a way that it swindles money from the poor as it discourages them from earthly reaches. They are made to believe that true Christians have riches in heaven. The poor become poorer as the rich become richer since the poor contribute every penny they have to secure their way to heaven. As per Surin (2013), Marxism has always considered that all modem religions and churches, and all religious bodies, are organizations used by bourgeois reactionary groups to buttress their system of exploitation and make the working class docile.

Bishop Rotich wages war on religion. He teachers his congregants on the secrets of the church thus angers the mother church and the Pope. He considers himself a whistle blower as he is against some practices of the Catholic church. When Pope Leo asks Bishop Rotich why he (Rotich) is revealing the 2000-year secrets of the church, Rotich responds:

"And all these trappings of power? Christ Himself was a poor tramp with nowhere to lay His head. But look—all this vast wealth, do you really need it, Holy Father? We live in mansions of human anguish, crowned with pomp and live in gilded rooms while the flocks we shepherd languish in poverty (n.p).

Bishop Rotich in this quote represents the middle class members of the society who have taken the risk to sensitize the poor against being too blind in religion that they are unable to meet their own livelihood but contribute the little they have to cater for the lavish spending of the men of cloth.

De Paul in "Daddy's Girl," shows how the rich use their position to fuel vices in the society. Loyce, who is the president's daughter, is using her position to sneak class A heroin into the country. Upon being arrested, she insults the police officer and tells her how her class would get her out of the cell. Loyce threatens inspector Lina that she would lose her job if she fails to release her. This shows how the middle class and the low class citizens keep supporting the rich to keep their position at the top of the ladder. Those in power use their power to manipulate the system to their advantage. This incident echoes some occurrences in Kenya where the political class use their power to hinder the smooth running of any case against them. In the recent past, many cases have been withdrawn from the court due to lack of evidence as witnesses are coerced to withdraw. In some cases, judges are bribed to rule in favour of the powerful in the society. Inspector Lina is sure enough that with the evidence she has, Loyce should rot in jail and she says:

"Not your dad's, junkie. And if the grapevine is anything to go by, your father is retiring tomorrow. If I were you, I'd be trying to persuade dad to chunk off part of his send-off package to get me the best criminal lawyer around. The judges might decide to get you a few years or a hefty fine, or both, which of course dad would pay, or you will rot in jail and no one will appeal."

This excerpt reveals more about the Kenyan system. One is powerful and can control strings only when on power. Things change with every regime. With the fact that the president is relinquishing power, his daughter is bound to rot in jail. It is evident that the rich are able to bribe the system and fail to serve the punishment they deserve. On the other hand, the poor suffer all the injustices. Loyce tries hard enough to bribe Inspector but the latter remains steadfast, ready to change the status quo. Calls from the Minister of internal affairs and the police commissioner reveal that Loyce has been on the trade for long and has always evaded arrest and trial because of the position of her father and her uncle who is also the Minister of internal security. They both come to one resolve, "Utumishi kwa wote." – service to all.

De Paul uses flash fiction as a genre to explore and expose how the powerful and the rich use their might to oppress the poor. With such rich flash fictions on the internet, the masses can read at the comfort of their work or busy schedule and take something home. De Paul has used flash fiction to highlight many social vices that ail the community. Some of the issues raised in his stories are domestic violence, rape, police killings, land injustices, infidelity and abortion just to mention a few. Since the new media has created a new avenue where the masses can be sensitized against such vices at a cheaper cost, then internet use and the flash fiction texts should be embraced.

CONCLUSION

Internet age has widened access to limitless reading materials. Reading is essential for both personal and academic success of an individual thus its importance cannot be overemphasized. Furthermore, it aids language development, socialization and civilization. To effectively survive and explore the environment, the society requires good reading materials. It is through reading that individuals are able to interact with information that leads them to betterment. It is therefore important to realize the need to read as a way of appreciating the importance of information and effective communication for the growth of a society. Moreover, the development of reading and availability of standard reading materials are basic needs, which society must confer on its citizens as part of their education. Some technological innovations are a great boost to dissemination of the information. Internet being one of the technological innovations has limitless treasure of information that are readily available and easily accessible for people to use worldwide and simultaneously. Therefore, Internet is a channel that supports wider dissemination of flash fictions. It is opening new avenues to address societal challenges and innovations for sustainability.

Basing on the analysis highlighted in this article, it is worth concluding that mini-fiction has opened new platforms to critique social vices and give possible ways of correction. Digital age has led to the rise and development of flash fiction which people can consume anywhere any time through their phones, laptops or tablets. Social media platforms

such as WhatsApp, twitter, and Facebook just to mention a few come in handy as they are frequently visited. Despite the fact that they are aesthetically created for entertainment, mini-fiction do function as points of inspiration and sources of correction and inspiration to the readers.

This paper has shown that flash fiction has created a new avenue to address and critique social vices and further sensitize people towards taking appropriate steps towards change. Through the selected flashes, Vincent portrays that change cannot be entrusted on the elite and the experts, it is the oppressed that should struggle for change. The oppressed have all it takes to transform the conditions of their own oppression through struggle. De Paul in Guilty as Charged" and "Of Lovers and Cheaters" expose issues like infidelity, abortion and domestic violence and social vices. In "Most Wanted," he addresses the injustice in the justice systems of the nation. It is therefore worth noting that writers respond to the global trends and with that they are able to direct the society towards its recovery.

The study recommends that scholars and avid readers should organize seminars aimed at sensitizing the public on the right use of the Internet to access different reading materials, and widening their knowledge for the socio-economic betterment and flash fiction as a genre is providing a wide platform for resources.

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UBABEDUME KATIKA TAMTHILIA YA *BEMBEA YA MAISHA* (2022)

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IKISIRI
Mfumo-dume humpa thamani kubwa mwanamume huku ukimdhalilisha mwanamke kwa sababu ya jinsia yake. Imani hii dunishi imo katika itikadi na tamaduni zinazohimiliwa na mfumo wa muundo wa kijamii ambao mwanamume anapewa nguvu na uwezo zaidi dhidi ya mwanamke katika nyanja zote za maisha hususan kiutawala, kiuchumi, kidini, kisiasa na kijamii. Basi, makala hii ililenga kuchunguza jinsi mwandishi wa tamthilia ya *Bembea ya Maisha* (2022*)* alivyomsawiri mhusika wa jinsia ya kiume katika kazi yake ili kuweka wazi shughuli za ubabedume zilizojengwa katika mila, itikadi na utamaduni wa jamii husika. Data ya makala ilipatikana kwa kuisoma tamthilia teule kisha kuichanganua kwa kutumia Nadharia ya Ubabedume ambayo hulenga kubainisha nguvu na mamlaka yanayomilikiwa na jinsia ya kiume, hasa kutokana na utamaduni wa jamii husika. Matokeo ya utafiti yalibainisha kuwa mhusika wa jinsia ya kiume amesawiriwa kama mtegemezi, mrithi wa mali, ameruhusiwa kupata mtoto nje ya ndoa, haruhusiwi kujishughulisha na kazi za nyumbani, anaitwa gumba kwa kutopata watoto na anayejitwika majukumu yote ya nyumbani. Masuala haya yamekithiri katika jamii za leo. Ikiwa nchi zinazoendelea zitapiga hatua katika maendeleo, basi usawa wa kijinsia unahitaji kutiliwa maanani na jamii zote.
Istilahi Muhimu: Usawiri, Mfumo-dume, Taswira, Ubabedume, Jinsia

UTANGULIZI

Walsh (1997) anasema kuwa uume huhusishwa na uwezo wa mwanamume kuwa na mafanikio kukimu na kutosheleza mahitaji ya familia. Mtaalamu huyu anasema kuwa mwanamume hazaliwi na uume kama sehemu ya viungo vyake bali hujengwa na kukuzwa na utamaduni anamokulia. Vilevile, Connell (2000), anashadidia hili kwa kusema kuwa ubabedume hutazamwa kwa njia zaidi ya moja kama vile mahusiano ya kijinsia, ukatili, malezi na hata kazi. Kauli hii imejengeka katika misingi kwamba utamaduni ni dhana muhimu na ni uti wa mgongo katika ujenzi na matumizi yake kutegemea jamii husika kwa vile, kila jamii ina utamaduni wake.

Kulingana na Chafetz (1974) na Doyle (1985) ubabedume ujitokeza katika desturi kwa jumla kupitia maumbile, nguvu za kimwili, ushujaa, kufanya kazi na kukidhia familia, kuwa na tajiriba na shari ya kijinsia, ukakamavu, urazini, kutaka makuu, majivuno, uadilifu, ushindani na kuthubutu mambo. Basi, makala haya yalikusudia kubainisha jinsi mwandishi alivyodhihirisha ubabedume katika kumsawiri mhusika wa jinsia ya kiume.

Wasifu wa Mwandishi Timothy Moriasi Arege

Kwa mujibu wa Kinuthia (2010), Timothy Arege ni mzaliwa wa Kaunti ya Kisii magharibi mwa Kenya. Alisomea kuko huko kabla ya kujiunga na Chuo Kikuu cha Nairobi, ambapo alijipatia shahada ya B.A. (Kiswahili na Sayansi ya Kijamii). Mnamo mwaka wa 1998 alipata shahada ya Uzamili (MA) katika taaluma ya Kiswahili katika Chuo Kikuu cha Nairobi. Katika mwaka wa 2013, alipata shahada ya Uzamifu katika chuo chicho hicho. Mwaka wa 2008/2009, Arege alituzwa kuwa msomi bora na Chuo Kikuu cha Kikatoliki cha Afrika Mashariki, Kenya. Vilevile mwaka wa 2011, Arege alishinda Tuzo ya Fasihi ya Jomo Kenyatta mnamo 2009 kwa kazi yake *Kijiba cha Moyo* (2009). Kwa sasa Arege ni mhadhiri wa somo la Kiswahili katika Chuo Kikuu cha Kenyatta, Kenya. Tamthilia zake nyingine ni pamoja na *Chamchela* (2007) na *Mstahiki Meya* (2009) na *Bembea ya Maisha* (2022).

Muhtasari wa Tamthilia ya *Bembea ya Maisha*

Tamthilia ya *Bembea ya Maisha* iliandikwa na Timothy Moriasi Arege katika mwaka wa 2022 na kuchapishwa na *Access Publishers Limited* mjini Nairobi. Tamthilia hii inawahusu wahusika wawili Yona na Sara ambao wanawapata watoto wa jinsia ya kike:- Neema na Asna baada ya kutojaliwa kwa miaka kadhaa. Hata hivyo, jamii inamwona asiye na mrithi kwani watoto hawa si wa jinsia ya kiume. Sara anamsaidia Yona kuwasomesha watoto wao. Neema anapata kazi kule mjini na kuwa wa manufaa kwa wazazi wake. Anatumia pesa zake kugharamia matibabu ya mamake na pia kuwakimu wazazi wake. Hatimaye, msimamo wa Yona kuhusu mila na desturi za jamii yake unabadilika na anaanza kumthamini Sara na Neema aliowadhulumu kabla ya mabadiliko hayo.

Nadharia ya Utafiti

Makala hii imetumia nadharia ya ubabedume. Kulingana na Wells na Holland (2001:2), mwasisi wa nadharia hii ni Robert Bly wa Marekani katika mwaka wa 1991. Nadharia hii inajikita katika maumbo ya vitambulishi vya jinsi ya kiume kwa kuzingatia jamii, maandishi na matukio au maelezo ya kihistoria. Isitoshe, mkondo wa nadharia hii unawania kuhalalisha desturi za jinsia ya kiume na ubabedume. Nadharia hii ilitokana na mwamko wa vuguvugu la wanaume ambalo lilichochewa na kazi za Robert Bly na wengine (Chafetz, 1974). Kichocheo cha vuguvugu la wanaume kilitokana na uhakiki wa jinsia ya kiume na utawala wa wanamume unaoathiri kila sehemu ya jinsia ya kike pamoja na mageuzi ya miaka ya 1960. Huu ulikuwa wakati wa upeo wa mgogoro wa itikadi za kijamii katika nchi za Marekani ambazo zilihitaji kuzingatia upya majukumu ya kijinsia. Mgogoro huu ulihusu nafasi na majukumu ya kijinsia katika jamii.

Kulingana na mihimili ya nadharia hii, utawala wa mwanamume umehalalishwa katika kila sehemu ya maisha kwa kusisitiza maumbo ya vitambulishi vya jinsia ya kiume kwa misingi ya jamii, maandishi, matukio na maelezo ya kihistoria (Wells na Holland, 2001). Aidha, wanaume wametawala na kuwa na mamlaka makuu katika jamii kwa kushikilia nafasi za rasilimali zenye thamani katika jamii kama vile kazi, pesa na taasisi za kijamii zenye nguvu kama vile serikali na dini (Collins, 1971). Nadharia hii ilifaa katika kuweka wazi masuala yanayodhihirisha vitendo vya ubabedume kupitia kwa wahusika wa jinsia ya kiume.

Mbinu za Utafiti

Data ilipatikana kwa tamthilia ya *Bembea ya Maisha* kisha kuzichanganua kwa kufuata lengo la makala na mihimili ya nadharia iliyotumika.

Matokeo ya Utafiti

Makala haya yalikusudia kubainisha usawiri wa mhusika wa jinsia ya kiume. Matokeo yamedhihirisha kwamba mwandishi amemchora mwanamume ambaye ana sifa zinazohalalishwa na mila na desturi za jamii ya mwandishi. Sifa hizi ni kama vile: mwanamume ni mtegemezi, mrithi wa mali, ameruhusiwa kupata mtoto nje ya ndoa, haruhusiwi kujishughulisha na kazi za nyumbani, gumba kwa kutopata watoto na anayejitwika majukumu yote ya nyumbani.

Mwanamume kama Mtegemezi

Kulingana na Nadharia ya Ubabedume majukumu katika jamii hugawanywa kiuana. Kuna yale ambayo yametengewa jinsia ya kike na mengine jinsia ya kiume. Mgawanyo huu hudhihirisha namna mamlaka na uwezo hugawanywa kijinsia. Mwandishi wa tamthilia husika amemsawiri mwanamume kama mhusika anayemtegemea mwanamke. Yona analalamika kuwa mkewe Sara hajapika chakula hata ingawa ni mgonjwa. Ijapokuwa Yona anayaelewa haya, kulingana na utamaduni wa jamii yake hawezi kumsaidia mkewe ila tu kumtegemea kwa majukumu ya nyumbani. Kwa mfano:

> **Yona**: Sara, bado ungali pale pale? Nyumba hii haifuki walau moshi hata kama chakula ni taabu kwako?
>
> **Sara:** Yona mume wangu, moshi utafukaje? Mwenzio hapa nilipo kichwa kimeudara mto siku nzima. Wewe unajua ni kwa ajili ya maradhi haya, si kwa uzembe wala raha.
>
> **Yona**: Ndipo tufe njaa?
>
> **Sara**: (Akimtazama usoni.) Sivyo…
>
> **Yona**: Ndivyo. Njaa haileti shibe Sara!
>
> **Sara**:…Miaka yote hiyo nikiwa ningali mzima na afya yangu mbona sikufanya ajizi? Muda wote huo nikipika mimi, nikiandaa na kukukaribisha ule. Iweje leo kazi hiyo inishinde? Yalaumu maradhi (Uk 1).

Suluhisho la Sara lawa nikumwita jirani yake Dina aje kumsaidia kupika kwani hawezi kupata usaidizi wa Yona katika kazi za nyumbani. Sara anasema yafuatayo anapoulizwa kama bado nyumba haifuki.

> **Yona**: Hivi leo nyumba hii haifuki?
>
> **Sara**: Subiri. Nimempelekea Dina salamu aje akatufanyie chochote. Mwenzio nilivyo hivi mwenyewe hata sijifai kitu. Mwili mzima mfano wa bua.
>
> **Yona**: Haidhuru. Nitasubiri.
>
> **Sara**: Hatakawia. Yeye huitika wito haraka (uk 4).

Hatimaye, Dina anaitikia wito wa Sara. Anamwambia Kiwa kuwa:

> **Dina**: Mwanangu sasa mimi ninaondoka. Ninaenda kwa Sara kumsaidia na upishi. Hali yake ile haimwezeshi kufanya chochote. Amenitumia salamu niende kumsaidia lakini kwa kuwa nilikuwa nimebandika sufuria, nikaona heri nimalize upishi wangu (uk 11).

Mazungumzo baina ya Dina na Sara yanaashiria kuwa malezi na makuzi ya Yona hayamruhusu kuingia jikoni ili kumfaa mkewe. Yona anaona heri kuondoka nyumbani badala ya kupika ilhali mkewe ni mgonjwa. Wanasema hivi:

> **Sara**: Ninajua sasa karibu arudi.
> **Dina**: (Anaanza kupika.) Hivi amekwenda wapi?
> **Sara**: Hakusema. Ameondoka tu. Alikuwa amekuja kutoka huko kwa wenziwe kupata chochote lakini akapata mwenyewe nilivyo hoi hata jiko halijaona kiberiti. Ilivyo desturi ya wanaume wetu, naye akataka kujua kwa nini sikumwandalia chochote.
> **Dina**: Haoni hali yako?
> **Sara**: Anaona lakini ninafikiri malezi na makuzi yanamtuma hivyo.
> **Dina**: Wanaume wetu hawa! Hawawezi hata kusaidia kupiga makasia chombo kinapopungukiwa upepo! (Uk 13-14).

Mwanamume kama mrithi wa mali

Wells na Holland (2001:16) wanadai kuwa nadharia ya ubabedume inawania kuhalalisha desturi za jinsia ya kiume na ubabedume. Wanajamii wanaunga hoja hii wanaposhikilia kuwa mtoto wa kiume ndiye hurithi fimbo ya baba. Mazungumzo baina ya Yona na Sara yanaangazia haya wanaposema yafuatayo:-

> **Yona**: …Sharti ujue kwamba fimbo ya mzee hurithi mtoto wa kwanza.
> **Sara**: Fimbo wanarithi watoto wa kiume; si wa kike (uk 2).

Mfumo dume huu unaungwa mkono na wanawake wenyewe kama Sara anavyosema.
Yona amejaliwa watoto wa jinsia ya kike kumaanisha kuwa hana mrithi kama vile Sara anavyosema.

Jamii nayo inaunga mkono kauli hii kama anavyosema Dina kwa Kiwa.

> **Dina**: Lakini kama ujuavyo mwanangu mwanadamu sawa na tumbo, hakinai.
> **Kiwa**: Hivi kweli mama tumbo halikinai?
> **Dina: …**Roho ndiyo hukinai.
> **Dina**: …hayakuishia hapo. Baada ya ile mvua ya baraka iliyowanyea, watu walianza tena kuwasema kuwa hawana mtoto wa kiume.
> **Kiwa**: Kwa nini hilo nalo liwakere:
> **Dina**: Mahasidi hawana sababu. Halafu upo huo Uafrika mwanangu. Watu waliuliza na wangali wanauliza ardhi ya Yona atarithi nani! (uk 8).

Ni wazi kwamba jamii inamthamini mtoto wa jinsi ya kiume kumliko wa kike. Imani ikiwa wa jinsia ya kike ataolewa na kumwacha mzazi wake. Imani hii inamdhalilisha mtoto wa jinsia ya kike na kumpa nafasi ya juu yule wa kiume.

Wazee wenzake Yona walimhimiza kumwoa mke mwingine ili amzalie mtoto wa kiume ambaye angekuwa mrithi wake. Dina anasema hivi: -

> **Dina**: Nilikuwa nimesahau. Naam, hazikwisha kamwe. Watu walimtia Yona maneno kuwa lazima awe na mrithi. Walimtaka aoe mke atakayemzalia watoto wa kiume kwa kuwa, kwa maneno yao, Sara alikuwa ameshindwa.
> **Kiwa**: Kweli?
> **Dina**: Sijui imekuwaje lakini haikupata kutokea hivyo licha ya minong'ono yote iliyokuwepo. Ila unyanyapaa ulimfanya Yona kuupokea ulevi kwa mikono miwili (uk 9).

Dondoo hili linaashiria kuwa mwanamume akosapo mtoto katika ndoa, mwanamke ndiye hulaumiwa.

Dina anamfahamisha Kiwa kuwa Sara alipokea kichapo kwa kutomzalia Yona mtoto wa kiume. Hatimaye, kichapo hiki kilimsababishia maradhi ya moyo.

> **Dina**: Hao wametoka mbali. Upo wakati hakuna aliyeamini wangeishi pamoja. Pamoja na ulevi wake, Yona alianza kumpiga Sara; tena kipigo cha mbwa hasa alipokuwa amelewa. Mara kadhaa alimwagiwa maji baridi kumrejeshea fahamu.
> **Kiwa**: Kwa nini kichapo chote hicho?
> **Dina**: Eti hakumzalia mtoto wa kiume (Uk 10).

Jamii ya Kiafrika ina Imani kuwa iwapo familia haina mtoto wa jinsia ya kiume basi haina mrithi yeyote.

Mwanamume ameruhusiwa kumpata Mtoto nje ya Ndoa

Kulingana na nadharia ya ubabedume, kunazo sifa angama za uwezo-uume ambazo ni sharti mwanamume awe nazo ili kuweza kujenga, kudumisha na kudhihirisha ubabe. Sifa hizi ni kama vile; uvumilivu, uwezo, kutoogopa, kuthubutu, ukware miongoni mwa sifa nyingine. Makala hii imepata kwamba jamii inamsukumwa Yona kuwa mkware ili kuthibitisha ubabedume wake. Sara anapomzalia Yona watoto wa jinsia ya kike, rafikize walimshauri aoe mke mwingine ambaye angemzalia watoto wa kiume kwani Sara alikuwa ameshindwa. Kauli hizi zilikuwa zikimwelekeza kuwa mkware. Dina anamwambia Kiwa yafuatayo:

> **Kiwa:** Ulikuwa unasema karo za watu hazikuishia pale.
> **Dina**: Nilikuwa nimesahau. Naam, hazikwisha kamwe. Watu walimtia Yona maneno kuwa lazima awe na mrithi. Walimtaka aoe mke atakayemzalia watoto wa kiume kwa kuwa, kwa maneno yao, Sara alikuwa ameshindwa (uk 9).

Rafikize Yona wanapendekeza kwamba atafute mtoto nje ya ndoa mradi awe wa kiume ili athibitishe kuwa ana ubabedume. Wanaamini kwamba atakuwa amepata mrithi na jina lake halitapotea. Haya yanafanyika ilhali Yona ana watoto wawili; Neema na Asna walio wa jinsia ya kike. Jamii haithamini watoto wa jinsia ya kike basi inachangia katika kuendeleza ubabedume. Shinikizo hili linamfanya Yona kuingia katika ulevi. Dina anamwambia Kiwa kuwa:-

> **Dina**: Ninakwambia kwa mikono yote miwili. Wewe umekua ukampataYona kipenzi cha maji. Hakuwa hivyo.
> **Kiwa**: Alaa!
> **Dina**: Alisukumwa huko na wimbi la maneno ya watu. Wengine wakamsukuma kutafuta mtoto huko nje kwa kila hali mradi awe wa kiume. Amrithi yeye. Eti jina lake lisipotee. Utambi wa ukoo wake usizime (uk 10).

Kwa hakika, jamii inachangia katika kumfanya mwanamume kufanya juu chini ili kuthibithisha nguvu zake za uume hata ingawa amezalisha kiumbe mwanamke.

Mwanamume Haruhusiwi Kujishughulisha na Kazi za Nyumbani

Sara anamwelezea Dina kuwa mila na desturi za jamii yao zimemkuza mwanamume kuwa kuna kazi za wanawake na za wanaume. Ni makosa kwa mwanamume kuingia jikoni. Isitoshe, iwapo atamsaidia mkewe, watu watasema kuwa amedhalilishwa. Sara anamwambia Dina: -

> **Dina**: Wakati mwingine ninashindwa kuwaelewa.
> **Sara**: Wenyewe tumewafanya hivyo. Mila na desturi zetu zimewajenga hivyo walivyo na sisi hivi tulivyo. Kazi zote za nyumbani ni zetu. Yaani kwake mtu lakini hajui hata chumvi inakowekwa. (Wanacheka.). Yeye anajua sebuleni, msalani na chumba cha kulala. Haya yasiyotarajiwa yajapo tayari mtu ana kilema kikubwa japo mzima viungo vyote. Anaishi kuwa mgeni wa mambo mengi kwake nyumbani. Tutafanya nini? Wenyewe tutasukuma vivyo hivyo (Uk 14).
> **Dina**: Sijui tufanye nini.
> **Sara**: Utafanya nini mwenzangu? Dunia ikijua anakusaidia jikoni itasema unashusha hadhi yake na kwa mizani ya jamii utakuwa unajivulia nguo (Uk 14).

Kutokana na mazungumzo ya Sara na Dina, ni wazi kuwa utamaduni wa jamii hii umejikita katika imani na desturi ambazo zimetamalaki katika mfumo mzima wa jamii.

Sara anashauriwa na Asna pamoja na Neema akae mjini ili apate matibabu kisha apumzike lakini anadai kuwa amemwacha Yona pweke nyumbani. Kazi za nyumbani kama vile kushughulikia kuku asubuhi kisha mbuzi na ng'ombe, kujipikia kiamshakinywa na kuendea maji kisimani zitamlemea. Baadaye, kijiji kizima kitamtazama Yona kwa jicho la dharau kwani kazi kama hizo ni za mkewe.

> **Asna**: Baba bado kijana. Hawezi kushindwa kuteka maji kisimani.
> **Sara**: (*Kwa ukali*.) Hivi mtoto una akili wewe? Babako aende kuteka maji kisimani? Wazee wenziwe watamwonaje? Kijiji kitasema nini? Kwamba amesomesha watoto ambao wameniweka jijini ili baba yao ataabike? Watu wapate sababu ya kumtazama kwa sini ya dharau? Hmm! Hiyo ndiyo heshima? (uk 44-45).

Dondoo hii inathibitisha kwamba kazi ya nyumbani ni za wanawake pekee. Wanaume hawapaswi kujishughulisha nazo kamwe.

Hata ingawa Beni aliye mzee mwenzake Yona anaelewa kuwa Sara yuko mjini kwa matibabu, analalamika kuwa Yona ameachwa pweke ili ajipikie.

> **Luka**: … Mtu kupata matibabu au kuja kumpikia mwenzake?

Beni: Yona, muda wote uliokaa nani anakupikia mzee mwenzetu? Hii ni miaka ya kujipikia? Ningeelewa zamani zile ukiwa mwalimu kabla ufutwe kazi. Siku zile ulikuwa na nguvu zako. Sasa misuli yako imenyauka (uk 61).

Mwanamume anaitwa Gumba kwa Kutopata Watoto

Nadharia ya Ubabe-Dume inataja kwamba kuna sifa angama za uwezo-uume ambazo ni sharti mwanamume awe nazo ili kuweza kujenga, kudumisha na kudhihirisha ubabe. Sifa hizi ni kama vile; uvumilivu, uwezo, kutoogopa, kuthubutu, ukware miongoni mwa sifa nyingine. Kulingana na tamthilia hii, mwandishi kwa kupitia mazungumzo ya Dina na Kiwa inaweka wazi kwamba ubabe dume wa Yona ulitiliwa shaka na jamii kwa kusema kuwa na watoto katika ndoa yake na Sara. Dina anamwambia Kiwa kuwa:-

Dina: Mwanangu nikwambie nini? (Kimya.) Sara ameitwa tasa. Wakati mwingine yeye na mumewe wameitwa wagumba, japo shoka la ugumba limemwangukia yeye zaidi kuliko mwenziwe.

Kiwa: Lakini mama, si wana watoto? Au ndiyo unasema watoto hawa si wao?

Dina: Damu yao hiyo lakini wameiona baada ya hodari wa kusema kuwabandika hili na lile.

Kiwa: Vipi hivyo?

Dina: Yaani yamesemwa mengi siku nyingi kama ilivyo ada katika jamii nyingi za Kiafrika… Kwa ufupi, Yona alifunga uchumba na Sara na hatimaye wakaoana na kuishhi vizuri ila milango ya baraka ya watoto ikakawia kufunguka. Tulivyo Waafrika, ikawa kuna waliolijua tatizo kuliko wenye tatizo. Kazi ikawa ni kuwasema, wakalaumiwa na kusutwa. …Lakini hatimaye Mungu akaridhia wakati wake aliouona bora (Uk 7).

Haya yanaashiria kwamba, jamii inamwona mwanamume asiye na watoto katika ndoa kuwa mwanamume asiyekamilika.

Sara anawaambia watoto wake Neema na Asna kuwa yeye na Yona walichukua muda kabla ya kuzaliwa mtoto. Jamii iliwalaumu na hata walipowapata kina Neema na Asna bado walionekana maskini wa mrithi. Anamwambia Asna:-

Sara: Tulikosa mengi. Kwanza sisi wazazi wenu tulichukua muda kabla ya kujaliwa mtoto. Watu walituona maskini wa watoto. Maskini wa kizazi…Tulipofarijika kwa kumpata Neema na nyinyi mkafuata, bado wakatuona maskini wa mrithi. Maskini wa kushikwa mkono uzeeni…Hatimaye wengine walitutenga lakini kwa kudura za Mungu jahazi halikuzama (Uk 55).

Mwanamume amejitwika Majukumu yote ya Nyumbani

Chafetz (1974) na Doyle (1985) wanasema kuwa maeneo ya ubabedume yanajitokeza katika desturi kwa jumla kupitia maumbile, nguvu za kimwili, ushujaa, kufanya kazi na kukidhia familia, kuwa na tajiriba na shari ya kijinsia, ukakamavu, urazini, kutaka makuu, majivuno, uadilifu, ushindani na kuthubutu mambo. Katika jamii za Kiafrika, majukumu hugawanywa kiuana. Kuna yale ambayo yametengewa jinsia ya kike na mengine jinsia ya kiume. Mgawanyo huu hudhihirisha namna mamlaka na uwezo hugawanywa kijinsia. Utamaduni wa jamii hujikita katika imani kuwa majukumu ya nyumbani hujitwika mwanamume. Yeye sharti aifae familia yake katika mahitaji ya kimsingi ambayo ni mavazi, nyumba, chakula na elimu. Bunju anamwambia Neema kuwa ni wajibu wake (Bunju) kukidhi mahitaji ya familia yake bila kumhusisha.

Bunju: Ema, unafahamu vizuri kuwa nimechukua mkopo wa benki kujengea nyumba hii. Mkopo huo haunipi amani. Ninahangaika kuulipa. Wewe mwenyewe ulikazana kwamba Mina aende *boarding school*. Tena shule ya gharama. Pesa nyingine nitatoa wapi?

Neema: Buu, mtoto wa kwanza anafaa kusomea shule ambayo inatia matumaini. Fahari iliyoje mtoto kusomea shule ambayo haikupi wasiwasi!

Bunju: Mimi wajibu wangu kwenu ninautimiza. Je, sinunui chakula?

Neema: Unanunua bila shaka.

Bunju: Mavazi?

Neema: Tunayo.

Bunju: Si hivi majuzi nimekununulia gari?

Neema:…

Bunju: …Mimi nilikwisha kukueleza kuwa mzigo wa familia yangu unatosha kunishughulisha (Uk 27).

Bunju anafahamu fika kuwa ni jukumu lake kama mwanamume kukidhi mahitaji ya familia yake bila kumhusisha Neema. Anamwambia Neema kuwa ana uhuru wa kutumia mshahara wake ili kulipia matibabu ya mamake. Bunju amemnunulia gari na ni wajibu wake kuinunulia mafuta. Anamwambia Neema haya:

Bunju: Shukuru una mahali pa kuamkia siku baada ya siku. Bila hapo ungekuwa unajipa shughuli gani?

Neema: Daima ninashukuru japo hakitoshi.
Bunju: Hakitoshi vipi?
Neema: Mahitaji yenyewe ni mengi.
Bunju: Sielewi. Nyumba ni juu yangu, karo ninalipa mimi, chakula ninanunua mimi, matibabu vilevile ni juu yangu. Sasa wewe mshahara wako huo mbona usitoshe? Mafuta ya gari ndiyo yanaumaliza?
Bunju: Wajibu wangu kama mume nitafanya na nimejitolea kutekeleza kwa hali na mali kufikia hapo. Wewe unajua uzito wa majukumu niliyo nayo. Mshahara wako sikuombi wala sikupangii. Gharama zote zinaujua tu mfuko wangu (uk 39-40).

Mazungumzo baina ya Bunju na Neema yanaashiria kuwa ni jukumu la mwanamume kukidhi mahitaji yote ya familia yake. Jamii inatarajia kwamba mkewe hatahusishwa kwa vyovyote vile. Kutekeleza majukumu haya ni ishara tosha kuwa mfumo dume umemwekea mwanamume masharti hayo.

HITIMISHO

Makala hii imebainisha kuwa kunao ubabedume uanodhihirika katika jamii kupitia kwa wahusika waliotumiwa na mwandishi. Mhusika wa jinsia ya kiume amesawiriwa kama mtegemezi, mrithi wa mali, ameruhusiwa kupata mtoto nje ya ndoa, haruhusiwi kujishughulisha na kazi za nyumbani, anaitwa gumba kwa kutopata watoto na anayejitwika majukumu yote ya nyumbani.

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BIBLICAL AND THEOLOGICAL BASIS FOR CHURCH INVOLVEMENT IN COMMUNITY DEVELOPMENT: A CASE OF THE ANGLICAN DEVELOPMENT SERVICES IN KENYA

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ABSTRACT
The study sought to establish the biblical and theological basis for church involvement in Community Development (CD). The Anglican Development Services (ADS) of the Anglican Church was used as the case for this study. The study targeted four ADS regions namely; Pwani, Eastern, Mount Kenya East and NAIKA (Nairobi, Kajiado and All Saints). The theory of Reconstruction Theology (RT) advanced by Jesse Mugambi as a paradigm for CD was employed. A sample of 330 respondents gotten from a target population of 1,827 was used. Descriptive survey design was employed. Utilizing questionnaires, interviews, and Focus Group discussions data was gathered. Statistical Package for Social Sciences (SPSS) version 26 computer software was used to analyze quantitative data in frequency and percentages while qualitative data was analyzed thematically and narrative formats in accordance with the study objectives. The findings showed that biblical and theological basis for church involvement in CD were highly valued. This compels the church to engage community in socio-economic and political development through conscientization, transformational participatory and goal-oriented empowerment. The study recommends more effort be made to disseminate biblical and theological teachings to educate communities about wholistic mission of the church. Implementation of CD be based upon proper biblical hermeneutics and contextual theologies as a demonstration of service to the poor, the marginalized and the vulnerable in community.
Keywords: Community Development, Anglican Church of Kenya, Anglican Development Services, Biblical and Theological Basis, Church Involvement

BACKGROUND OF STUDY

Collins English Dictionary (1999), defines development as a process of advancement, gradual growth or formation of new information. Constitutional Debate No.3 (1996), defines development as multi-dimensional process involving re-organization and re-orientation of socio-economic systems. Development means investing in peoples' through education, health, nutrition, safe water, communication systems and freedom to effectively participate in community. According to United Nations (1963), CD is a process by which the efforts of the people are aligned with those of state, Non-Governmental Organizations (NGOs), Faith Based Organizations (FBOs) and CD partners to improve locals in re-constructing socio-economic and political immediate needs of the people. In this study, CD points to self-realization, self-development, self-fulfillment and non-dependence of community.

The role of the church in development has generated debates in political, religious, cultural, environmental and socio-economic spheres. CD has been a critical discipline in the secular and religious fields locally and internationally, drawing considerable ecumenical interest since World Conference on Church and Society held in Geneva in 1966 (Klaasen, 2019). There has been a connection between the church and CD as both conterminously exist to address contextual realities affecting the poor, the marginalized, and the vulnerable. A church that disregards service to the community loses the rationale of its very existence.

In terms of biblical basis for church involvement in CD, God has since creation been empowering community (John 5:17). Okullu (1983), traces CD in creation; when God said ". . .be fruitful and multiply and fill the earth and subdue it" (Genesis 1:27). Luke 4: 18-21 and Matthew 25:35-40 serves as a fulfillment of the *euagellion* (good news) to the poor; the sick and liberation from oppressive forces (Lehman, 2018). Theologically, God is the source of life in the *cosmos* (all worlds) and is at the periphery of society (Webber, 2018). God's *anthropomorphism* (personalization) manifests *shalom* in terms abundance. The Old Testament (OT) affirms the dignity of humanity as created in the *imago Dei* (image of God) and likeness (Genesis 1:27-30). God places people in community to reflect His character in co-creation in the midst of a fallen world. Pillay (2007), holds that Jesus' *kenosis* (incarnation) in the New Testament (NT) relates to socio-economic and political ideologies; as He and the Apostles spearheaded the good news within and without communities.

Global perspectives on church involvement in CD dates back to Greco-Roman societies; the church found it a noble vocation to advance the welfare of the deprived (Luke 4:16-18). The church has continued to promote community

socio-economic and political development ideologies (Strivers, 1993; Winter, 2009; Pillay, 2007). The Anglican Church world-wide, has been offering assistance to the poor, the marginalized and the vulnerable, compelled with compassion of Jesus Christ in mitigating poverty, poor health, oppression and myriad forms of injustices (Omanyo, 2014).

In Africa, CD pre-existed the coming of Arabs (600-1450 AD), a distinctive feature that religion was integrated in African society (Mbiti, 1969 and Yusufu, 2016). Crooks (2009), states that the Methodist Church in Cambodia invested in Bible studies that offered communities knowledge and skills in farming, saving loans, and entrepreneurship. Klikberg (2003), rates FBOs highly in enhancing CD in Berlin, Southern Africa, and Malawi. Similarly, World Bank (2008), indicates that FBOs facilitate 50% of health and education services in Africa. However, despite FBOs success in enhancing CD in Africa, Green (1991), Sakwa (2007), and Tenai (2016), annotate that Sub-Saharan Africa has experienced poverty in rural households. World Bank (2018), indicates that 82% of Africans in Arid and Semi-Arid Land (ASAL) and conflict areas experience food insecurity, unemployment, poor infrastructure, inequality, poverty, lack of access to education, healthcare, and skills. World Bank (2019), forecasts increase of poverty in Africa from 55 % in 2015 to 90% in 2030, indicating widespread adverse effect on community livelihood.

In East Africa, Okoth (2000), traces the origin of CD to Portuguese Catholic missionary in the 15th Century, which involved evangelism, commerce, and trade. In Kenya, the arrival of Johann Krapf in Mombasa in 1844 provided a missionary strategy to health, agriculture, and education as social gospel (Nkonge, 2012). In Kenya, Anglican FBOs in CD include Primates World Relief and Development Fund which support alleviation of hunger and food production (Diocese of Ruperts Land, 2020), and Bread for World of Germany that empower the poor and promote justice (Anglican Aid-Let Grace Flow, 2020). Ole Sapit (2019), reinstates that the missionary strategy was to construct a school, health unit, a garden, and carpentry workshop at every mission station. The ACK has had a long history of commitment to integrated development with CD as one of the strategic plans dealing with maternal health and lifestyle diseases, HIV/AIDS, climate change, environment management livelihood, and emergency response (ADS Kenya Strategic Plan 2020-2024).

The church using biblical and theological impulses proclaim *euagellion* of justice and liberation for the down trodden (Luke 4:18-19). Omondi (2019) focuses on ACK Kenya Decade Strategy (2018-2027), on wholesome: evangelism and Christian formation, living, health, ecology, education, media and institutional sustainability and governance to enhance development processes. Tsuma and Wambua (2020), claim projects funded by the church are a powerful global drive with socio-economic, political and environment objectives. The study was valuable because, despite the effort of ADS in enhancing CD in Pwani, Eastern, Mt. Kenya East and NAIKA regions through agriculture, environment, health, human rights, poverty alleviation, peace building, food security, economic empowerment, advocacy, water and sanitation, HIV/AIDS, and governance strengthening, communities have persistently experienced poverty, poor health, unemployment, social inequalities, poor governance, and widespread corruption. This has been perceived by some critics as an evidence of the non-involvement of ADS in CD and lack of recent empirical data on the extent and influence of ADS contribution in enhancing livelihoods. In an attempt to contribute in bridging the existing knowledge gap, this study sought to investigate the dynamics of ADS of the AC in enhancing CD in Kenya.

Purpose of Study
To investigate the dynamics of ADS of the Anglican Church in enhancing CD in Kenya.

Objective of Study
To establish the Biblical and Theological basis for Church involvement in CD.

Research Question
What are the biblical and theological basis for church involvement in CD?

LITERATURE REVIEW
Christians approach the Bible as the final authority to development concerns of the world. Mugambi (1989), defines theology as the systematic discourse about God. According to Nkonge (2008), theology in its essence is aspects of training-formal or informal.

Biblical and Theological Basis for Church Involvement in Community Development

The Bible is the infallible word of God to the world. Pobee (1979), elucidates that theology is concerned with existential situations that humanity finds in. The biblical and theological teachings are based on fortitude that God provides to the oppressed through community. The development work of ADS in Kenya draws its mandate from John 10:10b "… I have come that they may have life to the full" (Bwibo, 2014). However, despite the church interventions in CD, there has been worrying poverty levels in Kenya. The study findings uphold that too often the people disregard or misapply biblical and theological impetuses.

Biblical Basis for Church Involvement in Community Development

The Israelites were involved in CD as a personal responsibility, unlike in modern dispensation where alignment is on the state, NGOs and FBOs for aid. Bindow (1988), argues that it is human right for citizenry to be provided by the state with basic needs like education, medical, water, food and security. This has biblical basis as God judges a nation that overlooks the deprived (Psalm 9:18-19). The study found a growing crisis caused by poverty, homelessness, poor health, joblessness, inequality, insecurity and criminal cases. This could be as a result of the church's concern over worship rather than *psychosomatic* (concern for body, mind, and soul). Okullu (1981), reinstates that the church is engaged in community by word and action. However, educational institutions, medical and social services, agricultural and technology advance the gospel message more than evangelization. Therefore, Christians all over the *cosmos* have a mandate of Matthew 25:35-46 to the plight of the deprived in terms of food, water, accommodation, freedom, clothing, security, and healing.

Thiong'o (2019), reinstates demand for spiritual than the physical goal of the church. Christians demand to give resources to the ministry is a hermeneutical problem on prosperity gospel (Malachi 3:10) that renders the church less functional as the poor are blamed for poverty. The *eschatological* (heaven-ward) gospel is detrimental as it lazes personal and communal economic development (1 Peter 2:11). This study established that biblical teachings lack a wholistic model of CD; thus inadequate livelihood. The study recommends church civic obligation in enhancing CD. There is need for a constructive biblical paradigm as Bosch (1982), puts it that Christian are in the world, but not of the world. Community has a task to share in God's creativity and stewardship of world resources to rebuild a better livelihood for all as depicted in Genesis 1:27.

The OT biblical basis for church involvement in CD identify with God's concern for justice and mercy (Proverbs 11:1; Amos 5:11). Bandow (1988), holds that God regulated Israelite's economy to safeguard widows garments (Exodus 22:26), control of excessive interest charges imposed on the poor (Exodus 18:17). The Israel's sabbatical year restored land to disadvantaged (Exodus 23: 10) and as Sider (1981) says, it led to release of the Israelites debts; spanning the rich and the poor gap (Exodus 23:10-11). Besides, every seventh year, the land was left uncultivated, and debts to poor Israelites cancelled (Deuteronomy 15), and *Yiddish* (fiftieth year), the land was redeemed by the original landlord (Leviticus 25). However, biblical and theological privileges, this study fronts that community must work and not be passive recipients from the church, FBOs, NGOs or states. The community has to conscientiously be productive and self-reliance. Kibucwa (2012), calls it theology of work that actively involves community in productive activities.

Kinyua (1999), exhibited CPK interventions such as health, education, spiritual, social, family life, community empowerment, livelihood, and social services as interventions to reduce poverty. However, his conclusion of development as a *bona fide* of the church is far-fetched, for no church on her own is capable of contributing to socio-economic and political developments. Further, although, Kinyua (1999) expounds on some biblical foundations for development such as Exodus 5-12, Psalm 24:1, and Amos 5:11, he fails to relate their practicality in the world of CD. The study established that biblical texts are meaningful when justice is made in terms of their hermeneutics and exegesis to derive contextual realities and CD priorities.

According to Owensby (1988), Daniel (2016), and Bandow (1988), Jeremiah, Zechariah and Ezekiel challenged Israel's leaders for ignoring the widows, the orphans, the poor, conceding violence, oppression, and exclusivity (Leviticus 25). This study instigates that the church has a duty to transform community by use of the biblical impetus not in selective forms but wholistically. The application of the deuterocanonical books such as Tobit, second Ezra and Sirach due to their richness to socio-economic and political aspects is critical. Authentic interpretation of the bible and theology according to contexts is valid and recommended.

In the NT dispensation, the mission of God to the world is to bring wholeness. Kibucwa (2012), asserts that God's mission is people's mission. However, the church has failed to apply the gospel to whole life, restricting it to spirituality (Kinoti, 1994). Monrose (2012), contention that the church is primarily a spiritual organization with a secondary focus on socio-economic issues is inappropriate distinctiveness (Matthew 5:13-16). To reduce poverty, the entirety of God's word has to be applied to every aspect of human existence. For instance, the medical care strategy of the church shows that the first converts to Christ were people helped through medical ministries (Luke 17; 12-19, James 2:15-16). This also holds true for the church's approach to providing aid to the homeless, hungry, sick, naked, and those in need. Paul's journey to Jerusalem and Judea served the deserving communities (Romans 15:25-27) while Tabitha's generosity (Acts 9:36), serve as demonstration of societal advancement.

Maggay (1994), avers that the NT speaks of existential relationship of God's creation with humanity personal responsibly through sharing clothes and food (Luke 3:11) as early believers had all things in common with no needy among them (Luke 2:44-45), material possessions to show God's love (1John 3:17), social justice in doctrine of service (Matthew 25:35-43), and Great Commission (Matthew 28:16-19). Brueggemann (2006), views on liturgy of abundance links to this study as Jesus Christ served God and *cosmos*. Mathew's comparison of the church as salt and light of the world (Matthew 5:13-16) represents the *Missio Dei* to the world.

The church as *koinonia* of members with *charisma* and the NT concept of *shalom* relates to abundance model to the world "Jesus went to all cities and villages, teaching, preaching and healing" (Matthew 6: 33; 9:35). Nkonge (2018)'s on community livelihood avers that Jesus on top of being a preacher was a carpenter (Mark 6:3), Paul was an Apostle and tent maker (Acts 18:3) while most disciples of Jesus Christ were fishermen (Mark 1:14-19). The choosing of deacons (Acts 6) marked social welfare ministry while priesthood of all believers, places Christian's role in CD. This study established that the church has less disseminated teachings on CD. This calls the clergy to address woes of tribalism, poverty, corruption and unjust economic structures using theological impulses such *oikos* (house) and community (Ephesians 2:19-22) as advocated by Nkonge (2016) and Mugambi (2015)'s RT that informs service to the disadvantaged into a new social order.

Theological Basis for Church's involvement in Community Development

Theology is a systematic disclosure of God (Mugambi, 1989). Villa Vicencio (1992) avers that a theology which fails to address the most urgent questions asked by ordinary people is not a theology at all. Okullu (1983), and Nthukah and Gathogo (2015), provide theological basis for church involvement in CD as… "Be fruitful, fill the earth, subdue, till and keep the garden and that God is the Lord of all life and fruition" (Genesis. 1:22-29; Matthew. 6:25). This study found that communities have the potential to revitalize economic and socio-political life through conscientization, and interventions such as *koinonia, diakonia*, agri-mission, laity theology, theology of work or development, and incarnation.

According to Groningen (2000), the church has a crucial role as a change agent and a witness to the community. In their 2015 study, Ayiemba et al. argued that the church is responsible for eradicating poverty and achievement of equality, dignity, and freedom for all people, regardless of faith or nationality. The findings by Bakker (2016), demonstrates that theological views of the church have significant role in uplifting the development welfare of communities. Bosch (1982), Mugambi (1995), and Pillay (2007), aver that the church has a transforming effect and exists to improvise people's standards of living by assimilating models of development that reflect values, self-reliance, self-actualization and self-fulfillment.

RESEARCH METHODOLOGY

Descriptive survey research design was adopted as it enabled explore, determine and report social issues (Mugenda and Mugenda, 1999). The study was carried in four ADS regions, namely; Pwani, Eastern, Mt. Kenya East and NAIKA which were purposively selected in line with Creswell and Garrett (2008), recommendation of arriving at investigated knowledgeable. The regions were unique in terms of diversity, occupation, ecosystem, resources, infrastructure and policies. The target population was 1,827 and a sample size of 330 respondents comprising of 206 ACK clergy, four ACK Bishops, 57 ADS staff, 26 ACK Christian lay leaders and 37 community leaders was sampled through a Sampling Matrix.

Table 1: The Sampling Matrix

Category of Participants	Population	ACK Bishops	Anglican Clergy	ADS Workers	ACK Lay Christian Leaders	Community Leaders	Sample Size
Pwani	404	1	43	12	5	11	72
Eastern	402	1	51	5	7	11	75
NAIKA	346	1	41	11	5	4	62
Mt. Kenya East ACK Bishops	675	1	71	29	9	11	121
Total	1,827	4	206	57	26	37	330

In terms of research instruments, questionnaires collected data from ACK clergy, ADS staff and community leaders. Interviews were conducted to ACK bishops and ADS top management. The FGDs gathered data from Christian lay leaders. Diagnostic tests were conducted to assess suitability of quantitative data focusing on research objectives. Quantitative data in raw form was processed. Statistical Package for Social Sciences (SPSS) version 26 software was used for analysis of quantitative data in forms of percentages and frequencies. Qualitative data was generated and presented thematically and in narrative formats.

FINDINGS

Biblical and Theological Basis for Church Involvement in Community Development

The study sought to establish the biblical and theological basis for church involvement in CD. The clergy, ADS staff and community leaders were provided with a set of Likert statements. Table 2 presents a summary.

Table 2: Biblical Basis for Church Involvement in Community Development

Statement	SD	D	NO	A	SA	Total
The creation of man in God's image (Genesis 1:26-28) is a basis of development	1.8 5	0.3 1	0.3 1	17.0 49	80.6 232	100.0 288
Psalm 9:18-19 (God's judgment upon a nation that forgets the disadvantaged) stirs the church to be involved in development	1.4 4	1.0 3	3.1 9	18.8 54	75.7 218	100.0 288
Nehemiah 2:18 (Let's us arise and build) motivates the church to participate in development	1.4 4	1.4 4	0.3 1	17.7 51	79.2 228	100.0 288
Tobit 4:7-10 (Taking care of the poor as an offering that pleases God in heaven) inspires the church to participate in development	1.7 5	1.4 4	15.6 45	39.2 113	42.0 121	100.0 288
Jesus's Great Commission in Matthew 28:16-21 inspires the church to participate in development	1.4 4	1.7 5	0.7 2	23.6 68	72.6 209	100.0 288
The church involvement in development is based on Christ's command of loving God and neighbour (Luke 10:27-29)	1.4 4	1.0 3	1.4 4	23.3 67	72.9 210	100.0 288
Luke 4:18-19 (Jesus' concern to the world in socio-economic and political matters) calls upon the church to participate in development	1.4 4	1.0 3	0.3 1	21.5 62	75.7 218	100.0 288
Abundant life taught in John 10:10 inspires the church to participate in development	1.4 4	1.7 5	1.0 3	16.7 48	79.2 228	100.0 288
The economic sharing of Christians by St. Paul's in Romans 15:25-27 serves as a motivation to development	1.4 4	1.0 3	1.4 4	34.7 100	61.5 177	100.0 288

Data obtained illustrated that the majority of the respondents 281(97.6%), acknowledged creation of man in God's image (Genesis 1:26-28) is a basis of CD, that God's judgment upon a nation that forgets the disadvantaged (Psalm 9:18-19), stirs the church involvement in CD, 272 (94.5%), and that the Nehemiah 2:18 "Let's us arise and build" motivates the church to participate in CD, 279 (96.9%). 234 (81.2%) respondents, maintained "Taking care of the poor as an offering that pleases God in heaven" (Tobit 4:7-10) inspires the church to participate in CD, 277(96.2%) respondents, indicated that Jesus' Great Commission in Matthew 28:16-21, inspires the church to participate in CD; church involvement in CD is based on Christ's command of loving God and neighbours in Luke 10:27-29 by 277(96.2%). The majority of the respondents 280 (97.2%) said Jesus' concern to the world in socio-economic and political matters calls upon the church to participate in CD (Luke 4:18-19), 276 (95.9%) respondents, maintained that abundant life taught in John 10:10 inspires the church to participate in CD and that the economic sharing of Christians as espoused by St. Paul's in Romans 15:25-27 serves as a motivation to CD by 277 (96.2%). In general, respondents scored highly for biblical basis for church involvement in CD, the variable obtaining a mean rating of 93.54%.

The findings confirm that Church involvement in CD has biblical basis, and are consistent with observations by Maggay (1994), Bosch (1977) that Christians have a biblical mandate to be involved in the CD not in doctrine but in

social justice (Matthew 25:35-43). Jesus destroyed fabrics of uncivilized communities by feeding over 5,000 men (Mark 8:1-21), as an indication of a church in the world but not of the world to propagate CD. However, there is need to use Deuterocanonical books such as Tobit, second Ezra and Sirach for their richness in socio-economic and political aspects unlike other studies that hardly considered Apocrypha as basis for CD.

Theological Basis for Church Involvement in Community Development

The study also intended to establish theological basis for church involvement in CD. To achieve this, respondents were provided with a set of six Likert statements. Their responses are as presented in Table 3.

Table 3: Theological Basis for Church Involvement in Community Development

Statement	SD	D	NO	A	SA	Total
The concept of *Shalom* (Peace)which means right relation with God, humanity and creation is crucial in enhancing development	1.7 5	0.7 2	3.1 9	43.4 125	51.0 147	100.0 288
Evangelization as the identifying feature of the church involves taking care of the poor, the marginalized and the vulnerable	1.7 5	0.7 2	3.1 9	47.6 137	46.9 135	100.0 288
Reconstruction Theology informs the church involvement in development	1.4 4	0.7 2	8.7 25	61.1 176	28.1 81	100.0 288
The church responds to peoples' socio-economic and political needs by empowering community in the area of development	1.7 5	0.3 1	3.1 9	42.7 123	52.1 150	100.0 288
Since creation, God has been transforming communities in development through His involvement in their daily affairs	1.4 4	1.4 4	1.4 4	36.5 105	59.4 171	100.0 288
Green Theology, Laity Theology, Eco-Theology, *Oikos* Theology, *Koinonia*, *Incarnation*, *Harambee* and *Diakonia* are integral interventions in enhancing development	1.4 4	1.4 4	9.4 27	60.4 174	27.4 79	100.0 288

Information obtained from respondents indicates that the majority 272 (94.4%), were of the view that *Shalom* is crucial in enhancing CD; 272 (94.4%) respondents, maintained that evangelization as the identifying feature of the church, involves taking care of the poor, the marginalized and the vulnerable and that RT informs the church involvement in CD by 257 (89.2%). 273 (94.8%) respondents, indicated the church should respond to peoples' socio-economic and political needs by empowering community; the majority stated that since creation, God has been transforming communities in CD through His involvement in their daily affairs by 276 (95.9%), and that Green Theology, Laity Theology, Eco-Theology, *Oikos* Theology, *Koinonia*, *Incarnation*, *Harambee* and *Diakonia* are integral interventions in enhancing CD by 253 (87.8%).

The results of the study on theological basis for church involvement in CD showed a mean rating of 92.8 % indicating a high degree of agreement by the majority of respondents. The findings imply that the church's contextual theologies justify her involvement in CD. This has reference to Villa Vicencio (1992), Nkonge (2008), and Magesa (1976), that community involvement in CD is an essential component of missiology. Similarly, Mugambi (1995), avers that Christian theology has a role to play in the socio-economic and political transformation of Africa *via* reconstruction on three levels: individual, cultural, and religious.

Extent to which the Church Disseminates Teachings on Community Development

To establish the extent to which the church disseminates teachings on CD. Table 4 presents summary of the findings.

Table 4: Church's Dissemination of Teachings on Community Development in the Community

Statement	NE	LE	AE	GE	VGE	Total
The church teaches about good agricultural practices to improve productivity	1.4 4	17.0 49	65.6 189	13.5 39	2.4 7	100.0 288
The church teaches about clean water and sanitation to enhance quality of life	1.0 3	16.7 48	64.9 187	13.9 40	3.5 10	100.0 288
The church promotes developmental education to reduce illiteracy and poverty	0.7 2	13.9 40	54.5 157	26.0 75	4.9 14	100.0 288
The church promotes justice and peace towards a conducive environment for development	0.3 1	12.1 35	53.5 154	27.8 80	6.3 18	100.0 288
The church propagates children, gender and human rights issues to enhance the quality of human life	1.0 3	22.9 66	60.4 174	10.8 31	4.9 14	100.0 288

The church promotes health care in community towards enhancing the quality of human life	-	6.6 19	38.2 110	38.5 111	16.7 48	100.0 288
The church calls upon community to offer relief to needy people in line with Christ's command to love and share	2.4 7	28.8 83	42.7 123	18.4 53	7.6 22	100.0 288
The church offers employment to the youth by providing micro-finance for self-reliance	2.8 8	25.0 72	51.0 147	15.6 45	5.6 16	100.0 288
The church assists persons living with disabilities by providing self-reliance skills	3.5 10	39.9 115	41.0 118	12.5 36	3.1 9	100.0 288
The church gives HIV and AIDS awareness and care to the community for the promotion of wholistic life	1.0 3	6.6 19	32.6 94	38.9 112	20.8 60	100.0 288
As a steward of God's creation, the church teaches community about environmental preservation and conservation	0.7 2	5.9 17	31.3 90	30.6 88	31.6 91	100.0 288

Data obtained show that the respondents who stated that the church teaches about good agricultural practices to improve productivity to a great extent by 46 (15.9%) were the minority. Those who opiniated that church teaches about clean water and sanitation to enhance quality of life were 50 (17.4%), 89 (30.9%) respondents indicated that church promotes developmental education to reduce illiteracy and poverty and, 98 (34.1%) respondents, said the church promotes justice and peace towards a conducive environment for CD. Respondents who thought that the church propagates children, gender and human rights issues to enhance the quality of human life were 45 (15.6%), those who acknowledged the church calls upon community to offer relief to needy people in line with Christ's command to love and share were 75 (26.0%), those who indicated that the church offers employment to the youth by providing micro-finance for self-reliance were 61(21.2%) and those who said the church assists persons living with disabilities by providing self-reliance skills were 45 (15.6%) fewer than those who thought to the contrary. The proportion of the respondents who indicated that the church promotes health care in community towards enhancing quality of human life were 159 (55.2%), those who felt that the church offers HIV and AIDS awareness and care to community for the promotion of wholistic life were 172 (59.7%) and those who stated that in stewarding God's creation, the church teaches community about environmental preservation and conservation were 179 (62.2%).The findings could be interpreted to mean that whereas the church could be perceived to minimally disseminate information on general CD issues, it has spent considerable effort in three main areas; Health Care (55.2%), HIV and AIDS awareness (59.7%), and environmental preservation and conservation (62.2%).

An inquiry was made to ACK bishops and ADS top management. The question posed was: What are the emerging biblical and theological issues in the world of community development? In response, Baya (OI.2021) observed that:

> The church is informed by the holistic gospel of Jesus Christ in John 10:10 that 'I have come so that you may have life in abundance'. This entails finding love, health and life in the present world. The philosophy of development is valuable in uplifting the livelihood of community. In the modern world of CD, the church could employ the concept of Agri-mission which means using agriculture as a tool for mission to address high poverty prevalence. The church has a role to execute her mandate employing non-discriminatory, humanitarian and missionary approaches that consider value for people as created in the image of God and to reach out to all people without discrimination on religious, socio-economic, cultural or political orientations. The church's role is to develop biblical and theological motifs that express meaning within the life-stream of the community.

According to Kibucwa (OI.2022):

> All theologies inform CD. A theology that does not propagate holistic concerns fails to meet community needs. The Church is a community itself and at the grassroot. CD involves adopting new farming methods at the ground root to where people are. The church is about: people, survival, food, hygiene, food, going to school, learning and living well. You cannot remove the church from development in anyway; the church must be and remain involved in matters of CD. It is the duty of the church to ensure that development is done in systematic way to ensure community benefits. A church that does not involve itself in challenges affecting community is not a church but a fake one. CD ensure people are enjoying life in wholeness, are healthy, have money, road to use and decent houses. There is no good news if people are not living well.

According to Mutua (OI.2022):

> The church must consider contextual reaity to cater for physical and spiritual needs of community. The church expedites a call for humanitarian approach to motivate participation in CD between various stakeholders in improvising productivity and better living standards.

According to Mugo (OI.2022):

> Biblical and theological emerging issues in the world of CD include intrinsic biblical and psychological social needs affecting community such as sexuality, ethical issues, technology, cash transfers, health issues in relation to genetically modified organisms, legal aspects, global warming, urbanization, environmental and climate change. The church consciousness in addressing the socio-economic challenges by putting into consideration the current scenarios in CD is critical.

Mwanziwe (OI.2021), responded that:

> Humanity is endowed with the sacred mandate to subdue earth by good stewardship, work is a responsibility from God to human beings through which God demands restoration of the creation. The church has an advocacy role for the voice of the voiceless by empowering community to a self-reliance livelihood.

This study established emerging biblical and theological trends in the world of CD. Traditionally, this was unnatural due to the skeptical perception of the church involvement in CD. Personalized believes on church ministry without socio-economic and political mission is biblically biasing, and inept to deal with poverty. This has reference to Kinoti (1994)'s report that one out of every three Africans lack enough to eat. This has dire effects due to its direct relationship with under-development, poor health, criminology, death and psychological consequences. The finding agrees with Mofikeng (1990), that liberative messages of God demand release from all that which negatively exploit community.

The qualitative results from FGDs with Christian lay leaders showed that: biblical and theological basis enhanced CD as the salt and light of the world (Matthew 5:13-14). The theology for life connects the church and underprivileged in community. The emphasis on humankind solidarity with creation as part of God's divine mandate in Genesis 2 is key in enhancing CD. The three servants and varied talents calls for productive economic model in Matthew 25:13-30, the good Samaritan (Luke 10:25-37), shows concern to the needy, poor in health and the vulnerable in community. Other biblical basis include: The rich man and Lazarus (Luke 16:19) emphasize on the plight of the poor, while 2 Timothy 2:15 calls for industriousness to God's and humanity service. Additionally, Christians are to eat from their labor (Psalm 128:2), a call for creative human stewardship (Ephesians 4:24), sharing things in common (Acts 2:42), enjoying good health in 3 John 1:12 and defending the weakly and fatherless (Psalms 140:12).

On enumerating other biblical and theological basis for church involvement in CD, qualitative responses from open-ended questions indicated thus: On agriculture, Jeremiah elucidates trees planted by the water side implying environmental conservation and management, Jewish calendar on agricultural work ensured productivity, Psalm 125 on the mountains that surround Jerusalem signifies promotion of natural resources; productive land requires proper management as depicted in Isaiah 5, Jesus as the branch that produces fruits informs CD in John 15:1-8, Magi in Matthew 2:11 symbolize abundance of the earth. In terms of wellness, Jesus went to communities doing good (Acts 10:38) while Matthew 25:40 signifies the plight of the poor and love of God exemplified in whatever you have done to the least of these, you have done to me. In terms of industriousness, James 2:14-28 demands faith and action, Joseph's steadfast in food economy and security in Genesis 41:41-46, and feeding of the 5000 demonstrates service to God and humanity (Matthew 14:13-21).

The study findings shows that the majority of the respondents, 183 (62.5%) answered the open-ended question on other biblical and theological basis for church involvement in CD. The most quoted biblical basis by the majority were placed using eight thematic areas namely: Matthew 14:13-21on feeding the 5000 men as a demonstration of service to God and humanity by 48 (26.2%), Joseph's socio-economic success story in Genesis 41:41-46 by 46 (25.1%), Jesus development intellectually, stature and in favor with humanity and God in Luke 2:52 by 21(11.4%), the three servants given talents to utilize in Matthew 25:13-30 by 16 (8.7%), faith without action as dead in James 2:26 by 14 (7.6%), stewardship and care of the land in Genesis 2:15 by 13(7.1%), James 1:25 on good health by 13(7.1%), and communal responsibility to the poor in Acts 2:37-47 by 12 (6.5%). The findings though minimally indicates that; feeding of the 5000 men by Jesus in Matthew (26.2%) and the story of Joseph's as the Egyptian economist in Genesis (25.1%) were the most preferred scriptural basis for church involvement in CD.

Further, the findings are an indication that CD as a *diakonia* (service) to community is critical and are consistent with Groningen (2000)'s claims that the church is a witness of the gospel and an agent of change in the world. Similar perspectives are shared by Alawode (2016), that role of the church is not solely to preach and evangelism, but progressive CD. According to Nkonge (2019), a wholesome ministry for a wholesome nation will be enhanced by a 'wholesome' set of Clergy who are well prepared for the challenges facing the country in this decade. Mosse (2002), Nkonge (2014) and Omanyo (2014), claim that for proclamation of the good news to be credible, the church in mission has to transform society by providing social services such as education, health and socio-economic and political impetus. Gitari (1996), holds that taking care of creation and execution of God-given responsibilities redeems humanity from woes. This kind of biblical and theological interventions in CD help address emerging trends within the health sector, research, technology, sexuality, modified elements, COVID 19, lifestyle diseases and worrying poverty levels.

CONCLUSION

The chapter confirms the fundamental function of biblical and theological basis in enhancing CD. This is despite CD being perceived as secular and alien to the ministry and mission of the church. The findings confirm that implementation of CD by the church is based upon strong biblical and theological basis to positively influence the livelihood of community. This realization serves as a strong demonstration of service to the poor, the marginalized and the vulnerable in community. Biblical basis inform socio-economic and political human spheres. Theologically, the source of life is God's work in creation that is continued to uplift community living standards and self-reliance for the current and future generations. Knowledge gained from the study shows that God's intention for humanity since creation has been a world filled with healthy, peaceful, equitable and lovingly engaged communities. The research found that central to the realization of effective CD is proper biblical hermeneutics, contextual use of theological impetus and inclusivity of the Bible. The study concludes that for ADS to become sustainable, there is need for training, and refreshing courses to varied cadres of people and development of CD training curriculums and community management skills aspects guided by contextual priorities.

RECOMMENDATIONS

Whereas findings illustrated strong biblical and theological basis for church involvement in CD, data obtained illustrated minimal extent of dissemination of information on specific but critical CD aspects including good agricultural practices to improve productivity, clean water and sanitation to enhance quality of life as well as developmental education to reduce illiteracy and poverty. To improve on the sustainability of CD within the targeted areas, it is recommended that more effort be made to disseminate biblical and theological teachings to educate communities about the wholistic mission of the church. To improve on development activities for the benefit of communities, beneficiary communities and CD partners should be appropriately engaged about the tenets, mission and strategic plans of ADS as an institution of CD. The ADS target recipients should be expanded through conscientization process, goal-oriented empowerment and transformative participatory approach. Suitable and contextual hermeneutical measures in terms of biblical and theological impetuses should be put into proper exegesis to address biases associated with interpretations regarding the church involvement in CD. This is crucial in contributing towards achievement of ADS community development objectives. Proper hermeneutics as well as the use of contextual theologies such as green theology, laity theology, eco-theology, *oikos* theology, koinonia, incarnation, harambee, *diakonia*, theology of work, theology of development, and reconstruction theology be intensified as integral interventions in enhancing CD in Kenya.

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STRATEGIES ENHANCING COMMUNITY DEVELOPMENT: A CASE OF ANGLICAN DEVELOPMENT SERVICES IN KENYA

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ABSTRACT
The dynamics of Anglican Development Services (ADS) of the Anglican Church necessitated an investigation of the aspects that contribute to the enhancement of Community Development (CD) in Kenya. Despite mitigation strategies by ADS in enhancing CD in Kenya, to improve the people's livelihoods, community has consistently experienced forms of under-development. This study, sought to investigate the strategies employed by ADS in enhancing CD in Kenya. The study targeted four ADS regions in Kenya namely; Pwani, Eastern, Mount Kenya East and NAIKA (Nairobi, Kajiado and All Saints). A descriptive survey design was used with a sample of 330 respondents drawn from a target population of 1,827. Statistical Package for Social Sciences (SPSS) version 26 was used. Quantitative data was analyzed using frequencies and percentages while thematic analysis was done on qualitative data. The findings illustrated that the ADS has an array of strategies for enhancing CD in Kenya. However, the strategies must be implementable on the ground to improve the sustainability of CD within the targeted areas. Strategies employed by the four ADS regions in enhancing CD in Kenya include mobilizing for food production and security in community, partnership and networking for community capacity building, promotion of health care, training and mobilizing farmers to form groups to promote Agri-business. It is recommended that for the effectiveness of ADS strategies, the target recipients should be expanded through a conscientization process, biblical and theological interventions, transformation participatory approach, and goal-oriented empowerment with the most vulnerable members of the community receiving priority. For ADS to be effective and efficient, it has to focus on transforming individuals, communities and systems without fully being dependent on donor funded activities.
Keywords:

INTRODUCTION

Background of Study

Development has been a critical discipline in the secular and religious fields locally and internationally, drawing considerable ecumenical interest since the World Conference on Church and Society held in Geneva in 1966 (Klaasen, 2019). The term CD comes into play when dealing with peoples' livelihood for a self-reliance community. The terms ‘community development’ entails all forms of activities that shape the human life; strategized according to priority realities. Nindamusta (2004), asserts that strategies translate the priorities of the organization as plans of action developed with an informed criteria and environmental know-how to attain a long-term objective. Mintzberg (1987), defines strategies as a plan, a pattern, a position and a perspective. According to Porter (1991), strategies help in determining the route in which the present and the future performance of organizations is measured. Strategies as the organizations management action plan for conducting operations efficiently and effectively have to be appropriate to enhance effectiveness in the socio-economic and political sphere.

The concept of CD has become imperative as the church exists in a community of people with varied socio-economic and political needs for their survival. Alawode (2016), asserts that CD has been a social discourse by governments, the public sector, organizations, and even ordinary people. Klaasen (2019), indicates that development has generated debates in the media, academia, and social globes, opting for a theological discourse nationally and internationally. There has been a close relationship between the church, Faith Based Organizations (FBOs) and CD as all conterminously exist to address contextual realities in response to the communitys’ needs; for the poor, the marginalized, and the vulnerable are found in every community globally. In the past, the concept of CD was perceived as secular and alien to the mission of the church. However, in the 21st Century, the church has been engaged in CD in response to the worldwide socio-economic and political challenges affecting humanity.

According to ADS Kenya Strategic Plan 2020-2024 (2020), one of the Strategic Pillars of ADS is CD that entails accompanying community in vulnerable situations to improve livelihood of target communities. The community development pillar empower community to attain a dignified living through participatory and empowering interventions. Alawode (2016), recognizes the role of the church in participating in the progressive development, besides, preaching, and evangelism. This prompts the church’s arm of development to be inclusive in community engagements to improve the livelihood of the community. Nindamusta (2004)’s study on *A Survey of Strategic Choices*

in Faith Based Governmental Organizations in Nairobi reveals that the most popular strategy used by FBOs was partnership. In dealing with CD, strategies foster effective use of resources by guiding priority setting and resource mobilization to achieve targeted goals.

In Kenya, the church has a long commitment to integrated CD as part of ministry (Consultant Report, 1997). Ole Sapit avers that from 1844 when Johhann Krapf began the first congregation in Mombasa, the missionary strategy was to construct a school, a health unit and a garden at every mission station (Anglican Provincial Clergy Conference, 2019). Through ADS, Anglican dioceses have continued to strategize on CD with rural socio-economic ADS as an institution of social transformation independently and professionally coordinates CD activities such as agriculture, education, environment, health, gender, human rights, poverty alleviation, peace building, justice, food security, economic empowerment, advocacy, water and sanitation, HIV/AIDS, climate change and governance strengthening (ADS Kenya, 2014). The ADS complements GoK Vision 2030 (2008) to deliver quality services to *wanainchi* (citizens)by utilizing human and financial resources towards self-reliance individually and communally by empowering communities.

The mission of ADS in building partnerships with communities and enabling exercise of God-given potentials in enhancing CD is imperative. Kaplan (1996), holds that FBOs strategies provide education, health, humanitarian relief and micro-finance services to communities, substituting for governments. However, Ngethe (1989), states that most of NGOs lack strategies to propel development agenda. The place of strategies in CD process is thus variable in educating local community agencies, individuals, community service providers and groups to build competencies (Anglican Alliance, 2021). However, there is need for training, empowerment, sensitization, conscientization and inter-dependence in physical, intellectual and spiritual dimensions. In this study, ecclesiastical strategies such as *koinonia, diaconia, incarnation*, *shalom*, creation, stewardship, and leadership were less exploited by ADS in enhancing CD. For instance, *koinonia* concept is a traditional interactive value of *Ubuntu* which holds being-self through others (Yusufu, 2006). The study calls for reconstruction of the strategies to serve as integral basis for CD to mitigate the persisting socio-economic and political challenges through transformational leadership, transformational participatory approach, hermeneutical formulations, organizational policies in place, training and biblical and theological basis. The aforementioned background issues informed the rationale for the study on strategies employed by ADS in enhancing CD in Kenya.

Purpose of Study
To investigate the dynamics of ADS of the Anglican Church in enhancing CD in Kenya.

Objective of the Study
To investigate the strategies employed by Anglican Development Services in enhancing CD in Kenya.

Research Question
What are the strategies employed by ADS in enhancing community development in Kenya?

LITERATURE REVIEW
This part reviews existing literature relevant to strategies employed by ADS of the Anglican Church in enhancing CD in Kenya.

Strategies Employed by ADS in Enhancing Community Development in Kenya
CD entails all forms of socio-economic and political activities that affect human livelihood. According to Carmen (1996), CD as a process of change mediated by some form of human intervention. Porter (1998), holds that strategies are vital in organizational planning to achieve the intended results. This has reference to the ADS Kenya Strategic Plan 2015-2019 (2015), which indicates that in 2013, Kenya ushered in a new era of devolved form of governance with more functions and resources in the grassroots. This prompted ADS Kenya to align her strategies to the changing political systems in Kenya by developing socio-economic and political activities to define community priority goals.

The ADS Kenya Strategic Plan 2015-2019 (2015), indicates strategies employed by ADS in its transformation agenda such as capacity strengthening, partnerships and strategic alliances, modeling, advocacy, participatory information sharing, communication and technology; participatory budgeting and research, learning and documentation. However, literature on ADS Pwani, Eastern, Mount Kenya East and NAIKA regions is limited on strategies employed by ADS in enhancing CD. Moreover, the strategies change according to ADS regions foci, new policies, donor influence,

environmental, cultural factors and socio-economic and political changes. Key to strategies is the implementation process to ensure effectiveness and efficiency in achieving organizational goals. Anglican Alliance (2021), states that strategies set forms of decision-making to realize effectiveness in an organization. However, as noted by Ngethe (1989), most NGOs lack defined strategies to propel CD agenda due to due to their short-term rather than long terms objectives This is a call for ADS through ACK to provide long term strategies that are sustainable in enhancing CD in Kenya. The growing debate in academic, policy and ecclesiastical circles on strategies used by FBOs in development is inadequate. Sakwa (2007), Bakker (2016), and Arudo (2011,) claim there is little that is known about the impact of FBOs to socio-economic and political development in public domain. A relative study by Nindamusta (2004) on a Survey of Strategic Choices in Faith Based Non-Governmental Organizations in Nairobi, fronted partnerships as the most popular strategy. This study established that mobilizing for food production and security in community by (61.5%) was rated high. The studies affirmed that without proper strategies in place, CD cannot survive. This study established that for the effectiveness of ADS, strategies have to be implemented and supported by community.

Another important consideration is that strategies encompass amassing of information and setting goals, focusing on competences of community by identifying, mobilizing community and creating initiatives in the socio-economic and political sphere. Kinyua (1999), demonstrates that integrated development approach model adopted by CCS is critical in CD, but failed to establish effective strategies that could enhance CD. Marshall and Van (2007), call for projects aimed at fighting poverty be evaluated on basis of advancement towards freedom and responsibility than remaining in a cycle of deprivation and dependence.

ACK formulations on Wholesome Ministry Strategies 2018-2027 (2018) with emphasis on community and individual empowerment, facilitating individuals and communities to sustainably meet needs is critical. Ole Sapit (2019), asserts that strategic activities are implemented through diocesan development officers, while advocacy role, prophetic ministry, justice-social, economic, administration and environmental protection of vulnerable groups through ADS. This study established that ADS end-up employing development approaches from a spiritual entity thus, impeding CD activities. In most of the study areas, community was informed of ACK and less on ADS. Moreover, the study established that contextual theologies such as inculturation, liberation, feminist, *oikos*, ecology, laity, theology of work and RT inform CD.

In matters of the church as institution for development, Nyorsok (2014), and Bwibo (2014) assert that the church stands as an established grassroots institution through which ADS structures serve as instrument for strategization. ADS systems, human resource, capacity investment, organizational policies, training, empowerment, and interdependence in physical, intellectual and spiritual dimensions are vital for enhancing CD. In this study, ecclesiastical strategies such as *koinonia*, *diaconia*, *incarnation*, *shalom*, creation, stewardship, sustainability and leadership were less exploited by ADS in enhancing CD. For instance, *koinonia* concept has a traditional interactive value of Ubuntu which holds being self through others.

On the issue of church-based projects and programs as strategies for CD, Tsuma and Wambua (2020) and Arudo (2011), attests that church-based projects fail after some time. The findings hold that ADS act as a catalyst to socio-economic and spiritual issues besetting community. However, there is need for efficient and effective ADS strategies as informed by Nehemiah's clarion call for focus, holistic and pragmatic principles (Nehemiah 2:18). This study established that strategies such as: conscientization, community mobilization, capacity building for individual and community, and transformational participatory are helpful in reconstructing CD mindset to address prevailing woes in community.

Participation as a strategy in enhancing CD is imperative. Chikati (1988), avers that participation in CD ensures beneficiaries' inclusion in project design, planning, decision-making and implementation process. This study proposed participation between the community, stakeholders and donor as crucial in enhancing CD in Kenya. Thiong'o (2019), found that strategies used in mitigation against poverty non-effective, thus, need to start teaching and implementing poverty eradication programs. Similarly, a study by Mbugua, Nyiva and Gathano (2017), reveals ineffective strategies in community-based projects. This study established a recurring problem of failing projects due to non-translation of strategies to programs and projects on the ground. The study proposes strategies that are local-driven and empowering community and local leaders, rather than imposing foreign solutions in addressing socio-economic and political challenges.

ADS is guided by strategies in its operations, but due to diversity and uniqueness in its structural operations, there is need for strategizing each region since generalization limits. The expansion of ADS regions calls for systems and structures to sustain activities. Reconstruction on socio-economic and political developments calls for more responsive capabilities on strategies employed by ADS to help build up competencies for sustaining livelihood of community.

RESEARCH METHODOLOGY

The study adopted a descriptive survey research design to explore, determine and report issues (Mugenda and Mugenda, 1999). The study was carried out in four ADS regions, namely; Pwani, Eastern, NAIKA, and Mt. Kenya East; purposively selected in line with Creswell and Garrett (2008), recommendation to choose respondents that help arrive at sought knowledge. The regions ensure criterion of equal representation of views due to uniqueness and diversity in terms of occupation, ecosystem, living standards and development priorities. The target population was 1,827 drawn from Pwani, Eastern, NAIKA and Mt. Kenya East ADS regions. The final sample size comprised of 330 gotten from the target population comprising of 206 ACK clergy, four ACK Bishops, 57 ADS staff and top management, 26 ACK Christian lay leaders and 37 community leaders sampled through a sampling matrix. The research instruments utilized were questionnaires to collect data from ACK Clergy, ADS Staff and Community Leaders. Oral interviews were conducted to ACK Bishops and ADS top managements while the FGDs gathered data from Christian lay leaders. In terms of data analysis, quantitative and qualitative data were analyzed with prior diagnostic tests to assess suitability of the data based on the research objectives. Quantitative data was analyzed using quantitative analysis techniques. Statistical Package for Social Sciences (SPSS) version 26 software enabled further analyzing of data in percentages and frequencies of certain concepts. Qualitative data was generated and presented thematically as well as in form of narrative formats.

FINDINGS

Strategies Employed by Anglican Development Services in Enhancing CD in Kenya

The respondents were asked to indicate the level of agreement with regard to strategies employed by ADS in enhancing CD based on twelve Likert scale statements. Table 1 provides a summary of the responses.

Table 1: Strategies Employed by Anglican Development Services in Enhancing Community Development in Kenya

Statement	SD	D	NO	A	SA	Total
Empowerment for sustainable and transformational development	6.3 18	38.9 112	7.3 21	41.0 118	6.5 19	100.0 288
Mobilizing for food production and security in community	5.5 16	30.2 87	2.8 8	51.4 148	10.1 29	100.0 288
Partnership and networking for community capacity building	5.2 15	30.5 88	4.5 13	49.0 141	10.8 31	100.0 288
Mobilizing community to join micro-finance schemes and financial saving culture	8.7 25	25.7 74	7.6 22	45.2 130	12.8 37	100.0 288
Mobilizing farmers to form groups to promote Agri-business by *Farming God's Way*	13.9 40	21.9 63	5.2 15	29.9 86	29.2 84	100.0 288
Advocacy for human rights and good governance	1.4 4	32.6 94	8.0 23	50.0 144	8.0 23	100.0 288
Promotion of preventive health care *via* training community health workers	10.8 31	22.9 66	6.9 20	34.7 100	24.7 71	100.0 288
Promotion of environmental conservation and preservation	14.9 43	24.3 70	2.8 8	25.7 74	32.3 93	100.0 288
Socio-economic and political empowerment	5.9 17	31.6 91	6.6 19	46.5 134	9.4 27	100.0 288
Promotion of justice and peace-building	5.2 15	32.6 94	5.2 15	45.2 130	11.8 34	100.0 288
Organizing community groups to collect, harvest and conserve water	14.2 41	22.9 66	5.6 16	28.1 81	29.2 84	100.0 288
Offering prophetic voice for the poor masses (voice of the voiceless)	12.5 36	32.6 94	10.8 31	38.5 111	5.6 16	100.0 288

Data obtained shows that, 137(47.5%), of the respondents consider empowerment for sustainable and transformational development as a strategy; 177(61.5%), of the respondents stated that mobilizing for food production and security in community is a strategy;172(59.8%), reiterate that partnership and networking for community capacity building is a strategy and 167(58.0%), consider mobilizing community to join micro-finance schemes and financial saving culture an ADS strategy for enhancing CD. Similarly, more than half of the respondents 170 (59.1%), indicated that mobilizing farmers to form groups to promote Agri-business by *Farming God's Way* is a strategy; slightly less than this proportion 167(58.0%), consider advocacy for human rights and good governance as a strategy; more than a half of this proportion 171(59.4%), said that promotion of preventive health care *via* training community health workers is a strategy and 167(58.0%), reported that promotion of environmental conservation and preservation is a strategy for enhancing CD. Other strategies considered include; socio-economic and political empowerment 161 (55.9%); promotion of justice and peace-building 164(57.0%), organizing community groups to collect, harvest and conserve water 165(57.3%), and offering prophetic voice for the poor masses by 127(44.1%). Findings show that more than half of the respondents 162 (56.3%), aver that ADS has a number of strategies for enhancing CD in Kenya thus the favorable percentage rating.

Responding to the objective of this study, that sought to investigate the strategies employed by ADS in enhancing CD in Kenya, quantitative findings illustrated that mobilizing for food production and security in community (61.5%), partnership and networking for community capacity building (59.8%), promotion of preventive health care *via* training community health workers (59.4), and mobilizing farmers to form groups to promote Agri-business by *Farming God's Way* (59.1%), are some of the most common strategies implemented to enhance CD in the four ADS regions. Other strategies include mobilizing community to join micro-finance schemes and financial saving culture (58.0%), advocacy for human rights and good governance (58.0%), promotion of environmental conservation and preservation (58.0%), organizing community groups to collect, harvest and conserve water (57.3%), promotion of justice and peace-building (57.0%); socio-economic and political empowerment (55.9%), and offering prophetic voice for the poor masses (44.1%). The findings illustrated that ADS has an array of strategies for enhancing CD in Kenya. It is in line with ADS Kenya Strategic Plan 2015-2019 (2015), which specifies strategies employed in enhancing CD in Kenya such as capacity strengthening, partnerships and strategic alliances, modeling, advocacy and sharing good practices, participatory information sharing, communication and technology; participatory budgeting and research, learning and documentation.

The findings on strategies employed by ADS in enhancing CD in Kenya from open-ended questionnaires that provide qualitative data include strategies on: health care, mobilization of farmers to form teams to promote *farming God's way*, advocacy, training on savings and loaning, community's household support, mobilizing training, teachings on good stewardship, natural resource management, mental health and HIV/AIDS advocacy, technical skill courses. In addition, construction of irrigation, boreholes, water tanks and reserves in community, empowerment and capacity building in small scale farming, agro-pastoralists, food security, livestock and, nutrition management, micro-finance, agri-business, peace and reconciliation, maternal health and new born and child care, anti-gender violence strategy, training on water harvesting techniques and environment care, advocacy for human rights, good governance, community mobilization, transformational development and ministry to the socially challenged such as women, youth, the displaced, street children, refugees, sick, the aged, and People Living with Disabilities (PLWD).

From the above supposition, it is evident that strategies employed by ADS are not static but keep on changing after the end of each strategic plan or region since each region has its own unique foci. This scenario makes it difficult to measure wholesomely the effectiveness of ADS strategies in the four regions. The determination is further complicated by lack of recent empirical data on the extent and influence of ADS contribution in enhancing livelihoods of communities. This has reference to Sakwa (2007), that the church is pivotal in poverty alleviation but ineffective strategies inhibit CD. Bakker (2016), terms strategies used by ADS as theoretical interventions that are blind of local contexts, hence, Kenyans feel cheated and manipulated. Arudo (2011), indicates that ADS that enjoyed sponsorship from international organizations experienced challenges of sustainability and ownership. The scholars express reservations with effectiveness of strategies employed by ADS in uplifting community livelihood, though fails to offer any tangible solution. This study established that for ADS to be effective and efficient, it has to focus on transforming individuals, communities and systems without fully being dependent on donor funded activities. According to Njogu (2022), the Church and Community Mobilization Process (CCMP), is a response of the church to the world. CCMP calls for the urgency of the church to leave the walls and engage the community. The program deals with empowerment of Christians and community members transforming situations wholistically using available local resources. This process is facilitative, makes learning easy for self-discovery and church awakening, church and community

mobilization, church and community description, information gathering, analysis and decision are valuable in facilitating people to realize selfs and meet the needs of the poor of the poorest in community using their own resources.

Qualitative data in terms of interviews was sought from the bishops and ADS top management. The question that guided the interview was: What are the strategies employed by ADS in enhancing CD in your jurisdiction? Mutua (OI.2022) stated that:

Strategies on ecology is by tree planting programs through Green Anglicans Movement at Diocese level, training on soil and water conservation, advocacy to encourage locals to grow traditional crops that are drought resistant and support agricultural value chains such as green grams, pigeon peas and fruits which as a region have a comparative advantage.

Baya (OI.2021) indicated that:
The ADS has made effort reach out to community by engaging opinion leaders in development issues. The use of the local people who understands the culture and challenges of the region is an important starting point. Development in this region, calls for strategies based on humanitarian, non-discriminatory, and missionary approaches that consider ACK as a mission of the church and values humanity as created in the image of God. The church's concept of Agri-mission use agriculture as a tool for mission to address the high poverty prevalence. This concept was compelled by a visit in Simba hills, a rich land, but the people are poor because the land is less exploited.

According to Okeyo (OI.2021)
Kilimo kanisani is one of the strategies employed during Covid 19 pandemic period to uplift the livelihood of community. This concept intensifies the need to plant various horticulture crops within the church compound using organic components in farming and pest control; an example of ACK Makupa Church.

Additionally, Maganga (OI.2021) indicated that:
Health care of the community comes first, advocacy, partnership, employment of volunteers to help manage HIV/AIDS programs, promotion of: natural resource management and Agri-pastoralists. Other strategies are: food security and storage to reduce aflatoxins, marketing linkages, parents' dialogue, African Youth Trust, and partnership of the National and County government and ADS.

According to Gitari (OI.2022), the strategies employed by ADS in enhancing CD are:
Advocacy, promotion of food security, sustainable community development, building resilience, capacity building of the church leaders and clergy, environmental management, nutrition, well-being education, social grouping, rearing of small animals, entry and reaching out to people of all ages. To enhance the relativeness of ADS and other FBOs, the researcher interviewed Mwanziwe (OI.2021), whose church in Kwale County is instrumental in CD and has several community strategies in place. He stated that:

Compassionate International has several support initiatives to the needy community, it strategizes on granting learners' school fees and metal boxes, food supplements, health care, voluntary treatment, building houses for the needy, offering Christmas, birthday and family gifts, free training in tailoring, computer, construction of water storage, educating on best practice of horticulture and marketing. The organization emphasis on inclusivity, partnership, reconstruction, harmonious co-existence irrespective of religious orientations.

The finding from FGDs conducted to ACK Christian lay leaders showed that ADS employed strategies in enhancing CD such as promotion of income generating projects, animal husbandry, financial investment using biblical and theological impetus, advocacy on prophetic voice, strategy on agriculture as business, capacity building, sensitization programs on health care, empowerment programs, sustainability programs on natural resources and mining, strategies on business as a mission, advocacy for youth career development, education, environmental care, and promotion of justice and peace-building through inter-religious conversations, and value addition programs. Righa (2021), holds that the effectiveness of ADS programs is determined through participation, support groups, involvement of local governance structures and adequate preparedness by ADS since every community is unique.

The study findings relate to Righa (2021), presentation that the role of ADS in uplifting the livelihood of the marginalized communities is crucial. The FGDs findings illustrate the need to enhance CD by translated strategies to programs and projects to meet the needs of the vulnerable in community. The aforementioned strategies relate to Korten (1990), that the effectiveness of CD strategies lies with community as the existent social beneficiaries of positive change. Similarly, Thiong'o (2019) argues that while churches may be doing holistic ministry, more advocacy

is needed to suppress rate of poverty in communities by empowering the needy through teaching and engaging them directly in strategies compelling community participation and ownership. In the same vein, Anderson (1984), using Henry Venn's three self-missionary policies, argues for a self-governing, self-supporting and self-propagating church. This should be the direction in which ADS ought to utilize in the implementation process of their strategies in enhancing CD in Kenya.

Community as Beneficiaries of Anglican Development Services in Community Development

The study also sought to assess the extent to which ADS has benefitted different categories of people/Institutions. Table 2 presents study findings.

Table 2: Beneficiaries of ADS Community Development

Statement	NE	LE	AE	GE	VGE	Total
People living with different disabilities	20.5	58.3	14.2	3.8	3.2	100.0
People living with HIV and AIDS	3.8	9.0	20.1	51.4	15.6	100.0
Girl child	43.4	41.7	7.6	4.5	2.8	100.0
Boy child	44.8	43.1	7.6	2.8	1.7	100.0
Senior Citizens (over 70 years old)	48.2	39.9	6.3	4.2	1.4	100.0
The vulnerable (poor, street children, orphans, prisoners, widows, widowers)	12.8	35.4	31.9	17.7	2.1	100.0
Small scale projects such as jua *kali, mama mboga business, bodaboda riders*	11.1	36.8	32.6	16.3	3.2	100.0
Supporting poor students at all levels of education to reduce poverty and illiteracy	12.5	27.1	32.3	22.9	5.2	100.0
Accessibility to medical services	2.8	6.6	23.6	38.2	28.8	100.0
Displaced population and war refugees	10.1	28.5	35.1	21.5	4.9	100.0
Abandoned street children	33.0	32.3	17.4	13.5	3.8	100.0
Communities living in Arid and Semi-Arid Land (ASAL)	2.4	9.0	17.0	38.9	32.6	100.0
Economic development in creation of jobs	3.8	9.4	20.5	54.9	11.5	100.0
Social development towards the reduction of violence and wars in community	4.5	16.3	31.3	39.2	8.7	100.0

The findings illustrated that the majority of the respondents indicated that the categories who benefitted much were people living with HIV and AIDS 192 (67.0%), accessibility to medical services 192 (67.0%), communities living in Arid and Semi-Arid Land (ASAL) 205 (71.5%) and economic development in creation of jobs 151 (66.4%), were beneficiaries of ADS either to a great or VGE. Social development towards the reduction of violence and wars in community 137(47.9%) received slightly less than average approval rating by the respondents as a beneficiary of ADS development implying average level of benefit. Others such as supporting poor students at all levels of education to reduce poverty and illiteracy 80 (28.1%), displaced population and war refugees 76 (26.4%), the vulnerable (poor, street children, orphans, prisoners, widows, widowers) 57 (19.8%), small scale projects such as *jua kali* (local industry), *mama mboga* (local business traders*), bodaboda riders (men and women committed in transport business to earn a living)* by 56 (19.5%) and abandoned street children 49 (17.3%) were reported to have benefitted to a great or VGE by less than a third of the respondents implying being minimal beneficiaries of ADS development programmes. People living with different disabilities, 20 (7.0%), girl child 21 (7.3%), Boy child 12 (4.5%), and senior citizens (over 70 years old) 16 (5.6%) received below 10% approval rating for great or VGE of adoption implying almost negligible attention by ADS.

Based on the implementation of the strategies, it was illustrated that communities living in Arid and Semi-Arid Land (ASAL) (71.5%), people living with HIV and AIDS (67.0%), accessibility to medical services (67.0%), and economic development in creation of jobs (66.4%), were the main beneficiaries of ADS. This can be taken to imply that ADS is concerned with change that is geared towards bringing about socio-economic and political development to the most vulnerable in ASAL areas. However, the findings showed that specific areas or target groups that are in dire need of focus for the development programs are still left behind. Such categories/institutions include support for poor students at all levels of education to reduce poverty and illiteracy (28.1%), support for displaced population and war refugees (26.4%), support for the vulnerable (poor, street children, orphans, prisoners, widows, widowers) (19.8%), support for small scale projects such as *jua kali, mama mboga business, bodaboda riders* (19.5%) and support for abandoned street children (17.3%) received minimal attention of ADS.

From the above findings, there is need for strategies focusing on: creation of jobs, anti-violence and war programs, supporting the poor students at all levels of education to reduce poverty and illiteracy, displaced population and war refugees the vulnerable poor, street children, orphans, prisoners, widows, widowers, small scale projects such as *jua kali, mama mboga, bodaboda,* abandoned street children, people living with disabilities, and senior citizens over 70 years old, for they received negligible attention from ADS. For instance, more effort is needed to the youth to improve on their self-esteem and lead a healthy lifestyle. Needy cases of learners still in school be granted school fees bursaries, strategies that uphold social inclusion and partnership with other organizations and institutions be fronted. The study ascertained that education for all learners is vital for enhanced development. Children from poor households cannot afford good education because of lack of school fees so they remain a casualty of poverty. There is evident that there is a relationship between education and poverty reduction especially, when good education leads to sustained livelihood. The findings are in line with the recommendations of Ovbiebo (2013), who called for social, economic, health, education and, political developments to the most vulnerable in the society.

The findings support Kinoti (1994), who contends that the old and the aging have been forgotten. The senior citizens in Africa deserve more than a casual notice. Any socio-pastoral program has to address the total welfare of the society by including the agenda for elderly and the plight of the street children. Getui (1994), holds that, the phenomenon of street children who are largely dirty, malnourished, and of poor health is a glaring reality in many parts of the world. ADS has a mission to reach out to community in war, those in agony, frustrated and in hopeless situation, the sick and troubled persons. This implies the global human community has been marked by injustice, and oppression thus causing suffering of community. More so, HIV/AIDS is a disease with moral, psychological, socio-economic and political consequences, thus ADS has a duty to provide psychological & pastoral care to the victims and those affected. Another pertinent area is the girl and boy child who in this study have been neglected. One of the basic strategies that the ADS should adopt in responding to boy and girl child is to guarantee the fundamental rights of children.

The ADS has a role to help children, people living with HIV and AIDS, communities living in ASAL, poor students at all levels of education, displaced population and war refugees, the poor, street children, orphans, prisoners, widows, widowers, jua *kali, mama mboga, bodaboda riders,* PLWD, girl child, and boy child. Keith (1984), using Henry Venn's three self-missionary policy, argued for a self-governing, self-supporting and self-propagating church. Henry Venn's principle could form the direction in which the ACK through ADS ought to emphasize in the implementation process of the strategies enhancing CD.

A relative study by Nindamusta (2004), fronted partnerships as the most popular strategy while this study, mobilizing for food production and security in community by 177(61.5%) was rated high. The studies affirm that no institution can survive without proper strategies. This implies that strategies foster effective use of limited resources by guiding priority setting and resource mobilization to produce or achieve the intended or targeted goals and results. Nindamusta (2004), holds strategies such as restructuring, networking, cooperation, internal capacity building, and marketing of activities. This study established that for effectiveness of ADS, CD strategies have to be implementation and supported by the community.

In matters of the church as institution for development, Nyorsok (2014), Bwibo (2014) and Omanyo (2014), assert that the church stands as an established grassroots institution through which ADS structures serve as instrument for strategizing of CD activities. The ADS systems, human resource, capacity investment and organizational policies are vital for enhancing CD. Voorhies (2009), contends that God is at work changing people and their community through holistic-oriented strategies such as health care, economic growth, political advocacy, relief and transformational development. In the same vein, ADS Kenya Consolidated Annual Report (2020), holds that ADS continues to spearhead the Church social transformation ministry to uplift the livelihood of the poor, marginalized and the vulnerable.

CONCLUSION

ADS is a critical institution of community socio-economic and political development. Implementation of CD by ADS is based upon encompassing strategies aimed at ensuring the targeted communities in need, reap maximum benefit. The strategies have to translate to programs and projects that benefit community livelihood right from the village, town, county and national levels. Key to CD is the conscientization of the community, goal-oriented empowerment and transformational participatory approach. This will unleash abilities to contextualize theologies and potentialities to meet community livelihood sustainably.

RECOMMENDATIONS

Whereas findings illustrated existence of ADS strategies capable of enhancing CD, data obtained illustrated a relatively high degree of neglect for the vulnerable population in quality implementation of CD programs and projects. It is recommended that for the effectiveness of ADS strategies, the target recipients should be expanded through a conscientization process, biblical and theological interventions, transformation participatory approach, and goal-oriented empowerment with the most vulnerable members of the community receiving priority. For ADS to be effective and efficient, it has to focus on transforming individuals, communities and systems without fully being dependent on donor funded activities.

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STATUS OF FEMALE CIRCUMCISION AMONG THE ABAGUSII OF NYAKOE VILLAGE, KISII COUNTY, KENYA BY 1963

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ABSTRACT
Female circumcision among communities in Kenya has a long historical dispensation tracing back to the colonial period. The colonial government put in place measures that were aimed at curbing this practice. Dispite all this unrelenting efforts, female circumcision continued to persist among the Abagusii of Nyakoe village, Kisii county, Kenya by 1963.The study was guided by the following objective. To establish the status of female circumcision among the Abagusii of Nyakoe village,Kisii county, Kenya by 1963.The study was based on the assumption that the status of female circumsion among the Abagusii of Nyakoe village had changed by 1963.The study used Structural Functionalism theory as a tool for analysis in establishing the status of female cicumstion among the Abagusii of Nyakoe village in Kisii county.Methodologically,being qualitative research, the study used descriptive research design. This study was conducted in the village of Nyakoe in Kisii county because of the continued persistence female cicumstion among the Abagusii of Nyakoe village despite the colonial government's efforts to stop it between 1907 and 1963.A sample size of 50 respondents were purposefully sampled using snowballing techniques. The data was collected from primary, archive and secondary sources and were corroborated to achieve reliability and objectivity of the study. Data was collected through Oral interviews and Focus group discussion. Data was analyzed and presented by qualitative data analysis. The main research findings were as follows: Christian missionaries and the African chiefs and the local native council, building schools, forced labor of the Gusii men, narrative of the European superiority, taxation, prosecution of the participants, trade and evangelization were used to protest against female circumstion. Female continues in the study area despite the colonial government's effort to stop it.
Keywords: Status, Female Circumcision, Abagusi, Nyakoe Village

INTRODUCTION

Today, information technology, education, cultural integration, quality of life concerns, and gender issues are changing people's perceptions of female genital mutilation. Efforts to abandon stakeholder practices have resulted in laws, treaties, laws and campaigns against them. However, in some of these areas, this practice continues unimpeded (Nypan,1991). Many societies around the world have different alternative enrollment ceremonies that members must undergo. These rituals include birth, naming, circumcision, marriage, and death (Gennep, 1999). Moen (1978) describes female circumcision as a conservative expression that includes a series of procedures that are classified as genital deformities. Female circumcision involves removing the clitoris and separating the initiate for a period (Magesa, 1998). In Africa, female circumcision is considered a precious rite and symbolizes the transition from childhood to adulthood. Mbiti (1990) argues that circumcision of young girls prepares them for marriage and their role as wives to be. Wilhelm (2009) aptly opines that this practice is aimed at reducing women's sexual desire and being subjective to their husbands. Therefore, young women were willingly circumcised and married off as soon as possible to gain wealth and fame. In the United States, female circumcision is performed to control masturbation and teenage pregnancy (Shryock, 1968).

Various modernization theorists believe that improving the economic status of women, in particular, will have a wide range of social implications, including reduced support for female circumcision (Kennedy, 1970; Hayes, 1975; Yount, 2002; Hayford, 2005). Data show that African female circumcision has several implications. 90% of women in western Sierra Leone participate in highly influential women's secret societies. Female circumcision incorporates and identifies them as members (Smyke, 1991). In the Igbo, Anambre and Cross River (Nigeria) states, female circumcision is performed on mature girls as part of adolescent rituals (Adebajo, 1992). Gruenbaum (2001) emphasizes that the ethnic identities of most people are carefully preserved and that their characteristics change only when there is a compelling incentive. If there is a strong link between female circumcision and ethnicity may indicate mutual expectations of retaining that practice.

Kanake (2007) used Grounded Theory to study the transformation of traditional circumcision rituals for girls in Meru, Kenya. He examined Meru's understanding, attitudes, and values expressed in connection with traditional Meru's upbringing and adult transition rituals. Studies have shown that 69.2% of the Meru people misunderstand various beliefs about current female circumcision rituals. 82.3% of Meru's population emphasizes female circumcision as a

means of guiding girls into adulthood. Occasionally, as the timing of female circumcision shifts from adolescence to younger age, it is done individually rather than in groups, separated from the training and celebrations that take place during the adult ceremonies (Hernlund, 2000; Njue & Askew, 2004; Yoder & Mahy, 2001). It is also generally reported that young girls heal faster and have less resistance than older girls and women. Hosken (1978) states that the combination of heavy bleeding with fear and pain can lead to shock and death. Urinary retention, infections and tetanus are also common. Kaplan (1994) states that in patriarchal societies men dominate women and justify women's domination through devaluation.

Momanyi (2001) uses structural-functionalist theory to study the circumcision of Abagusii women in Kenya. He states that the path for women in the Abagusii community was incomplete without being circumcised. Even after being banned, this practice continues to this day, as the Abagusii were determined to fight for the practice of female circumcision. Uncircumcised girls cannot marry and, if married, maybe circumcised at birth. Women are expected to be circumcised, bear children, perform household chores, and care for both husbands and children. Despite the traditional role of female circumcision in the Gusii community, today, there has been wide change in perception of the people towards the practice. This scenario necessitated a study on the status of female circumcision among the Nyakoe people, Kisii County, Kenya by 1963.

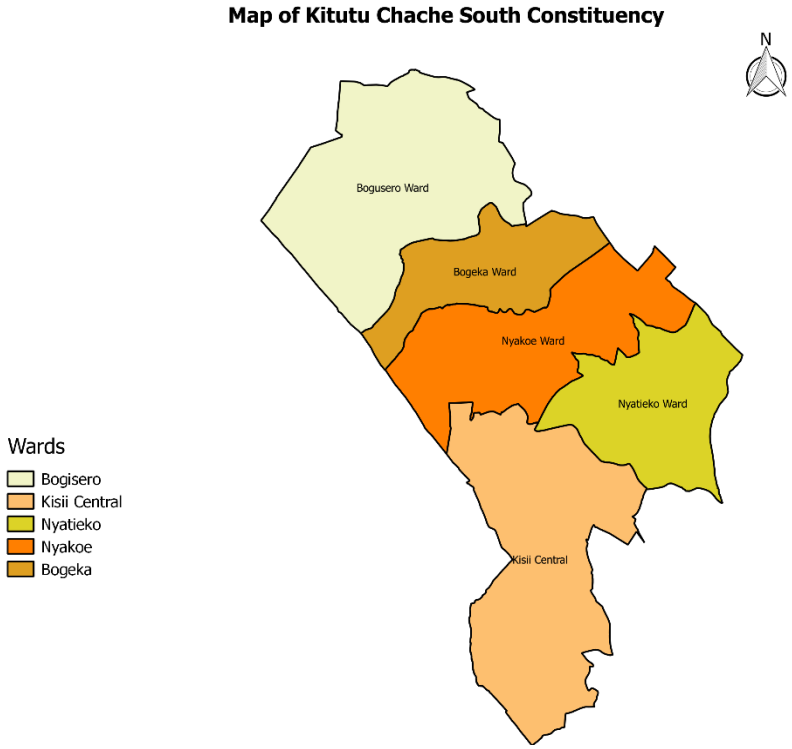


Figure 5: Administrative Boundaries of Kitutu Chache South Showing Location of Nyakoe. Source: Self (2021)

RESEARCH METHOD

This study used a descriptive study design to explain, record, analyze, report, and present the findings that were obtained from Kothari (1985). Kathuri and Pals (1993) add that the systematic and scientific nature of descriptive study design provides valid and reliable results. Kombo and Tromp (2006) also show that the main purpose of descriptive research is to explain the status quo, enabling both qualitative and quantitative research. Kerlinger (1969) points out that descriptive research is not only about establishing facts but also about formulating important principles of knowledge and solving essential problems. Therefore, the descriptive study design was suitable for this study because it allowed researchers to provide valid and reliable results. The study, therefore, used a descriptive research design to have an in-depth analysis of the respondents to give reliable and valid findings on the status of female circumcision among the Nyakoe people, Kisii County between by 1963.

Data Analysis Procedures and Presentation

The researcher analysed information through the use of Qualitative Data Analysis. Qualitative Data Analysis was used to explain and interpret the status of female circumcision among the Nyakoe people, Kisii County. Qualitative information involved the use of closed and open-ended questions analysed based on content. The researcher then grouped information from the questionnaire according to the precise study question. This was influenced by the data obtained from oral sources, archival sources and secondary sources which were corroborated to meet the reliability and validity of the study. Finally, the researcher summarised the key findings, gave explanations as well as interpretations and conclusions on the status of female circumcision among the Nyakoe people of Kisii County from by 1963.

Findings of the Study

This section presents the results of the study on the status of female circumcision in Nyakoe, Kisii County, Kenya until 1963. The discussion focuses on the main impact of colonial attitudes towards female circumcision on Abagusii women of Nyakoe village. Next, researchers show whether Abagusii women changed their perceptions of this culturally embedded practice after the colonial attack. Discussions were obtained from primary sources stored at the Kenyan National Archives in Nairobi, oral sources from Abagusii in the village of Nyakoe, and secondary sources from the various Kenyan libraries. Methodologically, structural functionalism theory that explains why certain behaviour and cultural practices exist because they are structurally entrenched in a particular system was used to demonstrate the status of female circumcision among the Nyakoe people in Nyakoe village by 1963.

Status of female circumcision among the Nyakoe people, Kisii County, Kenya by 1963

The issue of gender communal control was important in determining the status of women in British colonial society, as in the case with Abagusii in the village of Nyakoe in Kisii. The feminist movement has been steadily taking root in Britain for decades, but by the 1920s, British society generally rejected men's prominent and public role in women historically, and instead represented them. It was bound by the patriarchal ideology of empowering to protect their interests.

It was reported that even with colonial policies that discouraged the practice of female circumcision, among the Abagusii of Nyakoe village, women continued to cherish and uphold this practice even to the latter years of independence. They demonstrated this by being always ready to face the cut which was traditionally entrenched in the Gusii culture. The Gusii women believed that without being circumcised, they would be considered valueless in the community and therefore, they would not receive the same privilege like respect which was given to the circumcised women in Nyakoe village. Because female circumcision played an important role in Gusii's marriage. A day was then agreed on when the suitor would come to meet the girl and negotiations for marriage began. This made the women of Abagusii of Nyakoe village uphold the female circumcision practice more and more (Mauti, 2022).

Oral information from Nyakoe village during the interview, however, showed that little or no specific direction was given among the Abagusii tribes in the village of Nyakoe. On the other hand, casual lectures and circumcision emotional climaxes on life and sex appeal in the early childhood dance community undoubtedly represent the perfect sex thrive. That's because it overemphasizes the sexual life it puts at risk in the minds of the initiator (Magwara, 2022).

According an archival report, KNA: PC/NZA/2/3 Annual Reports (political records) 1908-1913, there was a Chiefs Act that was legislated in 1912. This act banned the practice of female circumcision among the residents of British colony especially among the Gusii people. This report was supported by another secondary source, that established that anyone who violates this decree may be prosecuted under the Chiefs Act of 1912 (Sanderson, 1986). At the local level, oral respondents, however, noted that there was pressure from the Nyakoe people and elsewhere to abolish the Chiefs Act. When this happens, there is no law to prosecute those who have committed circumcision crimes.

Those who have the operation completed successfully, are still being praised by those who escorted them with songs and ululations as discussed in the previous chapters of this thesis. The family and the clan they belong to are also praised. The songs are obscene but educate on acceptable behaviour in society with stress on sexuality. They mock ill behavior and praise success at the same time. They emphasize moral values such as, without women, there is no life, friends share food and sexual relations should be between the circumcised only. They sing initiation songs as the initiates walk back to their homesteads after the operation.

When they get to the home compound, the girls go through the side door or window *(were).* This is a ritual which is performed by initiates in the presence of elders to symbolize the custom that women do not belong to the lineage. They come to the lineage through the side door and leave for marriage through the front door. When they "enter" the house, a period of seclusion ensues. The initiates are restricted from meeting strangers and male relatives until their graduation, with the help of a mentor *(Omosegi)* they are trained and socialized on the customs, behaviors and practices of the community. They learn as much as they can about the environment surrounding them including therapy. They are fed luxuriously and are still restricted from doing any chores (Momanyi O.I, 2022).

According to Momanyi (O.I, 2022), on the eve of the graduation day, test ordeals are done. The initiates are warned that the moment they reveal what takes place during the ordeals, they will die. Nobody will know about the ceremony unless the person was participating in the group. The key informants indicated that the initiates are tested on their ability to show courage and keep secrets. The ordeals are usually administered by the senior age sets. The following day they graduate with more rituals and promises of blessings and good fortune. Early in the morning, they are allowed to go to the river to bathe. On the way from the river, they are joined by people who sing in their praise. They put flowers on each of them and give them presents. Each initiate is greeted at home with presents and congratulations for leaving the stage of childhood successfully and becoming an adult.

The now-adult girl goes to greet her father or guardian carrying milk in a calabash. The girl tells her father that she is now ready to earn bridewealth to the family which was very significant in the Gusii customs. The girl can be married off when a suitor is found. Apart from being a cultural heritage and its function as a socialising agent, key informants asserted that female circumcision is still a mark of identity for a grownup Gusii woman. This implies that female circumcision still brings homogeneity and is a sign of a proper Gusii woman (Ndiwa O.I, 2022).???

Female circumcision is a common practice in this area. Notwithstanding the peoples' religious beliefs and affiliation, their levels of education, training, income and employment type most Gusii women are circumcised. All community members came together for this initiation rite. Urbanisation has not alienated the residents from the practice. This is supported by the fact that most of the respondents were for the circumcision of their daughters. Likely, they are still influenced by their traditional customs and values. The prevalence of the practice tallies with Gwako (1992) whose study in Kisii noted that 97.1 % were in favour of the continuation of the practice even in the latter years of independence.

According to Moraa (O.I, 2022), the status of female circumcision is part of the Gusii cultural heritage. One oral respondent asked maintained that it was their duty to pass the practice to the next generation since their fore-parents practised it. They wondered how life could be without circumcision and insisted that they had to continue with their circumcision rites. This included individuals from high cadres who argued that those who campaign against the practise have been influenced by western culture and feminism. As a result, they have been misled to believe that one's culture is bad. They made a stand that they cannot abandon their traditions because somebody said so. Some people feel invaded.

The above discussion shows that there is no substitute for the initiation ceremony, as in the case of naming ceremonies, weddings and funerals. There are no signs of their future. The fact that male companions are started at the same time can further affect female circumcision. However, there are changes in the current practice of female circumcision. People had to sing and be cheerful, as they were shown at the inauguration. This was validated through observation. Many of the songs were traditional and were aimed at educating the initiates and expressing what was required of them. The songs could be Christian, mixed, but mostly traditional. This shows that even the initiation ceremonies are borrowing from society and adapting to change.

According to Bilingu and Bikundo (O.I, 2022), it is likely that for those who later have to have surgery in the hospital or as expected in modern society, families decide and carry out them themselves. Men are prohibited from seeing initiating women as indicated in the analysis of this practice. Requires no contact with members of the opposite sex until graduation. Ironically, focus group discussions revealed this requirement to be unmet, as men are known to perform surgical removals in hospitals as well as cure starters. Elderly members of the groups believe that if today's society cannot abide by the traditional provisions of the custom, they should abandon it.

Group discussion showed that elders must prove that women are not of their seed unless they marry them. They are considered foreigners because they are about to get married and leave. If the male elders are not there to show the

play, fellow initiates may not be allowed to enter the building or the receiving house. Ceremonies were held for fellow initiates. This part of the ceremony is very important because it involves feeding. As revealed by some respondents, some members have been known to harass these parties, especially if there is someone of a starting age in the family.

The period of isolation was observed by the majority of respondents. This time allowed fellow initiates to socialize, rest, and heal their wounds. Not all isolated people respond to the usual requirement to light fires and feed during isolation. The lowest number of days in solitary confinement recorded was five days while the highest recorded was one year. They mentioned that it was taboo to reveal what was done during these challenges. Only those who have gone through these challenges are allowed to trade. Other respondents explained that due to the scarcity of firewood, they would not be able to keep the fire even if they wanted to. Other herbs used in the initial trials were difficult to find because the environment had changed. This leads to the abandonment of certain practices.

Oral respondents established that they had age set names. One of these respondents with an age-set name *"Mameka*" (beads) revealed that age-set names were discouraged by a chief in 1949. At the same time, he directed people to use seven cows and three goats as payment for the bride's wealth. This was intended to create uniformity because people had become many and were managing their affairs independently. The chief wanted to discourage disparity.

The Nyakoe people lacked alternatives to replace or supplement initiation rites. Whereas rites of passage like naming, marriage ceremonies and funeral rites have been supplemented by church services, initiation rites have not. Nor is there any indication that any services will come up to replace initiation rites. The fact that male age-mates are initiated at the same period, may continue influencing female circumcision. Apart from the changes which are analyzed above, there are many others. lt was expected that clitoridectomy would be more prevalent in the rural than in the urban sample to allow comparison but both the rural and urban samples had high prevalence. This made it necessary for a comparison to be made between respondents and their children and a remarkable difference was recorded.

The respondents who were not circumcised were 3.5 %. This percentage is very low. An encouraging number of 22.0 % of the respondents had decided not to have their children initiated. A group of 9.5 **%** were yet to decide. The explanations they gave for deciding against the practice were the pain it caused, its purposelessness and the dangers it posed to the health of the young girls. They had been influenced by missionaries of the Lutheran denomination and the Seventh Day Adventists. These missionaries seemed to have convinced some of their followers that circumcision did not help them in their spiritual growth. Instead, it brought health complications. Among this group were the non-Abagusii who were married in Kisii.

Although the natives of Nyakoe village were not forced to have female circumcision, they were not able to stop the initiation of their daughters. This was due to the strong position of their husbands and their mothers-in-law. These women were prohibited from participating in the initiation ceremonies because they had never undergone them. The age of female circumcision and the associated practices had also declined. This was revealed by key informants who said that nowadays, very young children who have not learnt to respect themselves or their seniors are circumcised. The respondents were aware that the age of conducting female circumcision had declined. They explained that the fact that these children eat well and work less facilitates their early physical maturity. The parents were obliged to have their daughters circumcised early, to control their libido (Ongeri O.I, 2022).

The operation was always carried out on the circumcision stone. One old respondent reported that nowadays they have gone to hospital (Ndeke O.I, 2022). This concurred with the respondents who revealed that several Gusii women had their operations done in the hospital as others had them done traditionally. But this change is more marked for the children. When asked why they took their children to the hospital to accomplish a tradition, they said that the circumcisers died and there was nobody to take over. It is likely that in future the practice will be performed in the hospital unless hospital authorities prohibit it. When this is the case, it is assumed that the damage done to the external female genitalia will be reduced.

According to the functionalist`s perspective, (Ahlberg, 1992) one of the important functions of initiation rites was to mark age categories. This helped in the formation of social structure (Flemming, 1975). Initiation as a mark of age set was known to the respondents, but it has become redundant due to its replacement by countable years, birthdays, graduations and other social ranks which are concomitant with societal changes.

The average period of seclusion for the respondents was thirty days, and the average for their children was twelve days. This is evidence that the seclusion period has also declined significantly. As revealed by key informants, traditional society's admission rites aim to educate girls about family and life in general. This includes feeding them fatty foods and making them beautiful for the wedding market. These allowed them to be held in solitary confinement for almost a year. All this is hardly observed in modern society.

In addition, traditional courtship and education processes have been eliminated. The modern education system mainly takes young people and only cures are guaranteed during the quarantine period. No education is given by the elders. In addition to being reluctant to give out for fear of young people being too smart, older people also feel that young people despise their kind of education. Traditional values and norms are not maintained in modern society. The environment limited their existence as fellow initiates were taken to the hospital for surgery and traditional examinations and tests would not be allowed in the hospital. It is also difficult for communities to hold traditional educational sessions unless it is allowed in the school curriculum.

It has been argued that initiation ceremonies have become costly. Key informants note that in traditional societies, payment for activity is in kind. It can be a food or service donation. However, colonialism introduced cash payments. Respondents agree that they pay for their transactions in cash, with the lowest payout being Ksh. 50 cents and highest Ksh. 1,600. Also, they explained that they incur more expenses during parties, where the highest spending amount is Ksh. 6,000. This agrees with Gwako (1992) that the cost is high due to the foods used at the parties. While in traditional society beer was brewed for consumption, in colonial times this beer had to be purchased and, in most cases, made to order. Most of the respondents worried about the cost were employed. They complain that parties have become something to borrow. However, this does not prevent them from practising at all. They said they defaulted to circumcising all of their daughters if one was circumcised. To reduce costs, they said they would take their daughter to the hospital, use a National Hospital Insurance Fund card and not invite people to the party. This is proof that the practice is constantly adapting to change.

The most important part of the initiation rite is clitoral mutilation. This suggests that there are other reasons for the practice that goes beyond socialization and may not be remedied by changes occurring in society. This contradicts Murray (1974), who argues that socialization is more important than activity. In Kisii or modern society, activity is most important. This is evidence that the population studied is aware of the reasons cited to discourage the practice. The fact that they show no sign of abandoning this practice shows that they are not taking the campaigns seriously. Respondents who seem to believe that for whatever reason female circumcision should be abandoned are Protestants.

Those who say ablation is superfluous explain that it is useless and that people have changed their attitudes towards it. Young people are still initiated into adulthood, and this is morally controlled. Others feel that this has changed because not all rituals and ceremonies are performed. The female initiates were also very young and were taken to the hospital. It is not possible to train them according to the customs of the community.

Respondents noted changes in practice, but these changes are not enough to deter them from the attitude. A question about their attitudes showed that 36.0% of respondents liked the practice, 28.0% were indifferent and 25.0% disliked it. Those who hate it are few (11.0%), with relatively similar proportions in both samples. A conclusion can be made that only 35.0% of the study population disliked the practice.

When asked if they would be willing to give up the practice and allow their daughter to be uncircumcised, 45 per cent said they should give up the practice. A similar percentage (45.0%) said that the practice should not be given up because it is still very good. The Abagusii of Nyakoe village seems to be related to this practice, albeit with a decreasing trend. Parents and educators complain about the evils of teenage pregnancy, which they say causes waste and dropouts. At the same time, there is a strong belief that female circumcision controls sexual desire in women in Kisii and elsewhere (Nypan, 1991).

It can be legitimately asserted, contrary to the beliefs of Kisii and other locals, that for the Abagusii, mutilation encourages sexual abuse, pregnancy and thus school dropout. This argument is supported by proven evidence that female circumcision is a sign of maturity. After these rites, men were allowed to propose to their fellow believers. As the results of the study show, the majority of the respondents performed the initiation procedure because they wanted to be allowed to get married. Other respondents said that they were too young to think about getting married at the

time, but they wanted to make sure that when they were mature enough and wanted to get married, they wouldn't run out of suitors because they weren't circumcised.

CONCLUSIONS OF THE STUDY

This study concludes that despite this trend by the British colonialist to attempt to curb the practice of female circumcison, the Abagusii of Nyakoe village continued with the practice custom and even in the later years of independence, Abagusii women still cherish the practice however, it is not normally practised with the greatest significance it had during the pre-colonial period. This, therefore, means that female circumcision is a culturally entrenched practice which cannot be easily eradicated among the Abagusii of Nyakoe Village in Kisii County, Kenya.

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EFFECTIVENESS OF THE EXISTING STRATEGIES IN ENHANCING GENDER RESPONSIVE WILDLIFE MANAGEMENT AND CONSERVATION IN NAROK COUNTY, KENYA

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ABSTRACT
Gender equity and women's empowerment are prerequisites to effective biodiversity conservation, climate action and meeting the Sustainable Development Goals. In view of its ecological, social and economic value, wildlife is an important renewable natural resource. Its significance is felt in areas such as rural development, land-use planning, food supply, tourism, scientific research and cultural heritage. A better understanding of the different roles, knowledge, needs and aspirations of women and men with regard to wildlife management and conservation can help us achieve the twin goals of better conservation outcomes and increased gender equity. This study aimed at assessing the effectiveness of the existing strategies in enhancing gender responsive wildlife management and conservation in Narok County, Kenya. The study was carried out in four Maasai Mara wildlife conservancies. Descriptive survey and sequential explanatory mixed method approach were adopted for the study. A sample size of 167 respondents comprising of wildlife managers, conservancy landowners and conservancy rangers participated in the study. Data collection was done using questionnaires, Focused Group discussion and interviews. The data collected quantitatively was analyzed using descriptive statistics and the findings were presented using percentages, graphs and tables. The findings showed that the measures put in place to enhance gender responsive wildlife management and conservation in Maasai Mara conservancies by the wildlife stakeholders were inadequate. The strategies have failed to penetrate the cultural glass ceiling that has greatly impeded these strategies from taking root. The wildlife stakeholders have also failed to embrace and implement the existing strategies in order bring out the required change. The study recommends that the wildlife conservancies, institutions and managers should find ways of incorporating more women into wildlife management and conservation as well as employ gender advocacy and empowerment programmes to facilitate gender equity and sustainable wildlife ecosystems.
Keywords: Gender responsive, Wildlife management, Wildlife Conservation

INTRODUCTION

Gender equality and women's empowerment is a prerequisite to effective conservation, climate action and meeting the Sustainable Development Goals (SDGs). International agreements on biodiversity (CBD), sustainable development (Agenda 2030) and most recently climate change (the Paris Agreement) present new opportunities for engaging both men and women and accelerating equitable action. From Nationally Determined Contributions (NDC) processes to biodiversity strategies and climate change gender action plans (ccGAPs). Governments, businesses and civil society are now embracing gender-responsive solutions to address the world's most pressing development challenges, (IUCN, 2018).

In view of its ecological, social and economic value, wildlife is an important renewable natural resource. Its significance is felt in areas such as rural development, land-use planning, food supply, tourism, scientific research and cultural heritage, (FAO, 2017). A better understanding of the different roles, knowledge, needs and aspirations of women and men with regard to natural resources can help us achieve the twin goals of better conservation outcomes and increased gender equity. Since the development of wildlife management and conservation initiatives one wonders to what extent both men and women are involved in the management and conservation of wildlife as a natural resource. Therefore, the need to investigate the gender representations in wildlife management and conservation in Maasai Mara ecosystem, Narok County.

Historically, higher participation rates of men in various wildlife activities, as well as traditional employment patterns, may account for the substantially greater numbers of men working in wildlife and other natural resource professions. However, a study by Torres-Cruz and McElwee (2012), explained how treating illegal wildlife poaching and trade in a gender-blind way and failure to incorporate women in wildlife related crimes at decision making and investigations may prevent understanding the issues fully and finding more effective solutions because wildlife crimes are highly gendered activities.

There is a long history of community based conservation (CBC) throughout Africa, but in Kenya a new and important group of initiatives known as conservancies has emerged over recent years. Despite their growing importance there

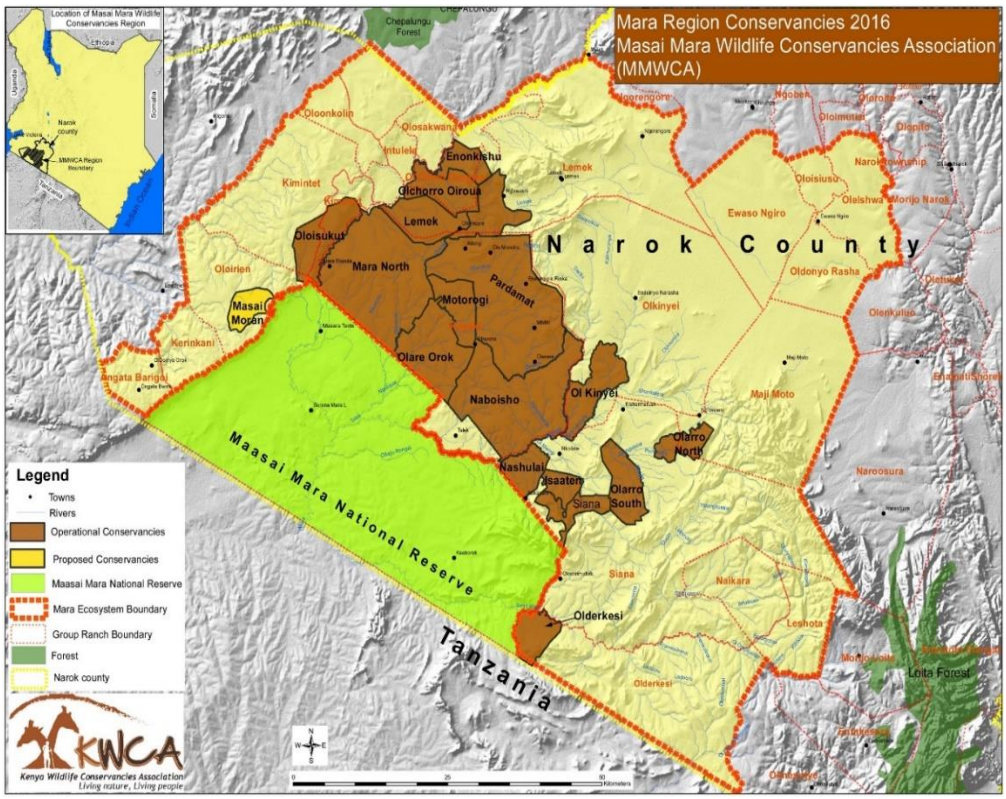
have been few attempts to evaluate the outcomes of conservancy establishment, (Keane, Kaelo, Gurd, Said, Rowcliffe and Homewood (2016). Thus a critical need to come up with gender disaggregated data on wildlife management and conservation for sustainable wildlife conservation interventions. It is thus essential to keep the changing patterns of gender relations in wildlife management and conservation under continual examination, to monitor the extent to which progress is being made towards gender emancipation and to interrogate the adequacy of prevailing strategies towards this goal (IUCN,2018), hence the current study.

Statement of the Problem

Establishment of wildlife conservancies creates potential local level partnerships for improving wildlife management and addressing gender inequalities in wildlife management and conservation for sustainable wildlife ecosystems. Despite their growing importance the attempts that have tried to evaluate the outcomes of conservancy establishment, are limited in their ability to unveil the gender disparities in wildlife management and conservation. This therefore makes it difficult for any intervention focusing on gender equity in wildlife management and conservation to know which direction to reinforce. There is therefore a critical need to come up with gender disaggregated data and gender analytical information on wildlife management and conservation for sustainable wildlife conservation interventions hence this study.

Study Area

The study was conducted in selected conservancies in Maasai Mara ecosystem, Narok County, Kenya. The Maasai Mara National Reserve ecosystem covers 1,510 km^2 in south-western Kenya. It is bordered by the Serengeti Park to the south, the Siria escarpment to the west, and Maasai pastoral ranches to the north, east and west. The Talek and Mara rivers are the major rivers draining the reserve. Shrubs and trees fringe most drainage lines and cover hill slopes and hilltops. The terrain of the reserve is primarily open grassland with seasonal riverlets. The long rains occur from March-June, followed by the dry season from July-October while the short rains fall during November-December, and a short dry season finishes off the year. The Altitude of Maasai Mara is: 1500-2180m; Rainfall: 83mm/month; Temperature range: 12-30^o



Map of Maasai Mara conservancies

LITERATURE REVIEW

Strategies to Enhance Gender Responsive and Sustainable Wildlife Ecosystem

Policies governing biodiversity conservation have historically not prioritized gender equity, and as a result, women are often excluded from participation in the planning, implementation, decision making and benefits of conservation policies. This not only halts the progress of women's empowerment; it devalues their contributions toward conservation efforts (Nellemann, 2011). Greater detail in reporting and establishment of mechanisms that measure cumulative progress toward equal participation of women could help improve the understanding of gender equity in protected areas conservation and management. Gender-responsive conservation can only occur when policies and programs that seek to achieve biodiversity conservation success explicitly take both men's and women's opinions, needs, and interests into account (IUCN, 2016). Some of the strategies that have been put into place globally and nationally to address gender inequalities in wildlife management and conservation include:

Legal and Policy Frameworks

Global commitments have increased political attention to Sustainable Wildlife Management (SWM) and species conservation. For example, the Strategic Plan for Biodiversity 2011–2020 and Aichi Biodiversity Targets, adopted at the Convention on Biological Diversity (CBD), have been accepted by other conventions and sectors as a useful global framework to conserve, restore, and sustainably use biodiversity and enhance its benefits for people (IUCN, 2018). The Addis Ababa Principles and Guidelines for the Sustainable use of Biodiversity (CBD, 2016) provide an additional framework to assist resource managers in ensuring that their use of biodiversity will not lead to a long-term decline. Other global contributions to SWM include Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and Convention on Conservation of Migratory Species of Wild Animals (IUCN 2016). At a regional level, several agreements exist among species range states, e.g. North American Migratory Birds Convention. It is not clear to what extent the governments have taken advantage of these agreements to support their own national programs in enhancing gender responsive wildlife management and conservation hence the current study.

Multilateral environmental agreements play a critical role in the overall framework of environmental laws and conventions. Complementing national legislation and bilateral or regional agreements, multilateral environmental agreements form the overarching international legal basis for global efforts to address particular environmental issues. The role of multilateral environmental agreements in achieving sustainable development has long been recognized. Multilateral environmental agreements guide global, regional and national action on environmental issues and are a result of multilateral processes, which makes them key elements of environmental, legal and governance regimes (Balakrishna, 2012). However, Pisupati, (2015), reports that the types of indicators considered by the Inter-Agency and Expert Group on Sustainable wildlife management and conservation appear to be inadequate for measuring progress towards achieving the gender equity and for leveraging the contribution of the multilateral environmental agreements in measuring progress in sustainable biodiversity ecosystems.

Pisupati, (2015) further argues that unless the gap between Goal indicators and other indicators under the multilateral environmental agreements is closed there may be a disjointed interpretation of what national-level actions are needed to achieve the 2030 Agenda. The role and relevance of biodiversity and ecosystems in securing the well-being of current and future generations, both urban and rural, cannot be overstated. The loss of biodiversity and ecosystems warrants a series of actions by countries and stakeholders to protect biodiversity through legal, policy and regulatory mechanisms. The evaluation of existing strategies in enhancing gender responsive wildlife management and conservation is critical for sustainable wildlife ecosystems.

World Wide Fund for Nature (WWF) is another strategy that was developed to work with partners at the local, national and regional level to secure a healthy environment and sustainable wildlife conservation. This has been achieved by: helping communities sustainably manage natural resources for their own benefit; strengthening national legislation and management systems for sustainable fisheries and logging operations; improving habitat and species conservation; and developing effective marine protected areas. Gender equity and social inclusion issues, twinned with good governance principles have been integrated in the WWF strategic plan, as overarching goals of biodiversity conservation and sustainable development. The strategic plan further internalized weak resource governance, inequality, discrimination on the basis of gender and ethnicity, and ambiguous policies as major challenges to achieving broader conservation and sustainable development goals (WWF report, 2016).

WWF has emphasized benefits to households in order to improve their overall capability. Women's role in the household economy and management are critical and WWF conservation efforts aim to enhance household and

community capability and economic empowerment, ensuring benefits accrue to all family members and are equitably shared in the community. This contributes to diversification of work, shared responsibility of domestic chores, and reduced pressure on biodiversity through diversification of use, and reduced dependence. Scaling up benefits from particular interventions from a gender point of view often became challenging. It is difficult to disaggregate the benefits from such interventions by gender, and requires a more in-depth analysis. Unless the attitudes of the family's head and other men change, and women's role in domestic care is well-understood, such role transformation will remain ineffective in reducing work pressure on women.

Kenya has signed many global and regional Multilateral environmental agreements (MEAs) such as National Biodiversity Strategy Action Plans (NBSAPs) and National Environmental Action Plans (NEAPs). Secondly, Kenya's policy and legal frameworks such as The Kenyan constitution of 2010, the affirmative action 2010 and the Wildlife Conservation and Management Act 2013, explicitly gave women and men the same legal rights to participate in development programmes and benefit equally from them. The devolution of government power to the counties, and devolution of national reserves to local community management creates potential local level partnerships for achieving gender equality in wildlife management and conservation and empowerment. However, despite all these efforts progress towards gender equity in wildlife management and conservation is still very slow. Given the scope and speed of contemporary change it is thus essential to keep the changing patterns of gender relations under continual examination, to monitor the extent to which progress is being made towards women's emancipation and to interrogate the adequacy of prevailing strategies towards this goal, hence this study.

Alternative Livelihoods

According to UNESCO (2016), one method of addressing gender inequalities in sustainable wildlife management and conservation is by supporting alternative livelihood activities for both women and men. In some cases, gender-differentiated livelihood opportunities may be the most suitable and viable options to respond to both women's and men's needs. In other cases, expanding beyond gender-differentiated livelihoods may help both sustainable wildlife management and gender equity goals. The employment of female rangers in the Virunga National Park highlights the potential for facilitating women's access to traditionally male-dominated activities. This strategy yields positive conservation results, and helps recast women from victims of human rights violations to full actors in the reconstruction of the Democratic Republic of the Congo.

CBD, (2011) however reports that, it is not enough simply to introduce an alternative livelihood activity without ensuring its social and economic viability and considering gender issues at every level of implementation. For instance, wildlife farming is a food and income-generating activity that is compatible with women's involvement. However, a study by Ogunjimni (2012), found that women were often excluded from training, which led to a low adoption of the practice by women. This reinforces the need for gender considerations to be taken into account in educational programmes and training, as well as provision of services and supportive technologies, to ensure that alternative livelihood opportunities are accessible to and can benefit both women and men.

Hunting in certain contexts, the legalization and regulation of selective bush meat hunting may be considered, particularly in cases where bush meat is central to food security (Groff and Axelrod, 2013). In addition to being often disproportionately affected by food insecurity, women's workload tends to increase substantially when hunting is banned in the land they use around protected areas (McElwee,2012). Hunters may disregard regulations when the subsistence needs of their families are not met, rendering outright bans ineffective (Groff, 2013). Conversely, allowing the hunting and trade of selected resilient species could avoid negative impacts on women and men while increasing the willingness of hunters to respect bans on more vulnerable species.

2.5.3 Environmental Education

Pinho, Grilo, Boone and Galvin (2014) argue that environmental education is an important tool to improve attitudes related to wildlife. For instance, education through direct experiences, such as visits to protected areas by local residents, can be a valuable learning tool. Particularly in the case of women, such visits can help reduce the participants' fear of wildlife and increase their support for the conservation of species that they rarely see or may view negatively due to HWCs. Education and training for women and men regarding the impacts of overharvesting and the loss of threatened and endangered species are also important measures to support SWM. Advances in science, technology, and social sciences also present significant opportunities for the development of alternative solutions and the dissemination of information.

However, Ogunjimni and Osunsina (2010) studies have shown that environmental education and technology development personnel frequently target men, wrongly expecting them to transfer information to women. This reinforces the importance of developing alternative solutions with women's and men's needs in mind, and to ensure that information on and access to technology are provided to both women and men. Evidence from different regions shows that men tend to dominate access to new technology, information and training related to natural resource management. Furthermore, male relatives often mediate women's access to information, markets and credit. In Vietnam, for example, women made up only 25 percent and 10 percent of participants in training programs on animal husbandry and on crop cultivation, respectively. In Cambodia, women were only 10 percent of extension beneficiaries (Howard,2003). For these and other regions, common reasons include that research and extension services tend to focus on the tasks that men specialize in; problems with mobility and time to travel to district centers in order to access services; and difficulties for women in communicating face-to-face with mostly male staff. The choice of methods and materials that address these gender inequalities become important elements in mainstreaming plans.

The inclusion of gender considerations in training for policy makers and practitioners, as well as within academic curricula, can increase the capacity of researchers, policy makers and Programme managers to address gender issues. Fostering an understanding of gender relations and their impacts on SWM among wildlife management practitioners and researchers can help bridge the gap between social scientists and natural scientists (Ogra,2012) as well as promote interventions that address wildlife conservation and gender equality objectives. WWF Nepal (2015), outlines the drivers that impede gender responsive wildlife management and conservation such as weak resource governance, inequality and discrimination based on gender, class, caste, ethnicity, remoteness and exclusion. Presence of these drivers in service delivery limits resource dependent communities, women and marginalized farmers' access, use, control and decision over improved services in areas such as health, drinking water, natural resources, and land use. Lack of these services eventually generates threats to biodiversity, particularly habitat, species and forest due to unsustainable harvesting, use, and consumption. Lack of control and ownership of resources, combined with high ambitions of asset accumulation to cope with future uncertainty generates stress, shocks and vulnerability that further weakened these groups' survival resilience.

According to McElwee, (2012), reducing the pressures on wildlife from illegal trade in exotic products requires consideration of the intended consumers of these products, who are typically defined in respect to gender stereotypes and cultural norms. Awareness-raising campaigns to counter consumption of exotic wildlife products could be made more effective by an enhanced understanding of the drivers, and by addressing the ideas and values tied to masculinity and femininity which drive gender-specific demands of consumers. Some of the main limitations to effective wildlife management are lack of organizational capacity, un-clear or weak land tenure, poverty and poor governance. This study therefore aimed at suggesting the best strategies for a gender responsive wildlife management and conservation.

Empowerment and Decision-Making for Sustainable Wildlife Management

SWM can reconcile the goals of promoting sustainable use and gender equality by strengthening women's leadership and decision-making power in relation to the use of resources. For instance, a project to diminish illegal wildlife trade in the Yasuní Biosphere Reserve in Ecuador has been led by a local women's group, which is engaging communities to reduce illegal over-harvesting and to improve food security. Strengthening women's leadership while allowing for the participation of both women and men has generated broad community support for adopting alternative income-generating activities, limiting bush meat hunting to subsistence needs, and conserving some highly threatened species. In addition, as women are often responsible for managing livestock and crops, their views on how to improve wildlife management should inform and guide decision-making for HWC projects and programmes, in which they should be actively engaged.

In contexts of highly unequal gender and class relations, achieving gender equality in participation in community-based decision-making can remain complex and difficult. Community-level participation can often fail to fully acknowledge the voices and concerns of women and marginal groups. Even when attending meetings, such groups may not feel free to voice their opinions, or feel that they are not taken seriously. Community participation can often be dominated by local elites, usually men, but sometimes elite women's concerns directly conflict and override poor women's access to resources. Decision-making at national and international levels on natural resources management and related issues generally continues to be dominated by men, despite efforts to mainstream gender at these levels of debate and policy-making. From community to national and international scales, it is clear that mainstreaming plans need to ensure more meaningful participation and decision-making by less powerful and under-represented groups, especially women.

According to Pinho, Grilo, Boone and Galvin, (2014), addressing the gendered impacts of HWCs requires gender-responsive solutions. Compensation schemes are one way of mitigating the negative impacts of HWCs. However, it is important to seek inputs from both women and men to ensure the inclusion of costs borne by all members of a household or community. Consultations that focus on obtaining feedback from the head of the household may be dominated by views and priorities of men, who are typically the household head. Including women's perspectives can lead to solutions. such as in-kind compensation through the provision of firewood, which can be more effective in compensating women's labour costs than simple monetary payments.

Summary of Literature Review and Gaps to be Filled

The literature reviewed indicate that although natural resource management researchers and policymakers are aware of the importance of gender issues, research is most often gender 'blind' (Currie and Vernooy, 2010). Community based conservation (CBC)also has failed to take account of the preferences and aspirations of the people whose behaviour they seek to alter. Instead, they treat communities as if they are a single coherent entity, rather than a collection of heterogeneous individuals with differing motivations and preferences. Pullin (2013) also noted that despite their growing importance there have been few attempts to evaluate the outcomes of conservancy establishment.

Despite the existing myth that me are the major actors in wildlife ecosystem destruction, women are also actively involved. McElwee (2001) observed that certain wildlife products are culturally valued for their purported medicinal properties for enhancing virility, masculinity, or fertility and are thereby marketed in ways that reinforce these norms and stereotypes, Understanding the cultural and gendered nuances influencing consumption can help create culturally appropriate and effective campaigns against illegal wildlife products. Among other things, this study was interested in getting gender disaggregated data and gender analytical information on the current trends in gender and wildlife management and conservation so as to monitor the extent to which progress is being made towards gender equity in wildlife management and conservation.

THEORETICAL FRAMEWORK

This study was grounded upon feminist political ecology theory. Feminist political ecology (FPE) emerged in the 1990s as a subfield of political ecology, building on previous Work by feminist scholars, and feminist theorists. Feminist political-ecology was developed by (Rocheleau, 1995,) The approach has extended "the multiple scale analysis of environment and power in political ecology to gendered relations both within and beyond the house-hold, from individual to national scales".

The theory demonstrates that gender is an important element in influencing access to resources, knowledge, and control over natural resources. This study thus adopted this gender-based political-ecology approach in analyzing biodiversity conservation and management issues. Access to, control over, and ownership of natural resources such as biodiversity resources and land are negotiated within and between households, and therefore gender and household relations are a focal point through which the relations of production are studied.

METHODOLOGY

The research design for this study was descriptive research. Orodho (2009) states that a descriptive research design is suitable where the study seeks to describe and portray characteristics of an event, situation, and a group of people, community or population as it is. Since descriptive research allows for a multifaceted approach to data collection and analysis, sequential explanatory mixed method approach was used to guide the data collection and analysis process of the study. This approach is characterized by collection and analysis of quantitative data followed by a collection and analysis of qualitative data. The fundamental principle of mixed method approach is that the combination of qualitative and quantitative approaches provides a better understanding of the problem than either approach can achieve alone (Creswell & Plano Clark, 2007).

RESULTS AND DISCUSSION

The Best Strategies for Sustainable Wildlife Ecosystem from a Gender Perspective

The section below discusses existing strategies for a gender responsive and sustainable wildlife ecosystem. It also explores why these strategies are not effective and discusses respondents, participants and informants' views on gender responsive measures that could be put in place to enhance sustainable wildlife ecosystem in Maasai Mara conservancies, Narok County.

Government's Effort

The study asked the respondents, informants and participants what the stakeholders were doing to enhance sustainable wildlife ecosystem in Maasai Mara. The respondents highlighted that in 2014, Kenya signed the Wildlife Conservation and Management Act which emphasized community participation and equitable sharing of benefits from wildlife. Establishment of wildlife endowment fund (WEF) was another mile by Kenyan government which was meant to develop wildlife conservation initiatives, manage and restore protected areas and conservancies; protect endangered species, habitats and ecosystems and support wildlife security operations. The rationale behind these initiatives was to facilitate community based wildlife initiatives and enhance sustainable wildlife ecosystems. Despite this rationale, the findings in section 4.4, 4.5 and 4.6 have revealed that men and women in Maasai Mara ecosystem are both actors in wildlife and wildlife habitat destruction.

The wildlife managers also stated that the Kenyan constitution of 2010 and the affirmative action (G.O.K. 2010), also explicitly gave women the same legal rights as men to participate and benefit equitably from all community projects and programmes. These legal frameworks also emphasis on the right to acquire land by women. Even with all these however, the emerging themes in section 4.5 portrayed women as underrepresented in the payment for ecosystem income in the conservancies due to the fact that very few women owned land in the conservancies.

The informants and participants also revealed that the Devolution of government power to the counties of Kenya also was another strategy by the government which would create potential county level partnerships for improving wildlife conservation and management. Devolution could also be used as a tool to enhance equitable empowerment of both men and women in community based conservancies. However, it is evident from the findings of this study that the gender disparities in wildlife management and conservation in Maasai Mara conservancies, are still very wide.

Critically analyzing the above mentioned strategies, it was clear that the legal and policy frameworks had been formulated, ratified and enacted. However, policy and legal frameworks cannot bring out gender equity unless they are properly communicated, implemented, enforced and institutionalized. There is a need hence to re-evaluate the policies and legal frameworks aforementioned taking into consideration the uniqueness of communities. There was need to improve the existing strategies by including gender specific responsive programmes.

Community's Effort

Aware of the influence of community based conservation to economic empowerment, the local communities surrounding the Maasai Mara game reserve leased out their lands to the wildlife conservancies. The registered conservancies formed an umbrella group called Maasai Mara Wildlife Conservancies Association MMWCA) which oversees the functioning of all the conservancies in Mara with the help of land owners' committees (LOCs) and conservancy managers. This shows a positive progress towards community's effort in wildlife management and conservation.

The land owners for example revealed that a lot of schools, health centers, cattle dips and water pans have been constructed in the conservancies by donors and camp owners. These can act as alternative employment and livelihood opportunities for men and women living in protected areas. Women participants however argued that the only alternative livelihood that benefited them was sale of milk, small scale cultivation, curio shops, beading business and sale of charcoal in the conservancies as discussed in section 4.5 previously. This can be interpreted to mean that the conservancies have failed to provide equitable alternative livelihoods through equitable empowerment of both men and women in the conservancies.

Other Wildlife Partners Efforts

The wildlife managers additionally reported that there were other wildlife stake holders who have greatly supported Mara in terms of funding and empowerment programmes towards sustaining wildlife ecosystem. They agreed that organizations such as USAID, Nature conservancy, Band Foundation, Kenya Wildlife Trust, Base camp explorer foundation and many others have supported projects like reforestation, waste management, empowering women and youth, and securing land for wildlife to flourish. The Nature Conservancy has worked to protect the lands and waters on which all life depends.

Some of these organizations have availed funds to sponsor the education needs of orphans and vulnerable children in the conservancies. Others have helped in building schools and dispensaries for the people living in conservation areas such as Siana springs dental clinic. The rangers discussed that there were very many opportunities for empowering people in Maasai Mara but even with all these men still dominated in the decision making levels of such initiatives.

Critically analyzing the above mentioned strategies, it was clear that the wildlife partners had not taken a gender dimension to empower the local residents living in conservancies. The wildlife partners had, therefore, not fabricated wildlife initiatives to suit the uniqueness of the community. But there was need to improve the existing strategies by including gender specific responsive programmes.

Why the Above Efforts are not Effective in Enhancing Gender Responsive and Sustainable Wildlife Ecosystems.

Table 1. Wildlife managers' response as to why strategies to enhance gender responsive and sustainable wildlife ecosystem are ineffective

Question	Responses	F	%
Why do you think the strategies to engender wildlife conservation are failing?	Failure to involve all community members especially women	6	26
	Resistance by the community members	8	35
	Poor implementation of conservation policies	7	30
	Lack of knowledge on conservation policies	2	9

From the table above, 26% of the wildlife managers reported failure to involve all the community members equitably while 35% reported resistance by the community. Other 30% reported poor implementation of the conservation policies and finally, 9% reported lack of knowledge on conservation policies. The landowners and rangers also explained that cultural restrictions played a great role in hindering gender responsive wildlife management and conservation. They explained that however much the government may emphasis on land acquisition and inheritance, it was very hard for this community to uphold that.

These findings are hence adamant to IUCN (2016) report that Policies governing biodiversity conservation have historically not prioritized gender equity, and as a result, women are often excluded from participation in the planning, implementation, decision making and benefits of conservation policies. This not only halts the progress of women's empowerment; it devalues their contributions toward conservation efforts. Greater detail in reporting and establishment of mechanisms that measure cumulative progress toward equal participation of women could help improve the understanding of gender equity in protected areas conservation and management. Gender-responsive conservation can only occur when policies and programs that seek to achieve biodiversity conservation success explicitly take both men's and women's opinions, needs, and interests into account.

Respondents Perception on Strategies to Enhance Gender Responsive and Sustainable Wildlife Ecosystem

A critical analysis of the afore-mentioned shows that measures put in place to enhance gender responsive and sustainable wildlife ecosystem within the region by the wildlife stakeholders were inadequate. The strategies have failed to penetrate the cultural glass ceiling that has greatly impeded these strategies from taking root. The wildlife stakeholders have also failed to embrace and implement the existing strategies in order bring out the required change. The respondents, participants and informants were asked to give their opinions on the best strategies for a gender responsive and sustainable wildlife ecosystem. These opinions are analyzed below.

The results from **figure 1** above shows that majority of the respondents (43.5%) recommended for educating the community on the importance of gender equity in wildlife conservation. Another 17.4% added that the laws on gender equity should be enforced in conservancies. Additionally, 13% suggested on employment of more women in conservancies. Other 8.7% suggested addressing the issue of land inheritance whereas 13% recorded evaluation of existing policies in wildlife management and conservation. Lastly, 4.3% of the respondents additionally suggested campaigns against gender biasness in wildlife management and conservation institutions.

The landowners suggested that educating the girl child is another strategy that can be employed to narrow the gap of disparities in wildlife management and conservation. They argued that proper understanding and implementation of conservation policies requires literate people. The conservancy rangers on the other hand added that women need to form women alliances and awaken from the homesteads to participate in wildlife management and conservation.

One-man ranger insisted this by saying:

Women should be aware that opportunities will not look for them. They need to come out of the chains of domestic work and seek jobs regardless of what the society dictates. They should also participate in empowerment programmes and avoid sending their sons to represent them. Let them carry children to the workshops, the panelists will understand.

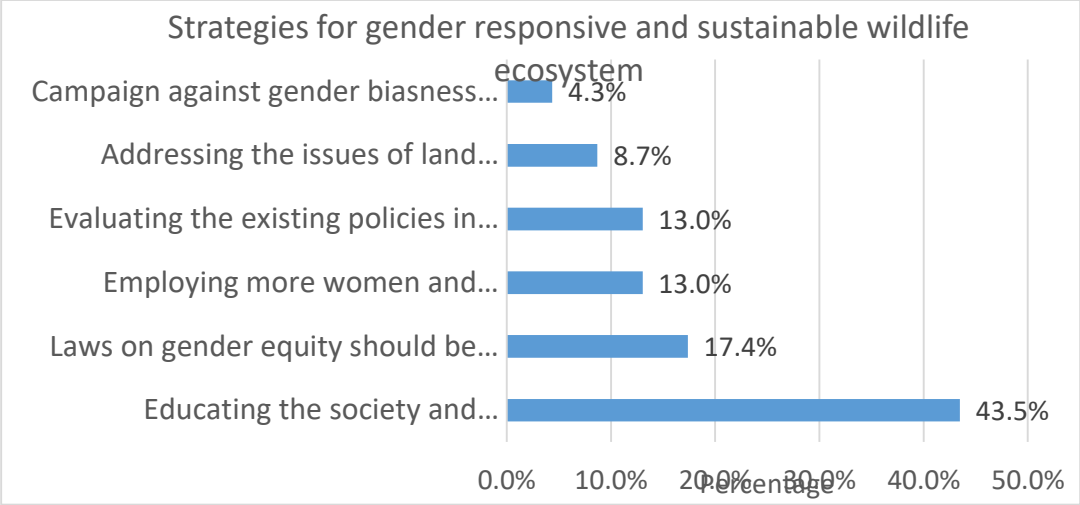


Figure 1: Best Strategies for Gender Responsive and Sustainable Wildlife Ecosystem

Empowerment Programmes

As earlier noted in the study in section 4.6 on socio-cultural factors influencing sustainable wildlife ecosystem, cultural norms, gender roles and land acquisition were among the key factors that impacted on the wildlife ecosystem. According to the study, 4.3% of the respondents suggested that campaigns against gender biased wildlife management and conservation can help awaken and empower the community. Another 43.5% also suggested that educating the community on importance of gender responsive and sustainable wildlife ecosystem was critical.13% of the respondents also affirmed that employing more women in the conservancies will help bridge the disparities in wildlife management and conservation institutions.

The study agrees with Galvin, (2014) study which argued that in contexts of highly unequal gender and class relations, achieving gender equity in participation in community-based decision-making can remain complex and difficult. Community-level participation hence needs to fully acknowledge the voices and concerns of women and marginal groups and mainstreaming plans need to ensure more meaningful participation and decision-making by less powerful and under-represented groups, especially women.

Environmental Education

The study also found that environmental education was supported by 43.5% of the respondents who argued that community members needed to be educated on the importance of gender responsive and sustainable wildlife ecosystems. The study hence agrees with the findings by Ogunjimni and Osunsina (2010) studies which reported that environmental education and technology development personnel frequently target men, wrongly expecting them to transfer information to women. In Maasai Mara conservation area therefore, environmental education needs to consider the unique role of women in conservation and focus on empowering them so as to achieve sustainable wildlife ecosystems.

Alternative Livelihoods in Conservancies

The study also found that creation of alternative livelihoods in conservancies would help reduce the margin of disparities between men and women.13% of the respondents agreed that mobilizing women to apply for jobs and creating job opportunities for women would help improve their attitudes towards wildlife conservation. The participants also noted that a lot of opportunities exist in Mara but men dominate in all of them. Women argued that the only alternative livelihood that benefit women is curio shops, sale of milk, firewood and charcoal, crop cultivation and beading business in Manyatta. This can be interpreted to mean that the conservancies have failed to provide alternative livelihoods that are not detrimental to wildlife ecosystem in the conservancies. CBD, (2011) reported that, it is not enough simply to introduce an alternative livelihood activity without ensuring its social and economic viability and considering gender issues at every level of implementation. The participants for example revealed that a lot of schools, health centers, cattle dips and water pans have been constructed in the conservancies by donors and camp

owners. These can act as alternative employment and livelihood opportunities for men and women living in protected areas if managed equitably.

Policies and Legal Frameworks

The study revealed that the legal and policy frameworks needs to be evaluated and implemented fully.13% of the respondents suggested that existing policies on wildlife conservation and land acquisition needs to be evaluated and revised. Another 17% also supported that legal frameworks that govern gender equity need to be fully implemented in wildlife conservation institutions in Maasai Mara. The study is hence adamant to IUCN (2016) report that Policies governing biodiversity conservation have historically not prioritized gender equity, and as a result, women are often excluded from participation in the planning, implementation, decision making and benefits of conservation policies.

This not only halts the progress of women's empowerment; it devalues their contributions toward conservation efforts. Greater detail in reporting and establishment of mechanisms that measure cumulative progress toward equal participation of women could help improve the understanding of gender equity in protected areas. Gender-responsive conservation can only occur when policies and programs that seek to achieve biodiversity conservation success explicitly take both men's and women's opinions, needs, and interests into account.

CONCLUSION OF THE FINDINGS

Specifically, it was found that some strategies employed by the women living in the conservancies had significant influence on the process and achievement of economic empowerment. The study found out that the women had put in place some strategies to enhance alternative livelihood in the conservancies by taking advantage of the tourist camps in the conservancies. Most women had grouped themselves to do cultural dances and beading activities in the manyattas near tourist lodges and camps which earned them substantial income. Other women who were financially stable had established curio shops to sell Maasai artefacts to the tourists visiting the conservancies.

On the contrally, it was established that some community members were engaging in activities that can pose major threats to wildlife conservation such as charcoal selling, illegal grazing and crop cultivation. This shows a disconnection between some community members and wildlife conservation initiatives and this may be as a result of failure to benefit equitably from the conservation initiatives. This implies that more needs to be done to ensure both men and women benefit equitably from the conservancies so that they all embrace wildlife conservation initiatives.

It was also noted that other wildlife partners and organizations have funded various projects in the community such as health dispensaries, schools and water pans to improve the livelihoods and general well-being of men and women living in conservancies. The funding organizations need to be aware that sustainability of these projects requires participation of both men and women at all stages.

RECOMMENDATIONS FOR POLICY

While the government gender policy, SDGs, Kenya constitution 2010 and the Kenya wildlife act 2013 have been formulated, ratified and enacted, gender disparities continue to persist in natural resource management. This is because policy and legal frameworks cannot bring out gender equity unless they are properly communicated, implemented, enforced and institutionalized. This study therefore recommends that the governmental and non-governmental organizations to revisit the policies and legal frameworks aforementioned so as to ensure they are effectively put into practice in wildlife management and conservation institutions. This calls for an evaluation Programme to address all the conformities and non-conformities with a purpose of implementing sustainable changes.

The study also recommends availability of gender disaggregated data in all wildlife management and conservation institutions so that it becomes easier to track the non-conformities and rectify. This is because without this data, wildlife management and conservation institutions cannot know where to reinforce and the course of action to be taken. Hiring and recruitment personnel will not know the group that has a deficit and the one that is overrepresented.

Based on the research findings, it is recommended that wildlife management and conservation institutions give a fresh look on addressing the issue of gender equity in wildlife management and conservation. This is because women have been depicted to have fewer opportunities than men in wildlife management and conservation. This overall puts the sustainability of wildlife conservation initiatives at stake as both men and women are actors in both wildlife conservation and wildlife destruction. The study for example revealed some forms of wildlife conservation threats in the conservancies such as charcoal burning, overgrazing and crop cultivation. This depicts a shift in focus by the

groups that benefit less or those that do not benefit at all from the conservation initiatives. It is against this that gender considerations in wildlife management need to be given a fresh look vis a vis the current situation.

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INFLUENCE OF IMPROVISED INSTRUCTIONAL RESOURCES ON TEACHING OF EARLY CHILDHOOD DEVELOPMENT AND EDUCATION LITERACY SKILLS IN KIAMBAA SUB-COUNTY KIAMBU COUNTY KENYA

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ABSTRACT
The purpose of this study was to establish the influence of improvised instructional resources on teaching of Early Childhood Development and Education (ECDE) literacy skills. This was as a result of limited empirical evidence on the extent and influence of use Improvised Instructional Resources (IIR) on instructional process generally and among ECDE learning specifically. This is particularly important for developing countries such as Kenya with limited financial resources for provision of standard resources. The study adopted descriptive survey research design. A census survey was conducted to collect data from 130 ECDE teachers using questionnaires and classroom observation checklist. Descriptive and inferential statistics were used to analyze quantitative data with the aid of SPSS version 25.0 while qualitative data was analyzed thematically. Findings indicated that most teachers engaged leaners to interact freely with improvised instructional resources (IIR), the most commonly used IIR being charts and flash cards which are visual aids. Chi-square results $\chi^2(1) = 33.69$, $p < 0.001$ indicated a significant influence of IIR on teaching of literacy skills, Contingency Coefficient measure of association (CC) illustrating a 48.1% variation in teaching of the literacy skills based on use of IIR. The study therefore recommends that ECDE teachers utilize a variety of IIR during teaching and learning of literacy skills to provide multi-sensory learning experiences to the young leaners.
Keywords: Literacy skills, Improvised instructional resources and Early Childhood Development and Education.

INTRODUCTION

Provision of quality education is essential in ensuring equity and equitability in every society. In appreciation of this, United Nations Conventions on the Rights of the Child (UNCRC, 1990) recognized and enshrined education as a fundamental right of all children. A consensus was also reached at the World conference on Education for All (EFA) in Jomtien, Thailand (1990) on providing educational services to every child. In addition, the World Education Forum (WEF) in Dakar, Senegal in 2000 and Sustainable Development Goals (SDGs) in September 2015 also emphasized on providing education to all including the vulnerable children. The instruments jointly advocate for the right to an equitable and inclusive education system and provision of continuous support to learners throughout their schooling to promote and sustain development.

In response to these initiatives, most governments, Kenya included, committed themselves to provide high standards of educational practice as a right for all their children at the basic education level. In Kenya, this commitment is enshrined in the government's policy documents for education including The Kenyan constitution, Sessional Papers and the Education Act (Kenya Education Act, 2013). For instance, the Constitution of Kenya (2010) articles 43 and 55(a) states that education is a right of every Kenyan child. Attainment of this policy involves provision of compulsory and free education of all children at the elementary level although attainment of this at the ECDE level remains a challenge.

Early Childhood Development and Education (ECDE) refer to a program which provides young learners with a motivating environment that encourages wholistic development. It is a service that offers diverse programs that broadly combine education and care in one coherent experience for young learners (ECDE Policy Guideline, 2006). This is achieved through provision of resources, care and first -hand experiences to the young children. This is achieved through provision of resources, care and first -hand experiences to the young children. Shonkoff and Richmond (2009) noted that allocating and providing both financial and human resources in pre-school education lays a firm basis for a sustainable and prosperous community. Studies on pre- school investments as observed by Heckman (2004) shows that learning during the early years is important as it lays a foundation for learning during the middle or high level. Hence, high quality investment in education has lasting effects on learning especially considering the fact that it is in pre-school level that children learn fundamental skills that form the foundation for further learning (Skinner,

Hyde, McPherson & Simpson 2016). These fundamental skills forming the foundation for further learning include numeracy, life skills, environmental skills and literacy skills.

The ECDE curriculum is designed with reading and writing at its heart because of the ability of learners to grasp such concepts this early in their development (ECDE Policy Guideline, 2006). Literacy skills are gained by involving ECDE learners in literacy activities such as tracing letters, listening to stories, reading picture books, news telling among others. Literacy activities are among the major learning areas offered in all ECDE set-ups. They aim at equipping learners with skills such as reading, writing, listening, speaking, comprehension, vocabulary and spelling (ECDE Policy Guideline, 2006). Literacy refers to the ability to use language proficiently especially while reading or writing. UNESCO, 2004;2017 cites that literacy involves the creation, interpretation, communication, identification and understanding of a text associated with varied contexts.

The National ECD Policy Framework (2015) cites that to succeed in education, an enabling quality environment which is learner friendly need to be created. This includes accessibility and use of relevant instructional resources. According to Engida (2012) there are two types of instructional resources: conventional (standard) and improvised. Conventional resources are imported or factory made and they are designed to serve a specific purpose during instruction. They include text books, stencils, photographs and electronic media. Standard resources lack versatility in their use as they may not be prepared to serve various purposes such as photographs. The teacher may not have the option of customizing the resource to fit the lesson objectives. For example, while introducing letters to learners in Kenyan ECDE centers, a procured chart with 'A' for 'alligator, 'Y' for yacht may not suit the learners needs and interests. On the other hand, a chart that is made from locally available materials will portray things that are familiar to the learners and can be observed in the surroundings such as 'A' for Ant, 'B' for Ball C' for Cat among others. This justifies the need to develop various ways by which locally available materials can be used for improvising instructional resources.

Improvised instructional resources (IIR) refer to a range of teaching and learning materials collected from the surroundings with familiar content and with a high application to the syllabus. They are also known as self- made teaching and learning resources. Examples include flip charts, mystery bags, flashcards, sand paper sounds. Due to socio-economic factors such as insufficient funds, teachers and learners face several challenges during acquisition of standard instructional resources required for use during literacy activities. This therefore, necessitates the need for improvised resources to serve as substitutes for the scarce standard resources.

Improvisation refers to the process of selecting and development of appropriate IR for instructional purposes to facilitate the achievement of the expected learning outcomes (Enigda, 2012). This means that the teacher improvises instructional resources based on the specific lesson objectives. Therefore, IIR helps in meeting the teacher's unique instructional needs. Improvisation allows learners to participate in developing resources and this promotes skills such creativity and innovation which promote learning in all areas. In the same breath, improvisation help instructors to utilize affordable, effective and efficient pedagogies of facilitating the instructional experiences thus making it easier for learners (Attah, 2014). Improvised instructional resources are collected from the surrounding environs whether at home or school. According to KIE (2008) improvised instructional materials helps young children to cope with schooling once they find familiar objects in school. This makes learning relevant as they connect new knowledge acquired at school to their own daily life experiences.

Resources for instruction in pre-school are carefully chosen, collected and prepared prior to the lesson since pre-school learners have very short attention span to sit and wait for the teacher to prepare resources during the lesson. This is achieved through lesson planning which is done the day before and it allows the teacher to gather the necessary resources. However, Abdullahi (2015) noted that accessibility of materials is highly dependent on the teacher's own usage habits and the available storage of materials after use or after improvisation. The use of instructional resources involves two processes; resource preparation and resource implementation. Resource preparation deals with what the teacher needs to prepare before teaching while resource implementation is the actual use of resources in class (Byrd, 2001). On the other hand, Graves and Bonnie (2003) posited that resource implementation refers to the actual use of resources in class by both the teachers and the learners. It includes resource organization and the degree of use of various types of instructional resources.

According to Bolick.C., Berson, M., Coutts, C. & Heinecke, W. (2003) productive teaching process is closely related to the use of teaching resources. Bolick et al. (2003) argued that "... while some educators have been fascinated by the potential of instructional materials to enhance teaching and learning, teachers lagged behind in using instructional

materials during teaching and learning. Others expressed doubts that instructional materials will ever incite teaching reform on participation". Instructional resources are crucial elements of teaching-learning process since they not only complement instruction but also supplement its process (Karaka, 2007). Therefore, use of instructional resources is necessary for effective and efficient instructional process.

Instructional resources have been shown to play critical role in teaching and learning. For instance, Landu (2010) cites that instructional resources perform significant roles such as providing diverse multi-sensory experiences, reinforce and concretize the teacher's oral presentations thus improving the learner's understanding of abstract and complex concepts. Use of the sense of sight, touch, smell and hearing are the features of improvised instructional resources and are the gateways of children's instruction in the 21st century (Adipo, 2015). In addition, Thungu (2008) stated that instructional materials help in content delivery, cater for individual differences and make the learning process more efficient. The utilization of instructional resources during the instruction process encompasses the sense of hearing, sight as well as touch. Based on the educational practices as cited by Eneh (2004) the Chinese proverb says that; I hear-I overlook, I see-I remember, I do-I comprehend. This saying additionally underscores that the learner should take an active part during reading and writing activities in the classroom.

Research has previously endeavored to examine the relationship between the use of IIR and management of instructional process. At the global level, existing literature show studies linking use of IIR with learning activities. For example, Culclasure. B., Fleming. D. & Riga. G. (2018) undertook a study to assess the effect of the Montessori curriculum on learners' achievement among public schools in South Carolina, USA. The study compared the Montessori and non-Montessori leaners' achievement in various aspects including numeracy, literacy and life skills. The findings indicated that Montessori leaners performed better in all activities. The study attributed the huge discrepancy in achievement to the varying classroom environment in terms of availability of resources. The Montessori classes had sufficient and diverse materials for use during the instructional process. In a study on methods of teaching math's lessons in USA, Leone. P., Wilson. M. & Mulcahy. C. (2010) posits that the use of instructional resources influences the learner's interest to actively participate in mathematics activities. The study observed that use of instructional resources promoted students' active participation in classrooms and promoted inclusion of all leaners.

Research done in Nigeria by Fakomogbon. M., & Adegbija M. (2006) posited that instructional resources have the capacity to influence the motivation, perceptions and attitudes of the learners. IR helps the teacher to achieve the following during instruction: motivation and attention, classroom control, content delivery, retention, recalling and evaluation of performance. To concur these findings, Kadzera (2006) cited those instructional resources are seen as significant elements during instruction. Utilization of IR in teaching promotes effective learning since learners are active participates in the instructional process not just mere recipients of knowledge.

While studying on the role of instructional materials as a tool of effective early childhood education in Agona region, central Ghana, Frimpong (2021) observed that most public ECE center lacked adequate instructional resources. The inadequacy of instructional resources resulted to minimal use of IR during the teaching and learning process. This implies that when instructional resources are unavailable, teachers and learners cannot utilize them during the instructional process and this affects the quality of early childhood education.

A study conducted in Winneba, Tanzania by Ghanney (2008) sought to determine the extent to which instructional resources were utilized during instruction primary schools. The study findings indicated that eight out of ten teachers in primary schools used only text books and chalkboard during the teaching and learning process. Instructional resources were unavailable for use during instruction. The study observed that the unavailability of IR resulted to teachers using only chalkboards and text books as the only IR and this led to reduced interest in learning activities thus poor academic performance

In Kenya, Muiruri (2014) carried out a study to establish the effect of instructional materials on number writing among ECDE leaners in Kamukunji District. The researcher adopted quasi experimental design. Learners who utilized instructional materials during number writing exercises scored higher marks than their counter parts in the control group. The children's skills in writing numbers, number sequence, number shaping, number sizing and number alignment performance improved tremendously due to active involvement in activities that used instructional materials. The children's level of number reflection errors, number omission, number sizing, number spacing significantly reduced. The use of instructional materials helped the children use their senses and develop children with motor muscles and eye-hand coordination. To assert these findings, Chepkoech (2019) conducted a study on the effect

of instructional resources on learner's early literacy performance in public ECDE centers in Kaduyi sub-county Bungoma county. The study employed descriptive survey design and it was based on Jean Piaget's constructivist theory. The study concluded that the use of instructional resources had a positive effect on the learners' acquisition of literacy skills.

In addition, Gitau (2013) carried out a study to establish the impact of instructional resources on the implementation of ECDE science curriculum in Naivasha Sub County, Nakuru County, Kenya. The study used the descriptive survey research design. The target population consisted ECDE teachers and ECDE learners. The researcher observed that availability and use of instructional resources had a positive impact on the effective delivery of ECDE science curriculum. In the same vein, Wambui (2013) conducted a study on the effect of utilization of IM on learner involvement in environmental activities in pre-school in Kiine Zone, Kirinyaga County, Kenya. The study discovered that instructional materials were not utilized effectively in teaching and learning due to overcrowded classes and this affected how the learners participated in science activities.

Similarly, Okune, Gudo and Odongo (2016) conducted a study on the impact of instructional resources on early childhood learners' oral skills in central zone Kisumu County Kenya. The target population consisted of 42 headteachers, 126 teachers and 3180 leaners. The study findings indicated that the use of IR significantly increased the learners' performance in various learning activities such as recognition of letters, repetition of words, and the ability to write dictated words. The learners' performance improved from 11% to 18%. The findings corroborate with Omaiyo (2013) who opined that good instructional materials stimulate the thinking of children and motivates them to participate in classroom activities thus improved performance. From the foregoing, it is evident that scarce literature on the influence of use of improvised instructional resources and teaching of ECDE literacy skills exists. Thus, this study sought to contribute by attempting to provide empirical evidence on the existing relationship between the elements. The study sought to establish the influence of use of IIR and teaching of ECDE literacy skills with a specific focus on public ECDE centers in Kiambaa Sub-County, Kiambu County Kenya.

THEORETICAL FRAMEWORK

The study was guided by the constructivist theory based on the work of Jean Piaget. Constructivism is a principle in ECDE which views learners as active participants in the process of constructing knowledge and meaning rather than mere recipients of knowledge. The child experiences the physical environment through interaction with concrete objects which helps the child to conceptualize, develop creative thinking and problem-solving skills. The child therefore acquires skills that help in solving complex. Jean Piaget's cognitive development theory of learning indicates that mental abilities increase with age following an innate maturational schedule. There are two mental processes helps in promoting cognitive development in children. The cognitive processes that complement each other and they include assimilation and accommodation. In assimilation, learners use what they already know as a framework for assimilating new experiences through the use of IIR from the local environment. On the other hand, accommodation involves the modification of what we already know so that new knowledge can fit in better. Therefore, for children to assimilate new information, they should be encouraged to carry out hands-on activities and actively explore their environment (Onwioduok, 2012). This implies that children should be given variety of IIR to enable them acquire literacy skills on their own.

The theory comprises of four stages of cognitive development including sensory-motor (0 to 2 years), pre-operational (2 to 7 years) concrete operational stage (7 to 11 years) and formal operational (12 and older). This implies that ECDE teachers should use instructional resources which are developmentally appropriate for the learners of a particular age. When the IIR are too complicated for the learners, the learners easily get frustrated while too simple IR may lead to boredom among learners. Therefore, learning materials should be matched with the learner's developmental age if the learners are to benefit. Piaget also perceived children as individuals. The theorist cites that children are born with individual differences and therefore, each child should be attended to as an individual.

According to Piaget's theory, ECDE learners are in pre-operational stage. Learners at this age have difficulties in thinking abstractly or doing mental manipulation exercises. They have to be practical activities by availing IIR to them and this will assist them to understand complex concepts during the learning process. Piaget (1980) posits that learners at pre-operational stage are self-centered. This means that children at this stage have difficulties with sharing materials during teaching and learning. Therefore, ECDE teachers should provide adequate IIR during instruction to minimize conflicts as the children fight for the insufficient IIR. Once the instructional resources are adequate, lessons become enjoyable and learner's attention is sustained throughout the lesson. The theory also posits that symbolic and abstract

concepts should be taught after the learners have had several concrete experiences through experiential activities hence making abstract thinking easier for the young minds (Rotumoi & Too, 2012). The teachers' role therefore, include provision of IR, catering for individual differences, providing varied activities and ensuring that all learners are safe and they fully participate in learning activities.

Research Questions

The study sought to answer the following questions.

i. What is the extent of use of improvised instructional resources during the teaching of literacy skills in ECDE classrooms in Kiambaa Sub-County?
ii. What is the influence of improvised instructional resources on the teaching of literacy skills among ECDE learners in Kiambaa sub-county?

METHODOLOGY

The study adopted descriptive survey research design. Census survey was used to include 130 ECDE teachers from 26 public ECDE centers in Kiambaa Sub- County. Data was collected through questionnaires and classroom observation checklist. Qualitative data obtained was analyzed thematically while quantitative data was screened, coded and analyzed with the aid of SPSS version 25.0 computer software using descriptive and inferential statistics Descriptive statistics such as frequencies and percentages were applied while inferential analysis involved Chi-Square analysis to establish the influence of IIR on teaching of ECDE literacy skills.

Study Variables

The study utilized the following variables:

Extent of use of IIR was assessed using a set of twelve Likert scaled statements where 1=None to 5=Very great extent. The variable attained reliability index of 0.859 thus was found to be reliable for use.

Teaching and Learning of Literacy skills was assessed using a set of six Likert scaled statements where 1=None to 5=Very great extent. The variable attained reliability index of 0.673 thus was found to be reliable for use.

Results and Findings

Information on respondents' demographics illustrated that all ECDE teachers were females, a majority (42.0%) being middle aged (30-45 years old) who were trained as ECDE teachers with at least 5 years teaching experience. Findings imply that female teachers are preferred as teachers for young learners due to their inherent caregiving qualities of compassion, politeness and warmth toward young children compared to their male counterparts.

Extent of Use of Improvised instructional Resources

The study sought to inquire on extent to which ECDE teachers used IIR during the teaching of ECDE literacy skills. The findings are presented in Table 1.

Table1: Extent of Use Improvised Instructional Resources

Statement	NE	SE	AE	GE	VGE	Total
Teachers engage learners to interact freely with IIR	0.9	3.6	10.7	17.9	67.0	100.0
Teachers and learners use IIR to demonstrate concepts during literacy activities	0.0	2.7	14.3	29.5	53.6	100.0
Teachers use IIR to assess learners during literacy activities	1.8	16.1	33.9	33.0	15.2	100.0
Teachers involve learners in literacy projects using IIR	1.8	7.1	17.9	33.0	40.2	100.0

Key NE-No extent SE-Small extent AE-Average extent GE-Great extent VGE-Very great extent.

Data obtained show that majority of teachers (84.9%) engaged learners to interact freely with IIR during the teaching and learning of literacy skills. Similarly, teachers and learners used IIR to demonstrate concepts during literacy activities at a great extent (83.1%) while most teachers (73.2%) involved learners in literacy projects using IIR. However, teachers who used IIR during assessment of learning during literacy activities were slightly below average (48.2%). Findings indicate that most teachers used IIR during the teaching and learning of ECDE literacy skills. The resources were frequently used for teaching, demonstrations, projects and assessment of learners. This is in consistence with Omwonyo (2003) who asserted that instructional resources enable the teacher to simplify complex content with ease thus enhances learner's understanding. Similarly, Fuller (2016) cited that availability of appropriate instructional

materials facilitates learner-centered instructional process which equips the learners with exploration and self-discovery skills which enables them to construct their own knowledge and skills.

In addition, the respondents were also asked to indicate the extent to which they used the specific instructional resources during the teaching of literacy skills and the responses are presented in Table 2.

Table 2: Extent of use of Specific Types of IIR

Type of IIR	NE	SE	AE	GE	VGE	Total
Sandpaper sounds	56.3	31.3	7.1	2.7	2.7	100.0
Letter models	22.3	31.3	19.6	19.6	7.1	100.0
Letter stencils	42.0	41.1	9.8	4.5	2.7	100.0
Flash cards	0.9	9.8	8.9	35.7	44.6	100.0
Charts	0.0	2.7	4.5	17.0	75.9	100.0
Pocket boards	38.4	29.5	20.5	9.8	1.8	100.0
Voice recording	33.0	56.3	9.8	0.9	0.0	100.0
Video recording	65.2	29.5	2.7	0.9	1.8	100.0

Key: NE-No extent SE-Small extent AE-Average extent GE-Great extent VGE-Very great extent.

Data obtained show that sand paper (5.4%), letter stencils (7.2%), voice recording (0.9%) and video recording (2.7%) were used by very few teachers to a great or very great extent. Resources such as letter models (26.1%) and pocket boards (11.6%) were used by few teachers to a great or very great extent. However, flash cards (80.3%) and charts (92.9%) were used by a majority of the teachers in teaching literacy skills to a great or very great extent. This means that the most commonly used IIR in teaching literacy skills were flash cards and charts. Data obtained from classroom observation indicated that voice and video recordings were very few in most schools thus their low use.

The findings are consistent with those of Gitau (2013) who carried out a study to establish the link between instructional resources and delivery of ECDE science curriculum in Naivasha Sub County. The study used the descriptive survey research design with a target population comprised of ECDE centers, ECDE teachers and ECDE learners. The researcher concluded that availability and use of IR is important for successful science lessons. On the contrary, Kitheka (2005) observed that schools with adequate materials may not always use them efficiently and thus fail to improve the learner's achievement in education. However, schools with insufficient materials may utilize what is available thus improving the leaner's academic achievement. Therefore, teachers and learners should be able to use the available resources maximumly so as to adequately improve the learners' academic achievement. These findings affirm the fact that ECDE teachers should not only improvise instructional resources, but should also use them during teaching and learning in all activity areas.

Influence of Improvised Instructional Resources

The second objective sought to establish the influence of use of IIR on teaching of literacy skills. To achieve the study objective, cross-tabulation of the data on extent of use of IIR and teaching of literacy skills was done. The results were as presented in Table 3.

Table 3: Influence of IIR on Teaching of ECDE Literacy Skills.

		Teaching of literacy skills		
		Negative	Positive	Total
Extent of use of IIR	Low	43.8%	17.0%	60.7%
	High	6.2%	33.0%	39.3%
Total		50.0%	50.0%	100.0%

Generally, more respondents (60.7%) reported low extent of use of IIR compared to those reporting high extent of use of IIR (39.3%). Cross tabulated results show that very few respondents (6.2%) with high extent of use perceived that influence of IIR on teaching of literacy skills to be negative compared to those who reported low use (43.8%) of the IIR. However, about twice as many respondents (33.0%) who used the IIR highly reported their positive influence on teaching of literacy skills compared to those indicating low use. Chi-Square results in Table 4 provides the interpretation of this observation.

Table 4: Chi-Square Results on the Influence of IIR

	Value	df	Sig.	CC
Pearson Chi-Square	33.690[a]	1	.000	.481
Continuity Correction[b]	31.481	1		
Likelihood Ratio	36.141	1		
Fisher's Exact Test		1		
Linear-by-Linear Association	33.389	1		
N of Valid Cases	112	1		

Chi-square results $\chi^2(1) = 33.69$, $p < 0.001$ indicated a significant influence of IIR on teaching of literacy skills. Contingency Coefficient measure of association (CC) illustrated a 48.1% variation in teaching of the literacy skills. Findings imply that use of IIR influences the teaching of ECDE literacy skills. These findings were consistent with the findings of a study conducted by Culclasure et al. (2006) which observed that Montessori leaners performed better in all activity areas as compared to those who attended non-Montessori schools. The study attributed the huge discrepancy in achievement to the varying classroom environment in terms of availability of assorted resources. The study findings also agree with what Fakomogbon.et al. (2006) concluded who posited that instructional resources have the capacity to influence the motivation, perceptions and attitudes of the learners. IR helps the teacher to achieve the following; improving learners' motivation and attention, maintaining classroom control, enhancing lesson delivery, boosting retention and recalling and facilitating evaluation of learners.

CONCLUSION

Based on the findings, a majority of teachers engaged learners to interact freely with IIR. Specifically, flash cards and charts were reported to be the most commonly used IIR. It can therefore be concluded that visual resources such as flashcards and charts are the most commonly integrated IIR in teaching literacy skills among ECDE teachers in Kiambaa Sub-County. In addition, the study sought to establish the influence of improvised instructional resources on teaching of ECDE literacy skills in Kiambaa sub-county. Inferential analysis based on Chi-Square indicated a significant influence of IIR on the teaching of ECDE literacy skills. It can therefore be concluded that the use of IIR significantly influences the teaching of ECDE literacy skills in Kiambaa sub-county. The study therefore recommends that public ECDE centers should be equipped with adequate instructional resources to ensure that every learner has access to instructional resources thus increasing the frequency of interaction with the resources. ECDE teachers should also utilize various types of improvised instructional resources during teaching and learning of literacy skills. Specific attention should be given to utilization of concrete, audio and audio-visual in addition to visual resources. This will provide multi-sensory learning experiences to the young leaners and improve the teaching of ECDE literacy skills.

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INFLUENCE OF WHATSAPP USE ON ACADEMIC PERFORMANCE AMONG PUBLIC DAY SECONDARY SCHOOL STUDENTS IN LARI SUB- COUNTY, KIAMBU COUNTY, KENYA

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ABSTRACT
In any particular country academic performance is vital for successful development of young people in the society. Through education, a country produces graduates who make up for social, political and economic development. The government of Kenya through the allocation of financial resources, provision of qualified teachers and a quality assurance department's establishment have demonstrated their commitment to providing quality secondary education. Despite their effort, the academic performance of students is still low. This has raised concerns to parents, teachers and other educational stakeholders on what influences academic performance of students. Over the years, education has evolved due to invention and usage of social media. Social media has transformed and impacted communication and learning among students by access of social media tools such as WhatsApp and other social sites. While such social networking is beneficial to students, the way they are occasionally used, time spent, information learned and shared on the tools are of major concern. The purpose of this study was to investigate the influence of Whatsapp use on academic performance among public day secondary school students in Lari Sub-County, Kiambu County, Kenya. Descriptive survey research design was adopted for the study. The target population of the study comprised of 9,429 subjects. A sample size of 378 respondents comprising of 336 students, 28 teachers and 14 parent representatives participated in the study. Data collection was done using questionnaires and interview. The validity of the instruments was enhanced through the expert judgment of the supervisors and other experts. Piloting was conducted in Limuru Sub-County. Descriptive and inferential statistics were used to analyze the data with the aid of Scientific Package for Social Sciences version 25.0. Reliability of the instruments was estimated by use of Cronbach alpha method where a reliability coefficient of 0.820 was obtained. Descriptive statistics were used for measures of central tendencies including mean and standard deviation. Research hypotheses were tested using Chi square at a significance level of $\alpha = 0.05$. The study established that students spent more time on WhatsApp. It was concluded that academic performance is negatively affected by WhatsApp use since students are not guided on its positive use to improve academic performance. Based on the study, the researcher recommends the involvement of parents, teachers and other educators in controlling and checking what is shared on WhatsApp by students. It is hoped that the findings of this study may provide useful information to policy makers, teachers, students and other educational stakeholders on the influence of WhatsApp use on academic performance of students.
Keywords: Influence, Social media, Social sites, Whatsapp use, Academic performance.

INTRODUCTION
Education is an important aspect of human development (Venkatraja & Indira, 2011). Through education, a country produces the best qualified graduates responsible for its social, political and economic development (Olufemi, Adediran & Oyediran, 2018). Education ensures that knowledge and skills learned in school enable people to increase their productivity and enhance their quality of life. Education consists of structured and sustained communication to bring about learning (Venkatraja & Indira, 2011). Through education, a country may achieve democracy, improve citizens' economic and financial lifestyles, and equalize inequality. One of the major goals of education is academic performance. According to Peter (2015) academic performance is the measurement of student achievement across various academic subjects. In this study, academic performance is defined as the quality and quantity of knowledge, skills, techniques, and positive attitudes, behavior and philosophy that students achieve. This can be measured through the use of oral tests, continuous assessment tests or examinations, completion of homework and school attendance.

Academic performance may be influenced by different variables and socializing agents such as family structure, school factors, social media, peer groups and religious organizations (Nato, 2016). Increased social media use has become very popular in the recent years. In contemporary communication, social sites discovery has had a huge influence and currently it is praised for its enhancement, from education to entertainment. The tremendous growth of the internet has a high impact on the development of the students in which they interact and socialize.

Malaney (2004) observed that the grade of the students is deteriorated as they spent too much time on social media. While Bowen (2009) found that students' academic performance is affected by social media tools and it will lead to unethical behavior like procrastination of assessments. This is the reason why some educators consider that social

media tools are not always a suitable platform for teaching and learning activities (Waycott, Bennett, Kennedy, Dalgarno & Gray, 2010). Lederer (2012) found that social media could be a distraction to students as it may divert students' attention from being active in class and would disrupt the whole learning process. Even though the role of social media is important for educational purpose, students tend to be distracted with several social networking sites that exist. Students tend to spend time for chatting, playing games, shopping and other activities not related to academic (Abbas Aman, Nurunnab & Bano, 2019).

In Kenya, a study done by Kiplagat and Ombiro (2016) on social media usage and academic performance in Kenyan secondary schools, indicates that students' access internet and social media tools and the frequented tools are Facebook, WhatsApp, Twitter, Instagram and YouTube. Majority of students in day secondary schools are aware and access social media tools with majority of them spending an average of over two hours per day. According to Kiplagat and Ombiro (2016) the most frequented social sites being WhatsApp and Facebook. Teachers, students and principal strongly agree that access of social media tools by high school students has affected negatively their academic work. Students strongly agreed that they use social media for chatting, posting photos, entertainment, watching pornographic videos, getting news and sports. A lot of concern is put on excellent academic performance because of the important role it plays in a person's life. It was necessary to investigate the influence of social media use on academic performance of public day secondary school students in Lari Sub- County, Kiambu County, Kenya.

Statement of the Problem

Education plays a crucial role in all spheres of human activities due to the enviable role it has in terms of human development. Education is a leading instrument for a country's development and therefore students' academic performance cannot be overlooked. A lot of concern is put on excellent academic performance because of the important role it plays in a person's life. A student's academic performance is influenced by various factors such as the family, peer group, religious societies, school and social media in which they interact in. The power of social media is significantly influential not only to a student's social life and relationship but also to academic performance. The invention of social media tools such as WhatsApp has impacted on academic performance. There are several benefits that come along with the usage of social media tools in education such as improvement of students' communication skills, increase in vocabulary, development of writing skills, access of learning materials and socialization. Despite the benefits of social media tools on academic performance, educational stakeholders have raised concerns on the social media tools since they divert students' focus and concentration from learning towards non-educational activities and behaviors. There is deviation, distraction and divided attention between social networking activities and students' academic work. Therefore, there was need to conduct a study on the influence of WhatsApp use on academic performance. The study sought to investigate the influence of WhatsApp use on academic performance among public day secondary school students in Lari Sub- County, Kiambu County, Kenya.

LITERATURE REVIEW

WhatsApp is a social media tool and with the help of it people can connect themselves to the society as well as whole world (Yeboah & Ewur, 2014). It is an effective medium for the flow of information and ideas. WhatsApp is affordable and user friendly since it does not require a lot of data bundles to watch a single video which students can easily afford (Waweru, 2018). WhatsApp is becoming a popular tool among youth, which is available in the various electronic items such as I-Phone, Android, windows phone and computer also (Irfan & Dhimmar, 2019). This avails young people the opportunity to share pictures, academic videos, group/class interaction and other vital academic materials online. On the contrary, some students also abuse the use of WhatsApp through the sharing of illicit and socially unaccepted pictures like pornographies, videos and others rather than academic motives. According to Waweru (2018) WhatsApp has adverse effects on student's study time, results in procrastination related problems, destroys students' grammar and spellings, leads to lack of concentration during class sessions and difficulty in balancing online activities and academic preparation.

In a study done by Alkhalaf, Tekian and Park (2018) on the relationship between WhatsApp and academic performance among Saudi medical school students at the University of AlBaha and the University of Dammam having a total of 160 students (79 students from AlBaha medical school and 81 students from Dammam medical school) with smartphones were surveyed on their use of social media services and their academic performance. The study indicated that the time spent on WhatsApp usage was directly proportional to the symptoms of addiction. The study further concluded that WhatsApp usage showed no relationship with the academic performance among Saudi medical students in both the universities. In Spain, Santovena (2019) conducted a study on the effect of use of Instant messaging service through WhatsApp on academic performance of Spanish secondary school students. The study

indicated that students have a high degree of dependence on instant messaging applications. A high percentage of them suffer from anxiety and stress derived from excessive use, which can lead to poor academic performance.

In Cameroon, a study done by Bongwong and Diangha (2020) on the impact of the use of WhatsApp on students' socio-emotional development and academic achievement indicated that video chatting, online chatting through WhatsApp and frequent use of WhatsApp has a significant effect on students' academic performance. In Nigeria, a study done by Omachonu and Akanya (2019) on effect of WhatsApp on the academic performance indicated that students are experiencing challenges in using WhatsApp for their academic work. It was also revealed that WhatsApp is not responsible for students' poor academic performance since they use it to share academic knowledge and information among themselves. According to Chibuzor, Eshika, Abubakar, Chijioke and Olawale (2019) students use WhatsApp to pass time, for entertainment and learning at large. WhatsApp enables students to share pictures, academic videos, group/class interaction and other vital academic materials online (Cetinkaya, 2017). Also most students tend to spend time on WhatsApp than academic activities.

In Nigeria, Olowo, Alabi, Okotoni and Yusuf (2020) reported that there was a significant relationship between the use of WhatsApp and students' academic performance in Osun State secondary schools. The study indicated that the use of the WhatsApp platform among the teachers and students positively contributed to students' academic performance. Discussing more on the subject taught in the class, allowing students to ask questions with prompt answers, sending subject material to read, and giving students assignments on the platform positively attract and enhance the students' ability to learn. It is therefore imperative for teachers and students to know that WhatsApp platform in an online platform for teaching-learning interaction.

In Tanzania, a study done by Moshi, Ndeke, Stephen and Ngozi (2018) showed that students preferred WhatsApp. The trend was attributed to the larger number of subscribers on WhatsApp making it highly preferred. Moreover, the ease with which people send and receive messages and images, some of which are uncensored, makes the site more desirable to students. In Kenya, a study done by Waweru (2018) indicated that WhatsApp supports students' academic work. This is because students are able to form academic groups within the tool where they can share notes and assignments. Waweru (2018) indicated that WhatsApp use may have fueled the unrest in schools experienced in 2018 across Kenya. This is after students managed to sneak mobile phones into schools. Students within a certain locality form groups on WhatsApp through which they communicate and plan strikes. This then affected their academic performance.

METHODOLOGY

The study was carried out in Kenya day public secondary schools and communities. Descriptive survey research design was adopted for the study. The target population of the study was comprised of 9429 subjects. A sample size of 378 respondents comprising of 336 students, 28 teachers and 14 parent representatives participated in the study. Data collection was done using questionnaires and interviews. A research permit was obtained from the National Commission of Science, Technology and Innovation after which a pilot study was conducted in order to improve on the reliability of the research instruments. Reliability of instruments was estimated by use of Cronbach alpha method. A reliability coefficient of 0.789 for the academic staff questionnaire and 0.792 for the students' questionnaire were realized. Validity of research instruments was ascertained by university supervisors and other experts. Descriptive statistics and inferential statistics were used to analyze the data with the aid of Scientific Package for Social Sciences version 25.0. Research hypotheses were tested using regression and correlation analysis at a significance level of $\alpha = 0.05$.

RESULTS AND DISCUSSIONS

Academic Performance

The indicators to study academic performance were students' achievement in tests, students' completion of homework and school attendance. These indicators were measured by use of five-point Likert scale; SD – Strongly Disagree; D – Disagree; N – Neutral; A – Agree and SA – Strongly Agree where 1=SD, 2=D, 3=N, 4=A and 5=SA. A key measure of central tendency (arithmetic mean) and standard deviation as measures of dispersion were computed for parameters of study variable. The results are presented in Table 1. During interviews, parents indicated that student can perform better by being subjected to or exposed to frequent CATS to improve their performance. Majority of the parents were positive on homework given to students. The purpose of the homework is to help improve what has been learned. It often seeks to obtain additional knowledge outside the classroom.

Table 1: Descriptive Statistics of Academic Performance

Statement	N	Min	Max	Mean	Std. Dev.
Performance in tests predicts performance in KCSE	364	1.00	5.00	3.62	1.41
Number of tests done improve academic performance	364	1.00	5.00	3.20	1.38
Students who complete homework perform well in school	364	1.00	5.00	3.33	1.40
Students have enough time to complete homework	364	1.00	3.00	4.17	1.35
Students with high school attendance rates achieve well in school	364	1.00	5.00	3.04	1.23
Overall Mean Score				3.47	1.35

Homework helps improve students' thoughts and memory and keeps them in touch with their work. Students need to take more responsibility for how to prioritize and structure other after-school activities on a weekly basis so that they are less likely to be sidetracked by thoughts of competing activities while doing daily homework. Parents also indicated that academic tours and timely completion of syllabus can improve academic performance. According to Kimani, Kara and Njagi (2013) timely completion of the form four syllabus significantly affected academic performance. Schools where teachers completed the syllabus three months before the examinations had higher grades compared to schools where teachers completed the syllabus in time for or a month to KCSE. Respondents were required to suggest ways of improving academic performance in school. Their suggestions are in Table 2.

Table 2: Suggestions on the Ways of Improving Academic Performance

Suggested Ways	Respondents (%)
Parental involvement in students' academics	36
Remedial classes	39
Capacity building strategy for teachers	42
Behavior modification strategy	12
Life skills strategy	21
Academic field trips	59

Six items were developed to measure the influence of WhatsApp use on academic performance. Respondents were required to rate the extent to which they agreed with the selected statements describing WhatsApp use such as time spent and perceived usefulness. The findings are presented in Table 3.

Table 3: Descriptive Statistics for WhatsApp Use

Statement	N	Min	Max	Mean	Std. Dev.
Students usually postpone academic tasks for spending more time on WhatsApp	364	1.00	5.00	3.25	1.38
Students spend more time on WhatsApp than initially intended	364	2.00	5.00	3.50	1.20
WhatsApp helps students solve academic problems	364	1.00	4.00	3.00	1.05
Students use WhatsApp for online academic group discussions	364	2.00	5.00	3.13	.99
Students communicate with friends through WhatsApp for the preparation of exams	364	1.00	4.00	2.38	1.06
Students use WhatsApp to pass academic information	364	1.00	4.00	2.63	1.40
Overall Mean Sore				2.98	1.26

Information in Table 3 reveals that overall mean was 2.98 indicating that respondents were neutral about WhatsApp use on academic performance. Respondents were neutral on the statement that students usually postpone academic tasks for spending more time on WhatsApp (M=3.25, std dev= 1.38). Respondents agreed (M=3.50, std dev=1.20) that students spend more time on WhatsApp than initially intended. Respondents were neutral about the statement that WhatsApp helps students solve academic problems(M=3.00, std dev=1.05) as well as the statement that students use WhatsApp for online academic gropu discussions (M=3.13, std dev=0.99).Respondents disagreed that students communicate with friends through WhatsApp for the preparation of exams with a mean of 2.38 and standard deviation of 1.06. Respondents were neutral on students using WhatsApp to pass academic information(M=2.63, std dev=1.40). The highest parameter was more time spent on WhatsApp by students being 3.5 and lowest was students communicate

with friends through WhatsApp for the preparation of exams with a mean score of 2.38. This means that the more time students spents on WhatsApp the low concetration they have on academic information. This is in agreement with a study by Irfan and Dhimmar (2019) who found out that the more time a student spends using WhatsApp, the less time he has to attend to academic matters such as class work, assignments, and preparation for exams which account for the student's lower or poor grade points.

This study concurs with the study of Chibuzor et al. (2019) who found out that WhatsApp use takes much of the student's studies time, resulting in procrastination-related problems, destroys students' grammar and spelling and difficulty in balancing online activities and academic preparation such as exams. Some students also abuse the use of WhatsApp through the sharing of illicit and socially unaccepted pictures like pornographies, videos and others rather than academic motives which have negatively affected their academic performance.

During the interviews, some parents observed that students are much involved in WhatsApp in that they forget important aspects of life. Some students chat while walking on the roads forgetting the dangers involved. Parents are complaining of diverted attention. Additionally, some of the interviewees noted that students are no longer interested in participating in house chores or creating time for their studies instead they prefer chatting. For many of these teens, logging onto WhatsApp is their first activity when they wake up and their last activity before they go to sleep. Parents noted that excessive use of WhatsApp may cause a person to be addicted to it which may affect their academic performance negatively. However, the majority of the parents were of the opinion that WhatsApp use can influence academically positively in that students chat with their classmates for academic purposes like sharing academic content and some WhatsApp groups have teachers as members and this shows that only academic resources will be shared on that particular WhatsApp group and this was evidenced during Covid-19 with the closure of schools where learning was being done at homes.

Correlation for WhatsApp Use

Spearman's rank correlation was used for data analysis to determine the relationship between WhatsApp use and academic performance. It was meant to identify the strength and direction of the association between the indicators of these variables. Values of correlation coefficient range from -1 and +1. A correlation coefficient of +1 indicates that the two variables are perfectly and positively related in a linear sense, while -1 shows that the two variables are perfectly related but in a negative linear sense. Hair, Anderson, Tatham, and Black, (2006) observe that correlation coefficient (r) ranging from 0.81 to 1.0 is very strong; from 0.61 to 0.80 is strong; from 0.41 to 0.60 is moderate; from 0.21 to 0.40 is weak; and from 0.00 to 0.20 indicates no relationship. The results are presented on Table 4.

Table 4: Correlation between WhatsApp Use and Academic Performance

			Academic Performance	WhatsApp Use
Spearman's rank	Academic Performance	Correlation Coefficient	1	-.623
		Sig. (2-tailed)		.099
		N	364	364
	WhatsApp Use	Correlation Coefficient	-.623	1
		Sig. (2-tailed)	.036	
		N	364	364

** Correlation is significant at the 0.05 level (2-tailed)*

Relationship between WhatsApp use and academic performance was negative as indicated. Results indicate moderate strong relationship of 0.623 which was significant at confidence level of 95% (0.036 < 0.05). the inalaysis indicated students spent more time on WhatsApp to chat with friends but not accessing academic information. It also revealed that the WhatsApp groups are not purely for academic purposes despite having teachers in those groups as administrators.

Chi-Square(X^2) Statistics for WhatsApp Use

To achieve the study objective, hypothesis of the study had to be tested. The study was composed of a null hypothesis and the researcher tested by use of Chi-Square(X^2) inferential statistics. To assess the relationship between WhatsApp use and academic performamnce, the following hypothesis was tested.

H_{01}: There is no statistically significant influence of Whatsap use on academic performance among public day secondary school students in Lari Sub- County, Kiambu County, Kenya.

Table 5: Chi-Square Analysis for WhatsApp and Academic Performance

Variable	Value	df	P- Value	Decision
Pearson Chi-Square	22.222[a]	1	.034	Rejected
N of Valid Cases	364			

Table 5 results indicated analysis of the second hypothesis of the study and table revealed calculated chi-square (χ^2) of 22.222, *P*-value of 0.034 which was significant at confidence level of 95% (0.034<0.05) therefore the null hypothesis which stated that; there is no statistically significant influence of WhatsApp use on academic performance among public day secondary school students in Lari Sub- County, Kiambu County, Kenya, was rejected and alternative hypothesis was taken stating that; there is statistically significant influence of WhatsApp use on academic performance among public day secondary school students in Lari Sub-County, Kiambu County, Kenya.

During the interviews, parents observed that the use social media cannot be over-emphasized among the teachers and students in the secondary schools. Social media tools such as Facebook WhatsApp, Instagram, YouTube, TikTok and others have been accepted as modern online tool that can facilitate the students' academic performance. The use of WhatsApp platform among the teachers and students positively contribute to students' academic performance. This means that discussing more on the platform on subject taught in the class, allow students to ask questions with prompt answers on the platform, sending subject material to read, and giving students assignment on the platform positively attract and enhance the students' ability to learn.

It is therefore imperative for teachers and students to know that WhatsApp platform in an online platform for teaching-learning interaction. The study is in consonance with the study of Bere (2013) who claimed that WhatsApp was an easier way for a student to communicate with their teachers and the rest of the class. The study concurred with the findings of Etim, Udosen and Ema (2016) who revealed that WhatsApp module utilization had positive significant influence on geography students' academic performance. The study equally concurred with the findings of Izyani and Mohamed (2016) who indicated that WhatsApp utilization enhanced students' proficiency in the use of English language and also helping the students to learn the language more.

CONCLUSIONS

The study found out that the more time a student spends using WhatsApp, the less time the student has in academic matters such as class work, assignments and preparation for examinations which account for the student's lower or poor academic performance. WhatsApp use takes much of the student's studies time, resulting in procrastination-related problems, destroys students' grammar and spelling and difficulty in balancing online activities and academic preparation such as examinations. Some students also abuse the use of WhatsApp through the sharing of illicit and socially unaccepted pictures like pornographies, videos and others rather than academic motives which have negatively affect their academic performance. It is therefore imperative for teachers and students to know that WhatsApp platform is an online platform for teaching-learning interaction. WhatsApp is an easier way for a student to communicate with their teachers and the rest of the class. Proper WhatsApp utilization has positive significant influence on students' academic performance.

RECOMMENDATION

Researcher made the following recommendations based on the research findings

i. Parents need to control the use of WhatsApp by their children especial day secondary school students by checking what is being shared on social media sites.
ii. Students need to be educated on the positive use of WhatsApp to improve academic performance.
iii. Students need to be educated on time management to enable them balance time for academic and social media interaction.
iv. Teachers should see WhatsApp as means of disseminating relevant information to their students.
v. Teachers should also sensitize and trigger the interest of their students so that they can use WhatsApp for the academic purposes

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INFLUENCE OF FAMILY BASED FACTORS ON STUDENTS' RETENTION IN PUBLIC SECONDARY SCHOOLS IN MAARA SUB-COUNTY, THARAKA NITHI COUNTY, KENYA

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ABSTRACT
Education plays a significant function in national development as well as influencing the socio-economic growth of any given country. The government of Kenya has made a significant milestone in ensuring a 100% transition of students from primary to secondary schools so as to increase access to basic education for all children. However, despite this effort, most transit learners are not retained in secondary schools. Regardless of this effort, most of the learners who transit are not retained in secondary schools. The purpose of this study was to determine the influence of family based factors on students' retention in public secondary schools in Maara Sub- County. Descriptive survey research design was adopted for the study. The target population was 22,105 involving 21,834 students, 216 class teachers, 54 head teachers and the Sub county education officer (SCEO). A sample size of 393 respondents including 360 students, 24 class teachers, eight principals and the Maara Sub county education officer was used in this study. Data collection was done using questionnaires and interviews. Piloting was done in Meru South sub-county since it had similar characteristic and also due to proximity. A total of 40 respondents was selected for piloting. To ensure validity of the research instruments, the researcher sought the opinions of experts in the field of study. Descriptive and inferential statistics was used to analyze the data with the aid of Scientific Package for Social Sciences version 25.0. Reliability of the instruments was estimated by use of Cronbach alpha method. Descriptive statistics were used for measures of central tendencies including mean and standard deviation. Research hypotheses was tested using Chi square at a significance level of $\alpha = 0.05$. The analyzed data was presented by use of tables and figures. This study established that students from families whose parents had education, income and small in size were likely to be retained in school. Based on the findings of this study, the researcher recommends parental level of education, level of income, small size of family as well as families with authoritative parenting style to influence students' retention. It is hoped that the findings of this study may provide useful information to curriculum developers, implementers, planners, policy makers and other stakeholders on influence of family based factors on students' retention in public
Keywords: Students' retention, Parenting style, level of education, level of income, Secondary schools.

INTRODUCTION

Education is consistently a significant resource and is viewed as a vital human advancement record (Psacharopoulos, 2006). Governments have devoted enormous portions of financial plans on education while parents invest in education expecting to gain in terms of academic achievement that guarantee their children employment in future (Menashy, Zakharia, and Gowda 2018).

Students' retention is the process by which learners in any educational level acquire an institutional fit, exhibit loyalty and remain enrolled until graduation or completion of the course (Jacky, 2014). Students' retention is the measure of students that enroll, continue and finish their academic studies. Retention refers to the ability of schools to keep their enrolled students and stop them from dropping out. The practice of students' retention encompasses all the things the school does to influence this rate, working to prevent students from leaving school before completing their course.

According to Wild and Ebbers (2002) students' retention is paramount for there can be no school without students. Once the students are enrolled, other personnel follow. There should be ways to ensure students achieve the purpose for which they came to school. It is easy to admit students but difficult to retain them. The retention of students in secondary education studies has been a topic of interest since the establishment of formal education systems (Aljahani, 2016). Students withdrawing from their studies before completion is costly for the education system overall, the individual students, their families and for their societies. Despite its longstanding nature and propelled by the large-scale changes that have occurred in education over recent decades, students' retention is currently receiving increased attention globally.

Family based factors are influences within the home of the learner that determine their ability to complete school. According to Hardy (2004) social aspects of people determine the education aspirations of such communities and the value that they put on education. There is a link between poverty and dropping out from school. Family size may also influence learners' ability to complete their studies as the parents may be unable to meet the cost of

education for all the children. Education level of parents exposes them to social networks and information and are much aware of the benefits of their children's education (Leclercq, 2001).

The Kenya's 100% transition policy will ensure quality access to secondary education irrespective of learner's social-economic background (Muli, 2014). The policy is aimed at addressing inequality and assuring equitable access to basic education program for all. The ministry of education has put a lot of effort to ensure that all the pupils are enrolled to the secondary schools but following up on these learners for the four years is a challenge. Despite the increase in the number of students who finalize both primary and secondary education, there are still a notable number of them that are unable to go through the secondary school education completion (Muli, 2014). School dropouts cause a major problem not only to the students but also to the society at large. Students are however at a disadvantage as they lose the capabilities to full development and self-realization. They lose the opportunity to nurture and grow their talents that could have been used to self-deployment and national building.

Statement of the Problem

The central role played by education in Kenya is captured prominently in various government policies. One of the roles of education policies is to attain 100% transition and retention rates of students in secondary schools. Retaining students is crucial since a school cannot exist without learners. Moreover, retaining a student is very important for an institution to carry out its mission and key objective. Low retention amounts to wastage of financial and human resources in addition to the time spent in school by those who drop out. The government introduced bursary for the needy and subsidized secondary education with an aim of retaining learners in secondary schools. Despite the enormous investment by the government on secondary education, there are cases of low retention rate. In Maara Sub County there is low retention rate of the enrolled students completing their studies. This research therefore sought to investigate the sociological factors that influence students' retention in public secondary schools in Maara Sub- County, Tharaka Nithi County.

LITERATURE REVIEW

This chapter reviewed literature on the family based factors that influence the retention of students in secondary schools. Factors like parental level of education, parent's level of income, parenting styles and the size as well as type of the family influence the retention of students in public secondary schools.

Parental Level of Education and Students' Retention

Parents are a child's biggest impact in life. The education of the parents' children is significantly influenced by their own education. Leclercq (2001) asserts that parents who are educated are much more aware of the advantages of their children's education and are more likely to have access to the social networks and information required for the kids to participate in activities that require a lot of human capital but have a big impact on education. This encourages their kids to concentrate on their education since they view their parents as role models.

According to Mutua (2014) poor relationships of students and their parents, failure of parents to understand that their children need motivation, poor role modelling, failure of the uneducated parents to guide their schooling children, involving their children in home chores when they are supposed to be doing their homework and failure to understand the educational needs for their children will lead to inability of students to complete schooling. Parental involvement has a positive impact on students' academic performance because it increases enrollment, raises grades and test scores, improves participation in class and completion rates, improves social skills and conduct, and gives students the confidence they need to adjust to the demands of the classroom.

Family networks and their structure, according to Mbui (2010) are essential to a child's education since they directly affect a child's success and involvement in school. Overall, this affects an individual's development, success, and degree of schooling. The level of success of an individual depends on the social class in which they participate. According to Pryor and Ampiah (2003) some of the parents who are not educated may not provide the required support for their children who may be in secondary schools. These parents may not also appreciate the value of one acquiring education. Students who come from such families may lack motivation to remain schools and they may not complete their studies. This study is in consistent with Mwingirwa (2016) in that parental level of education determines whether the student will drop out of the school or will complete their studies. The educated parents are much concerned with their children's' academics hence have a greater chance of being retained in the secondary schools compared to the uneducated parents.

According to a study on the determinants influencing students' transition and retention rates in the Msambweni sub-county by (Wanjala, 2018) parents with higher levels of education have fewer possibilities of seeing their kids drop out of school. For mothers, this condition may be explained by the fact that educated mothers are fully aware of the social and cultural repercussions of retrogressive social and cultural activities. As a result, they work hard to limit their children's exposure to such activities and invest more time in their education than their less educated counterparts.

Parents' Income Level and Students' Retention

Family poverty level might affect enrollment, retention, participation, and academic success (Chinyoka & Naidu, 2014). With high levels of family income, there may be a slight increase in demand for learning. There are different costs which are incurred in school and these require to be met by the parents some of them find it hard to maintain their children in schools even if the initial cost was funded by some well-wishers. According to World Bank (1995) statistics, many Kenyans no longer have access to education because they are unable to afford the costs involved because of the high levels of poverty in both rural and urban areas. This is because, despite their willingness, most parents are unable to educate their children due to decreasing income and rising educational material costs.

Children from richer households are more likely to enroll and stay in school, according to Hunt (2008) while children with low socioeconomic mobility qualities have a lower likelihood of doing so. The survey also revealed that children from underprivileged homes are less likely to enroll in school or are more likely to drop out after starting. According to UNESCO (2000) children living in poverty in developed nations like the USA are directly exposed to risks like illnesses, overcrowding and family stress, a lack of psychosocial stimulation, and scarce resources, which have a negative impact on academic performance, absenteeism, and grade retention. Compared to children from families with higher incomes, these kids frequently suffer more severe hazards' effects.

According to Mwihia and Ongek (2019) in their study on factors influencing boy child dropout from public secondary school in Kinangop, Nyandarua County noted that majority of the students who were not able to be retained in the public secondary schools came from low income earning families. The parents were not able to cater for the cost of education materials and other levies required at the school. The increasing level of poverty in their families made them not be sustained in schools hence discouraging them and making them dropout.

In Egypt, parents most frequently cite the cost of schooling as the reason for not taking their children to school (Assaad & Krafft, 2015) studies in Liberia and Philippines found that the parent's education attainments, income level and attitudes towards schooling were the most important determinants of children attendance. According to research conducted in Tanzania on cost sharing revealed that lack of school fees due to poverty leads to the dropping out of secondary school students. A high parental income enables parents to give their kids access to better schools, private lessons, and extra help if they are living at home, among other resources for their education. Children's education usually the first casualty in underprivileged homes during financial crises (Hunt, 2008). According to the UNESCO Institute for Statistics, households in India cover 28% of the expense of sending children to elementary and secondary schools. Children from low-income families face a very real barrier as a result of this expense.

The Size of the Family and Students' Retention

According to Njue (2015) in his study on the factors influencing the retention of pupils in Maparasha, Kajiado County noted that, the number of siblings significantly influence the retention of learners such that high number of siblings may lead to some dropping out. He also connotes that those learners whose siblings have failed to complete their secondary education may also probably be affected and dropout. According to Oteyo and Kariuki (2009) a big family may pose a big challenge to the siblings who are in secondary schools in that the older children may be forced to dropout and engage in casual in order to assist their parents bring up the smaller siblings.

According to Wairimu (2011) in her study on the determinants of low access and retention in schools in Mathioya District, large family size confines the parental involvement in the academic wellbeing of each child in the school activities and the child may eventually give up schooling. Mutua (2014) in his study on household factors influencing students drop out in public secondary schools in Kitui central found out that most of the students who had dropped out from the public secondary schools came from families where the number of children is large. These learners dropped due to the inability of their parents to cater for the school fees and other basic needs. Some students are even forced to dropout so as to assist their parents in taking care for the other siblings

Type of the Family and Students' Retention

A child's family type, including whether they are from a nuclear family, a polygamous family, divorced parents, remarried parents, or step-parents, has an effect on both their academic performance and their capacity to finish their education (Ella, Odok & Ella, 2015). Due to the financial stability of a two-parent system, children in nuclear families benefit from the strength and stability of both parents and therefore have more opportunities. Nearly 70% of children in the US live in nuclear households, and research has shown that kids from these families typically perform better in terms of a variety of cognitive, emotional, and behavioral needs. According to Mutua (2014) students who come from families where the parents are divorced and those whose parents are ever fighting especially in their presence are greatly affected in their academics. They are withdrawn and lack motivation in schools. The children who come from single parent headed families also have low self -esteem and may become in disciplined as they lack the guidance of both parents. These students have a greater probability of dropping out of the secondary schools.

According to Billings (2012) the majority of children raised by single parents grow up to commit crimes because they lack the safety, affection, and protection that children from both parent families should have. The child's or children's academic progress is negatively impacted by this. Inadequate nutrition, illness, insufficient sleep, and a bad attitude toward school, which develop in the formative years, are more likely to have a significant negative impact on these kids' capacity to finish their studies and performance. According to Rutakinikwa (2016) in his study on factors influencing secondary school dropout in Bagamoyo, Tanzania, found out that divorce was one of the cultural practices that influenced dropout in secondary schools in that the single parents faced difficulties of controlling the behavior of their children and also meeting their financial requirements especially in school. Where girls were involved they were forced to leave school to run family errands. He also found out that polygamous families contributed greatly to the drop out of the students from secondary schools in that there was unequal distribution of the family resources and some of the children resorted to living with their grandparents. Conflicts were also experienced by the children which highly contributed to low completion rates of students from schools.

Parenting Styles and Students' Retention

Odongo, Aloka and Raburu (2016) on their study on influence of parenting styles on adolescent students' academic achievement in Kenyan day secondary schools noted that the authoritative parents are friendly with their children hence promoting understanding between the guardians and their children thus enhances the academic performance of a child. These learners have great values like being self-directed, good engagement in classroom activities, higher education ambitions, much positive feeling about school, greater time spent on homework, more positive academic self-conceptions, and lower levels of school misconduct. Authoritative parents are more accommodating, receptive to their children's way of thinking; they encourage their children to speak freely their mind, explain to children their expectation, compliment children, respected their children opinion and were concerned about their welfare.

Berk (2003) noted that parents who apply permissive parenting style are less demanding and very receptive. They have low expectation for their children and may have less rules. These children have less self-motivation hence lack determination in studies. This parenting style is associated with poor academic performance. These learners are associated with high indiscipline in schools which may affect retention as they may be expelled or drop out.

Sarac (2001) noted that, authoritarian parents place high demands on their children but they are not approachable, they are less affectionate and not close to their children. Students whose parents apply authoritarian parenting style are obedient and develop different capabilities. However, these children have low self-esteem, are unable to cope with others, are withdrawn, rebellious and react poorly to frustrations. Most of them perform averagely in school and are less involved in indiscipline cases but have poor social skills and experience greater levels of depression. If these students are not assisted, they may not complete their studies.

Kemunto (2016) noted that, neglectful parenting style is less demanding, less responsive and has little communication between the parent and the child. Although these parents meet their children's' basic needs they are usually disconnected from their childrens' lives and expect fewer fulfillments of rules and regulations. These parents have no interactions with their children and are rarely receptive. The children of neglectful parents lack self-discipline, have low sense of worth, are less competent than their peers and may find themselves searching for love in the wrong places. They perform poorly in all areas and are likely to engage in socially unacceptable behavior as they attempt to seek for attention which they do not get from their parents.

METHODOLOGY

The study was carried out in Kenyan public secondary schools. Descriptive survey correlation research design was adopted for the study. The target population of the study was comprised of 22,105 subjects. A sample of 360 students ,24 class teachers ,8 principals and one sub-county education officer took part in the study. Data collection was done using questionnaires and interviews. A research permit was obtained from the National Commission of Sciences, Technology and Innovation after which the pilot study was conducted in order to test the reliability of the research instruments. Reliability of research instruments was estimated using the Cronbach alpha method where a reliability of 0.784 was realized. validity of the research instruments was ascertained by university supervisors and other experts. Descriptive statistics and inferential statistics were used to analyze the data with the aid of scientific package for social sciences version 25.0. Research hypothesis was tested using regression and correlation analysis at a significant level of $\alpha = 0.05$

RESULTS AND DISCUSSION

The study sought to determine the influence of family based factors on students' retention in public secondary schools. Family based factors represent conditions and features of a family environment that influence children's development in various dimensions such as academic, physical, emotional, spiritual among others. During analysis of data collected used a Likert scale indicating Strongly Disagree (SD) $1 < SD < 1.8$; Disagree (D) $1.8 < D < 2.6$; Neutral (N) $2.6 < N < 3.4$; Agree (A) $3.4 < A < 4.2$; and Strongly Agree (SA) $4.2 < SA < 5.0$ was used. Descriptive statistics of the mean and standard error were used to analyze the results.

Descriptive Statistics for Family Based Factors

A set of items were included in the questionnaire to measure the parental level of education, parent's level of income, parenting styles, size and type of the family influence on retention of students in public secondary schools. The analysis of data on family based factors was done using means and standard deviation (Table 14).

Table 12: Mean distribution for family based factors

	N	Min	Max	Mean	Std. Dev.
Majority of students whose parents have not attained higher level of education drop out of school.	384	1.00	5.00	2.50	1.17
Many of the students who drop out of school come from poor families	384	1.00	4.00	2.00	.94
Students who have many brothers/sisters may not complete their secondary school education	384	1.00	4.00	2.40	1.07
Many students who come from polygamous families are likely to drop out of school	384	1.00	5.00	3.00	1.24
Students who come from nuclear families (father and mother) are likely to complete schools	384	2.00	5.00	3.50	.84
Majority of students whose parents are very strict are likely to complete their secondary level of education	384	2.00	5.00	3.60	1.34
Many students whose parents are very permissive drop out of school	384	2.00	5.00	3.20	1.03
Overall Mean				2.96	

Results in Table 1 revealed an overall mean score of 2.96 indicating that research respondents were neutral about family factors influencing students' retention in secondary schools. The highest factor was parents' strictness enables students' retention in secondary school with mean score of 3.6 and lowest factor was students who come from poor families are easily to drop out of school with mean score of 2.00.

A statement was indicated in the questionnaire that suggested that "majority of students whose parents have not attained a higher level of education dropout of school "the mean was 2.50 with a standard deviation of 1.17. This indicated that respondents disagreed with the statement meaning that parental level of education does not necessarily influence retention of students in secondary schools. Respondents disagreed with a mean of 2.0 and standard deviation of 0.94 with the statement that many students who drop out of school come from poor families. This shows that even students whose parents afford to pay their school fees may drop out of school.

The respondents disagreed with a mean of 2.4 and a standard deviation of 1.07 on the statement that students who have many brothers and sisters may not complete their secondary education indicating that the number of siblings in family does not necessarily influence student retention. "Majority of the students who come from polygamous

families are likely to drop out of school ", this statement attracted a mean of 3.00 and a standard deviation of 1.24 indicating that the respondents were neutral. This means that polygamous families may or may not influence student retention. The respondents agreed with a mean of 3.5 and a standard deviation of 0.84 on the statement that students who come from nuclear families are likely to complete school. This means that nuclear type of a family influence students' retention in schools.

A statement that" majority of the students whose parents are very strict are likely to complete their secondary level education", attracted a mean of 3.6 and a standard deviation of 1.34. This shows that respondents agreed with the statement meaning that authoritative parenting greatly influence student retention. The respondents were neutral on the statement that suggested that many students whose parents are very permissive dropout of school. The mean was 3.2 and standard deviation of 1.03. This means that permissive style of parenting may or may not influence student retention.

Research participants from interview indicated that most of the uneducated parents are less concerned about the education of their children and are not able to offer proper guidance which may lead to children losing interests in their academics and eventually drop out. Educated parents always turn up for academic clinics and any other meetings organized in the school and this encourages their children to work hard and remain in schools. Parents act as role models and are very supportive to their children since they understand the value of education. Majority of the students dropped out due to financial constraint of their parents. Students who come from large families may not be able to complete their education because the parents may exhaust the financial resources.

Interviews indicated that students who come from polygamous and divorced families face a lot of hostility from parents making their lives unbearable and hence lose interest in school. The parents may also face financial constraints hence may not be able to cater education for their children. Nuclear families provide moral support to their children which may encourage them to remain in school and complete their studies. Permissiveness of the parents lead to indiscipline of the students which may eventually make them be expelled from the school and may fail to complete their education. Interview results also showed that parents who apply authoritative style of parenting are very accommodative and they let their children know what they expect from them and complement them. Children in return become self-directed and are likely to complete their studies. Parents discuss the challenges that their children may be undergoing and helping them come out them.

This study is concurring with the findings of Odongo, Aloka and Raburu (2016) who noted that children whose parents apply authoritative parenting style exhibit great values and have high education ambitions. These parents are more accommodating and compliment their children which make them to like school and are able to complete their studies. According to Hunt (2008) children from better households are likely to enroll and complete school while those from low socio-economic backgrounds have less chances of attending and completing their studies. Authoritative parenting was associated with good academic progress, high discipline and high educational achievement. Parents who are strict have a positive influence on the students' academic performance and good behavior during high school years.

According to Assaad and Krafft (2015) parents cite the cost of education as the major reason for not taking their children to school. UNESCO (2000) found out that children growing up in poverty are directly exposed to risks like limited resources leading to poor performance in schools, absenteeism and low retention. According to Hunt (2008) lack of school fees due to poverty made many students drop out secondary schools. According to findings of Chinyoka and Naidu (2014) access, retention, participation and performance in school was greatly attributed to family poverty level. According to Chapman, Laird, Fill and Kewal (2011) students who come from poor families may not be retained in secondary schools. The findings also concur with Mugisha (2006) in that economic strain on parents negatively influences learners' ability to be enrolled in a school and also their retention.

This study concurs with Mwingirwa (2016) in that families with little income are not able to retain students in public secondary schools and they drop out to engage in casual activities in order to support their little brothers and sisters and their parents as well. The school administrators held that the poor economic background of the parents in the region in Igembe, Meru County was a major setback and a contributor in poor retention of learners in secondary schools in the region.

Correlation between Family Based Factors and Students' Retention

The association among aspects relating to families and student retention was examined using data analysis on spearman's rank correlation analysis. It was intended to show the magnitude and direction of the relationship between the variables' markers. Correlation coefficients have values between -1 and +1. A correlation value of +1 denotes a perfect linear relationship between the two variables that is positively skewed, whereas a correlation coefficient of -1 denotes a perfect linear relationship between the two variables that is negatively skewed. According to Hair, Anderson, Tatham, and Black (2006), correlation coefficients (r) between 0.81 and 1.0 are extremely strong, 0.61 to 0.80 are strong, 0.41 to 0.60 are moderate, and 0.21 to 0.40 are weak and a value between 0.00 and 0.20 denotes no association. Table 2 displays the outcomes.

Table 13: Correlation between family based factors and students' retention

			Students' Retention	Family Based Factors
Spearman's rank	Students' Retention	Correlation Coefficient	1	-.636*
		Sig. (2-tailed)		.048
		N	384	384
	Family Based Factors	Correlation Coefficient	-.636*	1
		Sig. (2-tailed)	.048	

** Correlation is significant at the 0.05 level (2-tailed)*

Results indicated strong negative relationship between family based factors and students' retention of -0.636 which was significant at 95 percent level of confidence (0.048 < 0.05). The analysis showed that students who come from polygamous families drop out school which could be caused by lack of school fees because of low income from the parents. Results also indicated that some students whose siblings were in secondary did not complete school due to poverty.

Chi-Square Statistics for Family Based Factors

The study's hypothesis needed to be verified in order to meet the study's goal. The study included a null hypothesis, which the researcher evaluated using inferential statistics using Chi-Square. The following was explored in order to determine how family-based factors relate to student retention.

$H_0$1: In Maara sub-county, family-based factors have no statistically significant impact on students' retention in public secondary schools.

Table 14: Chi-square analysis for family based factors and students' retention

Variable	Value	df	P-Value	Decision
Pearson Chi-Square	50.000[a]	1	.037	Rejected
No. of Valid Cases	384			

Chi-Square analysis for the first null hypothesis of the study was presented on Table 3. Results indicated that Chi-Square (χ^2) of 50.000, *p*-value of 0.037 which was significant at confidence level of 95% (0.037<0.05); there was rejection of null hypothesis consequently, the researcher adopted the alternative hypothesis whereby; A statistically powerful effects exists of family-based factors on students' retention in public secondary schools in Maara.

CONCLUSION

The study established that majority of students who drop out of school come from poor families. Students whose parents had not attained higher level of education drop out of school because of lack of role models. In addition, students who have many siblings may not complete their secondary school education due to high cost of education and demands from each child.

RECOMMENDATIONS

This study undertook to determine the influence of family based factors on students' retention in public secondary schools. Following a reflection on the same the researcher recommends that family-based factors such as parental higher level of education, moderate level of income, small size of family, nuclear family as well as families with authoritative parenting style positively influence students' retention.

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INFLUENCE OF DRAMA-BASED INSTRUCTIONAL APPROACH ON TEACHING AND LEARNING OF KISWAHILI LANGUAGE AMONG PUBLIC SECONDARY SCHOOLS IN CHEPTAIS SUB-COUNTY, BUNGOMA COUNTY, KENYA

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ABSTRACT
Effective instruction relies on appropriate instructional approaches that necessitates easy transfer of knowledge to learners. The way instructors deliver course and subject matter to respective learners has a definite impact on students' performance and retention. To make teaching student-receptive, student-centered instructional approaches should be adopted which makes learners part of the knowledge creation and development. Drama-based instructional approach is one of the learner-centered instructional approach that aims at practically engaging learners learning skills in a classroom setup. The aim of this study was to establish the influence of drama-based instructional approach in teaching and learning of Kiswahili language among public secondary schools in Cheptais sub-county, Bungoma county, Kenya. The research design used in this study was descriptive survey where 342 form three students and 72 Kiswahili language teachers were sampled purposively and randomly to provide data on a questionnaire prepared by the researcher on influence of drama-based instructional approach on teaching and learning of Kiswahili language. Quantitative data was analyzed using SPSS version 25.0 in terms of descriptive statistics such as percentages and mean and inferential statistics such as chi-square to test the hypothesis at $\propto$=0.05 level of significance. Frequency distribution tables was used to present the data. The findings of this study showed that drama-based instructional approach significantly influences the teaching and learning of Kiswahili language and that it improves the performance of students in Kiswahili language. The study recommended that Kiswahili curriculum should be carefully designed to enhance the quality of teaching through learners' involvement. The study findings would improve the quality of teaching and learning of Kiswahili language in secondary schools and other levels of Kiswahili language education.
Keywords: Drama, Instructional Approach, Kiswahili Language, Teaching and Learning, Miming, Role play

INTRODUCTION
Quality educational discourse has been the basis of the socio-economic development of any nation worldwide. The key agents to national and individual posterities have a foundational attachment to the type of education a person receives at different tires of cognitive development in terms of skills, knowledge and attributes developed in an individual (Janks, 2014). One of the major facets that propels the attainment of educational objectives is the right choice of an instructional language which is facilitated with right instructional approach.

Choice of instructional approach has been emphasized by numerous researchers as one of the utmost critical facets contributing to the success of education system. According to Timperley (2008), teachers ought to line up their proficient skills with their teaching practices and instructions to profit their students and to realize instructional objectives depending on the changing learning environs. Given that demands and needs change with time, teacher also ought to undergo through professional and personal development (Edmiston, B. (2013). Effective teaching is not a convention of nonspecific practices, but is rather a set of context-driven verdicts about teaching. Stronge (2018) states that effective teachers do manipulate similar set of practices for every lesson, rather, teachers repetitively reflect about their work, perceive whether students are learning or not, and, then alter their practice accordingly to suit the state of their learners.

Instructional approaches are categorized by set of ideologies, measures or strategies and methods to be executed by teachers in a classroom situation to achieve desired learning objectives (Liu & Shi, 2007). Oseno (2015) categorized the instructional approaches into two main groups; teacher-centered and student-centered instructional approaches. Duruji, et al (2014), notes that teacher-centered approach to instruction includes lecture and direct teaching methods which focuses on teacher presentation and mastery of the subject matter and student evidence of learning is quantified through empirically scored tests and calculations. The 21st century instructional approach in education has presented the notion of learner-centered education which focuses on students' involvement in the learning process than being receptors of the knowledge to be acquired (Peregoy & Boyle, 2008).

Dramatization technique is one of the student-centered instructional approaches which comprises; mime, simulation, play-acting, language games, group discussion, debates and other teaching events which can be well-defined by the

wholesome term drama methods (Gomez, 2010). Numerous researches have revealed that exploiting dramatization method in teaching and learning in a classroom situation offers an exciting means of learning. Ozbek (2014) explains that drama methods with its potentiality to awaken excitement, inquisitiveness and interest to a subject matter can be rather operative in seizing thoughts and devotion of youngsters while maintaining students' concentration for long period of hours. Drama technique as illustrated by Stinson and Winston (2011), is an influential instruction and learning device with philosophical constructive effects on the students' perceptive, societal, emotive and physical change while fetching the feeling of legitimacy to the communication process as they provide frameworks for language that are effectual and feel tangible to learners.

Dramatization makes a learner dynamic participant in the course of Kiswahili language learning. It grants the student a chance to use the language with certainty and advance eloquence in dialogue. According to Astrid (2005), features such as play- acting, imitation, miming and language games endorse self-learning and group collaboration in reliable conditions. Fernandez and Coil (2010), maintains that drama encourages students to share concepts and advance their creativity in language activities while giving them an opportunity to develop social skills necessary for whole development of a learner in an informal educational setup.

Research designates that exploitation of drama in the classroom as a revenue of teaching supports students' study scholastically, informally, and developmentally. The practice of drama as an expedient attribute for teaching is not a novel concept. Factually, both drama and theatre have extensive been documented as effective resources of edification and indoctrination. Used ways are nevertheless different in aspects compared to traditional ways used (McCaslin, 1998). Art activists and educationalists have started to discover the practice of drama as a cohesive form of learning the set of courses. McCaslin sturdily believes that the arts ought to be manipulated in every teaching space as forms of reaching students who else couldn't be reached, and test students who have previously understood the notions. Drama offers an amusing means of learning while delivering a sentimental backbone into the classroom, an association where sentiments and knowledge are definitely alienated.

Several studies have proven that emotions are related with learning. When learners attach to the concepts expressively, they have an improved thought of it. When teachers clarify using the arts, we are connecting preceding understandings with new inducements. Teaching using drama conveys feelings and learning together. Most significantly of all, exploiting drama to communicate in a classroom situation gets students involved and grants them the supremacy to have a significant character in their education. Jordaan, (2015) wrote, "Drama is Imagining to Learn: Inquiry, Ethics, and Integration through Drama,". Through drama, students turn into a fragment of the learning course rather than meagre spectators or sedentary repositories of the amusing practice of learning; through this, learners understanding of notions is deeper, more recurrent, and strikingly more composite. Through study of the arts, drama in precise, and a near guise at how people learn, one can confirm that teaching using drama can augment the classroom setting.

Language is an experience critically thought to be effectively delivered and understood well when active verbal engagement is maximized at all tiers of academic life, Brown (2000). Active class verbal engagement ranges from the most obvious forms such as active class discussions and debates to the intricate drama technique which is seen to incorporate all other student-centered teaching approaches under it (Stinson & Winston, 2011). Kiswahili like any other language has its systemic distinctions that requires active verbal practice to effectively learn its syllables. Drama-based instruction uses in Kiswahili language teaching scopes students of various aptitude and of assorted knowledge aptitude (Tan, 2008). The insertion of dramatization in learning of Kiswahili language is to present learners with the chance to rehearse the language in speech and in adopting it (Suter, 2013).

Though Kiswahili is a compulsory subject in secondary and primary schools' curriculum, the language rule of a specified school marks the viewpoint of learners. Most schools grant eminence to English at the outlay of Kiswahili (Mbito, 2013). In this instance, the students incline to disregard Kiswahili and devote to English in language progression. English language has long led in communication and given more hours as far as lessons are concerned in schools which has resulted to damaging viewpoint and influence on the inclusive performance of Kiswahili language (Kimaro, 2013). As a national language, the performance of Kiswahili across the country has not progressed as expected as reported by Kimaro. The total mean score in Kiswahili of male and female candidates is below 50% (KNEC, 2021). The reports attributed poor performance to deprived teaching methods and influence of secondary dialects used by the students including mother tongue and sheng (Kang'ahi, et al., 2012). This is reflected in years where Kiswahili performance has shown a drastic drop.

KCSE performance of Kiswahili subject in Cheptais Sub-County, Bungoma County which is a reflection of the national performance has been below average for a period of 5 consecutive years which is not the case to other subjects posting good performance in more than 3 consecutive years. Table 1 illustrates the performance in Kiswahili subject in a period of 5 consecutive years in Cheptais sub county, Bungoma county, Kenya.

Table 15: Performance of Kiswahili Subject from 2016-2020

Year	Mean Score	Grade
2016	5.57	C
2017	4.67	C-
2018	4.16	D+
2019	3.98	D+
2020	3.04	D+

Source: MOE Cheptais Sub-County, KCSE Results for year 2016-2020

The results in Table 1 illustrates below average performance for the 5 consecutive years from 2016 to 2020; 5.57, 4.67, 4.16, 3.98, 3.04 respectively in Cheptais sub-county. Table 2 shows KCSE Kiswahili subject performance nationally in 5 consecutive years from 2016-2020.

Table 2: Performance of Kiswahili Subject Nationally from 2016-2020

Year	Mean Score	Grade
2016	5.745	C
2017	4.978	C-
2018	4.745	D+
2019	5.535	C
2020	4.647	C-

Source: KNEC reports, KCSE Results for year 2016-2020

National summative performance of Kiswahili language is slightly higher than the results posted in Table 1 for Cheptais sub-county though below average in the 5 consecutive years from 2016 to 2020; 5.745, 4.978, 4.745, 5.535, 4.647 respectively.

In relation to results in the Table 1 and Table 2, there has been variation of grades attained between 2016 to 2020 and the clearest problem is the below average performance seen in all the years analyzed between the national and sub-county levels. The sub-county results illustrate a lower average performance as compared to the national results as seen in the tables. In view of the results, the researcher aimed at finding out how best teachers are choosing their methods of instruction that culminates to best performance of their candidates and for specific concern on how drama-based instructional approach have been applied as a teaching and learning technique while instructing Kiswahili lessons which may have an impact on average performance of learners in public secondary schools in Cheptais sub-county, Bungoma, Kenya.

Statement of the Problem

Kiswahili as one of the official languages in Kenya has been lauded as an important tool for national integration. Consequently, educationists have called for more emphasis to be put in the instruction of the subject especially at the basic education subsector to provide young learners with a good foundation critical for use of the language in future. However, reports from KNEC indicate that most secondary school students continue to record below average performance in the subject in the summative assessments. This is despite the fact that Kiswahili language teaching and learning has for long been perceived to be significant in national integration. Learners' proficiency in the subject have previously been linked to mastery of listening, speaking writing and reading skills. Whereas a number of factors have been shown to predict mastery of the skills, the extent to which drama-based instructional approach is applied could help contribute towards mitigating the poor performance largely remains unknown. This is despite the fact that previous studies link adoption of drama-based instructional approach with optimal acquisition of language skills in other areas. This study therefore purposed to contribute in bridging the prevailing knowledge gap by establishing the extent to which drama-based instructional approach is used in instruction of Kiswahili language and how it influences students' performance in the subject with a specific focus on public secondary schools in Cheptais Sub-County, Kenya.

Purpose of the Study
The main purpose of this study was to examine the influence of drama-based instructional approach in teaching and learning of Kiswahili language in public secondary schools in Cheptais Sub-County, Bungoma county, Kenya.

Objective of the Study
This study sought to achieve the following specific objective;
To determine the influence of drama-based instructional approach on teaching and learning of Kiswahili language among public secondary schools in Cheptais Sub-County, Kenya.

Research Hypothesis
$H_0 1$ There is no statistically significant influence of drama-based instructional approach on teaching and learning of Kiswahili language among public secondary schools in Cheptais Sub-County, Kenya.

Significance of the Study
The findings of this study and possible suggestions may increase the knowledge on teaching and learning methods of Kiswahili language by teachers and also be of help to curriculum developers while developing the curriculum that correlates with what is in the syllabus and the methodologies effective for teaching Kiswahili language and development. The outcome of this research would be beneficial too to the Ministry of Education as they prepare workshops for teachers to equip them with knowledge on proper Language teaching and learning methods with the view of broadening the scope of Kiswahili language skills acquisition as well as development of Kiswahili language among learners, teachers and the society at large. Additionally, conclusions of this study provide comprehensive and useful evidence on influence of drama-based strategies in teaching of Kiswahili while noting various attribution of dramatization strategies that would better Kiswahili language learning amongst teachers and learners in secondary schools in Cheptais Sub- County, Bungoma county.

Scope of the Study
The study was conducted in public secondary schools in Cheptais, Bungoma which is one of sub counties recording below average performance in Kiswahili language national summative evaluation. The study focused on use of Drama-based Instructional Approaches in teaching and learning of Kiswahili Language among form three students.

RESEARCH METHODOLOGY

Research Design
This study adopted a descriptive survey research design. The reasons for adopting a descriptive survey study design are that it is regularly applied in initial and investigative inquiries to permit the investigator to acquire information, synthesize, present it, and evaluate it for elaboration and explanation of a phenomenon under study. In light of the fact that this was an educational study, the descriptive survey research design was selected, as Creswell (2011) maintains that this is the utmost appropriate research technique to use in the educational setting. As a result of the descriptive survey design being the most effective instrument for observing perspectives, attitudes, and suggestions for improvement in relation to obstacles that stand in the way of the teaching and learning of Kiswahili, this design was selected for the current study because it was appropriate in realization of the study objectives.

Sample Size
Sample size is the significant sum of population elements selected to be involved in research (Woodley, & Lockard, 2016). The selected elements provide the key information that is used in carrying out analysis and determining the key research items. In this study, the sample size was determined by following the method developed by Schoemann, Boulton, and Short (2017) who provided a simplified formula that is used to calculate the sample size. The formula is stated as follows:

$$\mathrm{n} = \frac{\mathrm{N}}{1 + \mathrm{N}(\mathrm{e})^2}$$

Whereby n is the size of the sample, N is the size of the population, and e is the precision level (5%) confidence level. Applying this formula to the target population of 2,346 form three student respondents and 72 Kiswahili language teachers, we get the sample size as:

$$\mathrm{n} = \frac{2418}{1 + 2418 \times (0.05)^2} = 344$$

Therefore, the study relied on 344 respondents as presented in Table 3 from the 24 public schools in Cheptais Sub County in soliciting for necessary information regarding the influence of drama-based instruction on teaching and learning of Kiswahili language in public secondary schools.

Table 16: Sampling Matrix

Respondent	Target Population	Sample
Students	2,346	272
Teachers	72	72
Total	2418	344

Research Instrument

This study made use of teachers and students' questionnaires which elicited vital information on use of drama-based instructional approach while instructing Kiswahili language lessons among public secondary schools in Cheptais sub county, Bungoma county, Kenya. As per Mugenda and Mugenda (1999), questionnaires are frequently utilized in the process of obtaining vital information pertaining to a population. It is helpful in determining shapes of rate of recurrence, prospects, needs, and priorities through investigation.

Data Analysis

Data analysis is carried out so as to bring order, design and meaning to the amount of information collected (Mugenda & Mugenda, 2012). Moreover, data analysis is a design from which the collected data is arranged with precision, understanding, and rewritten so as to present logical and clear conclusions (Kothari, 2014). On the basis of the study, the data analysis was carried out, findings interpreted, and the conclusions drawn in line with the study objectives. Data analysis was carried out with an aid of Statistical Package of Social Science (SPSS) version 26.0. Data was analyzed in terms inferential statistics with use of chi-square to test the hypothesis at $\propto$=0.05 level of significance. This involved summarizing data in form of frequencies and percentages.

RESULTS AND DISCUSSION

This study sought to determine the influence of drama-based instructional approach on teaching and learning of Kiswahili language among public secondary schools in Cheptais Sub-County, Kenya. Teachers' opinion on the use of the instructional approaches relative to Kiswahili language learning was sought based on five Likert-scaled statements. Data obtained were as summarized in Table 2.

Table 2: Drama-based Instructional Approach and Language Learning

Statement	**SD**	**D**	**NS**	**A**	**SA**	**Total**
Use of drama techniques makes teaching and learning of Kiswahili language more interesting	4.2	2.8	6.9	37.5	48.6	100.0
Use of drama techniques improves students understanding of Kiswahili language	5.6	4.2	12.5	40.3	37.5	100.0
Use of drama techniques enhances student participation during Kiswahili language teaching and learning	4.2	8.3	5.6	11.1	70.8	100.0
Use of drama techniques improves students' performance in Kiswahili language	4.2	6.9	6.9	20.8	61.3	100.0
Use of drama techniques motivates learners during Kiswahili language learning	5.6	2.8	6.9	33.3	51.3	100.0

It was determined that, as per majority of teachers, drama-based instructional approach enhances the interest of learners to learn Kiswahili language (86.1%), improves students understanding of Kiswahili language (77.8%) and that it enhances student participation during Kiswahili language teaching and learning (81.9%). Similarly, more than three quarters of the teachers believed that use of the techniques improves students' performance in Kiswahili language (82.1%) and that use of drama techniques motivates learners during Kiswahili language learning (84.6%). Generally, a majority of the teachers sampled believe that use of drama-based instructional approach influences Kiswahili language learning.

An inferential interpretational of the implication of this finding was sought via cross-tabulation and Chi-square analysis. Table 3 presents Chi – Square interpretation of this observation.

Table 3: Chi-Square Analysis

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	CC
Pearson Chi-Square	8.758[a]	1	.002			.186
Continuity Correction[b]	8.220	1	.002			
Likelihood Ratio	9.002	1	.002			
Fisher's Exact Test				.002	.001	
Linear-by-Linear Association	8.930	1	.002			

Chi-square results $\chi^2(1) = 8.758$, $p = 0.001$ indicates a significant influence of drama-based instructional approach on Kiswahili language learning. Contingency Coefficient measure of association (CC) illustrated 18.6% variation in Kiswahili language learning due to drama-based instructional approach. Therefore, the null hypothesis $H0_{1:}$ which stated that there is no statistically significant influence of drama-based instructional approach on teaching and learning of Kiswahili language among public secondary schools in Cheptais Sub-County, Kenya was rejected.

Findings imply that drama-based instructional approach significantly influences instruction of Kiswahili language. According to Stinson and Winston (2011), drama is a potent teaching and learning tool that has caused significant positive effects on students' conceptual, sociocultural, emotional, and physical development while instilling a sense of authenticity to the communication process because it provides learners with interactive and real-feeling contexts for language. According to Astrid (2005), dramatic elements such as role-playing, simulation, mime, and language games facilitate self-learning and group engagement in realistic scenarios. Similarly, Hetfield (2005) encouraged the use of theatre as a means of inspiring and promoting learners' creativity. In addition, the study by Stephen and Abrams (2006) on role-play and mime indicates that theatre promotes the social, intellectual, and linguistic growth of students. According to Clapper's (2010) research on role-playing and simulation, theater focuses on language formation, collaboration, self-and sensory-awareness, all of which stimulate imaginative growth and foster student creativity.

CONCLUSION

The objective sought to determine the influence of drama-based instructional approach on teaching and learning of Kiswahili language. Descriptive data obtained relative to the objective showed that a majority of the teachers sampled believe that use of drama-based instructional approach influences Kiswahili language learning. Chi-square analysis indicated a significant influence of drama-based instructional approach on Kiswahili language learning. Contingency Coefficient measure of association (CC) illustrated 18.6% variation in Kiswahili language learning due to drama-based instructional approach. It can therefore be concluded that use of drama-based instructional approach significantly influences the teaching and learning of Kiswahili language.

RECOMMENDATIONS

The study illustrated that the use of drama-based instructional approach significantly influences the teaching and learning of Kiswahili language learning. Based on the observations, the following recommendations are made:

i. Kiswahili teachers should enhance the use of learner centered approaches such as drama-based approaches in teaching and learning to foster learner conceptualization and performance in the subject.
ii. In the process of adoption of the approaches, specific focus should be given to other areas of the subject including comprehension and composition which though are challenging to learners have not been given adequate focus by teachers in use of the drama-based instructional approach.
iii. School administration should provide adequate teacher support including provision of requisite instructional materials like the teacher's drama-based activities guides, regular inservising and motivation necessary to enhance teaching and learning environment necessary for implementation of challenging learner centered approaches such as drama-based instructional approach.
iv. Enough lessons be allocated to Kiswahili language teaching and learning as it is with English language lessons per week for maximum utilization of the drama-based instructional approach in instructing Kiswahili lessons.

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RELEVANCE OF PRIMARY SCHOOL EDUCATIONAL GOALS IN INSTILLING DEMOCRATIC VALUES AMONG PUPILS IN PUBLIC PRIMARY SCHOOLS IN IGEMBE SOUTH SUB-COUNTY, KENYA

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ABSTRACT
The study focused in determining the relevance of primary school educational goals in instilling democratic values among pupils in public primary schools in Igembe South Sub-County, Kenya. The study adopted descriptive survey research design. The target population was 6700 subjects, comprising of 5950 standard seven pupils and 750 teachers in public primary schools in Igembe South Sub-County. Simple random sampling was used to select 325 pupils while purposive sampling was used to select 45 teachers forming a total sample of 370 respondents. Data was collected using questionnaires and interview schedules. Collected data was cleaned, coded and entered in the computer for analysis using SPSS version 21. Quantitative data was analyzed using frequencies and percentages while Qualitative data was analyzed thematically. The findings of the study revealed that the goals of primary school education are relevant in instilling democratic value of socio-economic equality amongst learners as advocated by John Rawls theory of justice. The study recommends that, there is need to sensitize teachers on the importance of understanding the goals of education. This is because besides forming basis for academic achievement they also form foundation for instilling democratic values on pupils. The study concludes that the recommendations made would prove quite instrumental in informing the policy makers, teachers, pupils and other education stakeholders on the relevance of primary school educational goals in instilling democratic values.
Keywords: Relevance, Primary School, Educational Goals, Democratic Values**.**

INTRODUCTION

Education is the process of changing behavior patterns of people by exposing them to a kind of knowledge, which is worthwhile and capable of achieving a voluntary and committed response from the learner (Farrant, 2004). Durkheim (1971) defined education as the systematic socialization of the younger generation by which the later learn religious and moral beliefs, feelings of nation and collective opinion of all kinds. In addition, education guarantees, through its content and procedures that children and young people learn to co-exist in a human world that is characterized by justice and fairness and where democratic rights of minorities are regarded as important as those of the majority (Sifuna & Otiende, 2006). Education thus plays an instrumental role in creating in learners a sense of citizenship and a commitment to democratic values.

In developed countries like United States of America, the major aim of education is development of nationalism (Fain, Barantovich & Raquel, 2004). In developing countries like Thailand, the major goal of education is to promote and develop learning abilities and knowledge. Education is recognized as a vital tool for fostering ethics and democratic values among youths and the public in order to instill values vital to the development of quality life (Carr, 2008). According to Subba (2014) it is the responsibility of education to instill democratic values such as freedom, equality, justice, autonomy, co-operation, shared decision-making, a sense of community, respect for life, tolerance, peace, development, perfection and effectiveness into the pupil. Through availing, a curriculum with varied content, which is, organized in a manner that benefits all individuals fairly and equally can help promote democratic values among the learners (Young, 2000). According to (Rawls, 2005), democratic values excludes the justification of inequalities on the ground that the disadvantages of those in one position are out-weighed by greater advantage of those in another position. Rawls, education should help instill into learners' democratic values that promote **social equality for a just society.** The curriculum content in primary schools is intended to develop values such as respect for others, openness, co-operation, tolerance, sharing, acceptance, peaceful coexistence and truthfulness (Rawls, 2005). Democratic values in the primary school syllabus in Kenya is mentioned in generalities and thus the impetus for this study.

In Kenya, democratic values in primary schools are mainly promoted through the teaching of Social Studies, Religious education, languages, Creative Arts and Life Skills (Jebungei, 2013; K.I.E, 2003). In the year 2008, the government of Kenya in partnership with UNICEF through the ministry of education introduced students' councils in the management of schools. This intervention was aimed at allowing pupils to exercise their democratic rights as envisaged in the Kenyan constitution (KICD, 2014). In spite of the government effort and emphasis to have all schools embrace change and incorporate democratic values, it has been found that schools are not giving young people

freedom of expression and appropriate participation in policy making (Bambang, 2019).The MOE task force, investigating the cause of unrests in school found out that there were no democratic criteria used in selecting students' councils (Republic of Kenya, 2010). A study by Subba (2014) also observed that, more often than not, students are not involved in the selection of students' councils. This study therefore analyzed the relevance of primary school goals of education in instilling democratic values among pupils in public primary schools in Igembe South Sub-County based on John Rawls theory of justice.

RESEARCH QUESTION

What is the relevance of primary school goals of education in instilling democratic values among pupils in public primary schools in Igembe South Sub-County?

METHODOLOGY

The study adopted descriptive survey research design. The target population was 6700 subjects, comprising of 5950 `standards seven pupils and 750 teachers in public primary schools in Igembe South Sub-County. Simple random sampling was used to select schools and standard seven pupils while purposive sampling was used to select teachers. A sample size of 370 respondents which comprised of 325 pupils and 45 teachers participated in the study. A pilot study was carried in two primary schools in Igembe South Sub-County, which were not to participate in the study because these schools had similar characteristics with the sampled schools. Validity of the instruments was ensured through expert judgment by supervisors from Chuka University. Pearson's Correlation Coefficient using the test-retest method was used to estimate reliability of instruments. A correlation coefficient of 0.78 was generated for the pupils' questionnaires and 0.82 for the teachers' questionnaires. The data collected from the questionnaires was cleaned, coded and entered in the computer for analysis using SPSS version 21. Quantitative data was analyzed using frequencies and percentages. Analyzed data was presented using frequency tables and pie charts. Qualitative data was analyzed thematically.

RESULTS AND DISCUSSION

The study was set out to establish the relevance of primary school goals of education in instilling democratic values among pupils in public primary schools in Igembe South Sub-County. Analyzed data generated the following results.

Relevance of Primary School goals of Education in Instilling Democratic Values among pupils in public primary schools in Igembe South Sub-County?

The first objective of the study sought information on the relevance of primary school goals of education in instilling democratic values among pupils in public primary schools. To achieve this, the respondents were required to indicate with a tick (√) their extent of agreement or disagreement on the items given in the questionnaire. The items were constructed based on the indicators of democratic values, which include equal liberty and socio-economic equality. These items were based on five level Likert scale. Figure 1 show responses on the relevance of goals of primary school education in promoting socio-economic equality.

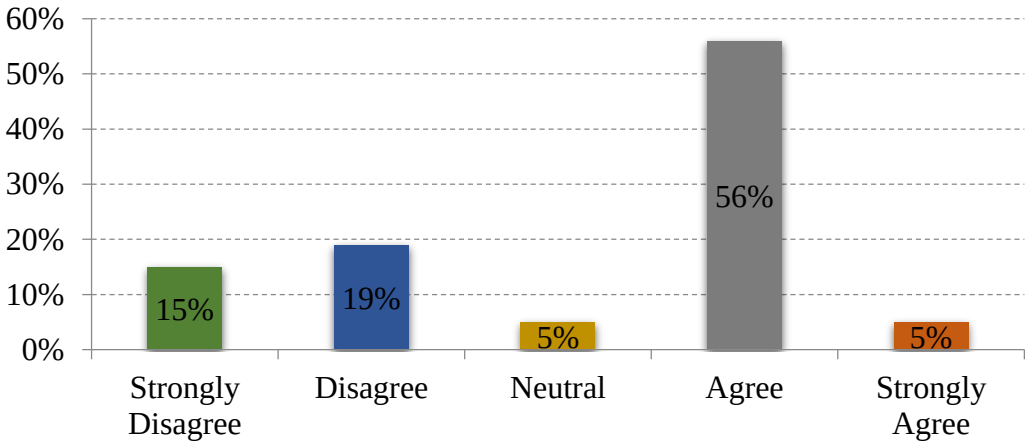


Figure 1: Pupils Responses on primary school Goals of Education in Promoting Socio-Economic Equality

Figure 1 shows that 56% agreed that education is relevant in promoting socio-economic equality. In addition, 5% of pupils strongly agreed that education is relevant in promoting socio-economic equality. Additionally, 15% of the pupils strongly disagreed that education is relevant in promoting socio-economic equality while 19% of the pupils' disagreed that education is relevant in promoting socio-economic equality. The combined proportion of pupils (34%) which disagreed that education is relevant in promoting socio-economic equality indicate that there exist mixed views on the relevance of goals of education in promoting socio-economic equality.

An item was also included in the teachers' questionnaire which sought information on the relevance of goals of education in promoting socio-economic equality among pupils in primary schools. Figure 2 shows the teacher responses.

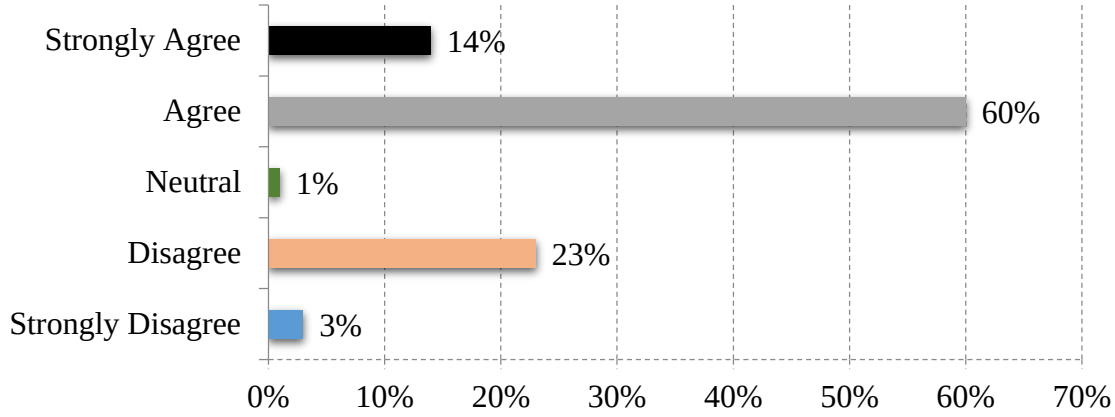


Figure 2: Teachers Responses on primary school Goals of Education in Promoting Socio-Economic Equality

The information in Figure 2 indicates that most of the teachers (60%) agreed that education is relevant in promoting socio-economic equality and 14% of the teachers strongly agreed that education is relevant in promoting socio-economic equality. A combined percentage of teachers who strongly disagreed and disagreed that education is relevant in promoting socio-economic equality stood at 26%. This proportion is also a bit high thus, indicating existence of mixed reactions on the relevance of primary school's goals of education in promoting socio-economic equality. Thus, the views of teachers and pupils regarding the goals of education in promoting socio-economic equality are concurring. The finding of this study has established that the goals of education do not only meet the threshold of contribution to country's economic development but also individual development in a democratic manner (Korir, 2015). Rawls theory of justice advocates for fairness in all fields including that of education.

Items were included in the pupils' questionnaire, which sought information on the relevance of goals of primary schools' education in instilling sense of equal liberty among pupils in primary schools. The responses of the pupils were as indicated on Table 1.

Table 1: Pupils' responses on the relevance of goals of primary schools education in instilling sense of equal liberty

Measurement scale	N	SD (%)	D (%)	N (%)	A (%)	SA (%)
Education is preparing me the same way with others so that we can be disciplined	325	3.7	0.9	2.2	48.3	44.9
Education is preparing me the same way with others so that we can have self-discipline	325	1.2	4.0	7.1	41.5	46.2
Education is preparing me the same way with others so that we can have good morals	325	2.8	0.6	4.9	39.7	52.0
Education is preparing me the same way with others so that we can be people who love our creator	325	11.7	6.2	9.6	40.7	31.8
In my school all pupils are treated equally even those with disabilities	325	4.9	12.0	13.6	37.7	31.8
My teachers teaches me to respect my country	325	5.6	10.5	7.1	46.9	29.9

The results in Table 1 show that most of the primary school pupils in Igembe South Sub County indicated that education prepares them equally to be disciplined. This is as substantiated by the fact that 48.3% and 44.9% of the pupils' strongly agreed and moderately agreed respectively that education prepares pupils equally so that they can be disciplined members of society. A small combined proportion, (4.6%) of primary school pupils in Igembe South Sub County however disagreed that education prepares pupils equally so that they can be disciplined members of society. Results I table 1 further indicate that primary school education prepares learners equally to develop self-discipline among pupils. This is as affirmed by proportion of pupils who approved and strongly approved that education is preparing learners the same way with others so that they can have self-discipline standing at 87.7 %. This finding concurs with Mimar (2012), assertion that the most important contribution of education is not only to upgrade the living standards of citizens but also to enable them to become disciplined citizens.

Further, results in Table 1 show that pupils indicated that education prepares learners equally in development and sound morals. This revelation is as indicated by 52.0% of the pupils who strongly affirmed that education prepares learners the same way with others so that they can have good morals. According to Mimar (2012), educating a person mentally without educating morally is to bring a menace into the society. A relatively higher proportion of pupils (39.7%) also affirmed that education prepares learners the same way with others so that they can have good morals. According to the results in Table 1, education enables learners to develop religious values. This is as indicated by 40.7% and 31.8% of pupils who strongly approved and approved respectively that education prepares learners the same way so that they can be people who love their creator. However, a combined proportion (17.9%) of pupils who disagreed and strongly disagreed is slightly high. This could be an indication that some pupils could not understand the meaning of the word creator as used in this study. Results in Table 1 show that education in primary school should provide equal opportunities for all. This is as indicated by 78.8% of the pupils who approves that all pupils are treated equally even those with disabilities.

Items were included in the teachers' questionnaire, which sought information on the relevance of goals of primary schools' education in instilling sense of equal liberty among pupils in primary schools. The responses of the teachers were as indicated on Table 2.

Table 2: Teachers' responses on the relevance of goals of primary school education in instilling sense of equal liberty

Measurement scale	N	SD (%)	D (%)	N (%)	A (%)	SA (%)
Education prepares pupils equally so that they can be disciplined members of society	40	0	0	0	70.0	30.0
Education offers equal opportunities for learners to develop self-discipline	40	0	2.5	5.0	42.5	50.0
Education offers equal opportunities for learners to develop good morals	40	0	2.5	12.5	70.0	15.0
Education offers equal opportunities for learners to develop religious values	40	0	0	7.5	62.5	30.0
Education offers equal opportunities for learners even those with disabilities	40	0	2.5	12.5	65.0	20.0

Results in Table 2 indicates that teachers supported that education prepares pupils equally so that they can be disciplined members of society. This is as indicated by majority of teachers (70%) who approved that education prepares pupils so that they can be disciplined members of society. Further 30% of the teachers strongly agreed that education prepares pupils so that they can be disciplined members of society. None of the teacher disagreed, was undecided or strongly disagreed that education prepares pupils equally so that they can be disciplined members of society. This finding matches the aim of primary school's education as provided for in the Kenya primary school syllabus (KIE 2003). The results further indicate 70% of the teachers agreed that education offers opportunities for learners to develop self-discipline. However, the proportion of teachers who were either indecisive or disagreed that education offers opportunities for learners to develop self-discipline was relatively high at combined percentage of 14.5%.

Information in Table 2 disclose that majority of teachers, 65.0% agreed that education offers equal opportunities for learners to develop good morals. More so, 32.5% of the teachers agreed that education offers equal opportunities for learners to develop good morals. KIE (2003) notes that education should promote morals and foster a sense of social responsibility within an education system. This opportunity should be provided to all learners within equal educational environment without discrimination. None of the teachers disagreed that education offers equal opportunities for learners to develop good morals. The teachers' responses that education offers equal opportunities for learners to develop good morals rhymes with those of pupils.

Results in Table 2 also indicate that 65.0% and 32.5% of the teachers agreed and strongly agreed respectively that education offers equal opportunities for learners to develop religious values. Additionally, 50.0% of teachers agreed and 47.5% of teachers strongly agreed that education offers equal opportunities for learners to develop religious values. None of the teachers disagreed that education offers equal opportunities for learners to develop religious values. Besides, teachers and pupils' views that education offers equal opportunities for learners to develop religious values. Information in Table 2 shows that a huge proportion of teachers (80.0%) approve that education offers equal opportunities for learners even those with disabilities. Only 2.5% of teachers disagreed that education offers equal opportunities for learners even those with disabilities.

The most important aim of education is not only to upgrade the living standards of citizens but also to enable them to become better citizens. In addition to being a human right, education today is a prerequisite for development and also an effective means for both taking knowledge-based decisions and improving democracy. Education improves and strengthens developmental capacities of individuals, communities, groups, institutions, and countries. However, as Roosevelt's said 'trying to educate a person mentally without educating morally is to bring a menace into the society' indicated, this is possible via educating people to become supporters of each other but not enemies at all. In this disposition, education can create a safer, healthier and more prosperous world and enhance the living standards by changing the visions and perspectives of individuals.

CONCLUSION

From the findings of the study, the researcher concludes the following.
The goals of primary school education are relevant in instilling democratic value of socio-economic equality amongst learners as advocated by Rawls theory of justice. This is as indicated by majority of teachers and pupils who showed that education promotes socio-economic well-being of individuals as well as that of a nation. The study also revealed that most of the respondents indicated that goals of education advocate for teaching and learning activities, which promote democratic value of sense, social equality and respect for others without discrimination as argued by Rawls theory of justice.

RECOMMENDATIONS

Based on conclusions of this study, the researchers came up with the following recommendations:
There is need to sensitize teachers on the importance of understanding the goals of education. This is because besides forming basis for academic achievement they also form foundation for instilling democratic values on pupils.

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INFLUENCE OF GOOD HEALTH ON QUALITY PRE-PRIMARY EDUCATION IN TURKANA CENTRAL SUB-COUNTY, KENYA

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ABSTRACT
Nurturing care plays an important role in enhancing the quality ofpre-primary school education. However, in Turkana Central Sub-county, the quality of pre- primary school education is a challenge. Many pre-primary school learners manifest low basicnumeracy, language and creativity skills. This study assessed the influence of good health on the quality of pre-primary school education in Turkana Central Sub-county, Turkana County, Kenya. The study was guided by the motivational theory and theory of all-round educational quality. A mixed methodology was applied and the concurrent triangulation design. Data analysis began by identifying common themes from the respondents' descriptions of theirexperiences. Qualitative data were analyzed thematically along the objectives and presented in narrative forms. Quantitative data were analyzed descriptively using frequencies and percentages and inferentially using Pearson's Product Moment Correlation Analysis with the use of Statistical Packages for Social Science (SPSS Version 23) and presented using tables. The study established that health improves the quality of pre-primary education. Thus, the study recommends that thegovernment should partner with stakeholders in pre-primary school education and other donorsto provide resources to promote health of learners.
Keywords: Health, Nutrition, balancediet, pre-primarylearners, stakeholders, Quality of PrePrimary Education

INTRODUCTION
Nutrition entails the provision of balanced diets to children. The nutrition practices adopted byparents and key caregivers are another important influence on dietary intake. Many parenting practices related to children and eating have evolved from a parental perception of environmental threats to their children's wellbeing and often pass from generation to generation. Some 'traditional' practices developed in a time of food scarcity (Savage, Fisher &Birch, 2017), whereas food for most New Zealanders is now relatively plentiful and current threats to wellbeing involve the abundance of energy-rich, nutrient-poor foods and the increasing risk of obesity.

In a study carried out in Nepal among 112 respondents about childhood malnutrition and cognition, Moorck and Leslie (2014) indicate that, in an educational world filled with failing schools and apathetic learners, school committees on education have searched for solutions onhow to increase test scores and create school systems where all learners receive the best education possible. Among the plethora of possible solutions have included a look at the nutritional substance of what school-aged children are eating each day as they struggle througha day of learning. According to Del Rosso (2013), there is a correlation between nutrition andlearners' cognitive development, health as well as school attendance which immensely contribute to the academic achievement of pre-primary school learners. However, this relationship has been highly under-researched, though there exist many studies that look at thenutritional benefits of many proteins, vitamins, and food substances as they affect learning andbrain function. Pre-primary schools have the potential to play a vital role in preparing and sustaining learners' potential learning abilities and benefitting their social behaviors by supplying nutritious mid-morning meals and lunches during school days. malnutrition as well as ill-health do not have the same potential to do well at school in comparison with well- nourished and healthy children. Poor health and malnutrition lower children's cognitive development and performance through physiological changes or reduced capacity to participatein learning activities. In New Zealand, for example, one-fifth of children leave for school without balanced dietary provisions and is more common among older children, girls, Maori and Pacific children, and those living in lower socio-economically resourced areas (Grantham,2015).

In Sub-Saharan Africa, poor nutrition has been associated with adverse effects on cognitive function including memory, academic performance, school attendance, psychosocialfunction and mood in children and young people. Conversely, a study carried out in Morocco by Grantham (2015) found that proper nutrition is associated with a range of positive outcomes,including better school attendance, academic performance, nutrient intake, fitness, and healthier body weight. In Kenya, following the initiation of school feeding programmes, nutritious breakfast provides 16% of children's daily energy intake, around one-third of calcium, iron, thiamine, riboflavin and folate intakes, and one-fifth of zinc intake (Hoyland, 2018). Children who miss such morning dietary provisions have significantly worse daily nutrient intakes, including higher intakes of total fat, and lower intakes of dietary fiber and micronutrients than those who eat nutritious breakfast. However, some parents and caregiversstill use 'clear your plate' messages concerning

their own and their children's eating. Putting pressure on children to eat healthy foods and to eat more, in general, can be counterproductive.

In Turkana Central Sub-county, young children depend on their families and teachers to support their well-being and promote positive development, including eating behaviors. Children's food preferences and willingness to try new foods are influenced by parental practices (Ministry of Education, 2019). The eating behaviors children practice early in life affect their health and nutrition and continue to shape food attitudes and eating patterns throughadulthood. A report by the Ministry of Education (2019) noted that eating environments, mealtime and snack that make food fun, offer new foods and a variety and encourage childrento taste and choose the foods they want to let children develop food attitudes and dietary practices that ultimately support good health. MoE (2019) asserts that such nutrition practicesenhance the quality of pre-primary school education among pre-primary school learners. However, this has been the case in many pre-primary schools in Turkana Central Sub-county where many pre-primary school learners manifest low grades in basic numeracy, language andcreativity skills as shown in Table 1.

Year of Assessment	**Annual Assessment Results in Basic Numeracy, Language andCreativity Skills**		
	Basic Numeracy Skills	**Language Skills**	**Creativity Skills**
2014	5.1	3.1	6.9
2015	4.9	2.7	6.2
2016	3.7	2.3	4.7
2017	3.1	2.1	3.4
2018	2.6	1.9	3.0

Table 1 paints a picture of the declining quality of pre-primary education in public pre-primary schools. It was against this background that the researcher sought to assess the influence of nutrition on the quality of pre-primary school education in Turkana Central Sub-county in Turkana County, Kenya.

Statement of the Problem

Health plays an important role in enhancing the quality of pre-primary school education. However, in many pre-primary schools in Turkana Central Sub-county, the quality of pre- primary school education of learners has been a challenge. Many pre-primary school learners manifest poorly developed basic numeracy, language and creativity skills. As indicated in Table 1, a report by the Ministry of Education (2019) indicates that only 23.9% of pre-primary school learners have competency in mathematics skills, have a well-developed communicativecompetency in reading, writing and oral skills whereas only 22.6% manifest creativity skills such as drawing, shape formation and coloring among others. Efforts to mitigate thesechallenges such as employment of pre-primary school teachers and provision of curriculum support materials have not registered remarkable improvement. Despite these observations, much is yet to be done to establish the extent to which nutrition practices adopted in schools influence the quality of pre-primary school education. In other words, few empirical studies have interrogated how parents' discipline, homework, nutrition and role modeling practices influence the quality of pre-primary school education; hence, the study.

Objectives of the Study

The study sought to address the following objective; To establish the influence of good health on quality of pre-primary education in Turkana Central Sub-county

THEORETICAL FRAMEWORK

This study was based on motivational theory which was postulated by Abraham Maslow in 1943. This theory suggests five interdependent levels of basic human needs (motivators) that must be satisfied in a strict sequence starting with the lowest level. This theory applies to the current study because if parents' basic needs have not been met, then they will not have time to involve themselves in their pre-school children's education. For example, when the physiological needs such as the needs for for food water and shelter have not been met, then parents might spend more time trying to meet these needs and they may not be motivated to get involved in their preschool children's education. This theory was appropriate for this studyin that it guides parents and the school system to meet children's needs so that these children may be more likely to learn effectively. This study was also guided by the Theory of all-round educational quality which was postulated by Xiangyang (2009). This theory holds that all- round quality education is the application of all-round quality management in the area of education. Xiangyang (2009) asserts that, as the continued expansion on the concept of education quality, the quality of education is not only to train learners to possess

knowledge, but also to help them have other various qualities such as working attitude, sense of cooperation and competition, professionalism, moral cultivation, environmental adaptability and mental endurance capabilities. In the context of this study, all-round quality management is applied inthe field of pre-primary school education since it emphasizes education as a service that is provided to meet learners' and their parents' needs, who are considered to be "consumers" and"customers". This theory underscores the fact that twin functions of schools are; the function in the quality of personnel training which is the most fundamental. The theory functions of pre-primary school education indicate that there are varieties of quality standards in the quality ofpre-primary school education.

RESEARCH METHODOLOGY

A mixed methodology was applied and the concurrent triangulation design. The target population consisted of 35 headteachers, 153 pre-primary school teachers, 490 parents' representatives and 606 learners totaling 1284 from which a sample of 305 respondents was determined using the Yamane's Formula. Stratified sampling was used to create five differentstrata based on the number of zones in Turkana Central Sub-county. For each zone, two headteachers, two parents' representatives and 22 pre-primary school teachers were selected using purposive sampling. However, from each zone, 35 pre-primary school learners were selected using simple random sampling. This procedure realized a sample of 10 headteachers,110 pre-primary school teachers, 10 parents' representatives and 175 pre-primary school learners. Questionnaires were used to collect data from pre-primary school teachers, whereas interviews were used to collect qualitative data from headteachers and parents' representatives.An observation checklist was used to collect data from learners. Data analysis began by identifying common themes. Qualitative data were analyzed thematically along the objectives and presented in narrative forms. Quantitative data were analyzed descriptively using frequencies and percentages and inferentially using Pearson's Product Moment Correlation Analysis with the help of Statistical Packages for Social Science (SPSS Version 23) and presented using tables.

RESULTS AND DISCUSSIONS

This section presents the findings of the study based on the objective. It also outlines the methods of presentation of the study findings and discussions.

Response Rates

In this study, 110 questionnaires were administered to pre-primary school teachers, out of which 106 were successfully filled and returned. At the same time, the researcher also interviewed eight (8) headteachers and seven (7) parents' representatives. The researcher alsoundertook observation schedules among 143 pre-primary school learners. This yielded response rates shown in Table 2;

Table 2: Response Rate

Respondents	Sampled Respondents	Those Who Participated	Achieved ReturnRate (%)
Headteachers	10	8	80.0
Pre-primary School Teachers	110	106	96.4
Parents' Representatives	10	7	70.0
Pre-primary School Learners	175	143	81.7
Total	**305**	**264**	**86.6**

Source: Field data (2021)

Table 2 shows that headteachers registered a response rate of 80.0%, pre-primary school teachers registered a response rate of 96.4%, parents' representatives registered a response rate of 70.0% whereas pre-primary school learners registered a response rate of 81.7%. This yieldedan average response rate of 86.6% which affirmed the assertions of Creswell (2014) that any response rate above 75% is sufficient and of the acceptable levels to enable the generalization of the results to the target population.

Good Health and Quality of Pre-primary School Education

The study sought to establish how good health practices adopted under nurturing care framework influence quality of pre-primary school education. Descriptive data were collected from pre-primary school teachers and results are shown in Table 3:

Table 3: Views of pre-primary school teachers on influence of good health on quality of pre-primary school education

Summary of Test Items	SA %	A %	U %	D %	SD %
Children's physical wellness has enhanced quality of pre-primary school education	71.7	11.8	1.5	10.1	5.3
Emotional wellness of learners is a determinant of quality of pre-primary school education	66.9	13.2	2.4	12.7	4.8
Conducive environment influence quality of pre-primary school education	80.5	12.4	1.6	3.3	2.2
Preventive healthcare practices influence quality of pre-primary school education	67.4	19.7	3.5	5.3	4.1
Hygiene practices are a determinant of quality of pre-primary school education	69.6	13.8	1.6	10.6	4.4

Source: Field Data (2021)

Table 8 reveals that majority, 76(71.7%) of the pre-primary school teachers strongly agreed with the view that children's physical wellness has enhanced quality of pre-primary school education while 13(11.8%) agreed with the statement. However, only a paltry, 2(1.5%) were undecided, 11(10.1%) disagreed whereas 6(5.3%) strongly disagreed. Slightly more than two-thirds, 71(66.9%) of the pre-primary school teachers strongly agreed with the view that emotional wellness of learners is a determinant of quality of pre-primary school education as did 14(13.2%) who agreed. At the same time, 3(2.4%) were undecided, 13(12.7%) disagreed whereas 5(4.8%) strongly disagreed. These findings are consistent with the assertions of Moorck and Leslie (2014) that, in Nepal, all young children need adequate nutrition, health and care from birth onwards and lack of these supports during the early years has permanent negative effects on later development.

According to Moorck & Leslie (2014), not only are there consequences for the child's physical and psychological well-being, but these variables also have an impact on the child's social and cognitive development. This implies, for children in pre-primary schools to register impressive grades in basic numeracy, language and creativity skills, their psychological and emotional wellness and stability are key. The study also revealed that an impressive majority of the pre-primary school teachers 85(80.5%) strongly agreed with the view that conducive environment influence quality of pre-primary school education as did 13(12.4%) of the pre-primary school teachers. However, 2(1.6%) of the pre-primary school teachers were undecided, 4(3.3%) disagreed whereas 3(2.2%) strongly disagreed.

These findings corroborate the assertions of WHO (2011) that healthy environment facilitates more effective learning in primary schools, it provides opportunities for pupils to gain life-long positive hygiene behaviours and opportunities for increased school enrolment, quality of pre-primary education. These findings further support the findings of a study carried out in Austria in which WHO (2011) found that 88% of the burden attributable to unsafe water supply, sanitation and hygiene severely affects primary school pupils in developing countries. This further supports the findings of a report by a Special Session on pupils in which the United Nations General Assembly (2012) reported that nearly 5,500 children die every day from diseases caused by contaminated food and water. This implies that, for quality of education to be achieved in pre-primary schools, the role played by environment cannot be overlooked.

Learning environment for learners ought to be conducive with clean and safe water supply as well as provision of good sanitation services. A fair majority, 71(67.4%), of the pre-primary school teachers strongly agreed with the view that preventive healthcare practices influence quality of pre-primary school education whereas 21(19.7%) agreed. However, 4(3.5%) were undecided, 6(5.3%) disagreed whereas 5(4.1%) strongly disagreed. Majority, 74(69.6%) of the pre-primary school teachers strongly agreed with the view that hygiene practices are a determinant of quality of pre-primary school education as did 15(13.8%) who agreed. On the other hand, 2(1.6%) were undecided, 11(10.6%) disagreed whereas 5(4.4%) strongly disagreed. These findings corroborate the assertions of UNICEF (2012) that hygiene and sanitation practices, in particular proper use of toilet and hand washing with soap at critical times, such as after defecating, and before eating and preparing food, is equally important and key in realization of quality education in pre-primary schools.

This lend credence to the assertions of Bwire & Ngumbao (2014) who note that, in safe schools, providing sanitation and hygiene facility is not sufficient but school helps them to develop hygiene behavior which includes hand washing, proper usage of toilets etc. According to the Ministry of Health (2010), to meet the goal of realizing quality education

in elementary schools, Ethiopian government has invested in construction of safe water sources, sanitary latrines with provision for learners in hygiene promotion through programmes like health promoting schools, Child-Friendly schools and fresh initiative.

These findings attest to the fact that, with these efforts, there is realization that sanitation and hygiene are fundamental to good health and dignity, and improving sanitation and hygiene practices contribute to realization of primary school pupils' rights to survival and development within school environment. This further implies that addressing learners' basic rights to health and hygiene education through implementing health and hygiene safety guidelines underscores a commitment of ensuring that all primary school pupils have access to high quality water and sanitation services at school.

Inferential Analysis of the Influence of Good Health on Quality of Preprimary School Education

To verify the possibility of difference between good health and quality of pre-primary school education, data were collected on the number of toilets compared to the number of pre-primary school learners and performance of pre-primary school learners in basic numeracy, language and creativity skills and results are shown in Table 4:

Table 4: Number of Toilets in Public Pre-primary Schools and Performance of Pre-primary School Learners

Number of Toilets in Public Pre-primary Schools	Performance of Pre-primary School Learners (%) in Skills		
	Basic Numeracy	Language	Creativity
3	21	19	45
5	36	19	50
5	59	17	61
6	58	21	68
7	57	23	72
9	63	43	77
10	74	57	77
12	81	62	70

Source: Field Data (2021)

Table 5 shows that public pre-primary schools have different number of toilets for learners with net effect on the quality of education which learners acquire in such schools. From Table 8, in public pre-primary schools where learners have access to adequate number of toilets, learning outcomes in basic numeracy, language and creativity skills are high and impressive. This implies that provision of toilets to pre-primary school learners constitute a major good health practice whose impact on quality of education cannot be overemphasized. These results were subjected to Pearson's product Moment Correlation Analysis and results are shown in Table 5:

Table 5: Pearson's product movement correlation analysis of the relationship between number of toilets in public pre-primary schools and performance of pre-primary school learners in basic numeracy, language and creativity skills

		No. of Toilets	Basic Numeracy	Language	Creativity
No. of Toilets	Pearson Correlation	1	.896**	.939**	.793*
	Sig. (2-tailed)		.003	.001	.019
	N	8	8	8	8
Basic Numeracy	Pearson Correlation	.896**	1	.760*	.873**
	Sig. (2-tailed)	.003		.029	.005
	N	8	8	8	8
Language	Pearson Correlation	.939**	.760*	1	.641
	Sig. (2-tailed)	.001	.029		.087
	N	8	8	8	8
Creativity	Pearson Correlation	.793*	.873**	.641	1
	Sig. (2-tailed)	.019	.005	.087	
	N	8	8	8	8

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Source: SPSS Generated (2021)

Table 6 shows that there is a strong positive correlation between good health practices such as provision of toilets and quality of pre-primary school education ($r(8) = 0.896, 0.939, 0.793$, $p = 0.003, 0.001, 0.019$ at $\alpha = 0.05$). These findings further support the fact that provision of quality of pre-primary education depends on good health practices such as provision of toilets. In other words, for pre-primary school learners to register impressive grades in basic numeracy, language and creativity skills, learners' physical and emotional wellness, conducive environment and good healthcare practices are really significant at all times.

Thematic Analysis of the Influence of Good Health on Quality of Preprimary School Education

Head teachers and parents' representatives were also interviewed on the extent to which good health practices influence quality of pre-primary school education.

They responded in favour of the view that children's physical and emotional wellness are key in enhancing quality of pre-primary school education. Headteacher, H2, noted;

I believe that learners need to be emotional and physically stable and fit to be able to concentrate in their learning studies. Emotional and physical wellness enables learners to focus on their studies and thus perform better in basic numeracy, language and creativity skills.

These views also support the views expressed by Moorck and Leslie (2014) that not only are there consequences for the child's physical and psychological well-being, but these variables also have an impact on the child's social and cognitive development. On the question of environment, the head teachers and parents' representatives too admitted that, despite the challenges of financial resources, they have tried to create conducive environment to facilitate smooth and effective learning of pre-primary school learners. Parents' Representative, PR2, stated;

My pre-primary school has ensured that learners have access to safe and clean drinking water and provided sanitation services. The school has ensured that learners and staff adhere to sanitation, grooming and hand washing regulations. This way, my school has kept learners in school, concentrate on their learning activities. In the end, basic numeracy, language and creativity skills among pre-primary school learners have improved tremendously.

Just as noted earlier in quantitative findings, these views are in agreement with the assertions of WHO (2011) that healthy environment facilitates more effective learning in primary schools, it provides opportunities for pupils to gain life-long positive hygiene behaviours and opportunities for increased school enrolment, quality of pre-primary education. The head teachers and parents' representatives also appreciated that preventive healthcare practices are crucial for enhancing quality of education among pre-primary school learners. This implies that hygiene and sanitation practices, in particular proper use of toilet and hand washing with soap at critical times, such as after defecating, and before eating and preparing food, is equally important and key in realization of quality education in pre-primary schools.

These views also support those expressed by Bwire & Ngumbao (2014) that, in safe schools, providing sanitation and hygiene facility is not sufficient but school helps them to develop hygiene behavior which includes hand washing, proper usage of toilets etc. In summary, both quantitative and qualitative findings point to the fact that good health practices such as construction of safe water sources, sanitary latrines and creation of child-friendly schools are important in realization of quality pre-primary school education. In other words, improving good health and hygiene practices contribute to realization of primary school pupils' rights to survival and development within school environment. Besides, addressing learners' basic rights to health education through implementing health and hygiene safety guidelines underscores a commitment of ensuring that all pupils have access to high quality water and sanitation services.

SUMMARY OF FINDINGS AND CONCLUSIONS

From the study findings, it is evident that there are numerous good health practices which pre-primary schools adopt to improve quality of education. These include; improving children's physical and emotional wellness and creating conducive environment. In public pre-primary schools, where such practices have been undertaken in earnest, quality of pre-primary school education in terms of syllabus coverage and performance of learners in basic numeracy, language and creativity skills has improved and vice-versa.

This affirms the fact that, for children in pre-primary schools to register impressive grades in basic numeracy, language and creativity skills, their psychological and emotional wellness as well as conducive learning environment are important. Healthy environment facilitates more effective learning in primary schools; it provides opportunities for

pupils to gain life-long positive hygiene behaviours and opportunities for increased school enrolment, quality of pre-primary education. That is, learning environment for learners ought to be conducive with clean and safe water supply as well as provision of good sanitation services.

In other words, hygiene and sanitation practices, in particular proper use of toilet and hand washing with soap at critical times, such as after defecating, and before eating and preparing food, are equally important and key in realization of quality education in pre-primary schools. This further implies that addressing learners' basic rights to health and hygiene education through implementing health and hygiene safety guidelines underscores a commitment of ensuring that all primary school pupils have access to high quality water and sanitation services at school.

RECOMMENDATIONS

School heads should partner with stakeholders in pre-primary school education to provide resources and ensure that good health practices and continuously adopted and practised as a way of improving quality of pre-primary school education

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EFFECTIVENESS OF COMPUTER BASED TEACHING IN ENHANCING STUDENT'S INTEREST TO LEARN AGRICULTURE IN SECONDARY SCHOOLS IN THARAKA-NITHI COUNTY, KENYA

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ABSTRACT
Interest plays a key role in learning. Interest motivates students and this enhances successful learning. Students' interest to learn is affected by the teacher's style of teaching. Students get interested in learning when they become engaged and actively involved in the learning process. In Computer Based Teaching (CBT), students have hands on activities and are actively involved in the learning process and this increases their interest to learn. Taking into account that agriculture is the backbone of Kenya's economy, students should develop an interest to learn the subject. The purpose of the present study was to investigate the effectiveness CBT in enhancing students' interest to learn agriculture. The study employed Solomon Four-Quasi-experimental design. Target population was the 1,779, 876 secondary school students in Kenya. The study was conducted in eight county secondary schools in Tharaka Nithi County, Kenya. Stratified random sampling technique was used in selecting participating schools. A sample of 327 Form One students participated in the study. The research instrument was Interest Towards Agriculture (ITA) questionnaire with a reliability coefficient of 0.78. Analysis of Variance (ANOVA) was used in data analysis. Statistical significant values were accepted at α level of 0.05. The findings indicated that CBT strategy improved students' interest to learn agriculture. The study concluded that CBT is an effective strategy in enhancing interest to learn agriculture and therefore agriculture teachers should be encouraged to incorporate CBT strategy in their teaching.
Keywords: Agriculture Subject, Computer Based Teaching, Conventional Teaching, Interest

INTRODUCTION

Agriculture is one of the subjects offered in Kenyan secondary schools (Mwiria, 2002; Ngugi, Isinika, Temu & Kitalyi, 2002). At the secondary school level, it is an optional subject right from form one. However, those who choose it in form one have an opportunity of dropping it in form three (KIE, 2002). The aim of teaching agriculture in secondary schools is to ensure that learners are exposed to basic principles necessary for agricultural production in the country. The teaching of agriculture is expected to promote the acquisition of skills for self reliance in agriculture (Mwiria, 2002). Learners are exposed and involved in various practical activities that will enable them to develop the necessary skills and abilities required in agricultural production (KIE, 2006). Bearing in mind the importance of agriculture to the economy of Kenya, students should be encouraged to have an interest in the subject.

Success of a subject is normally reflected by the number of students opting to study it (Tanui, Nassiuma & Kiboss, 2008). Being an elective subject, the development of agriculture in secondary schools depends very much on the number of students studying it. The percentage of students taking agriculture in secondary schools in Kenya, however has been on decline for the years, 2015-2019 (KNEC, 2019). For the year 2015, only 39% of the total number of students enrolled for agriculture at KCSE level. This low enrolment can partly be attributed to the students' lack of interest to learn the subject. Interest in the subject matter is one of the factors influencing enrolment (Calvin, 1986). It has been shown that interest influences academic choices. Interest plays a central role in motivation (Deci & Ryan, 2002). According to Silvia, 2006, interest is closely related to motivation.

Lack of interest to learn agriculture is partly as a result of the teaching strategies employed by the teacher. Teachers' teaching style affects students' interest in learning (Muhibin, 1999; Saswandi, 2004). Most of the teaching strategies practiced by agriculture teachers are expository and facts oriented, assigning the learners a passive role (Kathuri, 1990; Ngesa, 2006). Teachers usually act as the dispensers of knowledge while learners listen and take notes. Since interest is necessary in learning, strategies that enhance it should be adopted in teaching agriculture. The key to maintain interest in learning is engagement. Davis (2017) argues that students prefer to and get more interested in learning when they have hands –on activities and get to collaborate with their peers. Therefore, agriculture teachers should employ those strategies that make learners active in the teaching learning process.

Computer Based teaching strategy involves the use of computers in the learning process. Learners are actively involved in the learning process and this increases their interest to learn. The novelty of computers arouses enthusiasm among learners and enhances their interest to learn (Meena, 2008). According to Senemoglu (2003) computer based

instruction motivates students to learn better by creating an exciting and interesting game-like atmosphere. Use of computers has been shown to produce positive results in teaching difficult topics or where motivation is low in different subjects (Tanui, Kiboss & Nassiuma, 2008; Kiboss, Ndirangu & Wekesa, 2004). A study by Akudolu (1996) revealed that students found computer assisted language learning interesting and stimulating. Despite the effectiveness of computers in enhancing interest in learning, research on this area in relation to secondary school agriculture is limited. In an attempt to fill this gap, the present study investigated the effectiveness of CBT in enhancing interest in learning agriculture.

Purpose of the Study

The purpose of the study was to investigate the effectiveness of computers in enhancing students' interest to learn agriculture in secondary schools in Tharaka Nithi County, Kenya.

Objective of the StudY

To determine whether there is a difference in interest to learn agriculture between students exposed to computer based teaching and those exposed to conventional methods.

Hypothesis of the Study

The following null hypothesis guided the study.

$H_0$1: There is no statistically significant difference in interest to learn agriculture between students exposed to computer based teaching and those exposed to conventional teaching methods.

METHOD AND MATERIALS

Research Design

The study used quasi-experimental research design and in particular Solomon Four Group design. Quasi-experimental design uses natural assembled groups such as classes in research. The design allows the researcher to randomly select a sample from the population without the random assignment of individual cases to comparison groups. According to Ogunniyi (1992), Solomon Four-Group design is the most rigorous design that can be used in quantitative studies since it uses two control groups in comparison to other experimental designs. Solomon Four-Group design is as follows:

Group I (E1)		O_1 X	O_2	
Group II (C1)		O_3		O_4
Group III (E2)	X		O_5	
Group IV (C2)		O_6		

Key: O_1 and O_3 are pretests; O_2, O_4, O_5 and O_6 are posttests; X is the treatment.

Group I was the experimental group (E1) which received the pretest (O_1), the treatment (X) and the posttest (O_2). Group II was the control group (C1) which received a pretest (O_3), no treatment and the posttest (O_4). Group III was another experimental group (E2) which received treatment (X) and the posttest (O_5) but did not receive the pretest. Group IV was another control (C2) that received the posttest (O_6) only. Group 1 and III were exposed to CAT strategy. Group II and Group IV were taught agriculture using the conventional teaching strategy.

The design controls major threats to internal validity except those associated with interaction of: maturity and history, selection and maturation and selection and instrumentation (Cook & Campbell, 1979). Random assignment of schools to experimental and control groups controlled selection and maturation. To control interaction between selection and instrumentation, the conditions under which the instruments were administered were kept as similar as possible across the schools.

DATA COLLECTION AND ANALYSIS

The target population for the study was the 1,779, 876 students in secondary schools in Kenya. The study was carried out in Tharaka Nithi County, Kenya. At the time of the study, county had a total of 136 secondary schools comprising of 2 national, 14 extra-county, 29 county and 91 sub-county secondary schools. County secondary schools in possession of computers for teaching purposes were considered for this study. The accessible population was the 8,140 form one students in secondary schools in the county. Form ones were selected because the topic on Livestock Production I (Common livestock breeds) is taught at this level (KIE, 2006).

Stratified random sampling technique was used to select 4 girls' and 4 boys' secondary schools. A total of 163 boys and 164 girls participated in the study. Simple random sampling technique was used to select a particular stream for data analysis in cases where there was more than one stream in a participating school. However, for schools in the experimental groups, treatment was administered to all the streams.

Data was collected by an Interest Towards Agriculture (ITA) questionnaire. Items on interest were adopted from the scale developed by Vallerand, Petelleir, Blais, Bere, Senecal and Vallieres (1992) on measurement of intrinsic academic motivation. These items were slightly modified to suit agriculture. The ITA questionnaire items were based on a 5 point Likert scale where students were required to state whether they Strongly Agree(SA), Agree(A), Undecided(U), Disagree(D) or Strongly Disagree(SD) with the given statements. To ascertain the reliability of the questionnaire, a pilot study was carried out in a school in the neighbouring Embu County. Cronbach's Coefficient alpha was used to estimate reliability of the ITA. A reliability coefficient of 0.7 and above was accepted. The ITA yielded a coefficient of 0.78, hence was suitable for the study.

Form one agriculture teachers in the experimental groups were trained for one day on the use of CBT strategy in teaching. Teachers in the experimental groups taught agriculture by use CBT strategy while their counterparts in the control groups taught agriculture by use of Conventional Teaching (CT) strategy. The topic of instruction was Livestock Production I (Common livestock breeds). All the teachers in the sampled schools used a common implementation schedule which was prepared by the researcher. Before commencement of the study, groups I and II were given a pretest. This was followed by a three weeks' intervention of the CBT strategy for groups I and III. After the intervention, ITA was administered to all the groups. Students' pretest and posttest responses were scored to generate data for analysis. Data was analysed using descriptive and inferential statistics.

RESULTS AND DISCUSSION

Effectiveness of CBT strategy in enhancing Students' interest to Learn Agriculture

The objective of the study was to determine whether there was a difference in interest to learn agriculture between students exposed to Computer based teaching and those exposed to conventional teaching strategy. In order to measure interest to learn agriculture, students were asked to respond to items in the ITA questionnaire. The ITA had 14 items on perceived interest to learn agriculture. Each item in the questionnaire was rated on a five point Likert scale ranging from: Strongly Agree (SA) = 5, Agree (A)=4, Undecided (U)=3, Disagree (D)=2 and Strongly Disagree (SD)=1. Negatively stated items were scored in the reverse order. The mean rating score for all the responses was used to calculate the mean score for a particular group. This procedure was carried out for both the pretest and posttest.

Pretest Results on Interest to Learn Agriculture

In order to assess the level of interest to learn agriculture before exposure to CBT strateg, pretest scores on interest to learn agriculture were analysed. Table 1 shows the pretest mean scores on interest to learn agriculture.

Table 1: Pretest Mean Scores on Interest to Learn Agriculture

Group	N	Mean	Standard Deviation
E1	82	4.08	.47
C1	83	3.93	.63

Results in Table 1, show that the mean score for the experimental group E1 was 4.08 and that of the control group C1 was 3.93. This shows that the mean scores for the two groups were different, with the experimental group E1 having a higher mean score. In order to find out whether there was a significant difference in the pretest mean scores for the two groups, an independent t-test was carried out. The results are presented in Table 2.

Table 2: The t-test of Pretest Mean Scores on Interest to Learn Agriculture

	t	df	Sig. (2-tailed)
Equal variances assumed	1.705	163	.090
Equal variances not assumed	1.708	151.849	.090

Results in Table 2 reveals that there was no significant difference in the mean scores of the two groups, t (163) =1.705, p>0.05. This implies that the level of student's interest in learning agriculture in the two groups was equivalent before exposure to the treatment.

Posttest Results on Interest to Learn Agriculture

In order to determine the effect of CBT strategy on interest to learn agriculture, posttest scores obtained from ITA questionnaire were analysed. The mean score was then calculated. Figure 1 shows the posttest mean scores on interest to learn agriculture.

Table 3: Posttest Mean Scores on Interest to Learn Agriculture

Type of group	N	Mean	Standard Deviation
E1	82	4.44	0.48
C1	83	3.78	0.60
E2	81	4.20	0.61
C2	81	3.50	0.51
Total	327		

Results in Table 3, show that the mean scores for the experimental groups E1 and E2 were 4.44 and 4.2, respectively. Mean scores for control groups C1 and C2 were 3.78 and 3.50 respectively. To determine whether there was any significant difference on interest to learn agriculture among the four groups, ANOVA was run. Results of this analysis are presented in Table 4.

Table 4: Analysis of Variance (ANOVA) of the Posttest Mean Scores on Interest to Learn Agriculture

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	18.625	3	6.208	23.994	.000
Within Groups	83.573	323	.259		
Total	102.198	326			

Table 4 shows that there was a significant difference between the means F (3,323) =23.994, P<0.05, in favour of experimental groups. The results imply that there was a significant overall treatment effect. To investigate which groups differed, *post hoc* test of multiple comparison tests using *Bonferroni* test was used. *Bonferroni* test was preferred for this study because it controls for the overall rate, hence the observed significance level is adjusted for the fact that multiple comparisons are being made. Results of the analysis are shown in Table 5.

Table 5: Comparisons of Posttest Mean Scores on Interest to Learn Agriculture

(I) type of Group	(J) type of group	Mean Difference (I-J)	Std. Error	Sig.
E1	C1	.66015(*)	.07920	.000
	E2	.22655(*)	.07968	.029
	C2	.27064(*)	.07968	.005
C1	E1	-.66015(*)	.07920	.000
	E2	-.43361(*)	.07945	.000
	C2	-.38952(*)	.07945	.000
E2	E1	-.22655(*)	.07968	.029
	C1	.43361(*)	.07945	.000
	C2	-.32136(*)	.08925	.002
C2	E1	-.27064(*)	.07968	.005
	C1	.38952(*)	.07945	.000
	E2	-.32136(*)	.08925	.002

* The mean difference is significant at the .05 level.

Results in Table 5, show that the mean differences of group E1 versus C1, E1 versus C2 and E2 versus C2 were significant. This suggests that CBT strategy improved students' interest to learn agriculture. This led to the rejection of the null hypothesis ($H_0$1), which stated that there is no statistically significant difference in interest to learn agriculture between students exposed to CBT strategy and those exposed to CT strategy. According to Rieber (1999),

Computers make school curriculum more interesting. Students like to use computers and are more likely to develop positive attitude towards their learning and themselves when they use computers (Schacter, 1999).

Results from the present study are in line with Akudolu (1996), who reported that students of languages in Universities found computer assisted language learning interesting and stimulating. Similar findings were reported Nwanne and Agommuoh (2017) on the study of computer assisted instruction on students interest and achievement in Physics in Imo state, Nigeria. The study revealed that students taught physics with computer assisted instruction had a higher mean interest score than those taught using the lecture method. In addition, Singh (2008) reported a significance difference in interest in Mathematics between the experimental group and the control group in favour of the experimental group. The experimental group was exposed to computer assisted instruction while the control group was exposed to conventional teaching methods. Kadhiravan (2009) in the study of instructional media technology and services for special learners found that the adoption of any treatment as an instructional framework greatly improves students' academic interest.

CONCLUSION

Findings of the study demonstrated that CBT strategy enhances interest to learn agriculture better than the conventional teaching strategy. Therefore, students benefit more in terms of interest to learn agriculture when exposed to CBT strategy than the CT strategy.

RECOMMENDATION

Based on the findings of this study, it was recommended that agriculture teachers should embrace the use of CBT strategy as a way of motivating students to have interest in the subject especially in form one. This is necessary to ensure that students have interest in the subject by the time they are in form two. If interest of students to learn agriculture is enhanced, it may improve enrolment in agriculture at KCSE level.

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INFLUENCE OF TEACHER RECRUITMENT ON QUALITY EARLY CHILDHOOD DEVELOPMENT AND EDUCATION IN NYAMIRA-NORTH SUB-COUNTY, NYAMIRA COUNTY, KENYA

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ABSTRACT
The purpose of the study is to establish the influence of teacher recruitment on quality of Early Childhood Development and Education. The study adopted descriptive survey design. The study targeted 97 ECDE Centres. Simple random sampling technique was used to sample 49 ECDE Centres and 147 ECDE teachers. Purposive sampling technique was used to select 49 headteachers and one Sub-County Director was selected. Data was collected using questionnaire and interview guide. Piloting was done in Borabu Sub County whereby 30 ECDE teachers, 10 headteachers of ECDE Centres and one subcounty Director ECDE was involved. Expert judgement was sought to ensure content and face validity. Reliability of the instruments was estimated by use of Cronbach's Alpha Correlation Coefficient and obtained as 0.87 and 0.79 for headteachers questionnaire and teachers' questionnaires respectively. The hypothesis was tested at alpha $\alpha = 0.05$ using the Chi square model and simple linear regression. Data was analyzed by aid of Statistical Package for Social Sciences version 25.0. Qualitative data analysis from the interviews was categorized according to the themes based on research hypothesis. Descriptive statistics was presented using means, standard deviation, percentages and frequencies. The findings of the study revealed that the decentralized government function of recruitment has significant influence on the quality of ECDE in Nyamira South Subcounty of Nyamira County, Kenya. Recruitment of ECDE teachers significantly influenced quality of ECDE at 5 % significance level with chi square value $\chi^2 = 42.954$ and $P< 0.05$. Similarly, simple linear regression revealed that recruitment of ECDE teachers significantly influenced quality of ECDE at 5% with 61.4% variation. The study concluded that there was statistically significant influence of decentralized functions of recruitment. The study recommended that Nyamira county government should establish bills through the county assembly to ensure there is sufficient ECDE teachers to improve transition rate, participation rate and competence achievement among ECDE learners.
Keywords: Recruitment, Decentralization, Quality, Competence, Transition rate.

INTRODUCTION
Children under the age of eight are catered for Early Childhood Development and Education (ECDE), which is familiar internationally for crucial intervention in the life of a child. ECDE promotes the overall developmental milestones of a child which include: physical needs, cognitive, linguistic, social and emotional aimed at building a strong underpinning of the lifelong learning and well-being of all children, The teaching and learning experiences at the first level of schooling for children is central to growth and development and prepares children for higher levels of education which enhances realization of one's potential in life. Provision of high-quality ECDE promotes a vital factor aimed at every learner to thrive in learning.

According to the Oxford Advanced Learner's Dictionary (2010), defined quality as the ideal nature of a thing when it is linked to something of the same nature; how decent or indecent a thing may be. According to Nguluka (2007) the notion of quality extends to the attributes detected in something in comparison to others that might be understood as the extent to which the school characteristics are considered as the degree of goodness or value. A study conducted by Blatchford and Woodhead (2009), quality ECDE refers to the extent of the ideal that are seen at the various programs intended to enable children's growth, development and learning experiences. Moreover, the well-being of the programs in achieving goals. If quality education is provided in early childhood will support the success for further development and learning. According to the report alluded by World Bank (2006) on children receiving quality standards of ECDE are more likely to succeed in subsequent academic years than those who do not. From this observation, it was clear that quality ECDE was a concern of investigation for decentralization to provide appropriate functions that enhance quality education and care.

Early childhood is clearly described by UNESCO (2015) as a time between birth and age eight a remarkable period when the brain develops most rapidly. Furthermore, Sustainable Development Goals (SDGs) prioritize access to quality pre-primary care and education. Goal 4.2 states that by 2030 equal admittance to standardized quality pre-primary education will realized, paving the way for a brighter and more sustainable future for all. The concerns for quality ECDE education have been championed internationally. Importance for early years have perceived as the cornerstone of a person's life which was highlighted at World Conference of Education for All (EFA), which was

conducted in Jomtien Thailand in March 1990. EFA goal number one demands that the County Governments to be assigned the sole responsibility to expand and boost in-depth pre-school education programmes which are considered important for realization of Basic Education goals. Additionally, all children should acquire a decent flinch in life, according to the 2002 World Fit for Children Conference, which advocated for quality nurture, care, and self-environment.

In Kenya, quality of ECDE offered in decentralized government systems has puzzled many scholars like Piper, Merseth and Ngaruiya (2018) who carried out a study in seven counties and the participating Counties were; Laikipia, Nairobi, Siaya, Uasin Gishu, Embu, Marsabit and Mombasa. The study concluded that the delegation offers nations a special chance to enhance superior and fairness of ECDE provisions. Findings indicate necessity of devolution to raise financial resources for ECDE in order to guarantee that governmental schemes of building a successful and well-coordinated ECDE system. In 2016 and 2017, the study also reported that the decentralized governments temporarily appointed instructors, which led to a significant variation in the qualifications of the teachers and the pay compensated. This circumstance may cause teacher turnover owing to cross-county handovers to look for better compensation which may lead to inadequate teachers in the Counties that pay low salaries to ECDE teachers. The condition that may compromise quality ECDE services.

Purpose of the Study

The purpose of the study was to establish the Influence of Teacher Recruitment on Quality Early Childhood Development and Education in Nyamira-North Sub-County, Nyamira County, Kenya.

Research Objective

To determine the influence of teacher recruitment on quality Early Childhood Development and Education in public Centres in Nyamira-North Sub-County, Nyamira County.

Research Hypothesis

The hypothesis was tested at $\alpha = 0.05$ significant level

$H_0 1$: There is no statistical significant influence of teacher recruitment on quality Early Childhood Development and Education in public Centres in Nyamira-North Sub-County, Nyamira County.

The decision for rejecting or accepting null hypothesis was based on the reference to a p-value computed from Chi square analysis. Null hypothesis was to be rejected if p-value was less than $\alpha = 0.05$ level of significance; and accept null hypothesis if p-value equals or greater than $\alpha = 0.05$.

LITERATURE REVIEW

Recruitment largely is used in the context of employment. It has been utilized in a variety of work-related contexts. According to Heineman & Judge (2005) defined recruitment as the process of obtaining, deploying, and maintaining a workforce of sufficient size and capacity to produce favorable effects on the efficiency of the organization. Through postings, transfers, and the placement of institutional administrators involves the process of allocating teachers' tasks in locations where their services are needed.

In Norway, quality ECEC is determined by staff– child ratio as alluded by Løkken, Bjørnestad, Broekhuizen & Moser (2018), an investigation on how structural elements together with interaction elements of quality relate in Norwegian ECEC for preschoolers. 206 kindergarten classes were sampled to gathered data between 2013 and 2015. According to a two-way MANOVA, the teacher-to-learner ratio and interaction quality varied based on the various content dimensions, and organizational structures with small, stable groups were linked to better interaction quality. It was curious to establish the influence of decentralized function of teacher recruitment on quality ECDE in Kenyan context.

In Tanzania, teacher recruitment is an important element to enable quality ECDE as pointed out by Mabagala and Begi (2020), a study that examined the effects of various demographic variables, including gender, education level, and school type, on how satisfied parents were with the quality level of pre-primary education. The theory of ecological systems served as the study's foundation. The study was carried out using a descriptive survey research design with a sample size of 772 parents in pre-primary schools who were between the ages of 5 and 6. A questionnaire with a four-point Likert scale was used to collect the data required. The study concluded that parents were dissatisfied with the number of children in class which may lead to ineffective teacher performance in terms of lesson delivery

which may hinder achievement of competencies thus compromise the quality of ECDE. The current study employed a smaller sample size and more robust data analysis techniques to establish how recruitment predict quality of ECDE.

In Kenya, teacher recruitment has continued to affect quality ECDE as reported by scholars like Abuom, Gudo and Nyatuka (2018), a study on the status of quality ECDE teaching and learning in public preschools in four counties. These Counties include Kisumu, Siaya, Homabay and Migori. The study was influenced by Hawe and Stephen's (1990) Theory of Goals, Context, and Agency which states that quality is viewed through the lenses of effectiveness in achieving predetermined goals, relevance to human and environmental needs and conditions, pursuit of excellence and improvement of the human condition. Twelve representatives from the four counties and 27 sub county administrators were chosen using the census method. Information on the teacher to learner ratios was gathered using document analysis. To analyze qualitative data, thematic analysis was employed. The results showed that a high teacher-to-learner ratio at this level was detrimental to the quality of instruction. It was advised that the counties hire more teachers in order to raise the teacher to learner ratio to the desired levels set by international ideals which has been 1:20 since 1999. The current study sought to investigate whether Nyamira – North sub county has employed enough teachers to promote quality ECDE.

Similarly, a study conducted by Ratemo (2016) on the standard of instruction in public and private pre-primary schools in Nairobi City County, Kenya. Pre-primary schools in Nairobi City County comprised quality care and education among children. 280 head teachers and teachers in pre-primary schools were the intended target population. A sample size of 28 was randomly chosen. Descriptive survey was considered as the research design. A questionnaire for pre-primary teachers and interview schedules for head teachers were among the research tools used to collect data. The study employed both qualitative and quantitative methods to analyze data. Respondents were chosen using stratified random sampling and simple random sampling techniques to generate rich data that was inferred to all the private and public pre-primary schools in Nairobi City County, Kenya. According to the study by Ratemo (2016), staffing has an impact on educational quality. Comparing poorly staffed schools and pre-schools with adequate staffing, poor performance was found in the Centre with poorly staffed. The current study sought to determine the influence of decentralized recruitment on provision of quality ECDE in public ECDE Centres.

Quality ECDE can be promoted by ensuring and maintaining the appropriate teacher-pupil ratio as reported by Murithi (2016), a case study on Integration of the National Goals of Education in Early Childhood Development and Education in Kalundu Zone Kitui County, Kenya. A descriptive survey research design was used for the study. The intended respondents consisted of 158 respondents, including 130 early childhood educators and 28 head teachers. To choose the respondents, simple random sampling and purposeful sampling were both used. The sample size was 66 respondents, including 52 early childhood educators and 14 head teachers. The data was analyzed both quantitatively and qualitatively by the researcher. According to the study's findings, more teaching and learning resources would result in more successful ECDE. Besides, the study pointed out that teacher – pupil ratio is an important aspect to provide quality ECDE. The current study used slightly a larger sample size and seek to investigate decentralized teacher recruitment on provision of quality ECDE.

Quality of ECDE has been compromised by inadequate teachers in ECDE Centres as reported by Abuom (2019), a Comparative Study of Early Childhood Development and Education Implementation in Homa Bay, Kisumu, Migori, and Siaya Counties in Kenya. Descriptive survey research design was considered. The theory of goals, context, and agency from Hawes and Stephens (1990) and the socio-cultural and zone of proximal development theories from Vygotsky were adopted. The research study considered 27 sub county administrators and three officials in charge of ECDE from each of the four counties that made up the target population. The 27 sub county administrators and all 12 county officials were chosen using the census method. The findings showed that the counties' ECDE records were improperly maintained. In 2016, there were 33 to 101 students per class. Although the teacher to learner ratio was relatively higher, it was discovered that teachers had a good level of training but quality was compromised by higher teacher to learner ratio. The study reported that there were inadequate teaching materials and few teachers in ECDE sector. The current study sought to investigate the influence of recruitment of ECDE teachers on quality ECDE in Nyamira – North subcounty, Kenya.

Additionally, staffing has been a challenge that need to be given a priority in order to realize quality ECDE in the counties. A study was conducted by Mtana and Mange (2020) on the determinants that affect how early childhood education (ECE) is administered in Kilifi South Sub County. Descriptive study design was employed. All of the head teachers manning the 60 public ECE Centers in Kilifi South Sub County and the county education director ECE of

education made up the intended target population. 61 participants made up the study's sample size. The research study considered semi-structured questionnaires and an interview guide to be used in the study. The study revealed a strong correlation between staffing and the efficient management of ECE in Kilifi County. The current study sought to determine the influence of teacher recruitment on quality ECDE in Nyamira-North sub-county, Nyamira, Kenya.

Teacher recruitment with better pay promotes classroom performance as alluded by Gichuki (2015), a study on the effects of management on preschoolers' performance in Embu West, Embu County. The study adopted descriptive survey design where 11 headteachers 11 Early Childhood Development Education teachers and 160 children participated as the main respondents. The study pointed out that Early Childhood Development Education teachers view their position as a temporary stopgap measure to buy them time to look for better employment elsewhere. The study recommended that the public Early Childhood Development Education Centres employer to improve the salary of the teachers. The consideration of job as temporal has quality implication and hence proper scrutiny into the existing conditions to establish the status. The current study sought to examine if Nyamira-North sub county, Nyamira county, Kenya is likely to face similar shortcomings that was found in Embu County, Kenya.

Research Design

The study used descriptive survey research design to determine the effectiveness of ECDE for students in pre-primary schools. The descriptive design of the study was chosen because it allowed the researcher to gather comprehensive data on the population under study. The design made it possible for the researcher to use a large sample size, and it was effective for generalizing the findings.

Population and sample

The study population consisted of 97 headteachers of public ECDE Centres, 292 ECDE teachers in entire ECDE Centres in Nyamira-North sub county and one Sub County Dirctor ECDE making a total of 390, according to Nyamira North Sub-County office 2021. The ECDE Centres selected was 50% of 97 which was 49. The researcher adopted simple random sampling technique to select the ECDE Centres. The census method of sampling was used to select ECDE teachers which formed a sample size of 147. The headteachers from the Centres that were randomly selected were picked to form a sample size of 49. The Sub County Director of ECDE was a respondent of the study.

Data Analysis

The researcher double-checked the data collected to ensure that the questionnaires were correctly filled. The items were analyzed by the help of Statistical Package for the Social Sciences (SPSS) software version 26.0. Inferential statistics used to test hypothesis was Chi square model and verbatim was considered based on research objective to guide qualitative data analysis were discussed.

RESULTS AND DISCUSSION

The study sought to establish the influence of decentralized teacher recruitment on quality Early Childhood Development and Education in public Centres in Nyamira-North Sub-County, Nyamira County. The researcher summarized the descriptive statistic on the opinions of teachers and Headteachers. The study established the opinion of ECDE teachers and that of the headteachers on whether the decentralized function of recruitment of Early Childhood teachers have influence on quality ECDE. The responses are as shown in Table 1.

The Table 1 shows that, ECDE teachers and the headteachers agreed that the county government teachers are recruited on merit which has promoted the provision of quality ECDE (Mean=3.65, Mean = 3.65 respectively). The respondents agreed that the county government teachers are knowledgeable on preparing professional documents which has contributed to quality ECDE (Mean=4.16, Mean = 3.96 respectively). The respondents agreed that the county government teachers are able to improve learners' smooth transition rate which has improved quality ECDE (Mean=4.10, Mean = 3.90 respectively). The respondents agreed that the county government teachers are qualified to equip learners to achieve competencies that has greatly improved quality ECDE (Mean=4.05, Mean = 3.73 respectively). The respondents agreed that the county government teachers do not look for transfers for better pay which has improved quality ECDE (Mean=3.55, Mean = 3.48 respectively). The respondents were undecided that the county government teachers are adequate to improve learners' participation which has improved quality ECDE (Mean=3.23, Mean = 3.06 respectively). The respondents disagreed that the County government teachers are motivated to provide quality ECDE (Mean=1.86, Mean = 2.22 respectively).

Table 1: Opinion on Recruitment of ECDE teachers and quality ECDE

Statements	**Teachers**			**Headteachers**		
	N	Mean	Std.Dev	N	Mean	Std.Dev
County government teachers are recruited on merit which has promoted the provision of quality ECDE.	147	3.65	1.24	49	3.65	1.11
County government teachers are knowledgeable on preparing professional documents which has contributed to quality ECDE	147	4.16	3.36	49	3.96	0.68
County government teachers are able to improve learners' smooth transition rate which has improved quality ECDE.	147	4.10	0.70	49	3.90	0.80
County government teachers are qualified to equip learners to achieve competencies that has greatly improved quality ECDE.	147	4.05	0.70	49	3.73	0.76
County government teachers do not look for transfers for better pay which has improved quality ECDE.	147	3.55	1.12	49	3.48	1.20
County government teachers are adequate to improve learners' participation which has improved quality ECDE	147	3.23	1.14	49	3.06	1.27
County government teachers are motivated to provide quality ECDE	147	1.86	0.95	49	2.22	1.25
Mean		3.51			3.43	

The researcher established that for the entire construct on the decentralized function of recruitment, both teachers and the Headteachers felt that the county government had input toward quality ECDE. The findings of the study reveal the essential and critical role of recruitment of ECDE teachers towards the quality of education in ECDE centers. The general observation from the items in the recruitment of ECDE teachers construct was that teachers were recruited on merit hence they were trained on the roles of ECDE teachers. The findings concur with Ratemo (2016) who concluded that school staffing has an impact on educational quality and schools that are poorly staffed record poor performance

The researcher sought to collaborate the descriptive statistics with chi square analysis to determine whether there is association between ECDE Teachers Recruitment and quality of ECDE. The mean score values obtained for the questions seeking for the quality of ECDE and recruitment of ECDE teachers was recoded into categorical variable and the cross tabulation computed to estimate the association. The results obtained are presented in Table 2.

Table 2: Chi-Square Tests

	Value	**Df**	**Asymp. Sig. (2-sided)**
Pearson Chi-Square	42.954[a]	6	.000
Likelihood Ratio	45.131	6	.000
Linear-by-Linear Association	6.443	1	.011
N of Valid Cases	147		

The Table 2 shows the chi square statistics used to examine the association between the recoded categorical variables; quality of ECDE and the recruitment of ECDE teachers by the county government of the Nyamira County. There is significant association at 5 % significance level between the variable quality of ECDE and the recruitment of ECDE teachers by the county government by the teachers' respondents (χ^2 = 42.954, df = 6, p = 0.00). hence the null hypothesis that stated; there was no statistical significant influence of decentralized function of recruitment on the quality ECDE in Nyamira-North sub county, Nyamira County, Kenya was rejected in favour of the alternative hypothesis that there was statistically significant influence of decentralized function of recruitment on the quality ECDE in Nyamira-North sub county, Nyamira County, Kenya.

To further verify the descriptive statistics, the researcher tested the first objective of the study that stated that there is no statistical significant influence of decentralized teacher recruitment on quality Early Childhood Development and Education in public Centres in Nyamira-North Sub-County, Nyamira County. The researcher sought to establish whether the decentralized government function of recruitment influenced quality ECDE from the ECDE teacher's responses. The hypothesis was tested using linear regression at 0.05 significance level. The model summary for decentralized government function of recruitment regressed against quality ECDE is illustrated in Table 3

Table 17: Model Summary

Model	R	R-square	Adjusted R-Square	Std error of the estimate
1	0.784[a]	0.614	0.606	0.60773

Predictor (constant). Decentralized Function of Recruitment of ECDE teachers

From Table 3, R was obtained as 0.784 implying that there was high correlation between recruitment of ECDE teachers and the Quality of education offered to the ECDE learners. A beyond 0.5 in the model indicates that there is high level of correlation between the two variables. R square is the coefficient of determination of the proportion of variance in the dependent variable that can be explained by the independent variable of decentralized function of recruitment which is 0.614. This implies that 61.4% of variation of quality ECDE is explained by decentralized function of recruitment. The Estimates Model of Coefficients are illustrated in Table 4.

Table 18: Estimates Model of Coefficients

	Unstandardized coefficients		Standardized coefficients		
	B	Std error	Beta	T	Sig
1 (Constant)	1.048	0.326		3.213	0.002
Decentralized Function of Recruitment	0.864	0.102	0.784	8.462	0.000

Dependent Variable: Quality ECDE.

The general form of the equation from the above coefficient table to predict is:
$Y= a+bx$

Where,
Y = Quality ECDE
X = Decentralized Function of Recruitment
1.048 = is the constant
0.864 = unstandardized coefficient B
$Y =1.048+ 0.864X$

This shows how much quality ECDE varies with the recruitment. In this case the unstandardized coefficient B for the recruitment is 0.864. This implies that an increase in one unit of decentralized function of recruitment leads to 0.864 increase in the quality ECDE. This similarly means 10% increase in decentralized function of recruitment leads to 8.64% increase in quality ECDE.

The P- value was 0.00 which is less than 0.05 while the t value was 8.462 greater than 2.00. Since the P -value is < 0.05 and t is > 2.00, the null hypotheses was rejected at 95% level of confidence (α=0.05). The researcher concluded that there was statistically significant influence of decentralized function of recruitment on the quality ECDE in Nyamira-North sub county, Nyamira County, Kenya.

The researcher concluded that there was statistically significant influence of decentralized function of recruitment on the quality ECDE in Nyamira-North sub county, Nyamira County, Kenya. The findings collaborate with Abuom (2019) a Comparative Study of Implementation of Early Childhood Development and Education in Homa Bay, Kisumu, Migori and Siaya Counties in Kenya. The study established that teachers had good training but there was higher teacher - learner ratio and inadequate teaching and learning materials which compromised quality care and education in Early Childhood Development and Education Centres.

Further the study is collaborated with a study conducted by Mabagala and Begi (2020) in Tanzania which asserts that, parents were dissatisfied with the number of children in class which may lead to ineffective teacher performance in

terms of lesson delivery which may hinder achievement of competencies thus compromise the quality of care and education in the ECDE sector. This shows that for quality care and education to be realized the county government need to recruit more teachers to cater the ECDE Centres' population.

Thematic Analysis of Qualitative Data

The researcher sought to know the view of sub county director if the county government has recruited enough Early Childhood Development Education teachers in Nyamira-North Sub-County on provision of quality in terms of high participation rate, attendance and achievement of competences.

Excerpt 1

Researcher: The researcher sought to know if the county government had recruited enough Early Childhood Development Education teachers in Nyamira-North Sub-County. The Sub County Director had to say;

Respondent 1: *The county government has made remarkable progress in recruiting ECDE teachers in pre-primary Centres. However, the county government has not achieved the recommended child-teacher ratio. Most ECDE Centres have three teachers who are employed on contract terms but some ECDE centres do not have adequate teachers. Teachers are handling the children in the various centres as the county devise ways of recruiting enough teachers to cater for child-teacher ratio.*

Researcher: The researcher sought to know if the number of teachers recruited in the Sub-County affect the quality ECDE in terms of; participation rate, transition rate and competences achievement. The Sub County Director had to say;

Respondent 1: *There are limited resources to employ adequate ECDE teachers a situation that can demotivate ECDE teachers to ensure children are achieving relevant competences, attendance and participation rate may be affected. The county government is ensuring to recruit more ECDE teachers so that they will promote quality ECDE in the Centres.*

From the interview above, the study findings concur with the study conducted by Abuom, Gudo and Nyatuka (2018), a study on the status of quality of ECDE teaching and learning in public preschools in four counties. These Counties include Kisumu, Siaya, Homabay and Migori. the study found the high teacher to learner ratio at this level was compromising the quality of instruction. It was advised that the counties hire more teachers in order to raise the teacher to learner ratio to the desired levels set by international standards which has been 1:20 since 1999.

CONCLUSION

The study concluded that there was an influence of the decentralized function of recruitment on quality ECDE. This could be attributed by recruitment done to all pre-primary schools and continued support of ECDE teachers. Moreover, the break from earlier system of recruitment and payment of ECDE teachers by the parents before decentralized government. Decentralized government helped the ECDE teachers to have a stable jobs and job security to enhance quality services.

RECOMMENDATIONS

The recommendation was made based on the study findings and conclusions that Nyamira county government should consider having motivational system through scheme of service for all ECDE teachers who are currently working under the county government.

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INFLUENCE OF EXCURSIONS APPROACH ON LEARNER PARTICIPATION IN ENVIRONMENTAL CONSERVATION ACTIVITIES AMONG PRE-PRIMARY LEARNERS IN KAITI CONSTITUENCY, MAKUENI COUNTY, KENYA

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ABSTRACT
Learner participation in environmental conservation activities is key in ensuring learners gain skills of conserving the environment during their pre-primary years. In ensuring that learners participate in environmental conservation activities, teachers are expected to use instructional approaches that promote active participation of learners. The objective of the study was to examine the influence of excursions approach on learner participation in environmental conservation activities. Descriptive survey research design was used. The population of the study comprised of 119 headteachers, all the parents of pre-primary children and 238 pre-primary school teachers in Kaiti constituency. The sample unit was 65 headteachers, 30 parents of pre-primary children and 131 pre-primary teachers of the public pre-primary schools in Kaiti constituency. Data was collected using two research instruments which included questionnaires for pre-primary teachers and the headteachers and interview guides for parents. Qualitative data was analyzed thematically based on the research objective. Quantitative data was coded and analyzed using the Statistical Package for Social Sciences version 25.0. The study hypothesis was tested at 0.05 level of significance using Chi-Square. The findings of the study demonstrated that excursions approach had significant influence on learner participation in environmental conservation activities. The findings of the study may benefit teachers, curriculum developers and policy makers in ensuring that pre-primary learners are taught using instructional approaches that promote learners' participation in environmental conservation activities. The study recommends that the use of excursions approach should be promoted since it improves learner participation.
Keywords: Excursions approach, learner participation, environmental conservation activities, instructional approach

INTRODUCTION

Environmental education for ECDE learners includes methods, tools and plans that facilitate the development and sustenance of environmentally associated boldness, principles, consciousness, knowledge and skills which makes individuals take actions that promote environmental conservation. A successfully implemented environmental education is an inclusive course to help individuals understand their environment better, their position the environment, environmental hitches and interrelated issues (Talero, 2004). Educationalists are convinced that research on learners understanding of various aspects of environmental matters will be a treasure to instructors so as to facilitate their teaching by considering research findings on issues pertaining learner participation in environmental conservation activities. It may therefore require an exhaustive assessment of the progression curricular of any environmental education program. When the curriculum for developed nations is assessed, it is evident that environmental conservation concepts are included in the contexts of learning. However, for the underdeveloped and the developing nations, the same cannot be replicated.

At the pre-primary level, learners are curious and have interest in environmental conservation activities. Pre-primary learners get fun in exploring and experimenting in the environment. Studies by Shapiro and Pilsitz, (2005) cite that pre-school learners have a solid sense of natural and environmental consciousness established, but they later drop as a result of influence by instructional approaches used. It is therefore necessary to use instructional approaches that provide opportunities to learners to engage in activities during their formative years. This will in turn promote the child's knowledge about the environment and ways of conserving it. Learners will in turn participate in environmental conservation activities. A study by Harlan and Rivkin, (2008) revealed that in early childhood environmental education involves the growth of a sense of curiosity in learners, gratitude for the aesthetics and exploration of the natural flora and fauna. Environmental education gives opportunity to learners to experience the familiarity to nature and respect for creatures in their environment. Environmental education also involves the development of problem-solving skills, interest and appreciation of our immediate environment. Early childhood and education teachers should avail the opportunities for learners to experience joy and excitement with the natural environment since these feelings brace up the development of knowledge, skills and dispositions (Gardner, 1999). This is achieved when teachers vary the teacher-centered and learner centered instructional approaches used. Hence, to promote environmental attitudes in learners during the early years of life, environmental education should be considered as of significant importance.

Though there is increased public awareness on environmental conservation issues, inadequate environmental understanding can be a great hindrance towards achieving sustainable future for mankind at both international and local levels (Carnvale & Schulz, 2000). There is need for proper education and awareness campaigns on the importance of environmental health which is in the enhancement of the conservation and appropriate use of environmental resources for purposes of a sustainable future. Environmental Education (EE) incorporates a designed and strategic process seeking the development and execution of an environmental curriculum at all levels of the educational structure. The imperative requirement to edify people on protection and sustainable uses of environmental resources through environmental education is a global necessity.

Learner participation in early learning and childcare settings is core to a good education for children (Mannion, 2012). Learner participation means that the education provided to learners is of relevance, value and supportive of achievement and attainment. Teachers are particularly positioned to promote learner participation through use of child-friendly approaches. Participation is inclusive, respectful and involves transparency and power sharing. To achieve participation among learners, the teaching and learning arena must engage learners in classrooms, play rooms, sports, science laboratories and other learning spaces (Roninson, 2014). Through participation, learners exercise a key role in actively supporting learner participation. In ECDE, learners' participation in activities has raised concern and discussion whereby, there has been problems of deficiency in involvement of learners in experiences in the education settings (Bae, 2009; Emilson & Folkesson, 2006). A survey study conducted in Helsinki, (2010) focusing on instructors' perception and the conceptions of children's participation in ordinary educational practices revealed that children's opportunities to make autonomous initiatives and selections were considered as a right and an element of learning and developing participation skills among the children. Findings revealed that children had weak probabilities of participating in pedagogical processes. The less participation was connected to both school issues such as procedures, instructional approaches used and beliefs about children's competences.

In the United States of America, the United Kingdom, Australia, Germany, Mexico, India and Taiwan, there are some critical issues that face learner participation during the teaching of environmental conservation activities. Use of inappropriate teaching methods in teaching environmental activities is one of the issues. In early childhood, environmental conservation instruction is planned and executed using reputable developmentally apt practices. According to Oltman, (2002) matching the learning environment, curriculum and instructional procedures to the developmental stages of children promotes developmentally appropriate practice and education of learners. This will in turn help in promoting active learner involvement in activities. Lotz, (2015) conducted a study with first grade learners in Germany during individualized instruction. The study reported that the interactions between teachers and pupils were rather superficial and did not deal with the learning content in depth.

Curriculum modifications in Sub-saharan Africa have concentrated on revolutionizing instructional approaches in classroom, moving from instructor governed class to more effective models of learning in order to allow learners to be part of the learning experience (World Bank, 2008). The reforms are geared towards improving learner participation in activities. Studies by Melber, (2000) and Anderson, (2008) which focused on strategies on how to help teachers to prepare a learning environment that allows learning in a meaningful way by actively involving the learners. This is supported by Falk and Dierking, (2001) who believe that learning should take place in the context of authentic tasks and such environments should present opportunities for learners to visualize and concretize concepts introduced in class. The findings of the study reported that learners who experience opportunities during learning remember abstract concepts and displays with real activities.

Furu and Kaihovirta, (2020) as well as Furu, (2019) document that learners should be given chances to create meaning of their personal experiences during teaching and learning process. This is achieved through activities such as engaging learners in hands-on experiences and observation activities. Taylor, (2017) and Wals, (2017) indicate that a change is required in terms of promoting an understanding of individuals as part of nature who are proficient in caring and supporting the network of life. In this sense, Beery et al. (2020) document that nature contact is a central component of the teaching and learning process. Pre-primary school teachers need to expose learners to activities that promote learning through interaction with their environment such as through excursions.

Learner participation is considered to be vital in education systems that encourage democracy as a pedagogical right (Bernstein, 2000). Learner involvement is considered as part of instructional processes in early childhood education in the policy papers in the Republic of Finland. For instance, the main program for pre-school education in Finland, (2016) recognizes learner involvement as a part of their learning through taking part in preparation and assessment of

instructive activities. The program takes into consideration the children's initiatives and actions when planning and developing instructional practices. Instructors are encouraged to ensure that they back-up and lead learners in becoming aware of their own learning through ensuring use of instructional approaches that promote active learner participation in activities. Environmental conservation activities include children participation to ensure that the environment is being used in a way that is safe, sustainable and problem-free. Learners carry out activities such as proper waste disposal, litter picking and classroom cleaning. Silo (2009) conducted a study in Botswana on learner participation in waste management among primary learners. The instruments for the study were observation schedules, focus group discussions and participatory approaches. The respondents were teachers, grade six learners and school cleaners. The results of the study revealed that learners participated in school waste management activities such as litter picking and classroom cleaning. This promoted their participation in environmental conservation activities.

Excursions approach refer to an instructional method in which children visit places of learning where they interact with individuals, things around their environment and get first-hand information about things within their vicinity (Nasibi, 2003). An excursion is a journey, trip or tour planned for learners to get first-hand information. Through excursions, learners are involved in listening to sounds in the environment, interviewing people, observing people in action or examining real things like tools and reports. According to Sullenger, (2006), any form of instruction that is conducted outside the formal classroom setting in a school which involves gaining knowledge by interacting with living and non-living objects constitute an excursion. Experience is a powerful source of knowledge. Webb, (2006) emphasizes natural learning environments where children have the chance to encounter factual occurrences and phenomena from outside the classroom. Excursions are inclusive in that all learners are given an opportunity to participate unless exceptional circumstances exist. Checep, (2008) also supports that excursions approach is a way of presentation by taking the students to study outside the environment of class. Field excursions using the environment as a learning resource, stimulates the creativity of the students, information can be more comprehensive and real time, students can seek and process. Field excursions have several advantages based on Bahri, (2006) which are: field excursions have modern teaching principles that utilize the real environment in teaching, excursions make the lessons in school more relevant to the reality and the needs of the community, stimulates the creativity of learners and the information used in teaching is wider and more actual.

Brooks and Brooks (2001) comment that learners' exploration of their world should be promoted during activities as these fosters critical thinking in learners concerning the content of the lesson in relation to what they had learnt earlier learnt by being actively engaged. The findings of the study emphasized on interactive learning such as engaging learners in nature walks, field trips and visits to the environment for purposes of learning. Interactive learning promotes learner participation. Dowda et al, (2004) added that learners could never be coerced into a passive rote-education structure. The study emphasized on the importance of availing to children the opportunities to explore and consider discussing things instead of simply delivering knowledge. Nikolaeva, (2008) observation has in common with other social constructivists that learners are active participants in the environment, and both ideas agree that interaction is a powerful means of learning. The study documents two main reasons for preferring practices that enable learners to engage in investigation and intervention. First reason is that direct investigation is essential because it leads to children's successful constructivism, whereas social engagement allows for a diversity of cultural ideas to be learned. Combining vision, comprehension, actual events, and then determining if the results are better or worse than expected permits the learner to become proficient in perception and evaluation.

Fieldtrips and nature walks are important aspects of excursions. Noel, (2007) on a study of elements of winning a field trip notes that over 82% of students described an advantage of an interactive learning environment as a way to get out of the classroom and break from daily routine of school which tends to add interest in learning. Activities that combine academic study, problem-solving, and practical on-spot observation have been found to improve student skills and self-views while bolstering lasting connections in learning the value of land and ecosystems. Asah and Blahna, (2013) conducted a study on the use of excursion activities and its effect on learning. The observations were that students needed social interaction and need to feel free about themselves. During the early childhood years, any outdoor encounter with nature should be full of fun and give learners the feeling that they are part of something altruistic and bigger than themselves. The findings confirmed that excursions approach to learning had positive effects in improving participation in learners through reducing stress, increasing health and focus in activities. In another study by Owen, (2016) on nature walks-based instruction, nature walks which are part of excursions were considered viable alternative to classroom-based instruction for any topic that referenced the natural environment such as environmental conservation activities. The findings confirmed that nature walks promoted active participation among students.

Learners desire to have curriculum and materials that were designed to be flexible and adaptable to allow them take field excursions for their students (Nespor, 2000). A study by Wilson (2002) found out that the environment forms human history and that opportunities for community engagement in school activities were vital to learning. The studies show most of the work done centered on general teaching methods without specifically showing how field excursions method is used in environmental activities. King and Ginns, (2015) conducted a study on the effects of using field excursions among learners. The results of the study indicated that field excursion activities promoted learner participation through engaging in scientific concepts such as questioning, discovering and engaging with real life phenomena. Pink and Morgan, (2014) highlighted that student participatory processes increase when learners are engaged in excursion activities. Pink and Morgan explain that students learn through direct observation and tactile interaction with phenomena. This makes remembering of concepts easier for the learners.

Purpose of the Study

The study examined the influence of excursions approach on learners' participation in environmental conservation activities among pre-primary learners in Kaiti constituency, Makueni County, Kenya. The study was seeking to establish the influence of excursions approach on learner participation in environmental conservation activities.

Research Hypothesis

The study was guided by the following null hypothesis at $\alpha = 0.05$ significance level:

$H_0 1$: There is no statistically significant influence of use of excursions method on learner participation in environmental conservation activities among pre-primary learners in Kaiti constituency.

Research Design

This study adopted descriptive survey design that was deemed appropriate for this study since it pursues to establish the influence of excursions approach on learner participation in environmental conservation activities.

Target Population

The study targeted 119 headteachers of public pre-primary schools, the parents of pre-primary school children and 238 pre-primary teachers in Kaiti Constituency. Headteachers were selected because they are the policy implementers. Teachers were selected because they are the implementers of curriculum in the classroom. Parents were selected because Competency Based Curriculum outlines parental engagement as a pertinent and contemporary issue. Parents monitor and assist learners in carrying out environmental conservation activities at home and school.

Sampling Procedure

The study used simple random sampling technique which gives each member of the target population an equal chance of being selected to select 65 schools out of 119 schools in Kaiti Constituency. The headteachers of the randomly selected schools were respondents to the instruments of the study. With a total population of 357, the researcher used the sample size determination table by Krejcie and Morgan (1970) to select a sample at 95% confidence level which gave 196 respondents. The 196 respondents comprised of teachers and headteachers. Based on proportionate sampling, the researcher selected 65 headteachers and used simple random sampling technique to sample 131 pre-primary teachers. Since the study sought to conduct interviews with the parents of pre-primary school children, the researcher used convenience sampling technique to sample 30 parents of pre-primary children based on availability of the parents.

FINDINGS AND DISCUSSION

The researcher sought to establish the extent of adoption of excursions approach in environmental conservation activities. The results were as shown in Table 1.

Table 1: Extent of Adoption of Excursions Approach (%)

Statement	Not At all	Once in two weeks	Once a week	Twice a week	More than twice a week	Total
Visits to the school farm	-	3.1	5.6	26.0	65.3	100.0
Nature walks	-	-	8.7	52.6	38.8	100.0
Field trips	-	39.3	50.0	8.2	2.6	100.0
Visit to various sites including a dumping site, a nearby river	1.5	5.6	14.8	69.9	8.2	100.0

The findings obtained showed that almost all of the respondents (91.3%) engaged learners in visits to the school farm more than twice a week. A slightly higher percentage (91.4 %) engaged learners in nature walks twice a week. According to Owen, (2016), nature walks which are part of excursions are considered viable alternative to classroom-based instruction for any topic that references the natural environment such as environmental conservation activities. Findings illustrated that a very low number of respondents (10.8%) engaged learners in field trips. Low use of fieldtrips could be due to challenges of logistical planning of transport for learners, safety issues time lost trying to organize large groups as identified by (Hundak, 2003). More than three quarters (78.1%) engaged them in visit to various sites including a dumping site, a nearby river. School visits to protected areas provide opportunities for conducting practical activities which according to Andrade and Massabni, (2011) promote direct experience with physically present material, natural environment and social world. On average, more than a half of the respondents (67.9%) acknowledged adopting excursions approach in teaching environmental conservation activities. The respondents who reported to engage learners in excursion activities twice a week and more than twice a week were considered to be high extents of adoption of excursions approach while those that engaged learners in excursion activities once a week, once in two weeks and not at all were considered to be low extents of adoption of excursions approach.

To gain more understanding of the influence of excursions approach on learner participation in environmental conservation activities parents of pre-primary children gave responses which also indicated that pre-primary learners engage in excursion activities which promote environmental conservation activities. Responses given by some respondents were as follows:

Respondent 9 reported:

"*The teacher always informs us about upcoming trips and the requirements. I always pay money for trips. There was a time the children visited an animal farm in Isinya. After the trip, my child is always excited about animals we keep at home and always wants to feed them. I have even bought a rabbit for them. They usually collect leaves and weeds from the shamba to feed the rabbit every day."*

To add on that, Respondent 11 supported by reporting that**:**

"My child informs me about the occurrences at school. There was a day she told me that they had a walk to a forest near the school where they observed different trees and plants. Upon consulting with their teacher, she informed me that the learners usually have nature walks frequently to learn about their environment and how to take care of it."

Further, Respondent 15 said**:**

"When I plan on going to the shamba, my child always follows me to the farm. They help me in weeding and watering. They ask a lot of questions when we are in the shamba. One day she came home from school very excited and when I enquired from her about the excitement, she informed me that they went to the school farm and irrigated on the plants. My child always follows me to the shamba and tells me stories about the farm at school."

The responses obtained revealed that pre-primary learners participate in excursion activities such as nature walks, field trips and visits to various sites. The excursion activities that learners engage in influences their participation in environmental conservation activities positively. The responses from parents of pre-primary learners match the findings of Asah and Blahna, (2013) which confirmed that use of excursions approach has positive effects in improving participation of learners in learning activities through reducing stress, increasing health and focus in activities. The findings are also supported by the findings of Owen, (2016) that nature walks promote active participation in learning activities among learners. Data was further analyzed using inferential statistics (Chi-Square). The Chi-Square results in Table 2 provides the interpretation of this results.

Table 2: Chi-Square Results on the Influence of Excursions Approach

	Value	**Df**	**Sig**	**CC**
Pearson Chi-Square	7.976[a]	1	.004	0.198
Continuity Correction[b]	7.089	1		
Likelihood Ratio	7.936	1		
Fisher's Exact Test				
Linear-by-Linear Association	7.935	1		
N of Valid Cases	195			

Chi-Square results $X^2(1) = 7.976$, $p<0.05$ indicated as a significance influence of excursions approach on learner participation in in environmental conservation actions. Contingency Coefficient measure of association (CC) illustrated a 19.8% variation of learner participation due to excursion approach. Findings imply that use of excursion approach significantly influences learner participation in environmental conservation activities. Therefore, the null hypothesis $H_0 2$ which stated that there is no statistically significant influence of use of excursions method on learner participation in environmental conservation activities among pre-primary children in Kaiti constituency was rejected in favour of the alternative hypothesis. Learner participation in environmental conservation improved by 19.8% when excursions approach is used during the teaching and learning of environmental conservation among pre-primary learners. The results concur with findings of Asah and Blahna, (2013) which confirmed that excursions approach has positive effects in improving participation of learners in learning activities through reducing stress, increasing health and focus in activities. The findings are also matching with findings of Owen, (2016) that nature walks promote active participation among learners.

CONCLUSION

Findings revealed that a great percentage of respondents used excursions during environmental conservation activities. The parents were also involved in excursions by financing the learners for field trips, visiting the home garden with their children and keeping in touch with the teachers concerning the excursion activities organized at school. Learners participated in nature walks, visits to the school farm, visits to various sites and field trips. The study concluded that use of excursions approach highly influenced learner participation in environmental conservation activities.

RECOMMENDATIONS

The study recommends that:

i. Teachers who use excursions approach in low rates to improve its use as this approach increase learners' participation in environmental conservation activities.
ii. Headteachers should encourage the use of excursions approach in instruction of pre-school learners so as to improve learner participation in environmental conservation activities.
iii. Parents should cooperate with teachers in promoting excursion activities that promote learner participation in environmental conservation activities.

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SELF-ESTEEM AND ADJUSTMENT TO RETIREMENT AMONG RETIREE TEACHERS IN MERU COUNTY, KENYA

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ABSTRACT
Retirement poses psychological problem for many retirees. There is an increase in the number of retired teachers in Meru County in Kenya because majority of the pioneer teachers in Meru County have begun retiring since independence. It was necessary to establish the relationship between self-esteem and adjustment to retirement. The researcher established a relationship between self-esteem and adjustment to retirement among retiree teachers in Meru County. The study adopted descriptive survey research design. The study sampled 318 respondents from a population of 1800 comprising of 600 retirees, 600 spouses of retirees and 600 close relatives of the retiree teachers. A sample of 318 respondents was selected to participate in the study. Data was collected from retiree teachers and their spouses through questionnaires. Interview schedules were used to collect data from retiree teacher close relative. Quantitative data was analyzed with the help of Statistical Package for Social Science (SPSS) version 23. Descriptive statistics included frequencies, percentages, standard deviation and mean. Inferential statistics used was Wilcoxon signed rank test. Qualitative data collected was analyzed by classifying the responses into meaningful categories thematically. The findings of this study revealed that there is a significant relationship self-esteem and adjustment to retirement. The study recommends that Teacher Service Commission to organize pre-retirement training and counseling to prepare teachers to handle challenges that may affect their self-esteem in retirement.
Keywords: Retirement, Retiree, self-esteem, adjustment

INTRODUCTION

Retirement is gradually becoming a topic of research in contemporary society. This is because it is one of the challenges associated with aging. Growing old is not easy and involves life changes which demand multiple adjustments requiring stamina, ability and flexibility. The loss of work through retirement is one of the major adjustments for aging individual (Eliopoulos, 2010). Retirement therefore, it is a major stage in adult development and it essentially marks the split from middle years to old age. By the time one gets to retirement mental and physical exuberance has dwindled thus it becomes rational to relieve the person of some strenuous and excruciating duties that may weigh them down and consequently threaten their health.

Retirement can mean different things to different people. For some, retirement may mean reducing the amount of work hours per week from full-time to part time status, while for others it may mean working on a voluntary basis (Marshall, 2004). To others it can mean partial or complete withdrawal from career work accompanied by change in the source and decrease in income. According to Peeters, Van, Anne, Goldberg, Shore and Lipka, (2008) retirement is a complex social phenomenon that signifies the detachment from customary activities in business, industry, or active services as full-time employee. Hartman (2014) asserts that retirement is important because it reduces the stress level of employees and gives retirees the time to rest, exercise and lead a healthier life in general. The assertion is supported by (Marshall, 2004) who states that retirees have ample time to interact with family members, friends and engage in community activities. Contrary to assertions by Hartman (2014) and Marshall (2004), Drummond (2003) asserts that retirement affects income and employment status leading to reduced self-esteem among some retirees.

According to Longino (2009), retirees go through six phases. The first phase is the pre-retirement phase when the employee is preparing to retire. Then there is the actual retirement date when the employees leave the organization and get farewell messages or even a farewell party. After the farewell, the next phase is the honeymoon phase where the retiree feels that they are now free to do all that they dreamt of doing during their working period. Once the honeymoon phase is over the retiree now faces the reality of retirement at the disenchantment phase. If the disenchantment phase is not properly managed retirees develop Psychological problems one of them being complications with self-esteem (Longino, 2009). Many people who have been looking forward to retirement for a long time, when many retirees reach this phase they must deal with the feelings of being let down. They realize that retirement is not a permanent vocation after all, and that retirement brings along the feelings of loneliness, boredom, feelings of uselessness and disillusionment.

Self-esteem refers to how a person feels about them self. It is how people view themselves positively or negatively. It can also refer to the overall attitude towards oneself. Individuals with high self-esteem respect view themselves as useful individuals. Self-esteem is affected by three qualities of the worker's job: autonomy, power, and opportunities for socialization (Neff, 2009). Some of the factors that have been found to impact self-esteem are: education, income, and heath and employment status especially as people aged. People who have higher incomes and better health in later life tend to maintain their self-esteem as they age. This could be associated to the fact that it is possible that wealth and health are related to feeling more independent and better able to contribute to one's family and society which in turn boosts self-esteem.

Self-esteem was also found to be positively associated with financial satisfaction, optimism about the financial future, and future expectations of improvement in their financial situation Hira and Mugenda (1998). All these factors are often affected by retirement. High self-esteem is considered important because it is associated with higher levels of psychological health and functioning, and low levels of self-esteem are undesirable because it is associated with lower levels of psychological health and functioning (Glaus, 1999). A strong sense of self-esteem is needed among elderly population to whom every day is a struggle. The elderly population is suffering from decreased mobility, disabilities, and failing health can certainly affect one's sense of self-esteem.

Many people invest a lot in their time in careers and neglect other areas of their lives. These people suddenly feel emptiness and despair when they retire. People whose sense of self-esteem and worth is dependent on the work they do are particularly at risk of developing low self-esteem after retirement Peeters, Van, Anne, Goldberg, Shore and Lipka, (2008). They may feel that they have lost their purpose for living, that they are worthless and do not have a role to play in the society.

Research findings have shown that self-esteem takes a bit of a dive around the age of retirement. Midlife is a period mostly associated with highly stable work, family and solid romantic relationships. Things change when one enters retirement. It is a period that can mean that one is too old for many employers despite having the skills and experience they required and that can make somebody's health start to suffer as a result. It is easy to think of retirement as the end of somebody's value. Retirees could have become so caught up in their work, identity or their worth as a parent that the idea of losing those identities can fill them with dread (Drummond 2003). The study on self-esteem did not establish the relationship between self-esteem and retiree teacher adjustment to retirement hence the study intends to fill this gap.

The mandatory retirement age varies from country to country, and even within the same country it may still vary based on occupation and gender (Kwesi& Allen, 2012), generally ranging between 55-75 years (Kim, Kwon & Anderson, 2005). Ogunbameru (2004) showed that retirement is a major crisis especially in sub-Saharan Africa. The transition from work to retirement is often perceived as resulting into loss of status especially leading to esteem problems and other psychological problems. The views by Ogunbameru (2004) were corroborated by the findings of Anyah (2008) who stated that teachers in Ghana feared to and were refusing to go on retirement because of boredom and loss of sense of self-worth which is attributed to lack of pre- retirement counseling.

The standard age of retirement in Kenya is considered 60 years with some exceptions where some employees retire at the age of 65 and 75 such as members of judiciary, university staff and researchers at the research centers (Ross & Willis, 2009). Many retirees in Kenya face a lot of challenges in securing their pension and other benefits hence hitting on their self-esteem negatively. The teachers' in Kenya retire at the age of sixty years. However, teachers with disabilities and registered by the National Council for Persons with Disabilities have their retirement age set as sixty five years according to government of Kenya policy (GoK, 2012). Upon retirement, the teachers are entitled to pension from the government to sustain their livelihood and help them adjust to retirement (GoK, 2012).

Retired teachers in Kenya have been facing challenges in getting their pension which could affect their psychosocial wellbeing. Retiree teachers in Meru County have often ended up with psychosocial, financial and health challenges due to delays in getting their pension (Openda, 2018). The study therefore found it necessary to establish how teacher retirees adjusting to challenges of self-esteem in retirement.

Statement of the Problem

Retirement is viewed with great anticipation and anxiety, probably because of the uncertainties regarding the future. It is a threat to many workers who may not know what to do with their lives after retiring from active service. This

poses psychosocial problems such as low self-esteem to many retirees. These problems are described as having relationships with many life circumstances such as finances, bridgework, family issues, housing issues, and physical health, pension among others during retirement. Previous studies have found a link between self-esteem and adjustment to retirement. However, these studies were mainly focused in the developed countries whose setups may not be the same as the developing countries in general and Kenya in particular hence this study intends to fill the gap.

Objective of the Study
The study set out to establish the relationship between self-esteem and adjustment to retirement among retiree teachers in Meru County of Kenya

Hypothesis
H_{01} There is no statistically significant relationship between self-esteem and adjustment to retirement among retiree teachers in Meru County, Kenya.

Research Design
This study adopted a descriptive survey research design.

Location of the Study
The study was conducted in Meru County. Meru County is the home of the Ameru. There are ten sub-counties in Meru County namely, Igembe North, Igembe Central, Igembe South, Tigania East, Tigania Central, Tigania West, Buuri, Imenti North, Imenti Central and Imenti South. Meru shares its border with five counties: Isiolo to the North, Nyeri to the South West, Laikipia to the West, Mwingi to the East and Tharaka Nithi to the South East.

Population of the Study
The study targeted 600 teachers from Meru County who had retired from the Teachers Service Commission between 2014 and 2018 (TSC, 2018). Spouses and selected close relatives of the retiree teacher participated in the study. Therefore, the target population comprises of 600 retiree teachers, 600 spouses to retiree teachers and 600 close relatives of retiree teachers hence a population of 1800 persons.

Sampling Procedures and Sample Size
A sample of 318 respondents who were proportionately selected was used in this study. The sample was distributed as shown it Table 1:

Table 19: Sample Size

Group	Population	Sample Size	Sampling Procedure
Retiree Teacher	600	106	Snowballing
Spouses of Retiree Teachers	600	106	Purposive
Retiree Teachers 'close relatives	600	106	Simple Random
Total	1800	318	

Research Instruments
Questionnaires and interview schedules were used to collect data from the respondents.

Questionnaire
Two sets of structured questionnaire were used to collect data. A set of questionnaires were made for the retired teachers and another set for the spouses of retiree teachers.

Interview Schedule
Interview schedule was used to collect qualitative data from the close relatives of retiree teachers.

Data Analysis
Quantitative data was analyzed with the help of Statistical Package for Social Science version 23 using descriptive and inferential statistics. Descriptive statistics included frequencies, percentages, standard deviations and means. Inferential statistics used were one sample Wilcoxon signed rank test. The variables used were the 10-item Kessler psychological distress scale (K10) scores obtained from the retirees' data (Bougie *et al*., 2016). The Kessler psychological distress scale(K10) is designed to measure anxiety and depression through a10-item questionnaire. Each

question pertains to an emotional state and each has a five-level response scale. The higher the score, the greater the psychological distress due to depression or anxiety. A score of less than 15 shows no distress or anxiety. A score of 16-30 indicates moderate distress and a score of over 30 means high distress (Blanc *et al*., 2014).

Ethical Considerations

All information collected was treated with utmost confidentiality. The researcher also explained all that entails the research. Potential respondents were given information about the study objectives to ensure they are well explained. Consent from the respondent was sought and anonymity was guaranteed.

Self-Esteem and Adjustment to Retirement

The descriptive statistics analysis results were obtained by summarizing the responses of the retirees, the retirees' spouses and relatives. The results on self-esteem and adjustment to retirement were based on the responses from teacher retirees, spouses of teacher retirees and close relatives of the teacher retirees.

Retirees' Responses on Self-esteem and Adjustment to Retirement

Descriptive statistics were used to analyze retirees' responses to a questionnaire self-esteem and adjustment to retirement: Table 2.

Table 20: Retirees' Responses on Self-esteem and Adjustment to Retirement

Variable	5	4	3	2	1	f	Med.	Avg	sd.	mode
I have hard time nurturing myself	47	17	8	6	28	106	4	3.49	1.68	5
I turn down invitations to parties because I fear about myself since retirement	46	22	11	4	23	106	4	3.63	1.57	5
I support others but belittle myself since retirement	33	30	13	9	21	106	4	3.42	1.5	5
I blame myself whenever things go wrong since retirement	39	24	9	9	25	106	4	3.41	1.61	5
I begin each day with a negative attitude since retirement	41	27	9	7	22	106	4	3.55	1.56	5
I feel undeserving since retirement	36	32	8	5	25	106	4	3.46	1.57	5
I feel like an imposter and soon my deficiencies will be exposed	44	23	13	6	20	106	4	3.61	1.53	5
I have an inner critic who is demeaning me since retirement	31	33	11	10	21	106	4	3.43	1.48	4
I believe that being hard on myself is the best motivation for change since retirement	43	29	8	10	16	106	4	3.69	1.46	5
I feel unattractive since retirement	27	34	18	6	21	106	4	3.38	1.44	4
My good points seem ordinary and my failings all important since retirement	48	20	11	9	18	106	4	3.67	1.53	5
I feel unappreciated since retirement	34	29	14	7	22	106	4	3.43	1.51	5
I feel lonely since retirement	39	30	8	8	21	106	4	3.55	1.53	5
I criticize myself often after retirement	32	37	7	5	25	106	4	3.43	1.54	4
Others criticize me since retirement	41	24	14	5	22	106	4	3.56	1.53	5
I struggle with feelings of inferiority since retirement	33	32	11	4	26	106	4	3.4	1.56	5
I hesitate to do things because of what others might think since retirement	48	23	7	7	21	106	4	3.66	1.57	5

Likert scale score strongly agree = 5, agree = 4, not sure =3, disagree = 2, strongly disagree = 1

The retirees tended to agree that they had hard time nurturing themselves, they had turned down invitations to parties because they feared about themselves since retirement, supported others but belated themselves since they retired, blamed themselves whenever things went wrong since retirement, they begun each day with a negative attitude since retirement, felt like an imposter and felt that soon their deficiencies would be exposed and they had an inner critic who was demeaning them. They also agreed that they believed that being hard on themselves was the best motivation for change, they felt unattractive, their good points seemed ordinary and their failings were all important, they felt lonely, they criticized myself often, others criticized them, struggled with feelings of inferiority, hesitated to do things because of what others might think

Retirees' Spouses Responses on Self-esteem and Adjustment to Retirement

Descriptive statistics were used to analysis the responses of retirees' spouses on self-esteem and retirement (Table 3).

Table 3: Response of Retirees' Spouses' on Self-esteem and Adjustment to Retirement

Variable	5	4	3	2	1	Freq	med	Avg	Sd	mode
Your spouse have hard time nurturing themselves since retirement	19	25	29	2	31	106	3	2.99	1.47	1
Your spouse has ever turned down invitations to parties because he/she fears about him/herself since retirement	16	23	49	8	10	106	3	3.25	1.1	3
Your spouse is supportive of others but belated him/herself since retirement	42	42	4	4	14	106	4	3.89	1.33	4
Your spouse blames him/herself whenever things go wrong since retirement	14	31	26	10	25	106	3	3.01	1.36	4
Your spouse begins each day with a negative attitude since retirement	38	24	26	7	11	106	4	3.67	1.31	5
Your spouse feels undeserving since retirement	31	26	31	9	9	106	4	3.58	1.23	5
Your spouse feels like an imposter and soon his/her deficiencies will be exposed	40	44	5	4	13	106	4	3.89	1.3	4
Your spouse has an inner critic who is demeaning him/her since retirement	24	41	26	4	11	106	4	3.59	1.19	4
Your spouse believes that being hard on myself is the best motivation for change since retirement	39	48	4	4	11	106	4	3.94	1.23	4
Your spouse feels unattractive since retirement	22	39	30	5	10	106	4	3.55	1.16	4
Your spouse good points seem ordinary and his/her failings all important since retirement	40	39	12	4	11	106	4	3.88	1.26	5
Your spouse feels unappreciated since retirement	19	43	31	5	8	106	4	3.57	1.08	4
Your spouse feels lonely since retirement	18	41	13	24	10	106	4	3.31	1.26	4

Likert scale score strongly agree = 5, agree = 4, not sure =3, disagree = 2, strongly disagree = 1

The retirees spouses agreed that the retirees were supportive of others but belated themselves since retirement, begun each day with a negative attitude since retirement, felt undeserving since retirement, felt like an imposter and soon their deficiencies would be exposed, had an inner critic who was demeaning them since retirement, believed that being hard on themselves was the best motivation for change since retirement, felt unattractive since retirement, their good points seemed ordinary and their failings were all important since retirement and felt unappreciated since retirement |Table 11|. However, they were not sure if the retirees had hard time nurturing themselves since retirement,

had ever turned down invitations to parties because they fear about themselves since retirement and blamed themselves whenever things went wrong since retirement.

Retirees' Close Relatives Responses on Self-esteem and Adjustment to Retirement
Close relatives to the retirees were interveweed on self-esteem and adjustment to retirement: Findings revealed that relatives (35.85 %) had observed that the retirees experienced reduced self-confidence and reduced self-respec among the retirees. Emptiness and despair among the retirees was also observed by 28.3 % of the relatives. These results shows that retirement had negatively affected the retirees 'self-esteem.

Relationship between Self-Esteem and Adjustment to Retirement
Relationship between self-esteem and adjustment retirement was investigated inferentially using the Wilcoxon signed rank test using the K10 scores for the self-esteem. The K10 scores for self-esteem obtained were graphically presented in a histogram: The histogram was skewed to the right. This means that the scores were not normally distributed. This justified the use of the Wilcoxon signed rank test which is non-parametric and does not require the scores to be normally distributed.

The hypothesis tested using the obtained K10 scores was;

$H_0 : M = 40$ Self-esteem did not change after retirement
$H_1: M > 40$ Self-esteem changed after retirement

The result of showed that the computed value of the Wilcoxon signed rank test statistic was 4675.5 with a probability value of 3.90E-12. The probability value for the test statistic was less than the level of significance (5 %).The hypothesis stated that there is no significant relationship between self-esteem and adjustment to retirement among retiree teachers in Meru County Kenya. This means that the null hypothesis that self-esteem did not change after retirement was rejected when at 5 % level of significance. This showed that there was a statistical significant relationship between self-esteem and adjustment to retirement among retired teachers.

Different perspectives have characterized retirement either in terms of losses or in terms of potential gains, and the pathways through which such losses and gains may impact retirees' psychological well-being and self-concept remain largely unclear. These perspectives argue can lead to psychological stress and potentially also to decreases in retirees' self-esteem, particularly for those who view their career as central to their identity. The results of this study are similar to ones from a study that revealed that retirees experienced a change in self-esteem trajectory following retirement (Bleidorn, &Schwaba, 2018). This was attributed to a reason that people who have invested a lot in their careers and neglected other areas of their lives suddenly feel emptiness and despair when they retire.

People whose sense of self-esteem and worth is dependent on the work they do are particularly at risk. They may feel that they have lost their purpose for living, that they are worthless and do not have a role to play in the society. After looking forward to retirement for a long time, when many retirees reach this phase they must deal with the feelings of being let down. They realize that retirement is not a permanent vocation after all and that retirement brings along the feelings of loneliness, boredom, feelings of uselessness and disillusionment. Others can sink into depression and appear more likely to deepen their depression as time in retirement increases. Aging also tends to affect identity and self-confidence in terms of what activities are possible. Another similar study on life without professional work-perceptions about one's self, interpersonal relations and social life after retirement, found out that retirement had a significant impact on their perceptions of their life situation. Concerns resulting from retirement were further described as a sense of the declining status in society (Dahlheim-Englund*et al*., 2019).

Studies reviewed have obtained similar results to the ones in this study. They have found out that some of the factors that impact on self-esteem is; Education, income, health and employment status especially as people aged. People who have higher incomes and better health in later life tend to maintain their self-esteem as they age. This could be associated to the fact that it is possible that wealth and health are related to feeling more independent and better able to contribute to one's family and society, which in turn bolsters self-esteem. Retirement affects income and employment status leading to reduced self-esteem. Research findings also in agreement to this study have also shown that self-esteem takes a bit of a dive around the age of retirement (Drummond, 2003). Midlife is a period mostly associated with highly stable work, family and solid romantic relationships. Things change when one enters retirement. It is a period that can mean that somebody is too old for many employers despite having the skills and experience they

required, and that can make somebody's health starts to suffer as a result. It can be easy to think of retirement as the end of somebody's value. Retirees could have become so caught up in their work identity or their worth as a parent that the idea of losing those identities can fill them with dread.

CONCLUSION

The study set out to establish if there was a statistical significant relationship between self-esteem and adjustment to retirement among retiree teachers in Meru County. This was inferentially tested using the Wicoxon signed rank test. These results led to rejection of the null hypothesis. It was thus concluded that adjustment to retirement affected the self-esteem of the retired teachers. This was also evident from the analysis of the responses of the retirees, their spouses and their close relatives.

RECOMMENDATIONS

The study recommend that it is necessary for the Teachers Service Commission to organize pre-retirement counseling and preparedness training among teachers who are near retirement in Meru County to minimize the effects of retirement on their self-esteem.

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KIPSIGIS CULTURAL VALUES AND PARTICIPATION RATES AMONG BOYS IN PUBLIC DAY PRIMARY SCHOOLS IN TRANS-MARA EAST SUB-COUNTY, NAROK COUNTY, KENYA

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ABSTRACT
Education is the foundation of economic development of human resources. A country that provides free access to quality education for all its citizens is far more likely to reduce poverty, promote economic growth, lower child and maternal mortality and achieve social inclusion. Despite efforts by the Kenyan government to attain gender parity in access and participation of school by both boys and girls, there are still gaps in Trans Mara East Sub-County, Narok County with boys' participation being low. This study aimed at establishing the influence of the Kipsigis cultural values on participation rates among boys in selected public day primary schools in Trans Mara East Sub-County, Narok County. The study used descriptive survey research design. Study was conducted in twelve public day primary schools selected randomly from sixty primary schools in Trans Mara East Sub-County. The target population for this study was 10,060 comprising of 120 parent representatives, 60 Head teachers, 9600 pupils in class six, seven and eight and 240 class teachers. Simple random sampling was used to select 144 pupils while purposive sampling was used to select 12 head teachers, 31 class teachers and 12 parent representatives from which a sample of 199 participants was achieved. A pilot study was carried out in Mogondo zone that was not part of the actual study involving 33 respondents. Reliability of the instruments was tested using Cronbach's Alpha and a reliability coefficient of 0.758 was obtained. The quantitative data was analyzed using descriptive statistics and inferential statistics with the help of Statistical Package for Social Sciences version 25.0. The descriptive data was presented using tables of frequencies and percentages, while the Spearman Rho' Correlation Coefficient was used to infer on the relationship between Kipsigis cultural values and the primary school participation among boys. The findings of the study showed that there is a moderate positive correlation between Kipsigis cultural values and participation rates (r =0.587).The study concluded that Kipsigis cultural values greatly influenced primary school participation among boys in public day primary schools. Based on the study, the researcher recommends positive cultural values to be used as instrumental tools to instill positive values in enhancing participation of boys in primary schooling. It is hoped that the findings of this study may be useful in helping primary school administrators and managers, the ministry of education, and other key educational stakeholders in coming up with ways of strengthening primary school participation among boys.
Keywords: Kipsigis Cultural Values, Participation Rates

INTRODUCTION
Education disparities are highlighted over the world in the enrollment, attendance and transition rates of the boy child in developing countries (UNESCO, 2013). Students' enrollment and transition in schools is vital in reducing societal inequalities and fostering completion in schooling (UNESCO, 2005). In order for a country to achieve sustainable participation rates, there must be substantial investment in enrollment, attendance and transition of learners at all levels of schooling (Wilayat, 2019). The purpose of having sound participation policies worldwide is to ensure more children access education and reduce educational wastage (UNESCO, 2010). The ultimate goal of participation efforts is an improved educational experiences, rather than participation itself.

In Europe and Central Asia, the reasons for children and young people not being enrolled, not attending or dropping out of school are multiple and complex, and vary among countries and regions and between individuals, (UNICEF, 2017). As enrollment rates are relatively high in basic education across the region, children out of school or dropping out tend to be the most marginalized. Policies and interventions underpinned by the principles of social justice and equity have not effectively tackled the causes of dropout, hence compromising improved socio-economic returns for individuals and for societies as a whole. There has been hardly any robust evaluation of policies, strategies or interventions that have resulted in a reduction of out-of-school children and dropout in the region. Hence this study provided measures that can be used to enhance primary school participation rates among boys in marginalized areas.

In Bangladesh, the primary school participation rate has remained at around 60 percent since 2001 (UNICEF, 2012); as a result of substantial rates of non-completion of primary school many children are leaving schooling without acquiring the most basic skills (National Center for Educational Statistics, 2014). According to Ricardo, Kwame, Westbrook and Hunt (2010) strategies to improve access to education and reduce the numbers of children not completing school are critical if Universal Primary Education (UPE) is to be achieved. Children are starting primary

school in greater numbers than ever before but completion rates are significantly low and lead to low levels of primary school completion in many countries.Studies carried out in Ghana, on access and participation in schooling have revealed that although their government is committed to provision of education, children from poor households continue to stay out of school (Akyeampong, 2009). In addition, studies carried out in Malawi on education access have revealed that children from poor households cannot enroll and complete education (Chimombo, 2009). Tanzania, Uganda and Rwanda have registered progress in enhancing retention but completion rates are still low (UNDP, 2009). In a survey done by Bruneforth (2006) on Burkina, Ethiopia, Kenya, Mali, Mozambique, Namibia, and Nigeria on the characteristics of children who did not participate in school, more than half of all children aged 10 to 19 years left school without completion. This was majorly due to lack of a combination of social and economic factors more specifically to income and societal culture. Chang'ach (2012) argues that social-economic factors alone are not sufficient enough to account for non-participation of boys in both primary and secondary schools. Cultural values and norms need to be given a fresh look, a gap that this study intended to fill.

The influence of cultural values on cognitive development, health as well as school attendance among boys which immensely contribute to their effective school participation rates cannot be understated (Adan, 2018). This influence however has been highly under-researched though there exist many studies that look at the socio-cultural practices and how they influence girl child participation in school. Other studies have heightened on the influence of cultural practices on moral development, academic achievement and discipline in schools (Zanin, da Cunha, de Rosso, Capriles & Stedefeldt, 2017). Primary schools have the potential of preparing and sustaining cultured primary school boys by reintegrating them after the rites of passage. This has been a major concern for this study.Cultural practices or the manifestation of a culture especially in regard to the traditional and customary practices of a particular ethnic or group is another major factor that greatly affects pupils' participation in education (Busienei, 2018). A study done by Mushibwe (2009) on Tumbuka people of Zambia pointed out that patrilineal groupings are strongholds of the patriarchal predisposition and that patriarchal attitudes and cultural traditions place men and boys on an heightened position. Tumbuka socio-cultural traditions tend to limit gender equality, compel and justify male domination regarding consequent inequalities as normal.This poses a far reaching implication on the moral development, academic achievement and discipline in schools among learners, which finally imparts negatively on their lives.

Busienei (2018) in her research in Narok County stated that education is seen as a basic right, although there has been a disparity in its access, retention and performance. This implies that there are groups that are particularly disadvantaged in terms of access, retention and performance in education. These include the poor, rural populations, physically challenged, orphans, those in armed conflict situations and the nomadic pastoralist (Busienei, 2018). Studies by Kiungu (2000) and Okuma (2011) indicate that reaching pastoral communities with formal education has been a major challenge. There is growing awareness that the target of education for all will not be met unless efforts are made to improve access for the marginalized and hard to reach children hence the current study.

The high premium attached on education is stressed against the backdrop that the deadline for the realization of the Millennium Development Goals that called for increased access to quality basic education and training which have been domesticated in Kenya elapsed in 2015; Republic of Kenya (UNESCO, 2012). This broad Vision of education and the holistic approach to sector development was fully embraced by Kenya as a critical vehicle for realizing Vision 2030, the road map for development (Gakidou, Cowling, Lozano & Murray, 2010; UNESCO, 2012; Orodho, 2015). Despite all these efforts however, the education sector in Kenya has posted wide disparities in terms of school participation at all levels and the disparities are even wider in Arid and Semi-Arid Lands (ASALS) and those areas that still uphold strong cultural values, morals and traditions such as the Kipsigis community in Trans Mara East, Narok County, Kenya.

Amdany (2016) asserts that the symbols produced by Kipsigis culture produces a state of heightened awareness. As Rono (2002) theorized, cultural systems are extra ordinary powerful. Once, thoroughly embedded cultural systems tend to reside at the level of assumptions and presupposition rather than at the constructed explanations. This is one of their most salient characteristics, and the importance of this feature may hardly be overstated for its influence on learning. Cultural systems affect the most objective enterprises and indeed interfere with educational participation. Cultural practices that persist over generations and centuries are rich in opinions on a variety of subjects (Chang'ach, 2011). While cultural systems may be more or less efficacious, the more areas of life they address the more influence they have on thought, behavior and adaptation. Kalenjin cultural practices uses a holistic approach. While ethnic traditions, circumcision and cultural practices for instance should be respected because they define one's identity, in aspects of culture they are discriminatory, restrictive and tend to prevent school-going children from attending school

(Bosibori, 2011 & Ndungu, 2008). It holds concepts about value of life and the way life should be managed. The perspectives of these scholars depict that culture plays a key role in influencing people's identity, behaviour and thought. This may affect the retention, attendance and enrollment of boys in modern schooling as the school rules and regulations requires high level of subordination. An amicable way to bridge the gap between cultural practices and school participation should be sought hence the need for the current study.

Statement of the Problem

Education is considered as a basic human right and a basic need for all because of the crucial role it plays in the human development. Boy-child education is recognized as one of the critical pathways to promote social and economic development. Despite the introduction of free primary education (FPE) in Kenya and numerous campaigns made by the Kenyan government and other stakeholders such as United Nations and Non Governmental Organizations in the country to enhance school participation and ensure Education For All (EFA) is realized, primary school participation rates among boys in Narok County is still unexpectedly low. This results in wastage of the scarce national resources since the pupils who do not participate in primary schooling do not acquire the knowledge and skills expected of them. The boy child goes through rigorous socialization process during cultural practices and during seclusion period which puts young boys at crossroads thus affecting their primary school participation rates. Despite research on various aspects of African cultural values and practices, much thought has not been given to its influence on school participation among boys. Cultural values need a fresh look with great emphasis on understanding and re-interpreting the rituals vis-à-vis the current situation and realities therefore this study sought to establish the influence of Kipsigis cultural values on participation rates among boys in selected public day primary schools in Trans Mara East Sub-County, Narok County, Kenya.

Cultural Values and Participation Rates in Primary Schools

In Europe and Central Asia, the reasons for children and young people not being enrolled, not attending or dropping out of school are multiple and complex, and vary among countries and regions and between individuals (UNICEF, 2018). As enrollment rates are relatively high in basic education across the region, the children out of school or dropping out tend to be the most marginalized where a combination of social,cultural and economic factors all together affect primary school enrollment (Winthrop & McGivney, 2015). There has been hardly any robust evaluation of policies, strategies or interventions that have resulted in a reduction of out-of-school children and dropout in the region. Among other reasons this is because of the complex nature of programme that combine a range of interventions to address the complex needs of children at risk of education exclusion (Humble & Dixon, 2017). This calls for a multi-dimensional approach to address the issue of education exclusion hence the current study.

Gender stereotype is the over generalization about the characteristics and behaviour of individuals based on gender. Stereotypes help people to categorize things and simplify day-to-day activities and cognitive process. Society differentiates the characteristics of boys and girls with clear boundaries. Therefore, individuals are expected to behave in a particular way that is appropriate for their gender. The gender bias in society sometimes restricts people in achieving their dreams because as per societal norms certain positions are not apt for every gender (Agyeman, 2016). Gender disparity develops as a consequence of gender stereotype that has a significant role in creating gender disparity in education. This is reflected in the academic achievement, career aspiration and academic involvement of students. Gender stereotype regarding education is spread through socialization agents, culture being among them. It is one of the social constraints that make education an unachievable dream for many individuals. It is unfair that certain individuals are restricted from education because of gender biases shared in the society through cultural labels (Akessa 2016). This paper established the influence of cultural values on primary school participation among boys in public day primary schools in Trans-Mara East Sub-County, Narok County, Kenya.

Sharma (2014) and Bello (2015) both in Fiji Islands investigated the cultural influences on academics. The studies used students from communities with different cultures on which anecdotal evidence had pointed out that there was a consistent higher school participation from one community and consistent low participation in another community. Sharma (2014) found out that a collective culture with a strong communal sense and social obligations was working against school participation among the pupils in Fiji. In addition Nguyen (2015) in Vietnam studied the role of cultural factors affecting the school enrollment among students. The findings indicated that cultural values emphasizing school achievement predicted higher participation rates in school. This study however highlighted the impact of favourable cultural values on school participation without pointing out the negative impact cultural teachings may have in participation rates among pupils, a gap this study intended to fill.

India follows patriarchal cultural norms. The influence of patriarchy is clearly visible in educational field. Indian society expects the boys to be more educated than their girls. Sarkar, Karim and Suffiun (2017) found in their study that parents with high traditional gender role attitude and gender biases hold positive and favorable attitude towards boys' education, however, their attitude towards girl's education decreases significantly. Chingtham and Guite (2017) found that the cultural influence is still a barrier to both boys' and girls' education even in this modern era. Aeschlimann and Herzog (2019) in an alternative study in India for example, noted that school participation rates of the boys were also hampered by economic pressure asserted to boys by the Indian culture. Researchers noted that when a family faces financial crisis, the boy child is forced to drop education and look for job to support the family.

Culture dictates a number of things in an individual's life. This ranges from values, norms as well as economic activities of the society. In cases where cultural activities are highly regarded they have negative effect on formal education. A survey carried by World Vision (2016) in East Pokot and Baringo East Sub-counties in Rift valley shows that challenges against boys and girls enrollment in schools in the area are mainly cultural practices as well as conflict between neighboring communities. All these activities are culturally oriented and negatively affect education. However, culture also plays a major role in development of curriculum. According to Shiundu and Omulando (2012) in planning and development of curriculum it is important to analyze the kind of knowledge, skills and competence that youths in society will need so that they can cope with tasks and roles in that society and the problems prevalent in the society for which education should provide an answer, a gap that this study intends to address.

A study conducted by Muchunku (2014) on the effect of socio cultural factors on academic achievement in Tharaka Nithi County revealed that certain socio-cultural factors negatively affected the pupils' participation in schools. The socio-cultural factors identified by Muchunku (2014) as having a negative influence on academic performance were initiation ceremonies, circumcising girls, polygamous family background cultural tendency towards early marriages and community attitudes towards education. Social arrangement and cultural forms have functional significance in relation to the psychological needs of individuals. The in-depth description of the cultural practices in this study clearly indicates the holistic approach to issues by the cultural phenomenon. Kibiego (2010) argues that the amount of knowledge that we obtain is filtered through a cultural screen that selects stimuli for attention. These stimuli effectively define the larger experience, the object, person or idea. On this basis, cultural rules organize the field of experience into categories. On the basis of cultural knowledge, individuals discover meaning by grasping the underlying pattern and the implicit frame of reference that people have learned. It is this then that influences behaviour and attitude towards social issues like education. According to Kibiego (2010) boys who are encultured tend to develop rebellion, truancy and deviancy. In relation to schooling matters, absenteeism and indiscipline are common phenomenon hence leading to low school attendance.

Cheison (2008) in the Kalenjin cultural practices research emphasized the structural aspect of culture when they identified culture as patterns of values, ideas and other symbolic meaningful systems. Culture concerns the forms of things that people have in their minds. It functions as a set of plans for ordering behavior. These attributes are greatly embedded in the Kalenjin cultural practices. The cultural screens therefore determine the learner's attendance rates in schools, which is a key concern in this study. Amdany (2016) in the study on African Religion in the Study of Comparative Religion. A case study of Kipsigis practices, also asserts that the symbols produced by Kipsigis culture produces a state of heighted awareness. It should be noted that as Rono (2002) theorized, cultural systems are extra ordinary powerful. Once thoroughly embedded cultural systems tend to reside at the level of assumptions and presupposition rather than at the constructed explanations. This is one of their most salient characteristics, and the importance of this feature may hardly be overstated for its influence on learning. Cultural systems affect the most objective enterprises and indeed interfere with educational participation,a gap the study intended to address.

THEORETICAL FRAMEWORK

This study is guided by Structural functionalism theory developed by Durkheim (1893) a French sociologist and refined by Merto (1910) and Parsons (1975) and System approach theory by Kurt Lewin (1890-1947).

Structural Functionalism Theory

The theory views society as a well-organized system in which most members agree on common values and norms. Institutions, groups and roles fit together in a unified whole. Members of the society do what is necessary to maintain a stable society because they accept the regulations and rules. The theory serves as a model for this study in that the Kipsigis society is stratified with various cultural forms coming together to form an organized cohesive and functional system. Cultural practices component occupies a key position in the cultural strata. Structural functionalism is centered

on two claims; first any society is a unique functioning whole and second, that the social arrangement and cultural forms obtained in a society have functional significance in relation to the psychological needs of individuals. Cultural practices serves to elevate the esteem of the man and his position in society is accepted as superior. Introduction of new ideas by Western education and which are apparently being forced to form part of the already existing functional whole has caused dysfunctional tendencies which is the major concern of this study.

Research Design

The study employed the descriptive survey research design to determine the influence of Kipsigis cultural practices on primary school participation among boys in public schools in Trans Mara East sub county Narok county, Kenya. Descriptive survey research design is used in preliminary and exploratory studies to allow the researcher to gather information, summarize, present and interpret for the purpose of clarification (Orodho, 2012). Descriptive survey is intended to produce statistical information about the aspect of education by reporting the way things are (Mugenda & Mugenda, 2003). Descriptive research survey is concerned with conditions that are already existing, practices that are held, processes that are ongoing and trends that are developing. This design was most appropriate for this study because it enabled the researcher to collect information about Kipsigis cultural practices and school participation among boys in public schools in Trans Mara East, Narok County.

Target Population

According to Mugenda and Mugenda (2013) the target population is the larger group to which the researcher wants to generalize the results of a study. The entire Trans Mara East Sub-county has four educational zones which include; Emarti, Emurua Dikirr, Ololmasani and Mogondo.The total number of schools in the sub-county are 60. The target population for this study was10,080. This includes 9,600 pupils in class six, seven and eight, 60 head teachers from the 60 schools in the Trans Mara East sub-county,240 class teachers and 180 parent representatives from the selected classes. (Trans Mara East sub-county Education office, 2020).

RESULTS AND DISCUSSION

Response Rate

The study sample size was 199 comprising of 144 boys in class six, seven and eight then twelve headteachers, 31 class teachers and 12 representatives of Parents Teachers association (PTA) from the twelve public day primary schools in Trans Mara East-sub county, Narok county. A total of 199 questionnaires were successfully completed (Table 1).

Table 1: Response rate

Category of respondents	Target population	Sample size	Response rate %
Parent representatives	180	12	100
H/Teachers	60	12	100
Class teachers	240	31	100
Boys in class (6,7,8)	9,600	144	100
Total	**10,080**	**199**	**100**

The information in Table 1 indicates that 199 subjects participated in the study across all the categories of the respondents. The high return rate was possible since the researcher personally administered the instruments and used drop and pick method with all the respondents.

Kipsigis Cultural Values and Participation Rates

The first objective of the study sought to establish the influence of Kipsigis cultural values on participation rates among boys in public primary schools in Trans –Mara east sub-county. Cultural values are elements that bind people together which make them strong and united. Cultural values were conceived in terms of morals, rules, values, languages, beliefs, arts, literature, music, social roles, customs and traditions.

Descriptive Statistics on Kipsigis Cultural Values and Participation Rates

Teachers were asked to indicate the extent to which they agreed or disagreed with the statements on Kipsigis cultural values and participation rates listed on a five point likert scale ranging from: Strongly Disagree (SD), Disagree (D), Uncertain (U), Agree (A) and Strongly Agree(SA). Data was analyzed using frequencies and percentages. Information in Table 2 presents the results.

Table 21: Teachers' Response on Kipsigis Cultural Values and Participation Rates

Statement	SD	D	U	A	SA
Moral lessons encourage boys to progress with education	11 (36%)	18 (58%)	1 (3%)	1 (3%)	0
Moral lessons do not encourage progression with education	3 (10%)	1 (3%)	1 (3%)	10 (33%)	16 (52%)
Cultural beliefs encourage participation in education	24 (77%)	4 (13%)	0	1 (3%)	2 (7%)
Cultural beliefs discourage participation in education	0	1 (3%)	1 (3%)	9 (29%)	20 (65%)
The cultural norms encourage boys to respect men and women	19 (63%)	1 (3%)	0	5 (17%)	6 (20%)
The cultural norms encourage boys to respect men only	6 (20%)	1 (3%)	0	3 (10%)	21 (70%)
The cultural norms encourage boys to respect women only	26 (86%)	1 (3%)	0	4 (13%)	0
Cultural taboos prohibit boys participation in schooling	14 (47%)	7 (23%)	10 (32%)	0	0
Cultural taboos encourage boys participation in schooling	23 (77%)	1 (3%)	0	0	7 (23%)
Cultural values make the boys more adjusted to school life	26 (90%)	2 (7%)	1 (3%)	1 (3%)	1 (3%)
Cultural values make the boys more indisciplined	0	1 (3%)	0	1 (3%)	29 (94%)

Information in Table 2 shows that majority of the respondents disagreed at 58% and 36% strongly disagreed on the statement that boys received moral lessons that encouraged progression with education during Kipsigis cultural practices. In addition 52% strongly agreed and 33% agreed that the moral lessons taught to the boys do not in any way encourage progression with education. The findings are in tandem with Chang'ach (2013) and Rono (2002) findings who highlighted that Kalenjin cultural systems are extra ordinary powerful tools. Once thoroughly embedded Kipsigis cultural systems tend to reside at the level of assumptions and presupposition rather than at the constructed explanations. This is one of their most salient characteristics, and the importance of this feature may hardly be overstated for its influence on learning.

The statement on whether cultural beliefs encourage participation in education was strongly disagreed by 77% respondents and 13% disagreed. On the contrary, 65% of the respondents strongly agreed and 29% agreed that Kipsigis cultural beliefs discourage participation in education.This could explain the rising cases of drop out rates among teenage boys in Trans-Mara East as evident in the enrollment data presented in Table 1. The findings agree with Herzog (2019) in a study in India which potrayed that school participation rates of the boys were also hampered by economic pressure asserted to boys by the Indian culture.

The next aspect of Kipsigis cultural norms were gauged through teachings on respect, majority of the respondents that is 63% strongly disagreed that boys are taught to respect both men and women. Majority of the respondents that is 70% strongly agreed that boys were taught to respect men more and on the other hand 86% of the respondents strongly disagreed that boys were taught to respect women more.The findings agree with Kibiego (2010) on a study in Kwale County which established that failure in areas of responsibility, respect and manners are more pronounced in conservative African society. The new status acquired by encultured boys alienates them and this influences on their primary school participation.

Basing on the statement whether cultural taboos prohibited participation in school, 47% strongly disagreed and additional 23% disagreed; on whether cultural values made the boys more or less adjusted to shool life, 94% of the respondents strongly agreed that boys were more indisciplined to school life after cultural practices.The findings show a strong indication that Kipsigis cultural values negatively affect primary school boys. The current study conforms to the suggestion of Django (2017) in a study on culturally relevant pedagogy which advised schools to develop students' cultural competence to assist students in developing positive ethnic and social identities.

The findings from the pupils and teachers were in agreement with those from the interviewed parent representatives. Majority of the interviewed PTA members agreed that cultural values influenced primary school participation among the boys to a great extent. One member exemplified this by reporting that in Kipsigis community the boy child is encultured to be hardy, warry, hardworking and fierce/courageous. The interviewee added that a man (Muren) among the Kipsigis was trained to be a breadwinner from a young age. Boys are trained to plough lands, graze cattle, fence homesteads, hunt, own property and also protect the homestead from intruders. A boy with these qualities was labelled a man enough.

Boys in the Kipsigis community were trained the gender roles of men at a young age and some of these roles such as war, hunting and protective role may mismatch the expectations in the formal education set up. Protective roles for example may make the boys prone to ethnic conflicts, strikes and demonstrations in schools as well as bullying. Kasiku (2012) in a study on ethnic conflicts in Kirindoni among Maasai and Kipsigis communities highlighted that cultural practices such as cattle rustling and competition for pastureland were key catalysts of violence. However some cultural attributes such as hard work can be emphasized even in educational activities in order to encourage boys participation in schooling.

Correlation of Kipsigis Cultural Values and Participation Rates

Spearman's rho Correlation analysis was used to determine the relationship between cultural values and primary school participation among boys. This was meant to identify the magnitude, direction, nature and strength of the association between the two variables. The results are presented in Table 3.

Table 3: Correlation of Cultural Values and Primary School Participation

	Statistic	Participation rate	Cultural values
Cultural values	r	.587**	1
	P	0.001	
	N	28	28

The results in Table 3 reveal that there is a moderate, positive and significant correlation between Kipsigis cultural values and primary school participation in Trans-Mara east sub-county (r=0.587 p value=0.001). This can be interpreted to mean that increase in positive cultural values results to an increase in primary school participation rates among boys in Trans mara East sub county. Sadam and Abd (2020) study in Indonesia indicate that a positive sense of cultural possession is expounded to numerous positive individual developments as well as tutorial engagement, action and prosocial behavior related to favorable psychological and school adjustment for young cultural minorities.

Busienei (2018) in a study in Narok reported that cultural beliefs and practices acted as a great setback to educational achievement for girls. Data from descriptive statistics also unveiled that there were negative cultural aspects that influenced primary school participation rates among boys in Trans-Mara East. However, the current study revealed that there are positive cultural values that can be emphasized to promote primary school participation among boys such as respect for both men and women, teachings on hard work as well as formal employment.

Test for Independence Between Participation Rates and Kipsigis Cultural Values

The first objective of the study was to determine the influence of cultural values on primary school participation among boys in public day primary schools in Trans-Mara East sub county,Narok county. To assess the relationship between cultural values and primary school participation, the following hypothesis was tested. $H_0$1: There is no statistically significant influence of the Kipsigis cultural values on participation rates among boys in selected public day primary schools in Trans Mara East Sub-County, Narok County, Kenya.

In order to test the hypothesis, a chi-sqaure test was conducted. The three measure variables: cultural values, cultural festivities, circumcision rites, and participation rates were all continuous. Thus, respective binary variable was created using median as their cut points, that is 1.909 (n = 28), 1.00 (n =23), 2.00 (N = 30) and 3.167 (N = 31), respectively to make Chi-square test appropriate. Table 4 presents the resultant frequency table.

Table 4: Cross-tabulation between degree of cultural values positivity and participation rates

	Cultural values		cultural festivities		Circumcision rites		Participation rates	
Degree of positivity	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Low	16	57.1	12	52.2	19	63.3	16	51.6
High	12	42.9	11	47.8	11	36.7	15	48.4
Total	**28**	**100**	**23**	**100**	**30**	**100**	**31**	**100**

Chi-square test was then conducted to test for independence between participation rates and cultural values. The test results were found to be statistically significant at a 5% level ($\chi^2(1) = 2.250, p = 0.022$) (Table 5).

Table 5: Cross-tabulation and Chi-sqaure test of indendence between degree of cultural values positivity and participation rates

	Participation rates		
Degree of positive cultural values	**Low**	**High**	**Total**
Low	11 (68.8%)	5 (31.3%)	16 (100%)
High	3 (25%)	9 (75%)	12 (100%)
Total	**14 (50%)**	**14 (50%)**	**28 (100%)**

Note. All percentages are row percentages. $\chi^2(1) = 2.250$, p = 0.022. Minimum expected count is 6.

Thus, the null hypothesis ($H_0$1) There is no significant influence of Kipsigis cultural values on primary school participation rate in Trans-Mara East sub-county was hence rejected at a 5% level. High degree of positive cultural values was associated with high participation rate (n = 9, 75%) than with low degree of positive cultural values (n = 5, 31.3%).The results are consistent with the Spearman's rho correlation results that there is a moderate and significant positive correlation between Kipsigis cultural value and primary school participation rate in Trans-Mara East sub-county.

SUMMARY AND CONCLUSION

The first objective of the study was to determine the influence of Kipsigis cultural values on participation rates among the boys. This objective was analyzed with indicators such as cultural norms, morals, beliefs and taboos that are embedded in Kipsigis community. The study found out that boys in the Kipsigis community were taught many taboos, beliefs, morals and norms but none of these emphasized on progression with schooling. Instead the cultural values taught to the boys by the Kipsigis culture encouraged hard work in other areas of life other than education.Cultural values also were found to teach boys more of respect to men than women. In addition cultural values gave the boys freedom to choose whether to participate in schooling or not.

Judging from the findings resulting from the quantitative and qualitative data collected for this study, the results reveal some vital facts upon which the conclusions are based.

Kipsigis cultural values greatly influenced primary school participation among boys in public day primary schools.The cultural values, norms and morals that were taught to the boys during cultural practices emphasized on hard work in other areas other than education. In addition, cultural values gave boys a lot of freedom to choose whether or not to attend school. The cultural norms also taught the boys to respect men more than women and hence this perpetuated male chauvinism at a very early stage. This implies that there is need to advocate for cultural values that positively influence participation of boys in school.

RECOMMENDATIONS

The study recommends that Kipsigis cultural values, norms and morals taught to boys during cultural practices through initiate caregivers, education stakeholders and the community at large, should emphasize on virtues that positively influence participation of boys in school.

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PREVALENCE AND CHARACTERIZATION OF AVOCADO FRUIT FUNGAL DISEASES IN EMBU COUNTY AND EFFICACY OF *Aloe secundiflora* CRUDE EXTRACTS IN THEIR CONTROL

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ABSTRACT
Avocado production faces various constraints that include common post-harvest fungal diseases. Most of these diseases are difficult to control using cultural measures while use of chemicals leads to pathogen reistance in addition to being harmful to human and environment. The objective of this study was therefore to determine the prevalence of the fungal avocado fruit diseases in Embu County, isolate and characterize the causal pathogens and test the efficacy of *Aloe secundiflora* extract in the diseases. Questionnaires were administered to a total of 120 respodents to gather additional information on avocado production, marketing and management. The stores and avocado bags were randomly identified and the fruits assessed for the prevalence of fungal avocado diseases. *Aloe* leaves were collected in the field and phytochemical analysis done using standard procedures. The efficacy of *Aloe secundiflora* extract against the avocado fungal diseases was done in the laboratory using a Completely Randomized Design. The extracts were then assessed for antimicrobial activity against *Colletotrichum gloeosporioides* (scab disease), *Sphaceloma perseae* (anthracnose) and *Cercospora purpurea* (Cercospora spot). In the results, chemicals were widely used to control the pathogens. The mean percentage prevalence of scab, cercospora spot and anthracnose diseases was 36.4%, 35.15% and 35.0%, respectively, among the markets, although anthracnose was highly prevalent within each market. Four avocado varieties were commonly sold with *Fuerte* and *Puebla* being the most susceptible to the fungal diseases. There were significant variations in the morphological characteristics of the pathogen isolates. The aloe extract revealed the presence of steroids, phenolics, flavonoids, saponins, terpenoids and phenolics. The extract prepared using ethanol had a high inhibitory activity against *C. gloeosporioides* (15.59mm) and *Cercospora purpurea* (7.22mm), while hexane solvent extract had minimal antimicrobial activity (10.53 and 5.22mm respectively). Aloe crude extract is therefore a potential antifungal agent against *C. gloeosporioides* and *Cercospora purpurea*.
Keywords prevalence, avocado, fungal diseases, *Aloe secundiflora*

INTRODUCTION
Avocado (*Persea americana* Miller) is a significant fruit crop grown in tropical and subtropical regions (Selladurai & Awachare, 2020). The crop is gaining acceptance worldwide and has received extensive marketing due to its uses in pharmaceutical, cosmetic, oil and food industries (Kumar Gupta *et al.*, 2018). Avocado is grown in over three million hectares world wide. Mexico is the leading producer and exporter of the fruit worldwide with an average of 10.7 tonnes of avocado per hectare (FAOSTAT, 2020). This translates to about 33.9% of avocado harvested worldwide (Wasilwa *et al.*, 2018). The crop thrives well in subtropical climates such as Pacific America, South East Asia and Africa. Africa is one of the avocado fruit exporters mostly from Kenya and South Africa (Wolstenholme, 2008). Kenya has a conducive environment for avocado production. It produces approximately 13.22 tons of avocados per hectare for local use and for export (FAOSTAT, 2020) making it the sixth largest producer of avocado in the world and the leading in Africa (FAO, 2019). It produces 15.7 tons of avocados per hectare for fruits produced every year (Wasilwa *et al.*, 2018). About 70% of avocado is produced by small-scale growers mainly in Murang'a, Bungoma, Migori, Kiambu, Kisii, Nyamira, Tharaka Nithi and Embu counties of Kenya (Johnny *et al.*, 2019). Embu County accounts for approximately 30% of total avocado production in Kenya (Hortinews, 2015).

The popular avocado varieties grown in Kenya are *Hass*, *Fuerte*, *Puebla*, *Duke*, *G6* and *G7* (WAC, 2004). Avocado is a nutritious fruit rich in essential minerals such as manganese, phosphorus, iron and potassium. It is rich in vitamins such as vitamin A, B, E and β-carotene (FAO, 2018). It is a high source of protein and carbohydrate for populations in avocado producing and non-producing countries (Fan *et al*., 2017). Avocados can be consumed in various forms and do not require processing, preservatives or taste enhancers (Chaves & Borges, 2016). The fruit has various uses in pharmaceutical, cosmetic and oil industries (Kumar Gupta *et al*., 2018). In Kenya, production and marketing of avocadoes contributes to economic development and reduction of poverty because avocadoes are a source of income and foreign exchange to the farmer, thus generating capital for economic development (Karingu *et al*., 2020). Avocado

production and marketing has also contributed immensely to the growth of some rural areas in terms of job creation and income (Edna, 2019).

Avocado production in Kenya is faced by various biotic constraints for example diseases such as avocado anthracnose, scab disease, *Cercospora* spot, Verticillium wilt, Bacterial canker, among others. The fruit is also attacked by pests such as false codling moth, thrips, scales and fruit flies (Marais, 2016). Avocado fruit diseases of economic importance include anthracnose, scab and *Cercospora* spot that are caused by *Colletotrichum gloeosporioides*, *Sphaceloma perseae* and *Cercospora purpurea*, respectively (Marais, 2016). Characterizing these diseases is vital for developing and implementing effective control strategies.There are several post-harvest fungal pathogens that infect various avocado cultivars thus reducing the shelf life and marketability of the fruit. These post- harvest fungal diseases are estimated to cause about 83% losses in avocado production threatening the global avocado market (Fan *et al.,* 2017). Infection may go unnoticed during fruit development and appear at maturity in storage or while fruits are sold in the markets (Mekonnen *et al.,* 2015). This poses a challenge for their management because disease presence is identified when fruits begin to soften or rot, symptoms that usually occur at the market stage when it is not possible to control the problem (Sharma *et al.,* 2017).

Nevertheless, the awareness of farmers on protection of fruits from infection during growth in the field and postharvest care is little or lacking (Mekonnen *et al.,* 2015). Assessment of the prevalence of these diseases is therefore important to map the geographic distribution and determine the status of the disease, in addition to providing baseline data to prioritize research problems (Eshte *et al.,* 2015). Post-harvest fungal diseases are mainly controlled using synthetic chemicals (Yoon *et al.,* 2013). However, the use of fungicides is becoming increasingly restricted particularly in many countries especially those applied after postharvest (Mekonnen *et al.,* 2015). For instance, regular copper fungicide sprays such as benomyl are applied in the postharvest control of avocado fruit diseases (Fesenko & Edwards, 2014). These chemicals contribute to toxicity in food and thus not suitable for human consumption, in addition to polluting the environment (Plant *et al.,* 2005). Excessive use of chemicals also contributes to microbial fungal resistance to fungicides, which complicates fungal disease managements in many countries (Roca *et al.,* 2015). Furthermore, losses due to fungal avocado diseases are still high about 83% despite the use of synthetic chemicals by avocado growers and traders (Fan *et al.,* 2017).

Cultural methods of controlling post-harvest fungal diseases include good sanitation procedures involving collection and disposal of diseased fruits (Agrios, 2005). Further, adequate postharvest handling practices are applied to prevent cuts and bruises to fruit surfaces (Wasilwa *et al.,* 2006). Fruits showing symptoms of postharvest diseases are not packed into cartons containing healthy fruits (Sarkhosh *et al.,* 2017). However, these methods are not effective, despite their use, market losses attributed to postharvest fungal diseases are still high (Agrios, 2005). It is therefore necessary to develop new and more antimicrobial substances against the pathogen for proper control and management (Carocho and Ferreira, 2013). Use of bio pesticide control agents is a promising approach for control of pathogens (Kesho, 2020) and plant extracts with secondary metabolites could be a good control measure against fungal pathogens.Natural plant extracts have been widely used in the control of plants and animals diseases (Savoia, 2012). Plant extracts are easily obtained, economical, non-toxic and do not interfere with the biological balance compared to synthetic chemicals (Proestos, 2020). The antimicrobial properties of most plant extracts are as a result of essential oils and other secondary metabolites in the plants such as terpenoids, flavonoids, saponins, alkaloids and tannins (Akinmoladun *et al*., 2007).

Aloe plant is important in the control and management of diseases. It has been exploited since prehistoric times as a source medicine for the treatment of various diseases. This is because Aloe has antibacterial, antifungal, anticancer, antiviral and immunomodulatory properties (Bashir *et al.,* 2011). Despite the wide usage of Aloe, there is little literature on the type of the active ingredients within the plant's extracts (Bashir *et al.,* 2011). Aloe plant is tolerant to harsh environmental conditions and therefore able to reproduce continuously even during the dry season. As a way of survival, it produces some metabolites that enable them to survive. Many of these metabolites have antimicrobial activities and have been used to control some plant diseases such as *F. oxysporum* that cause wilt in several plant species (Rachuonyo, 2016). Sixty-three species of Aloe occur in Kenya, of which around 50% are endemic (Bjorå *et al.,* 2015). They are widely distributed in the semi-arid areas and open grasslands of Kenya. Several of these species are threatened with extinction and knowledge about their use is important for their conservation strategies (Bjorå *et al.,* 2015). *Aloe secundiflora* Engl. is among the most important species. There is limited information on the application of crude extracts of *A. secundiflora* in the control of post-harvest avocado fungal disease pathogens.

Statement of the Problem

Fungal avocado fruit diseases account for about 83% losses in avocado production hence threaten the avocado market worldwide. They infect all cultivars of avocado including the *Hass*, *Fuerte* and *Puebla* varieties grown in Kenya and hence reduce the shelf life and marketability of the fruit. Information on the prevalence of these diseases in market stores and packing houses before entering into global market is very limited and could be utilized as an early control and management measure. Cultural methods of controlling the pathogens are ineffective while chemical methods are costly and unsafe to humans and environment. In addition, the continuous use of the chemicals has led to pathogen resistance hence creating a serious challenge in their management. Furthermore, despite their use, losses due to post-harvest avocado fungal infestation are still high. Natural plant extracts are an alternative and have been used widely to protect the plants and animals against disease causing pathogens. Among the plants is *Aloe secundiflora,* which has not been evaluated for its bioactivity against fungal avocado fruit diseases despite its antimicrobial activity against different fungal and bacterial pathogens.

Objectives of the Study

Broad Objective

To assess the prevalence of fungal diseases of avocado fruit in selected markets in Embu County, characterize the pathogens and test the efficacy of *Aloe secundiflora* crude extracts against the fungal pathogens.

Specific Objectives

i. To determine the prevalence of post-harvest fungal diseases affecting avocado fruits in selected markets in Embu.
ii. To isolate and morphologically characterize postharvest fungal pathogens infecting avocado fruits.
iii. To evaluate the *in-vitro* efficacy of *Aloe secundiflora* crude extracts against isolates of fungal avocado fruit pathogens.

MATERIALS AND METHODS

The study was carried out in different markets in Embu County, Kenya. A descriptive cross-sectional survey design was adopted for this study. The survey was carried out in the six purposively selected avocado markets in the study area to assess the prevalence of fungal diseases of avocado fruit. A structured questionnaire was administered to avocado fruits sellers to gather information on challenges of avocado marketing, incidences of fungal diseases of avocado fruit, management strategies used and perceived success of such management options. In the laboratory, a 3×4 factorial experiment was laid out in a Completely Randomized Design. The isolates of the conidia were in three different levels and the concentrations of the plant extracts were at four different levels (0mg/ml, 2.5mg/ml, 5.0mg/ml, and 10.0mg/ml). Treatment with 0mg/ml concentration of Dimethylsulfoxide (DMSO) served as the negative control and Copper oxychloride was used as a positive control. The experiment was replicated three times.

Data Collection Procedures

Reconnaissance field visit was made to establish the administrative network and authority to conduct research, study the market and distribution of avocado in Embu County specifically in Runyenjes, Kiritiri, Siakago, Embu town, Mutunduri and Kianjokoma markets. Further studies were conducted to establish the nature and management of the fungal fruit diseases of avocadoes after harvesting. This was done through interaction with 100 vendors by administration of the questionnaire through face-face interviews and also discussions. The visit was also used to identify vendors that formed part of the sample used in the study of disease prevalence. Data on the prevalence of fungal avocado fruit diseases was obtained during market survey in avocado stores per the storage container i.e bags, crates, buckets. All avocado fruits in the storage containers, both infected and uninfected were counted and recorded to determine the prevalence as shown in equation 1 (Aslam *et al.,* 2015). Symptoms that were investigated included those related to fungal avocado fruit diseases such as dark brown lesions, grey spots on the epidermis of the fruit and rotten avocado fruits.

$$[1]\ \%\ \text{Prevalence} = -\frac{\text{No.of fruits infected}}{\text{Total number of fruits assessed}}\ x\ 100$$

Isolation of Avocado Fruit Fungal Pathogens

Infected avocado fruits were cleaned with distilled water to remove dust and dried using a soft cloth. The diseased fruits were surface sterilized with 70% ethanol using cotton wool. The scalpel was then flame sterilized. The diseased parts were removed from advanced margins of the lesion and carefully placed into a petri plate containing potato dextrose agar (PDA) media and another containing Corn meal agar. The petri plates were covered, sealed with parafilm

and labeled with a permanent marker. They were then incubated at room temperature for 7 days in the laboratory. Colony morphology was observed and recorded. Isolation of the pure culture of the fungal pathogens was done by single spore isolation technique whereby an inoculating loop was sterilized and used to scrap a single colony from the isolated fungi and grown on PDA media.

Phenotypic Characterization of the Avocado Fruit Fungal Pathogens

Identification and characterization of the avocado fruit fungal pathogens was carried out according to Fawole & Oso (1995). A drop of Lactophenol cotton blue stain was placed on a clean microscopic slide. A small portion of the mycelium from each of the fungal cultures was picked using a sterile wire loop and placed in the drop of the stain. Two wire loops were used to spread the mycelium well on the slide and a cover slip gently placed over the slide. Microscopic examination was carried out under high power objective lens (×40). Phenotypic characteristics such as color, texture, shape of mycelia, hyphae septation colonies of the fungi were observed and recorded. The most prevalent fungal pathogen was also determined from the growth of colonies. One isolate from each species was further confirmed through Koch's postulate where the pure cultures of the isolates growing on PDA were inoculated to healthy avocado fruit at different surfaces. Pure cultures of fungal isolates grown on PDA for 10 days at room temperature were flooded with sterile distilled water and filtered through double layer cheese cloth to remove mycelia. The filtrate was collected in clean universal bottles and then diluted serially. Using a pipette, a drop of the filtrate was placed on a slide, covered with a cover slip and then placed on microscope stage. Lactophenol cotton blue stain was added to stain the spores to improve visibility. The shape of the spores was noted and the size (length and width) of the 3 spores per isolate was measured using calibrated ocular slide and stage micrometer.

Efficacy of *Aloe secundiflora* on Avocado Fruit Fungal Pathogen

Collection of *Aloe secundiflora* Leaves and Preparation of Crude Extract

Mature Aloe leaves were collected from the field in Mbeere sub-county, a semi-arid region in Embu county. A knife was used to cut the Aloe leaves at the base. The leaves were then put in sterilized buckets and taken to the laboratory for analysis. In the laboratory the leaves were thoroughly washed with running water and rinsed with distilled water to remove dust particles and any other debris. They were then cut into small pieces and spread on a clean and sterilized bench to dry under shade for seven days. The dried Aloe leaves samples were ground into fine powder using a blender. Two samples each of 112g were then soaked in separate organic solvents; hexane and ethanol just enough to cover the mass of the samples. The samples were then left for 72hrs to allow enough time for absoprtion. Each sample was filtered using Whatmann filter papers and the filtrates poured into a round bottomed flask. The round bottomed flask with the contents was then connected to a rotary evaporator to evaporate the solvents under vacuum using a vacuum pump. This was carried out until maximum solvent had been removed. The extracts were then transferred into different beakers and kept into an oven and set at the respective boiling points of the solvents i.e for hexane 68 ºc and for ethanol 78 ºc to fully evaporate the remaining amount of the solvents in the extract to remain with solid phytochemicals. Different concentrations of 2.5mg/ml, 5.0mg/ml and 10.0mg/ml of the extracts were prepared.

For each concentration, a volume of 50ml was prepared for the separate extracts. To prepare 2.5mg/ml, 5.0mg/ml and 10.0mg/ml concentration, 0.125g, 0.25g and 0.50g of the plant extracts respectively were measured and transferred into a 50ml volumetric flask. Dimethylsulfoxide (DMSO) solvent was then added to dissolve the extract before topping it to the mark. They were then transfered to reagent bottles ready for use.

Phytochemical Analysis of the Plant Extract

The phytocompounds in the *Aloe secundiflora* leaf extracts for the two solvents were examined using standard procedures according to Parekh and Chanda (2007). The antimicrobial test was done according to Assob *et al*. (2011). Fifty-four plates of Potato Dextrose Agar (PDA) media were prepared for the three most common pathogens: *C. gloeosporioides, Cercospora purpurea and Sphaceloma perseae*. The spore suspensions were cultured by transferring a lump of the picked fungal pathogen spores using the cork borer into sterile PDA medium on each plate. The antimicrobial test disc or the Whatman paper disc soaked with plant extract was then introduced on to the media at four different positions on the plate; the media was placed in an inverted position and incubated at 25 °C in an incubator for one week in the Laboratory to allow for growth. The zones of inhibition in which no microbial growth had occurred were measured in millimetres. The negative control was done with water while the positive control was a fungicide (copper oxychloride).

Data Analysis

Descriptive statistics was used to summarize data into means and percentages. Data on prevalence of post harvest fungal avocado diseases recorded in percentages was subjected to one way analysis of variance using Microsoft excel

software. Data obtained from efficacy of *A. secundiflora* crude extracts against the three most prevalent fungal avocado pathogens was subjected to analysis of variance using Scientific Analysis System (SAS) version 9.4 software. Significant means were separated using Least Significance Difference (LSD) $\alpha = 0.05$

RESULTS

Prevalence of Anthracnose, Cercospora spot and Scab Disease on Avocado Fruits

There was a statistically significant difference in the prevalence of the avocado fruit fungal diseases at 5% probability level.

Table 1: Percentage Mean Prevalence of anthracnose disease on avocado fruits

	Anthracnose	**Scab**	**Cercospora spot**
Markets	Mean estimate	Mean estimate	Mean estimate
RM	35.00a	32.75b	28.60b
KJM	34.00 b	35.85a	35.15a
SM	29.30bc	36.40a	26.23bc
KM	27.95bc	34.25ab	21.65cd
ETM	26.45c	28.70c	25.70bc
MM	21.30d	20.70d	18.95d
LSD	6.295	12.51	11.42
Mean	29.00	31.44	25.975
CV%	34.57	32.71	38.35

*****Means followed by the same letter are not significantly different. RM represents Runyenjes market, SM-Siakago market, KM- Kiritiri market, ETM-Embu town market, MM-Mutunduri market and KJM- Kianjokoma market.

Morphological Characterization of Fungal Avocado Fruit Pathogens

A total of 72 fungal isolates from diseased avocado fruits in all the markets were identified. A total of 40 isolates had whitish to greyish colour and cottony smooth mycelium on the top side and greyish cream colour as shown in figure 1 and on the bottom side similarly, the lower side of the sub-cultures had creamish grey colour. On re-isolation and inoculation into a healthy avocado fruit, a characteristic darkly coloured, rounded lesion on fruit epicarp and inside the fruit, mesocarp soft rot of light color was formed. A total of 18 isolates had yellow colonies. Cultures were white on the underside of the plates, and mycelia had white and yellow layers. On re-isolation and inoculation into a healthy avocado fruit, a dark brown lesion was confirmed in the epidermis of the fruit. All the 18 isolates of *Sphaceloma perseae* typically formed a slow-growing mycelium, raised and gummy to mucoid colonies on PDA medium. The mycelial growth rate was very slow. *Sphaceloma perseae* isolates developed masses of conidiophores bearing hyaline conidia ovoid or elongated coloured conidia with septation and 5-8 x3-4 µm. The spores sizes of the isolates did not differ significantly ($P > 0.05$) in terms of width and length among the isolates

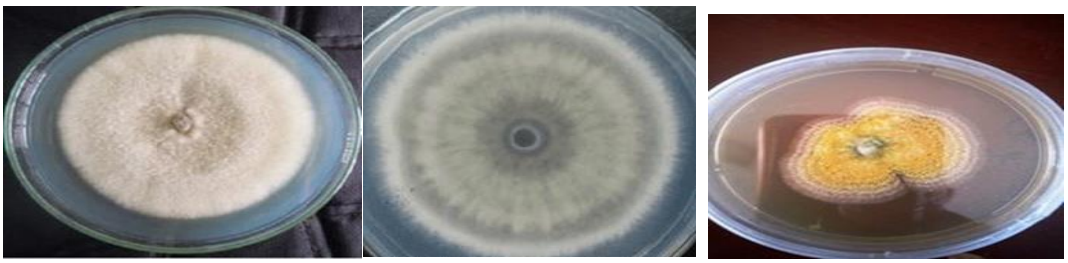


Figure 1: Pure Cultures Isolates of *C. gloeosporioides* upper side of the culture (a) and bottom side of the culture (b), and *S. perseae*(c)

The mycelial colour of the isolates varied from whitish grey, whitish cream and greyish on the upper side of the culture. Similarly, the lower side of the cultures was creamish grey in colour. In terms of mycelia structure, cottony was observed in 24 isolates as compared to velvety observed in 16 isolates. It had a fast growing mycelium that formed concentric zonations. All the *C. gloeosporioides* spores observed were cylindrical and straight with smooth round ends, of large masses that were scattered over the colony and lacked a perithecia with sizes ranging from 3.0-5.0 µm in width and 10.3 – 18.2 µm in length.

Morphological Characterization of *Cercospora purpurea*

Fourteen isolates had colonies which were white leathery with tuffs of grey-brown conidiomata on them, initially grey becoming brown with age (Figure 2). The 14 isolates of *Cercospora purpurea* formed a tufted, leather-like mycelium with a slow mycelial growing rate. *Cercospora purpurea* conidia were long rod shaped to cylindrical, with a blunt end, pale olive, 9 – 11 septate, straight or curved and 20 –34 x 2 – 5 µm were cylindrical in shape with a truncate base.

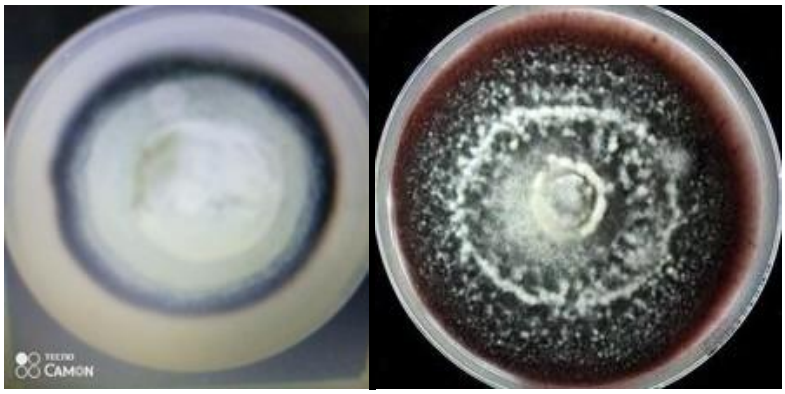


Figure2: A pure culture of *Cercospora purpurea* isolate, (a) for the upper side while (b) on the lower side

Qualitative Analysis of Phytochemicals in *Aloe Secundiflora* Crude Extract

A total of five phytocompounds were found using ethanol extract and four using hexane extract as shown in Table 2. Phenolics were only detected in ethanol solvent extract. Tannins and Alkaloids were not present in any of the crude extract.

Table 2: Results of phytochemical analysis of *Aloe secundiflora* extract

Phytochemical present	Plant crude Extract	
	Ethanolic solvent extract	Hexanic solvent extract
Saponins	+	+
Tannins	-	-
Alkaloids	-	-
Flavonoids	+	+
Terpenoids	+	+
Phenolics	+	-
Steroids	+	+

* (+) signifies presence of the phytochemical compound while (-) signifies the absence of the phytochemical compound.

Antimicrobial Activity of *Aloe secundiflora* Crude Extracts

The inhibitory activities of *A. secundiflora* on Avocado fruit fungal isolates were determined by measuring the diameter of zones of inhibition in millimetres. There were observable zones of inhibition for only *C. gloeosporioides* and *C. purpurea* in different concentrations. However, the extract did not inhibit *Sphaceloma perseae* in vitro. Various concentrations of plant extracts obtained using ethanol and hexane had inhibitory activities against *Colletotrichum gloeosporioides*. There was an increase in the diameter of zone of inhibition as the *Aloe secundiflora* extract concentration was increased. The effect of the different concentration of the plant extract was statistically significant ($P < 0.05$). The mean zone of inhibition for the ethanol extract ranged from 15.59 mm to 11.67 mm. *Aloe secundiflora* ethanol extract concentration of 10.0mg/ml had more microbial inhibitory activity on the *C. gloeosporioides* growth than the lower concentration of 5.0 mg/ml. The concentration of 2.5 mg/ml had the lowest zone of inhibition on the pathogen growth. However, the *Aloe secundiflora* hexane crude extract showed lower mean diameters of zones of inhibition activity (10.59mm to 8.01mm) on *Colletotrichum gloeosporioides* than that of ethanol extract as shown in Table 3.



Figure 4: Zones of inhibition for *Colletotrichum gloeosporioides* isolates for *Aloe secundiflora* crude extract at 25mg/ml for (a) ethanol solvent extract and (b) for hexane.

Table 3: Mean Zones of inhibition recorded on Petri dishes treated with different concentrations of *A. secundiflora* ethanol and hexane extract against *Colletotrichum gloeosporioides* isolates

	*ethanol	*hexane
Concentration(mg/ml)	Mean Zones of inhibition (mm)	Mean Zones of inhibition (mm)
10	15.59[a]	10.53a
5	13.20[b]	9.63b
2.5	11.67[c]	8.01c
LSD	0.49	0.21
Mean	13.50	9.36
CV	3.71	2.29

[**]Means followed by different letter are not significantly different at 5% probability level. Values are means of three isolates each with three replicates.

Antimicrobial Activity against *Cercospora purpurea*

Increase in the concentration of *Aloe secundiflora* extract increased the inhibition of *C. purpurea*. The effect of the different concentration of the plant extract was statistically significant ($P < 0.05$) The Mean zone of inhibition for ethanolic extract ranged from 7.22 mm to 2.80 mm (table 4)The Mean zone of inhibition for hexane extract ranged from 5.27 mm to 3.38 mm as shown in table 10. The plant extract concentration of 10.0 mg/ml had more microbial inhibitory activity on the *Cercospora purpurea* growth compared to the concentration of 2.5 mg/ml which had the lowest zone of inhibition. The inhibitory activity against *Cercospora purpurea* increased linearly with an increase in the concentration of the *A. secundiflora* crude extract. The zone of inhibition on the positive control were significantly higher (21.67mm) than for the plant extract. The zone of inhibition for concentration 10.0 mg/ml was lower than the zone of inhibition of the positive control using copper oxychloride fungicide.

Table 4: Mean Zones of inhibition recorded on Petri dishes treated with different concentrations of *A. secundiflora* ethanol and hexane extract against *Cercospora purpurea.*

	ethanol	hexane
Concentration(mg/ml)	Mean Zones of inhibition (mm)	Mean Zones of inhibition (mm)
10	7.22a	5.27[a]
5	4.31b	4.32[b]
2.5	2.80c	3.38[c]
LSD	0.37	0.15
Mean	4.77	4.32
CV	7.81	3.56

Means followed by the different letter are significantly different at 5% probability level.

Antimicrobial Activity against *Sphaceloma perseae*

There were observable zones of inhibition for copper oxychloride fungicide, positive control, against *Sphaceloma perseae* pathogen isolates with a mean diameter of 17.3mm. However, *A. secundiflora* crude extracts did not inhibit

the growth of the pure cultures of *S. perseae* at any concentration. There was no significant difference in the results between the negative control and all the concentrations of *A. secundiflora* crude extract.

DISCUSSION

The percentage mean prevalence of anthracnose disease of avocado caused by *C. gloeosporioides* was recorded in Runyenjes and Kianjokoma market stores as 41 percent and 36 percent respectively). These findings concur with Handiso *et al* (2019) who found that the highest and lowest anthracnose disease spread was observed in Alaba and Shashogo markets with cumulative prevalence of 41.88% and 36.81%, respectively. These results also concur with Mezgebe *et al*. (2016) findings on post -harvest losses of perishable fruits during harvesting, handling and storage in Ethiopia due to high prevalence of athracnose disease. The highest and lowest mean prevalence of infection by the avocado scab disease (*Sphaceloma perseae*) were recorded in Siakago market and Mitunduri market with a mean prevalence value of 35.16% and 16.37%, respectively.

A study conducted by Trucks *et al* (2011) showed a high prevalence of *Sphaceloma perseae* pathogen of avocado which is carried to infection sites by wind, rain and insects. He did also report that injuries caused by thrips (insects) create entry wounds for *S. perseae* and greatly exacerbate scab development and its prevalence. This was also in agreement with findings by Omolo *et al*. 2011 and Dessalegn *et al*. (2016) on high prevalence of avocado scab whereby 100% avocado dark brown lesions and fruit rots on storage was recorded in on avocado fruits harvested by tree shaking method.There was high prevalence of infection by the Cercospora spot (*Cercospora purpurea*) recorded in Kianjokoma market with and Mitunduri market with the lowest mean prevalence value among the selected markets. The same high prevalence of Cercospora spot was recorded by the findings of Darvas *et al* (1987) who reported that one of the most important pre and post-harvest fruit disease of avocado at Westfalia Estate was Cercospora spot, caused by *Cercospora purpurea*. The high percentage prevalence may have been due to presence of humid and rainy conditions in Kianjokoma region. Similarly, Kallideen, R. (2020) reported high prevalence of Cercospora spot disease in commonly avocado producing and marketing regions where warm, humid and rainy conditions persist in South Africa.

The fungal isolates from diseased avocado fruits showing symptoms of anthracnose collected from the study area varied in their morphological characteristics in terms of conidial lengths. A total of 40 isolates had whitish to greyish colour and cottony smooth mycelium on the top side and greyish cream colour and on the bottom side similarly, the lower side of the sub-cultures had creamish grey colour typical of *C. gloeosporioides*. These cultural characteristics were similar to those of *Colletotrichum gloeosporioides* isolates observed by Pallem *et al*. (2012) in avocado fruits with wide cultural variations among *C. gloeosporioides* isolates. The cultures produced spores were straight with rounded end, ranging within 3.0-5.1 micron in width and 10.3 – 18.2 micron in length characteristic of *C. gloeosporiodes* as reported by Kimaru (2020). The mycelial colour of the isolates observed was predominantly whitish grey compared to cream grey on the upper side of the culture.

Creamish-grey, however, was the most common colour on the lower side of the culture among isolates. The differences observed in cultural and morphological features of the fungus could be associated to their genetic variations and different conditions of growth in terms of temperature, light aspects and repeated laboratory sub culturing as also reported by Vidyalakshini and Divya (2013). A total of 18 isolates obtained from avocado fruits showing symptoms of avocado scab disease had white and yellow colonies. Cultures were white on the underside of the plates, and mycelia had white and yellow layers. *Sphaceloma perseae* isolates developed masses of conidiophores bearing hyaline conidia ovoid or elongated coloured conidia with septation and a range of 5-8 x3-4 µm. These findings were similar to those of Fan *et al* (2018), who reported that the colour of the *Sphaceloma perseae* pathogen may be white to brown and also reported that the mycelia of the pathogen grows at a very slow rate wen grown on PDA media.

The remaining 14 isolates had colonies which were white leathery with tuffs of grey-brown conidiomata on them, initially grey becoming brown with age. These cultural characteristics were typical to those of *Cercospora purpurea* reported by Khallideen (2020) . Similar results were reported by Marais (2004) that once the pathogen is isolated it grows readily on ordinary nutrient media, producing a tufted leathery growth, which is first greyish in color, later becoming brown or blackish-brown. The conidia were long rod-shaped to cylindrical, with a blunt end, pale olive, 9 – 11 septate, straight or curved and 20 – 180 x 2 – 5 µm were cylindrical in shape with a truncate base. Similarly, Groenewald *et al* (2013) reported almost similar conidia characteristics with a wide range of the measurement of the length and width of the spores.

Efficacy of *Aloe secundiflora* Crude Extracts on the Fungal Avocado Pathogens

The study revealed the presence of various phytochemicals present within the *Aloe secundiflora* crude plant extracts prepared using Ethanol and hexane solvents. The two are organic solvents whereby ethanol is a polar solvent while hexane is non-polar and they are able to dissolve some phytochemicals (Gupta *et al.,* 2010). Different solvents are required in crude extraction and phytochemical analysis. The extraction yield and biological activity of the resulting extract is not only affected by the extraction technique but also by the extraction solvent (Ajana *et al.,* 2012). Many solvents, including methanol, ethanol, acetone, and water, have been used for extracting bioactive compounds from the plant material. Due to the variety of bioactive compounds contained in plant materials and their differing solubility properties in different solvents, the optimal solvent for extraction depends on the particular plant materials, and the compounds that are to be isolated (Mahdi *et al.,* 2012). Therefore, recommendation of suitable extraction solvent for individual plant materials is generally difficult. *Aloe secundiflora* crude extract contains phytochemicals such as terpenoids, steroids, saponins, phenolics and flavonoids when extracted using ethanol solvent (Mariita, 2011). However, Kaingu *et al.,* (2013) revealed the absence of phenolics in hexane solvent extract of *A. secundiflora* when used to treat *Ascaridia galli* and various bacterial diseases. This difference in the phenolic content could be due to the solvent nature, method of extraction and duration of extraction having an effect on the concentrations of the phytochemicals.

Antimicrobial activity of *Aloe secundiflora* Crude Extracts

The mean diameter of zones of inhibition for *A. secundiflora* ethanol extract ranged from 15.59 mm to 11.67mm and for hexane extract ranged from10.59 mm to 8.01 mm. These findings were similar to the one reported by Micheni (2015) on the anti-fungal activity of *A. secundiflora* against *Pythium ultimum* that attacks potatoes and *Fusarium oxysporum* which is a pathogen that attacks bananas who reported the highest mean inhibition as 16.01mm for both organisms using ethanol solvent. Similar results were also reported by Itonga, (2011) who reported that the crude extract of *A. secundiflora* was effective against eight different fungi species. Al-Mujammaa'e, (2008) reported that *A. secundiflora* extracts induce the disruption in fungal cell metabolism, increased permeability of fungal plasma membrane and destruction of the conidial wall structure. The more the *A. secundiflora* extract is concentrated the higher the zone of inhibition level. The negative control plates treated with DMSO alone had no zone of inhibition which confirms that *A. secundiflora* extract has antifungal compounds that inhibited the growth of *C. gloeosporioides* .This could be attributed to the various phytochemical constituents such as; glucorunic acid, p- coumaric acid, ferulic acid, phenylpropanoids, dehydro α lapachone and lapachol, β-sitosterol, ferulic acid and iridoids that could be causing the zone of inhibition (Waithaka *et al.,* 2018). The study also revealed that as the concentration of *A. secundiflora* extract was increased, the zone of inhibition by the plant extract also increased .*Sphaceloma perseae* pathogen mycelial growth was not inhibited by crude extracts of *A. secundiflora.* There were observable zones of inhibition when treated with copper oxychloride fungicide as the positive control.

Antimicrobial Activity of *Aloe secundiflora* on the Fungal Avocado Fruit Pathogens

Al-Mujammaa'e, (2008) reported that *A.secundiflora* extracts induce the disruption in fungal cell metabolism, increased permeability of fungal plasma membrane and destruction of the conidial wall structure. Waithaka *et al.,* (2018), reported a similar finding that the antifungal activities of acetone extract of *A. secundiflora* were effective against various fungal pathogen. Moreover, he reported that the antimicrobial activity of the plant extract was due to the phytochemical constituents for instance terpenoids and other polyphenols present in the extracts. Rachuonyo *et al* (2016) also reported that *Aloe secundiflora* leaves extract contain glycosides, phenyl propanoid derivatives, and a eucommiol derivative that are toxic to plant fungal pathogen. He also reported that iridoid glycosides, phenyl propanoid derivatives from *Aloe secundiflora* leaves, is a volatile phyto-anticipin that has been shown to be responsible for the anti-microbial effects of species. Due to the lack of awareness from the consumer and the farmer, they are exposed to these synthetics when they consume food crops that pesticides are used in the management of the pest (Singh and Sharma, 2018).The plant extract had a variation in the zone of inhibition. The differences might be due to the difference in nature, quality and quantity of the inhibitory substances present in the botanicals (Ceylan & Fung, 2004). It was evident from results that the zones of inhibition of the *Colletotrichum gloeosporioides* and *Cercospora purpurea* pathogens by the plant extracts depends upon plant species and extracts concentration. Veresoglou *et al.,* (2013); Kumaran, (2003) did report comparable findings that the fungal susceptibility toward a plant extract was due to plant species, the solvent used for extraction and extract concentration, as well as the organism tested.

CONCLUSION

Most vendors in Embu County have avocado trees in their farms. Avocado fruits produced are consumed as a source of nutrients and sold as source of income both at local market. Marketing and production of avocado in the County is mainly by unskilled vendors who had little knowledge and awareness on proper fruits management. Most vendors did

not use any strategy to manage the fungal avocado fruit diseases. However, few used fungicides such as Bayleton, Milraz and copper oxychloride to control anthracnose in avocado though not registered for use in avocado by the pesticide regulatory authority in Kenya, PCPB. Avocadoes have a high economic return in the county hence highly preferred by farmers and vendors. Anthracnose, Cercospora spot and Scab diseases of avocado cases were noted in all the area. *C. gloeosporioides*, *Cercospora purpurea* and *Sphaceloma perseae* were identified as the causal pathogens of anthracnose, avocado scab and Cercospora spot diseases through characterization. The growth of *C. gloeosporioides* and *Cercospora purpurea* isolates were inhibited by *Aloe secundiflora* crude extract *in vitro* at varying concentrations. Plant extracts used as an antimicrobial agent are relatively economical, safe and non-hazardous and show antimicrobial or antifungal activity against *C. gloeosporioides*, *C. purpurea* and other diseases caused by pathogenic fungal organisms. These plant extracts provide an effective measure for the management of the pathogens that cause avocado anthracnose and cercospora spots in avocadoes that may form an integral part of integrated management and it also has prospect as an alternative to reliance only on fungicides.

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CHARACTERIZATION OF ANTIBIOTIC PRODUCING *ACTINOMYCES* FROM RIVER TANA AND LAKE ELEMENTAITA.

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ABSTRACT
The aquatic environment has many Actinomyces such as Streptomyces species, that produces anti-tumors, enzymes, antibiotics, antivirals, and antifungals. Actinomyces species have produced antibiotics such as chloramphenicol, streptomycin, gentamycin, among others. The increased prevalence of bacterial infections has been a major challenge to the human population with devastating high morbidity and mortality rates. This situation has been worsened by increasing antibiotic resistant strains of pathogenic bacteria, reduced effectiveness of antibiotics in the market, and the emergence of new bacterial infections. This study aimed at isolation and molecular identification of antibacterial Actinomyces species. The experiments for this study was laid out in Complete Randomized Design and replicated three times to determine the difference between the inhibition zones (mm) of isolates against the tests organisms. A total of six antibiotic producing Actinomyces species were isolated from river Tana and lake Elementaita and identified through morphological and molecular characterizations. There was significant ($\alpha = 0.05$) difference on antibacterial activity of Actinomyces isolates against Escherichia coli, Salmonella typhi and Staphylococcus aureus. The findings of this study can help in developing new or alternative antibiotics that can be used for treatment of pathogenic and resistant bacteria.
Keywords: Six *Actinomyces*, antibiotic resistance, antibacterial activity.

INTRODUCTION
Natural products have been extracted from plants, animals and bacteria and used in various industries such as pharmacy, medicine, agriculture, and food. Natural products from microbes have acted as a major source of antibiotics used to treat many bacterial infections worldwide. Starting from penicillin discovered in 1929 by Alexander Fleming, studies have indicated that microbes are a great source bioactive compounds (Mohr *et al.,* 2016). The increased prevalence of bacterial infections has been a major challenge to the human population with devastating high morbidity and mortality rates. This situation has been worsened by increasing antibiotic resistant strains of bacteria, reduced effectiveness of antibiotics in the market, and the emergence of new bacterial infections (Nordenfjäll *et al.,* 2014).

The yearly report of Global Antimicrobial Resistance and Use Surveillance System (GLASS) indicate rising cases of antibiotic resistance for treatment of sepsis, sexually transmitted diseases, urinary tract infections, and diarrhea (WHO, 2022). A good example is percentage resistance against ciprofloxacin meant to treatment urinary tract infection is between 4.1% - 79.4% in *Klebsiella pneumoniae* and 8.4% - 92.9% in *Escherichia coli* (GLASS, 2021). Studies show 64% mortality rate amongst people infected with Methicillin-Resistant *Staphylococcus aureus* (MRSA). *Escherichia coli* and MRSA have developed resistance to third generation cephalosporins. *Neisseria gonorrhea* has shown resistance to sulphonamides, fluoroquinolones, tetracycline, macrolides and penicillins. It is only susceptible to extended spectrum cephalosporins ceftriaxone is effective. In 2018 WHO reported about 500,000 incidences of rifampicin resistance and multidrug resistant *Mycobacterium tuberculosis* (WHO,2022).

The *Actinomyces* species such as *Streptomyces*, *Actinoallumurus and Micromonospora* isolated from various parts of the world has revealed various secondary metabolites of polyketide, cyclo dipeptides, alkaloids and terpenes that have antibiotic activity against pathogenic bacteria (Rao *et al.*,2017). The *Streptomyces* sp. SA32 isolated from India was found to produce biomolecules that were active against multi drug resistance strains of *E. coli, K. pneumonia, S. aureus*, E. *cloacae* and *Enterococcus* species *(Sanghvi et al., 2014).* Eleven species of *Actinomyces* obtained from sediments and water of Lake Tana in Ethiopia had antimicrobial metabolites with activity against *P. aeruginosa, S. aureus E. coli*, and *S. typhi* (Gebreyohannes *et al.,* 2013). *The species of Streptomyces isolated from soil samples in* Bangladesh had zones of inhibition against *Bacillus subtilis* (Ripa *et al.*,2009). *The bacteria isolated from River Wiwi and* Lake Bosomtwe showed activity againsst *Proteus vulgaris, B. thuringiensis. P. aeruginosa, S. aureus,* and *Bacillus Subtilis* (Tawiah *et al.*,2012). This study aimed at isolation and identification and characterization of antibacterial *Actinomyces* from river Tana and lake Elementaita.

MATERIALS AND METHODS

Study Area

The samples for this study were collected from Lake Elementaita and River Tana. River Tana is the longest river in Kenya which is about 1000 km long. Its GPRS coordinates are -2°35'56.42" S 40°20'19.04" E. Lake Elementaita is a soda lake located in the Great Rift Valley about 120 kilometers from Nairobi. Its GPRS coordinates are 0°26'59.99" N 36°14'60.00" E.

Isolation and Identification of Antibacterial *Actinomyces* Species from River Tana and Lake Elementaita

Sample Collection and Inoculation

Using a simple random sampling method, sampling and specific sampling sites identification at R. Tana and L. Elementaita were carried out. During sampling, a total of 64 water and sediment samples were collected into sterile five hundred millilitre screw cap bottles and spaces left to allow mixing and proper aeration. During collection of water samples, the 500 ml bottle were submerged to a depth of approximately 10 cm of water and opened to allow water to fill, closed and removed from water. The water and sediment material were collected at the shallow parts of the lake and river. The water samples were packed in cooler box at 4°C. The packed samples were transported to the Animal Science Laboratory in Chuka University and stored at same temperature awaiting processing (Tawiah *et al.,* 2012). All the samples were tested within 6-24 hours after collection.

Actinomyces were isolated by serial dilution from sediments and water samples. Stock solution was prepared by diluting 1g of sediment in 9 ml of sterile normal saline (8.5g/l) and shaken well using vortex mixer. From stock solution 1 ml was used to prepare the final dilutions of 10^{-1},10^{-2} and 10^{-3} by serial dilution. The 0.1 ml of suspension from 10^{-3} and 10^{-2} were spread on starch casein agar while observing aseptic conditions (Gebreyohannes *et al.,* 2013). For water samples, 1 ml of the stock solution was used to make ultimate volume of 10^{-1},10^{-2} and 10^{-3} by serial dilution. Only the 0.1 ml of 10^{-3} and 10^{-2} suspension were spread on starch casein agar using L-shaped glass rod. To reduce the growth of other bacteria and fungi, starch casein was supplemented with doxycline 100 mg/L and 100 ml of nystatin during preparation. The plates were incubated at 28˚C and monitored after 24hrs, 36hrs and 48 hrs. The resultant colonies were repeatedly streaked on nutrient agar to get pure colonies. The pure colonies were maintained in nutrient agar at 4˚C (Gebreyohannes *et al.,* 2013).

Testing for Antimicrobial Activity of *Actinomyces* Isolates

The isolates were screened for antibacterial activity by agar well diffusion method. To prepare the inoculum, test organisms were grown separately on nutrient agar plates and resultant colonies transferred into 3 ml of normal saline in test tubes (Tawiah *et al.,* 2012). The surface of the Muller-Hinton agar plate was evenly inoculated with *Escherichia coli* with a sterile swab. Then by means of sterile wet swab Muller-Hinton agar plates were inoculated by even streaking of the plate surface (Tawiah *et al.,* 2012). This was repeated for *Salmonella typhi* and *Staphylococcus aureus.* The agar wells (eight milmetres) were made in the inoculated agar using a sterile cork borer and applied with 0.2ml of pure culture of the isolates. The experiment was replicated three times for each of the tests organisms. The plate was incubated at 37˚Cfor 24 hours. The diameter of the zone of growth-inhibition produced were measured using a ruler and the mean value calculated (Tawiah *et al.,* 2012).

Molecular characterization of *Actinomyces* isolates.

Extraction of genomic DNA

The genomic DNA was extracted using a protocol described by Azadi *et al* (2020) with modifications. The *Actinomyces* were allowed to grow in nutrient broth at 37˚C for three days after which the cells pelleted through centrifugation. The *Actinomyces* cells were lysised by pretreating with lipase (200mg/ml) and sonication. The cell wall was disrupted with concentration of lysozyme (200mg/ml) and proteinase K (300mg/ml) in the presence of sodium dodecyl sulfate (SDS) and eventually treated using guanidium isothiocyanate (Azadi *et al.,* 2020). The extracted DNA was purified by phenol-chloroform-isoamyl alcohol (25:24:1, vol/vol/vol) and chloroform-isoamyl alcohol (:24:1, vol/vol) then precitated with ethanol and sodium acetate at 20˚C. The precipitated DNA was washed with 70% ethanol and resuspended in 200 ml of mill-Q water (Azadi *et al.,* 2020). The purified DNA was quantified by agarose gel electrophoresis after staining with ethidium bromide (Rajivgandhi *et al.,*2016).

Amplification of *Actinomyces* DNA

The 16SrRNA gene of *Actinomyces* were amplified with universal primesrs 27F (5'-AGAGTT TGATCMTGGCTCAG-3') to 1492R (5'-CGGTTACCTTGTTACGACTT-3') (Rajivgandhi *et al.,* 2016). The thermocycler Biometra T Personal (Germany) PCR amplifications were done in 20µl volume of reaction mixture

containing 10µl of master mix (10 × DreamTaq Green PCR buffer, 3dNTP and Taq DNA polymerase), 1µl of each primer (20 pmol/µl), 1µl (approximately 200 ng) of template DNA and 7µl of sterile Millipore water. There were 30 cycles of amplification (94˚C for 5min, 94˚C for 40 sec, 52˚Cfor 1 min and 72˚C for 90 sec and final extension at 72˚C for 10 min) (Rajivgandhi *et al.*,2016).

Sequencing similarities and Phylogenetic Analysis

The PCR products was subjected to Sanger sequencing using ABI3730 genetic analyzer (USA). Then BLAST program (www.ncbi.nlm.nih.gov/blst) was used to determine the degree of DNA similarity (Rajivgandhi *et al.*,2016). Multiple sequence alignment was done using clustalW and molecular phylogenetic tree drawn MEGA X version 11.0. (Kumar *et al.*, 2018).

Statistical Analysis

The measurement of the zones of inhibition (mm) for determination of antibacterial activity of *Actinomyces* was analysed using Kruskal Wallis test in SAS version 9.4 because the the data was not normaly distributed even after it was log transformed Significance means were compared using Wilcoxon with Bonferroni correction at alpha = 0.05.

RESULTS

Isolation of Antibacterial *Actinomyces*

Growth Morphology of *Actinomyces* Isolates.

A total of 11 *Actinomyces* colonies were isolated from 64 samples collected at River Tana and Lake Elementaita. Isolate A, B, C, D, E, F and G were isolated from River Tana while isolates H, I, J and K were isolated from Lake Elementaita. The morphological characteristics on starch casein agar and nutrient agar and images of each colony are indicated in the Table 1 and plate 1 below. The isolates had smooth and crenated edges, raised, mucoid, cream -yellow and produced earth like odour.

Table 22*:* Growth Characteristics of *Actinomyces* Isolates on Starch Casein Agar Plates.

Isolates	Outline	Elevation	Consistency	Colour	Smell	Media alteration
A	Entire	Raised	Mucoid	Cream	Earth like odour	Clear
B	Entire	Raised	Mucoid	Creamish yellow	Earth like odour	Clear
C	Crenated	Raised	Mucoid	Creamish yellow	Earth like odour	Clear
D	Crenated	Raised	Mucoid	Creamish yellow	Earth like odour	Clear
E	Entire	Raised	mucoid	Cream	Earth like odour	Clear
F	Crenated	Raised	Mucoid	Cream	Earth like odour	Clear
G	Entire	Raised	Mucoid	Cream	Earth like odour	Clear
H	Entire	Raised	Mucoid	Cream	Earth like odour	Clear
I	Entire	Raised	Mucoid	Cream	Earth like odour	Clear
J	Entire	Raised	Mucoid	Cream	Earth like odour	Clear
k	Entire	Raised	Mucoid	Cream	Earth like odour	Clear
Control	None	None	None	None	None	None

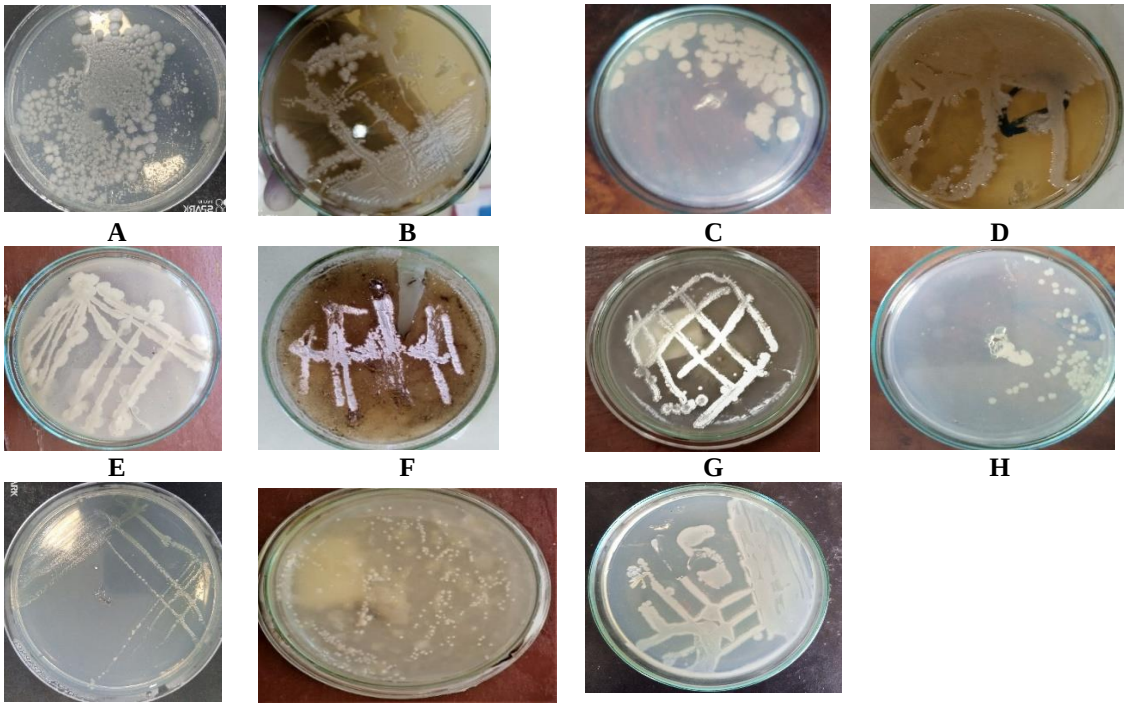


Plate 3: Images of *Actinomyces* isolates on starch casein agar plates. . Isolate A, B, E, G, H, I, J and K had smooth margins, mucoid, raised and white while isolate C, D, F had crenated margins, mucoid, raised and white.

Bioactivity of Selected *Actinomyces* Isolates from River Tana and Lake Elementaita against Selected Test Organisms

Bioactivity of *Actinomyces* Against *E. coli*

There was significant ($p<0.05$) difference in zones of inhibition of *Actinomyces* isolates and standard drugss against *E. coli*. Isolate B (8.8 mm) had the largest zone of inhibition compared to all other *Actinomyces* isolates followed by isolate G (4.2 mm) (Table 5). Isolate B performed lower than standard gentamycin (10 mm), cotrimazole (9.9 mm) and chloramphenicol (9 mm) but performed better than standard streptomycin (5 mm), kanamycin (5 mm), tetracycline (2 mm), sulphamethoxazole (0.0 mm), and ampicillin (0.0 mm). Isolate A, D and H had the lowest zones of inhibition (2 mm) against *E. coli* however they performed better than ampicillin and equal to tetracycline (2 mm). In total 54.5 % of isolates had activity against *E. coli* (Table 2).

Table 23:The Bioactivity of *Actinomyces* Isolates Against *E. coli*

	Analysis Variable : INHIBITION				
Isolates and controls	**N**	**Mean**	**Median**	**Minimum**	**Maximum**
A	3	2.333	2.0^{c}	2.000	3.000
Ampicillin	3	0.000	0.0^{d}	0.000	0.000
B	3	8.767	8.8^{a}	8.600	8.900
C	3	0.000	0.0^{d}	0.000	0.000
D	3	2.633	2.0^{c}	2.000	3.900
E	3	3.333	3.0^{c}	3.000	4.000
F	3	0.000	0.0^{d}	0.000	0.000
G	3	4.300	4.2^{c}	3.800	4.900
Gentamycin	3	9.933	10.0^{a}	9.800	10.000
H	3	2.000	2.0^{c}	1.500	2.500
I	3	0.000	0.0^{d}	0.000	0.000
J	3	0.000	0.0^{d}	0.000	0.000
K	3	0.000	0.0^{d}	0.000	0.000
Tetracycline	3	1.967	2.0^{c}	1.800	2.100

Analysis Variable : INHIBITION					
Isolates and controls	**N**	**Mean**	**Median**	**Minimum**	**Maximum**
chloramphenicol	3	8.967	9.0[a]	8.800	9.100
Cotrimazole	3	9.800	9.9[a]	9.500	10.000
Kanamycin	3	4.900	5.0[b]	4.700	5.000
Saline	3	0.000	0.0[d]	0.000	0.000
Streptomycin	3	4.967	5.0[b]	4.700	5.200
sulphamethoxazole	3	0.00	0.00[d]	0.00	0.00

Bioactivity of *Actinomyces* Against *S. aureus*

There was significant ($p<0.05$) difference in antibacterial activity of *Actinomyces* isolates against *S. aureus* (Table 6). Isolate H (25 mm) had the largest zone of inhibition against *S. aureus* followed by isolate A (8.5 mm) (Table 6). Isolate H performed better than standard gentamycin (7 mm), chloramphenicol (6 mm), cotrimazole (6 mm), tetracycline (4 mm), sulphamethoxazole (4 mm), kanamycin (3 mm), streptomycin (3 mm) and ampicillin (3 mm). Isolate G (1.5 mm) had the lowest zone of inhibition against *S. aureus* performing lower than all the standard antibiotics in the study except ampicillin. In total 45.5% of isolates had bioactivity against *S. aureus* (Table 3).

Table 24: Bioactivity of *Actinomyces* Isolates Against *S. aureus*

Analysis Variable : INHIBITION					
Isolates	**N**	**Mean**	**Median**	**Minimum**	**Maximum**
A	3	9.133	8.5[b]	8.000	10.900
Ampicillin	3	3.900	4.0[c]	3.700	4.000
B	3	3.933	3.9[c]	3.800	4.100
C	3	0.000	0.0[e]	0.000	0.000
D	3	0.000	0.0[e]	0.000	0.000
E	3	6.667	7.0[b]	6.000	7.000
F	3	0.000	0.0[e]	0.000	0.000
G	3	1.667	1.5[de]	1.500	2.000
Gentamycin	3	6.967	7.0[b]	6.700	7.200
H	3	25.333	25.0[a]	21.000	30.000
I	3	0.000	0.0[e]	0.000	0.000
J	3	0.000	0.0[e]	0.000	0.000
K	3	0.000	0.0[e]	0.000	0.000
Tetracycline	3	3.900	4.0[c]	3.700	4.000
chloramaphenical	3	5.867	6.0[b]	5.600	6.000
Cotrimazole	3	5.967	6.0[b]	5.800	6.100
Kanamycin	3	2.867	3.0[c]	2.600	3.000
Saline	3	0.000	0.0[e]	0.000	0.000
Streptomycin	3	3.033	3.0[c]	2.700	3.400
sulphamethoxazole	3	4.000	4.0[c]	3.800	4.200

Bioactivity of *Actinomyces* against *S. typhi*

There was significant ($p<0.05$) difference in antibacterial activity of *Actinomyces* isolates against *S. typhi* (Table 4). Isolate A (8.6 mm) had the largest zone of inhibition against *S. typhi* followed by isolate B (7 mm). Isolate A performed better than standard cotrimazole (8mm), sulphamethoxazole (7 mm), chloramphenicol (7 mm), kanamycin (6 mm), gentamycin (5mm), streptomycin (4mm) and ampicillin (5.0 mm). Isolate H and G (4 mm) had the lowest zones of inhibition which are equal to standard streptomycin and better than ampicillin. In total 45.5% of isolates had bioactivity against *S. typhi* (Table 4).

Table 25: Zones of Inhibition of Actinomyces Isolates Against *S. typhi*

Analysis Variable : INHIBITION					
Isolates	**N**	**Mean**	**Median**	**Minimum**	**Maximum**
A	3	9.167	8.6[a]	8.400	10.500
Ampicillin	3	5.033	5.0[b]	4.800	5.300
B	3	7.000	7.0[a]	5.000	9.000
C	3	0.000	0.0[c]	0.000	0.000
D	3	5.367	5.1[b]	5.000	6.000
E	3	0.000	0.0[c]	0.000	0.000
F	3	0.000	0.0[c]	0.000	0.000
G	3	3.500	4.0[b]	2.000	4.500
Gentamycin	3	5.033	5.0[b]	4.800	5.300
H	3	3.500	4.0[b]	1.500	5.000
I	3	0.000	0.0[c]	0.000	0.000
J	3	0.000	0.0[c]	0.000	0.000
K	3	0.000	0.0[c]	0.000	0.000
Tetracycline	3	5.033	5.0[b]	4.800	5.300
chloramphenicol	3	6.933	7.0[a]	6.700	7.100
Cotrimazole	3	7.900	8.0[a]	7.500	8.200
Kanamycin	3	5.933	6.0[ab]	5.800	6.000
Saline	3	0.000	0.0[c]	0.000	0.000
Streptomycin	3	3.933	4.0[b]	3.800	4.000
sulphamethoxazole	3	7.100	7.0[a]	6.900	7.400

Molecular Characterization of Selected *Actinomyces* Isolates

DNA Extraction and Polymerase Chain Reaction.

The genomic DNA of the six isolates was extracted and underwent polymerase chain reaction of 16S rDNA and electrophoresis on 1% agarose gel stained with ethidium bromide and observed under UV transilluminator. A positive amplification was seen as a bright band at 1500 bp which is the size of the 16S rDNA gene of *Actinomyces* species (1250-1500bp) as shown in Figure 1 below.

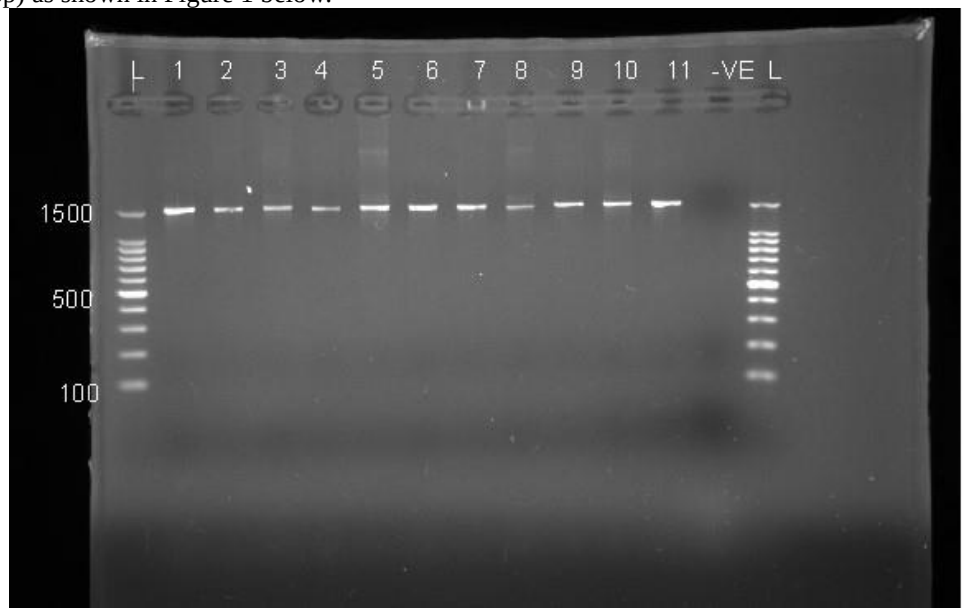


Figure 6: Ethidium bromide stained agarose gel (1%) containing PCR products, primer and template DNA from selected antibiotic producing *Actinomyces* species. L=molecular ladder, 1=isolate A, 2=Isolate B, 3=isolate C, 4=Isolate D, 5=Isolate E, 6=Isolate F, 7=Isolate G, 8=Isolate H, 9=Isolate I, 10=Isolate J, 11=Isolate J, and -VE=Negative control. All the isolates had a bright band at 1500 kb.

Molecular Sequencing of the 16S rRNA Gene

The results of the molecular sequencing of 16S rRNA gene indicated that all the six isolates belong to order *Actinobacterium* as shown above.

Table 26: The results of molecular sequencing showing percentage similarity of related known organisms to isolates.

Isolate	GeneBank Accession No.	% similarity	Scientific name	Country
A	OK483100.1	99.83	*Streptomyces sp.*	India
B	MT039501.1	74.88	*Streptomyces flavomacrosporus*	China
D	LC425654.1	84.59	*Streptomyces sp.*	Nepal
E	JQ437562.1	84.22	*Actinomycetales bacterium*	China
G	KP53721.1	100	*Actinobacteria bacterium*	China
H	KM588147.1	91.66	*Streptomyces intermedius*	Iran

The phylogenetic tree divided the six isolates into four dendrograms. The isolate G and E formed the first dendrograms, isolate H formed the second dendrograms, isolate D and isolate B formed the third dendrograms and isolate A formed the last dendrograms as shown in the Figure 2 below.

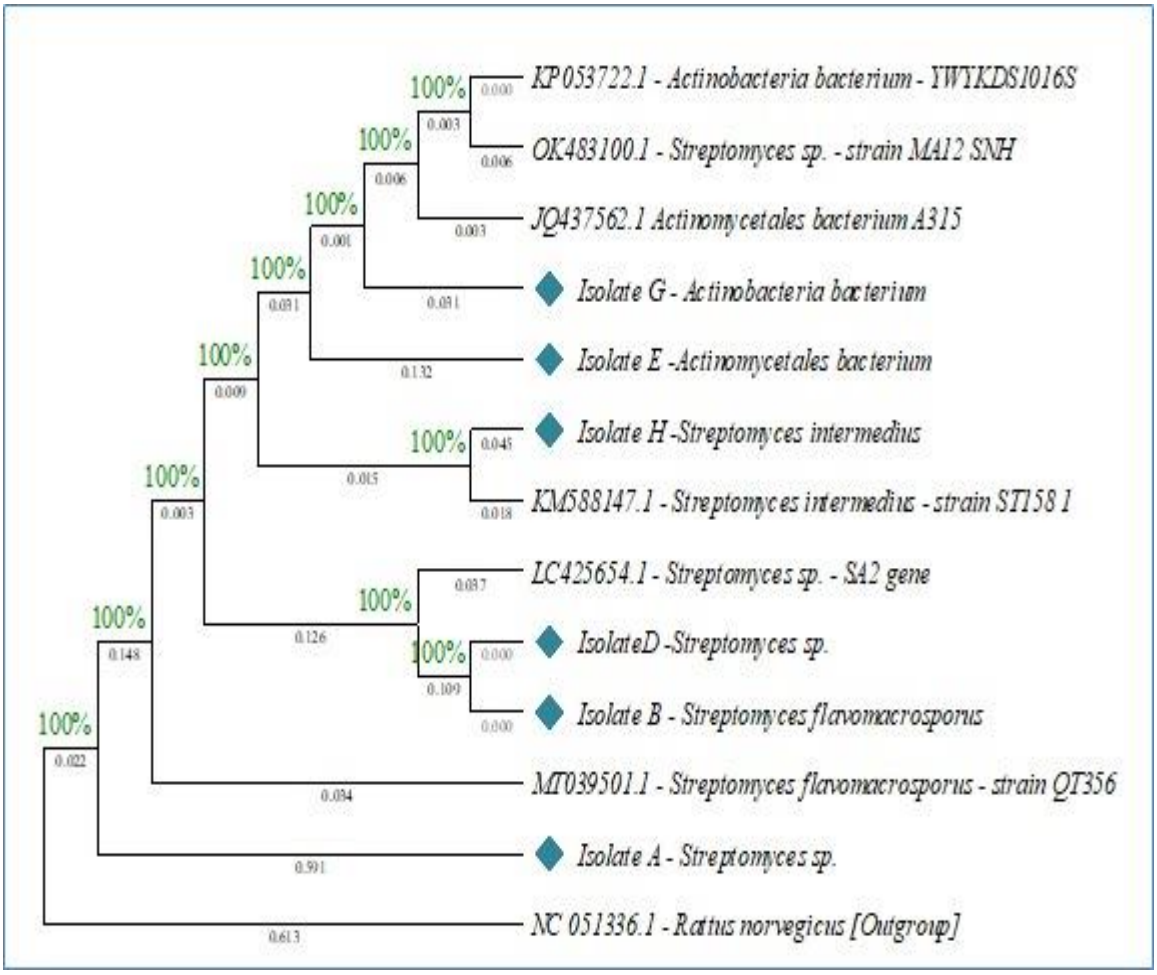


Figure 7: The phylogenetic tree showing the six isolates divided into four dendrograms.
The evolutionary distance matrix of the *Actinomyces* isolates and various *Actinomyces* in the gene bank in the above phylogenetic tree is shown in Table 6 below.

Table 27: A matrix showing relationship amongst six isolates.

Actinomyces	1	2	3	4	5	6	7	8	9	10	11	12
LC425654.1-*Streptomyces_sp*._SA2	0											
IsolateD -*Streptomyces sp.*	0.21											
JQ437562.1-*Actinomycetales bacterium*-A315	0.22	0.29										
IsolateE-*Actinomycetales bacterium*	0.33	0.42	0.16									
IsolateG - *Actinobacteria bacterium*	0.24	0.36	0.06	0.28								
KP053722.1– *Actinobacteria-bacterium*-YWYKDS1016S	0.23	0.35	0.01	0.28	0.10							
Isolate H -*Streptomyces intermedius*	0.27	0.38	0.11	0.34	0.19	0.20						
KM588147.1-*Streptomyces-intermedius*-strain-ST158	0.25	0.27	0.05	0.25	0.07	0.04	0.11					
OK483100.1-*Streptomycessp*.strain-MA12-SNH	0.23	0.35	0.01	0.28	0.10	0.00	0.20	0.05				
Isolate A -*Streptomyces sp.*	0.55	0.55	0.51	0.54	0.51	0.49	0.52	0.50	0.50			
MT039501.1-*Streptomyces_flavomacrosporus*_strain_QT356	0.24	0.36	0.07	0.31	0.16	0.05	0.20	0.03	0.05	0.50		
Isolate B -*Streptomyces flavomacrosporus*	0.16	0.00	0.29	0.34	0.30	0.28	0.31	0.29	0.28	0.55	0.29	
MH028054.1-*Nigrospora_sphaerica*_strain_E6_{outgroup}	0.50	0.51	0.42	0.51	0.46	0.44	0.49	0.45	0.45	0.60	0.45	0.48

DISCUSSION

Morphological Characteristics and Antibacterial properties of Actinomyces Isolates

The *Actinomyces* isolates (A-K) had excellent growth in both starch casein and nutrient agar this can be due to sufficient nutrients and minerals in the two media (Gebreyohannes *et al.,* 2013). On starch casein, *Actinomyces* isolates appeared smooth edged, raised, mucoid, soil like odour, and white to cream. These morphological characteristics are similar to Gebreyohannes *et al*. *Actinomyces* isolates from Lake Tana in Ethiopia. *Actinomyces* isolates in Gebreyohannes *et al*. had excellent growth in starch casein agar appearing as white or cream colonies that were Gram positive (Gebreyohannes *et al.,* 2013). Observed morphological characteristics of Gouse *et al.* (2017) indicated *Actinomyces* that were white yellow or cream in colour, wrinkled or smooth edged and Gram positive, this is comparable with the findings of this study. *Actinomyces* produce volatile essential oils which makes them to have characteristic soil-like odour (Hasani *et al.*, 2014).

There was significantly ($p<0.05$) different in antibacterial activity of *Actinomyces* isolates against *E. coli* (54.5%), *S. aureus* (45.5%) and *S. typhi* (45.5%). This results are comparable to other studies worldwide which have revealed that *Actinomyces* have potential to produce metabolites with antibacterial activities against pathogenic bacteria. The study carried out by Gouse *et al.* (2017) indicated that 59% of *Actinomyces* isolates had antibacterial activity against test organisms. A study by Charousová *et al*. (2019) results indicates that 39.5% of *Actinomyces* isolates had bioactivity

against *Bacillus subtilis, E. coli* and *Pseudomonas aeruginosa*. Eleven species (35.5%) of *Actinomyces* isolated in Lake Tana Ethiopia had bioactivity against *E. coli, S. typhi, k pneumonia, Pseudomonas aeruginosa* and *S. aureus*.

There was significant ($p<0.05$) difference in antibacterial activities ofethyl acetate and chloroform extracts. Ethyl acetate extracts had a higher inhibition against test organisms than chloroform extracts. This is contrast to Sanghvi *et al.,* (2014) who reported that *Actinomyces* isolates from India had chloroform extracts with broad spectrum but ethyl acetate extract had limited activity.The secondary metabolites are more soluble in ethyl acetate than chloroform.The antibacterial difference between these extracts can be attributed to large number and high concentration of antibacterial metabolites of *Actinomyces* isolates in ethyl acetate extracts than in chloroform (Bernier *et al.,* 2013).

Molecular Characterization of the *Actinomyces* Isolates

The sequencing of 16S rRNA gene of isolate A (99.83%) revealed that it is closely related to *Streptomyces sp.* OK483100.1. The isolate B (74.88%) is closely related to *Streptomyces flavomacrosporus* MT039501. The *Streptomyces flavomacrosporus* has been reported to have antibacterial activity against *B. subtilis, E. coli, S. typhi, P. aeruginosa* and antifungal activity against *Apergillus species* (Khalid *et al.,* 213). The isolate D (84.59 %) was identified to be closely related to *Streptomyces sp.* LC425654.1. The *Streptomyces sp.* LC425654 isolated from the soil samples in Nepal had bioactivity against extended spectrum beta- lactamase producing *E. coli, S. typhimurium, K. pneumonia* and *S. aureus* (Khadayat *et al.,* 2020).

The *Actinomyces* isolate E (84.22%) and G (100%) was found to be closely related to *Actinobacteria bacterium* JQ437562 and KP53721 respectively. The isolate H (91%) is closely related to *Streptomyces intermedius* KM588147.1 which is closely related to haloalkaliphilic *Streptomyces intermedius* isolated in India that activity against *E. coli* and *B. subtilis* (Dayma *et al.,* 2019).

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PHYTOCHEMICAL ANALYSIS, *IN VITRO* TESTING OF ANTIBACTERIAL PROPERTIES, ANTI-INFLAMMATORY ACTIVITY, AND CYTOTOXICITY OF AQUEOUS AND DICHLOROMETHANE LEAF EXTRACTS OF *SOLANUM INCANUM* AND *TAMARINDUS INDICA*

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ABSTRACT
Most communities use medicinal plants to treat and prevent various diseases. The use of the plants demonstrates the need to study the efficacy of selected medicinal plants. There is limited information on the antibacterial, anti-inflammatory activity, and cytotoxicity of *Solanum incanum* and *Tamarindus indica* leaves extracted using polar and less polar solvents. This study focused on analyzing phytochemicals present in aqueous and dichloromethane leaf extracts of the two plants and testing their antibacterial, anti-inflammatory, and cytotoxic properties. The phytochemical analysis was done using standard chemical tests followed by Gas Chromatography-Mass Spectroscopy of dichloromethane extracts. The antibacterial potency of the extracts was tested against *Escherichia coli, Salmonella typhi,* and *Staphylococcus aureus* using disc diffusion, Minimum Inhibitory Concentration, and Minimum Bactericidal concentrations. The anti-inflammatory potency of the extracts was tested using an Erythrocyte stabilization assay, while the toxicity of the extract was tested using brine shrimp lethality tests. The chemical test revealed that all the plant extracts contained flavonoids, tannins, saponins, phenols, and alkaloids. The *T. indica* dichloromethane and *S. incanum* water extracts had no glycosides, while anthraquinones were absent in all the plant extracts. The chromatographic analysis demonstrated the presence of flavonoids, phenols, and alkaloids in the selected plant extracts. The antibacterial activity revealed no significant difference in antibacterial activities between the two plants at $\alpha = 0.05$. *E. coli* and *S. Typhi* were the most sensitive, while *S. aureus* was the least sensitive to the extracts. The Minimum Inhibitory Concentration of *T. indica* ranged between 62.5 µg/mL and 125 µg/mL among the test organisms, while the Minimum Inhibitory Concentrations of *S. incanum* ranged between 62.5 µg/mL and 250 µg/mL. The Minimum Bactericidal Concentration of both plants ranged between 125 µg/mL and 500 µg/mL. The *T. indica* dichloromethane extracts had the highest stabilization, 57.64 ±13.90%, while *S. incanum* water extract had the lowest erythrocyte stabilization percentage, 19.06 ±14.43%. *T. indica* plant was more effective at 45.59 ±27.09% compared to *S. incunum*, 37.12 ±15.70%. The dichloromethane extracts of the two plants were more effective, 56.41 ±19.71% than water extracts at 26.30 ±12.53%. *T. indica* dichloromethane extract has the highest toxicity (LD_{50} of 113.57 µg/mL) while *S. incanum* was least toxic (LD_{50} of 2341 µg/mL). The assays demonstrated that the two plants are effective in treating bacterial infections and managing inflammation. Also, the two plants were toxic at higher doses.
Keywords: Anti-inflammatory, Anti-bacterial, Toxicity, Phytochemicals, Lethal Dose, Bactericidal concentrations

INTRODUCTION
Background Information
Most communities in Kenya have been using various plants to prevent, manage and treat diseases (Gakuya *et al*., 2020). The successful use of medicinal plants is attributed to their phytochemical composition, which explains the importance of phytochemical analysis in medicinal plants research (Yoo *et al*., 2018). Phytochemical analysis entails all studies done to determine the phytochemical composition of various extracts and their concentrations. The preliminary testing is then followed by elucidation of chemical structures of phytochemicals of interest. Yoo *et al*. (2018) also revealed that understanding the molecular composition of a plant extract is essential in accurately predicting its health effects. There is limited information on the phytochemical composition of *S. incanum* and *T. indica* leaf extracts from Tharaka Nithi county. Therefore, it is important to conduct a preliminary phytochemical analysis of the two plant extracts and link the phytochemicals present with various health benefits.

Traditional practitioners have been using *S. incanum* and *T. indica* to cure bacterial infections and manage diseases caused by inflammation (Akanmu *et al*., 2018; Enoc *et al*., 2018). The herbalists justify their efficacy by the ability of the plant extracts to promote the healing of chronic wounds and manage gastrointestinal Tract illnesses (Taye *et al.*, 2011). Studies using plants from other regions have demonstrated that these plants could have antibacterial potency. Sbhatu and Abraha (2020) explained that both ethanolic and aqueous leaf extracts of *S. incanum* were effective against *S. aureus, S. typhi,* and *E. coli*. Similar results were reported when methanolic leaf extracts of the plant were used against *Streptococcus pyogenes* and *Pseudomonas aerugninosa* (Akanmu *et al.*, 2018). Other studies concluded that ethanolic and methanolic leaf and fruit extracts of *T. indica* were active against several bacterial species, including *Bacillus subtilis, E. coli,* and *P. aeruginosa* (Abdallah and Ali, 2018; Hassan *et al*., 2019). Based on the solvents used,

the studies focused more on polar phytochemicals, leaving a knowledge gap on the efficacy of less polar phytochemicals present in the extracts. Less polar solvents such as Dichloromethane (DCM) can be used to extract nonpolar phytochemicals. DCM extract can then be used to assess the effectiveness of the target phytochemicals.

S. incanum and *T. indica* from other world regions have been assessed for their anti-inflammatory potency. Da Costa *et al*. (2015), using *S. incanum* from Brazil, reported that the plant effectively controlled inflammation at dosages above 75 mg/kg. Enoc *et al*. (2018) found that *S. incanum* extracts effectively managed acute inflammation at dosages above 6.5 mg/kg. Researchers confirmed that the ethanolic extracts of the *T. indica* roots and back have antioxidant and anti-inflammatory effects, with the roots being superior to the back (Borquaye *et al*., 2020). These studies on the antibacterial and anti-inflammatory potency of the plant explain why traditional healers have successfully managed bacterial and inflammatory diseases over the years. However, no studies have been published on the anti-inflammatory potency of *S. incanum* and *T. indica* used in eastern Kenya despite their regular use in Meru traditional medicine. Several studies have been done to assess the toxicity of various plant extracts. Da Costa *et al*. (2015) reported that dichloromethane extracts of *Solanum lycocarpum* leaves had lower toxicity than ethyl acetate and hexane extracts. A study using *T. indica* seeds demonstrated that vincristine sulfate extracts of the seeds had lower toxicity compared to ethanolic and methanolic extracts (Hassan *et al*., 2019). These studies show variation in toxicity levels in plants extracted using different solvents. Due to this, it was also important to evaluate the toxicity levels of various concentrations of *S. incanum* and *T. indica* extracts.

Statement of the Problem

The emergence of multidrug-resistant bacteria strains such as Methicillin-Resistant *Staphylococcus aureus* (MRSA) and toxicity caused by most anti-inflammatory medications pose a significant health problem globally. Traditional practitioners in Eastern Kenya use *S. incanum* and *T. indica* to manage bacterial-related diseases and inflamation. However, the plants in the region have not been scientifically evaluated for their antibacterial and anti-inflammatory properties. In addition, there is limited information on the toxicity profile of the two plants. Using plants with toxic metabolites can affect the users' health in the long run.

General Objective

To determine the phytochemical composition, antibacterial properties, anti-inflammatory activities, and cytotoxicity of aqueous and dichloromethane leaf extracts of *Solanum incanum* and *Tamarindus indica.*

Specific Objectives

-To determine phytochemical composition of aqueous and dichloromethane leaf extracts of *S. incanum* and *T. indica*.
-To determine the antibacterial potency of aqueous and dichloromethane leaf extracts of *S. incanum* and *T. indica* using diffusion and dilution methods.
-To determine the anti-inflammatory activity of aqueous and dichloromethane leaf extracts of *S. incanum* and *T. indica* in erythrocytes.
-To determine the cytotoxicity of aqueous and dichloromethane leaf extracts of *S. incanum* and *T. indica* using the brine shrimp lethality test.

MATERIALS AND METHODS

Study Site

The leaves of *S. incanum* and *T. indica* were obtained from their natural habitat in Karingani ward, Tharaka Nithi County (0° 17' 60.00" N Longitude: 38° 00' 0.00" E). The plants were identified based on their ethnobotanical information. The sampling of *S. incanum* was based on their age (plants that have not produced any flowers were the most preferred), while only fresh *T. indica* leaves were picked for the study.

Research Design

The antibacterial assay was performed using a 3×3×2×2 factorial design laid out in Complete Randomized Design (CRD). The four factors used were three bacterial stains, three concentrations two plant species, and two extraction modes. The anti-inflammatory assay was done using a 4×2×2 factorial design laid out in CRD. Three factors to used were concentrations at four levels, plant species at two levels and modes of extraction at two levels. Three replicates were used in the two research layouts. The toxicity test was conducted using a 3×2×2 factorial design laid in CRD. The three factors used for the study were concentration at three levels, two modes of extractions and two plant species. Each concentration in the toxicity assay was replicated five times.

Data Collection

Sample Preparation and Extraction of Phytochemicals

The leaves were collected while green and washed with running water at room temperature to remove dust. They were dried at room temperature away from direct sunlight until they were completely dry. The duration taken to complete the drying process depended on the succulence of the leaves. Each dried sample was milled independently using a blender to obtain a fine powder. The powdered samples were stored in waterproof bags to avoid contamination and exposure to moisture. The extraction process was done according to Jimoh *et al*. (2019) with minor modifications. Two hundred grams of each powdered sample were soaked in four different reagent bottles containing 1000 mL of the respective solvents (Distilled water and DCM) for 48 hours. The mixtures were vigorously hand-shaken every 12 hours to facilitate extraction. The mixtures were filtered using a cotton cloth and Whatman No. 1 filter papers into four separate beakers. A rotary evaporator was used to concentrate the DCM crude extract at 40 ºC and 100 mbar. The water filtrates were chilled at -20 ºC to facilitate the freeze-drying process. To maximize the extraction process, each sample was divided into approximately 200 mL portions, which were poured into different plates of the freeze-drier. The freeze-drying process was done for 72 hours.

Determination of Phytochemical Composition

Test for Phenols

The test was performed as described by Mumtaz *et al*. (2014). One milliliter of each extract was added to test tubes containing one milliliter of distilled water. Two drops of Iron III chloride ($FeCl_3$) were added, and the mixture was shaken several times. A bluish-green colour indicated the presence of phenols. The data was recorded in a table.

Test for Saponins

The test was performed according to the method described by Mumtaz *et al*. (2014). Two grams of powdered samples were added to 20 mL of distilled water and boiled in a water bath for five minutes. The mixture was filtered using filter paper. To 10 mL of the filtrate, 5 mL of distilled water was added, and the mixture was shaken vigorously. A stable foam indicated the presence of saponins. The data was then recorded.

Test for Flavonoids

The test was performed as described by Mumtaz *et a*l. (2014). One gram of the powdered extracts was heated in 10 mL ethyl acetate for five minutes. The mixture was filtered, and one milliliter of dilute ammonia was added to the samples. The yellow colour indicated the presence of flavonoids. The data was recorded in a table.

Test for Alkaloids

The test was conducted as described by Rao *et al*. (2016). Two milliliters of each extract were mixed with 0.2 mL of 2 N HCl. One milliliter of Meyer's reagent was added, and the mixture was shaken. The yellow colour indicated the presence of alkaloids. The data was recorded in a table.

Test for Terpenoids

Two milliliters of chloroform were mixed with 0.5 mL of each extract, and three milliliters of concentrated sulfuric acid were added. The mixture was gently shaken. Red or brown colour at the interphase between sulfuric acid and chloroform will indicate the presence of terpenoids (Rao *et al*., 2016). The data obtained was then recorded.

Test for Glycosides

In one milliliter of distilled water, 0.5 g of each extract was added. Three drops of aqueous sodium hydroxide were added, and the mixture was shaken. The yellow colour indicates that glycosides are present (Rao *et al*., 2016). The obtained data were recorded in a table.

Test for Anthraquinones

Twenty milliliters of chloroform were added to a test tube containing one gram of powdered leaf. The mixture was heated in a water bath for five minutes. The extract was filtered and allowed to cool before 10% ammonia was added (Auwal *et al*., 2014). The mixture was vigorously shaken, and the upper later of the mixture was observed for pink colouration. The results were recorded in a table. The described tests were used to determine the presence or absence of the selected phytochemicals, which are important in understanding the basis of the bioactivity of the plant extracts.

Gas Chromatography-Mass Spectrometer (GC-MS)
The plant extracts were subjected to GC-MS analysis to obtain a spectrum that was used to estimate the concentrations of each compound. Solid extracts obtained during the extraction phase were dissolved in DCM. To 1 mL of DCM, 0.2 g of the extract was added. The mixtures were hand-shaken until the extracts are dissolved. The samples were filtered using filter paper to obtain an injectable sample (Komappa *et al*., 2020). The carrier gas for analysis was helium, which was set at a flow rate of 1.0 mL/min. Other conditions set on the GC-MS machine include 16.2 psi, 1 µL injector, a split ratio of 1:50, interphase temperature at 300 ºC and ion-source temperature at 250 ºC. The average percentage of each phytochemical class was determined by comparing the peak area of the phytochemicals to the total areas. The data from this analysis was used to estimate the concentration of the phytochemicals in each extract.

Determination of Antibacterial Activity
Three bacterial strains (*Staphylococcus aureus* ATCC 25923, *Escherichia coli* ATCC 25922, and *Salmonella typhi* ATCC 6539) were used to test the antibacterial potency of the plant extracts. The bacteria strains were obtained from the biological sciences laboratory at Chuka University.

Disc Diffusion Assay
The disc diffusion method was done using the modified Kirby-Bauer assay as described by Hudzicki (2019). Muller Hinton Agar (MHA) was prepared by dissolving 19 g of the agar powder in 500 mL distilled water. The mixture was autoclaved at 121 ºC for 15 minutes. Thirty-Six Petri dishes were labelled and subdivided into four quadrants using a marker pen. The label contained the name of the bacteria, the plant species, the extraction solvent used, and the concentration of the extract. Fifteen milliliters of the media were poured into each of the thirty-six sterile Petri dishes and allowed to solidify. The microorganisms were suspended in 10 mL of normal saline. Using a sterile wire loop, the microorganisms were applied to the Petri dishes with MHA while rotating the dishes for uniform inoculation. Discs (6 mm diameter) were made from a Whatman filter paper No.1 using a paper punch. The discs were covered with an aluminum foil and sterilized by autoclaving at 121ºC for 15 minutes. Three concentrations (3000 µg/mL, 1500 µg/mL, and 750 µg/mL) of each extract were prepared as described by Burman *et al*. (2018).

Ten microliters of each sample were applied to the 6 mm discs so that each disc was soaked with the different concentrations of the extracts. The discs were dried at room temperature covered in sterile Petri dishes for thirty minutes. The dried discs were placed on MHA plates with the bacterial strains, one at a time, using a pair of sterilized forceps. Each disk was placed at the center of a quadrant. A positive control disk (ciprofloxacin commercial disk) was placed on the fourth quadrant. Each Petri dish will contain three discs with the extract at the same concentration and one positive control placed in independent quadrants. The forceps were sterilized after each transfer stage. The plates were incubated for 24 hours at 37 ºC after which the zones of inhibition produced by the extracts and control were measured in millimeters using a ruler. The data was used to compare the efficacy of the plant extracts with the positive control and differences in antibacterial potency of the two plant extracts. In addition, the zone of inhibitions was used to compare the differences in antibacterial activities of aqueous and DCM extracts of the same plant.

Determination of Minimum Inhibition Concentration
Determination of Minimum Inhibition Concentration (MIC) was conducted according to Bussmann *et al*. (2011) with minor modifications. The process was done only for the extract that showed a strong antibacterial activity (zone of inhibition ≥ 10 mm) (Mariita *et al*., 2011). All the plant extracts were diluted to attain a 500 µg/mL, 250 µg/mL, 125 µg/mL, 62.5 µg/mL, concentrations. Five hundred milliliters of nutrient broth were prepared by dissolving 6.5 g of nutrient broth powder into 500 mL distilled water in a conical flask. The mixture was gently mixed and heated to ensure all the powder had dissolved. The conical flask was tightly covered with aluminium foil and the mixture autoclaved at 121 ºC for 15 minutes. The broth was allowed to cool at room temperature for subsequent procedures.

Fifteen milliliters of microorganism suspensions were prepared by picking a small sample of each strain from sample vials. The bacteria were transferred into two test tubes each containing 15 mL of distilled. The tubes were gently shaken to ensure that the microorganisms were evenly suspended in distilled water. For the first extract, A set up for MIC contained two sets of four test tubes, with each tube containing 1 mL of nutrient broth. To the first tubes in each set, 500 µg/mL (1 mL) of the first extracts was added and mixed by pipetting the extract up and down. From the first tubes, one milliliter of the mixture was obtained and transferred to the second tubes. The same procedure was used for the third and fourth tubes. The next stage involved the addition of 100 µL of the individual bacterial strains into each tube containing plant extracts such that set one contained a gram-positive bacterium (*S. aureus*) while set two contained a gram-negative bacterium (*E. coli*). The same procedure was repeated for the other three extracts. For the

positive control, amoxicillin was diluted to attain the same concentration as the extracts. The control setup was similar to that for the extracts, but the extracts were replaced with the standard drug. Two tubes, one inoculated with *S. aureus* and another inoculated with *E. coli*, were used as negative controls. All the tubes were incubated at 37 ºC for 24 hours, after which visible turbidity in the tubes was assessed. The minimum concentration without any visible turbidity was used for the MBC assay.

Determination of Minimum Bactericidal Concentration

The assay was conducted as described by Mostafa *et al*. (2018) with minor modifications. Twenty-four Petri dishes were labelled, and MHA was prepared as described in procedure 3.3.3.1. The sub-culturing process was done by taking 100 µL samples from the two lowest concentration tubes without any visible bacterial growth. The samples were inoculated in independent MHA plates. A sterile wire loop was used to spread the samples evenly on the media. All the Petri dishes were incubated for 24 hours at 37 ºC, after which the MBC values were obtained. The lowest concentration without visible growth on MHA after the specified duration was recorded as MBC. The subculturing was done in duplicates for each concentration. The data from this assay will help determine whether the extracts have bacteriostatic or bactericidal effects on the three strains.

Determination of anti-Inflammatory Activity

An anti-inflammatory assay was performed using the membrane stabilization method as described by Yesmin *et al*. (2020) with minor modifications. Twelve milliliters of blood samples were collected from healthy sheep using 20-gauge needles and 5 mm syringes. The blood was gently transferred to three-4 mL EDTA tubes and gently shaken five times. This helped prevent hemolysis and ensure that the blood samples were well mixed with the anticoagulant. The three blood-containing tubes were transported in cool boxes. In preparation for the assay, the blood was removed from the cool boxes and kept at room temperature for 20 minutes. The samples were centrifuged at 2500 rpm for 5 minutes, and the packed cells were washed three times with isosaline (0.9% w/v NaCl, pH 7.2). A 10 % v/v suspension of the erythrocytes was prepared by adding 4 mL of the cells to 36 mL of Isosaline. A phosphate buffer (0.15 M, pH 7.4) was prepared by mixing 121.5 mL of 0.15 M $NaH_2PO_4.2H_2O$ and 28.5 mL of 0.15 M Na_2HPO_4 solutions (Kezia *et al*., 2020). Positive control was prepared by dissolving 0.1g of diclofenac sodium in 100 mL isosaline to form the mother liquor. The solution was diluted using isosaline to attain a 100 µg/mL concentration.

A 4.5 mL solution containing 0.25% w/v hyposaline (2 mL), 0.15 M sodium phosphate buffer (1 mL), 10% erythrocytes (0.5 mL) and plant extracts (1 mL) at different concentrations (500 µg/mL, 1000 µg/mL, 2000 µg/mL, and 4000 µg/mL were prepared (Kezia *et al*., 2020). In the negative control, the extracts were replaced with 1 mL isosaline, while in the positive control, the extracts were replaced with 1 mL diclofenac sodium solution. The tubes were incubated in a water bath at 50 ºC for 20 minutes and then centrifuged at 3000 rpm for five minutes. Two milliliters of the supernatant were gently pipetted into cuvettes. The absorbance of the supernatant was read at 560 nm. The experiment was performed in three replicates for all the test samples. The percentage of hemolysis was estimated by assuming the hemolysis produced by the negative control was 100%. The percentage of erythrocyte membrane stabilization or protection was calculated using the following formula described by Yesmin *et al*. (2020).

$$\text{Percentage protection} = 100 - (\text{OD sample} / \text{OD control}) \times 100$$

The data obtained from this assay were analyzed to compare the effectiveness of the extracts and the positive control (diclofenac sodium). The data also demonstrated the difference in efficacy between the plant extracts.

Determination of Cytotoxicity of Plant Extracts

Hatching the Brine Shrimp

Three liters of distilled water were measured and poured into a rectangular jar. Twenty-seven grams of table salt were added to the water and stirred to ensure that the salt had completely dissolved. An airline was placed on one side of the jar to enhance air circulation. Fifteen grams of brine shrimp eggs were added to the top of the water jar, followed by mixing (Sarah *et al*., 2017). A 75-watt bulb was placed a few inches from the jar and was switched on. The nauplii hatched after 24 hours, after which they were obtained for toxicity testing.

Toxicity Testing

All the extracts prepared in procedure 3.3.1 were diluted to attain three different concentrations (10 µg/mL, 100 µg/mL and 1000 µg/mL) in 10 mL seawater containing 1% dimethyl sulfoxide (DMSO). Five replicates were prepared for each concentration. Nauplii were picked by sterilized forceps and exposed to the three concentrations such that each

tube with the extracts contained ten live nauplii (Sarah *et al*., 2017). The positive control setup was prepared using vincristine sulphate, while the hatching solution containing 1% DMSO was used as the negative control. The number of live nauplii was counted after 24 hours. A nauplius was considered dead after 30 seconds of no forward motion. The percentage of death of nauplii was calculated as follows.

$$\text{Percentage Death} = \frac{\text{Number of dead nauplii}}{\text{Number of dead nauplii} + \text{Number of live nauplii}} \times 100$$

The LD_{50} was calculated using the probit method. An extract was considered toxic if 50% of the nauplii died at lower concentrations. The data is important in deciding the safest concentrations, but with maximum health benefits.

Statistical Analysis

The values of average zones of inhibition produced by the four plant extracts and RBC stabilization assay results were analyzed using one-way Analysis of Variance (ANOVA). The significance level for the differences will be set at a 5% probability level, after which Least Significant Difference mean separation procedures were applied. The percentage death data obtained from the brine shrimp lethality test was analyzed using probit analysis, and LD_{50} will be obtained using regression at a 5% probability level. All the analysis was done using STATA software.

RESULTS

Yields of the Extracts

The yield of the extract was calculated using the formula below.

$$\text{Percentage Yield} = \frac{\text{Weight of the extracts after concentration}}{\text{Weight of the powdered leaves used}} \times 100$$

Each plant had a different yield, based on their phytochemical compositions. Also, the yield varied based on the mode of extraction used. After calculating the yields using the formula stated above, *S. incunum* water extract had the highest yield (4.7% w/w) while *T. indica* had the lowest yield (1.07% w/w). For both plants, water extracts had a higher yield than DCM extracts. The percentage yields of the extracts are summarized in Table 1 below.

Table 1: A summary of the percentage yield of the extracts obtained after the final concentration of the extracts

Extract	**Percentage Yield (w/w)**
S. incanum (DCM)	2.54
T. indica (DCM)	1.07
S. incanum (Water)	4.7
T. indica (Water)	2.53

Qualitative Phytochemical Analysis

Chemical Identification of Phytochemicals

Phytochemical analysis was done using standard chemical tests. The analysis is based on the chemical reaction between phytochemicals and selected solvents. From the analysis, all the extracts contained phenols, saponins, flavonoids, alkaloids, and terpenoids. However, glycosides were absent in *T. indica* (Water) and *S. incunum* (DCM). None of the extracts had anthraquinones. Table 2 below summarizes the qualitative phytochemical analysis results.

Table 2: A representation of qualitative phytochemical analysis results. A Positive (+) indicates presence, while a negative (-) indicates an absence of selected phytochemicals.

Extract **Phytochemicals**	***S. incanum* (Water)**	***T. indica* (Water)**	***S. incanum* (DCM)**	***T. indica* (DCM)**
Phenols	+	+	+	+
Saponins	+	+	+	+
Flavonoids	+	+	+	+
Alkaloids	+	+	+	+
Terpenoids	+	+	+	+
Glycosides	+	-	-	+
Anthraquinones	-	-	-	-

Estimation of phytochemical composition using GC-MS

The GC-MS analysis revealed compounds that are unique to selected extracts. The phytochemicals are of different classes and are summarized in table 3. The limited number of phytochemicals listed is based on the library IDs present in the GC-MS system. Although the GC-MS could not identify all compounds as expected, the listed compounds are similar to those identified by other researchers.

Table 3: A Summary of GC-MS Results of Two Plant Extracts

Plant Extract	Phytochemical	Molecular Formulae	Peak Area	Phytochemical Class
T. indica	Phthalic acid, di(2-propylpentyl) ester	$C_{24}H_{22}O_4$	488940	Flavonoid
	Diisooctyl phthalate	$C_{24}H_{38}O_4$	448929	Flavonoid
	Phthalic acid, butyl tetradecyl ester	$C_{26}H_{42}O_4$	327849	Flavonoid
	1,2-Benzisothiazol-3-amine	$C_7H_6N_2S$	299972	Alkaloid
	Phthalic acid (2-cyclohexylethyl isobutyl ester)	$C_{16}H_{22}O_5$	272036	Flavonoid
	Phthalic acid, butyl isohexyl ester	$C_{18}H_{26}O_4$	212980	Flavonoid
	1,2-Benzenedicarboxylic acid, bis(2-methylpropyl) ester	$C_{16}H_{22}O$	175642	Phenols
S. incanum	2-chloro-2-methyl-Butane	$C_5H_{11}Cl$	1142168	Alkane
	1,2-Benzisothiazol-3-amine	$C_7H_6N_2S$	17797	Alkaloid
	N-(4-methoxyphenyl)-2,2-dimethyl	$C_{12}H_{17}NO_2$	173554	Phenols

Determination of antibacterial Activity

Disc Diffusion Assay

There were significant differences in the four extracts applied in different bacterial strains at $\alpha = 0.05$. All the controls had the highest inhibition zones, with the largest highest zone being that of ciprofloxacin against *E. coli* (29.27 ±0.40 mm). *S. incanum* water extract was the least effective, with a zone of inhibition of 7.79 ±1.76 mm. On the other hand, the *S. incanum* DCM extract had the largest zone of inhibition (18.90 ±2.38 mm). The mean inhibition of the four extracts is summarized in table 4 below.

Table 4: Means Zone of inhibition produced by the four plant extracts as tested against different bacteria strains.

Plant/ Control	Extraction	Bacteria	Zones of Inhibition (mm ± SEM)
Control	Water	*E. coli*	29.27 ±0.40[a]
Control	Water	*S. typhi*	27.23 ±0.40[ab]
Control	Water	*S. aureus*	24.83 ±0.42[b]
S. incanum	DCM	*E. coli*	18.90 ±2.38[c]
S. incanum	Water	*S. typhi*	18.12 ±2.69[c]
T. indica	DCM	*S. typhi*	17.99 ±1.61[c]
T. indica	Water	*E. coli*	17.60 ±3.77[c]
T. indica	DCM	*E. coli*	17.39 ±0.54[c]
T. indica	Water	*S. typhi*	17.38 ±1.76[c]
S. incanum	Water	*E. coli*	17.31 ±2.49[c]
S. incanum	DCM	*S. typhi*	16.38 ±1.35[c]
T. indica	DCM	*S. aureus*	11.68 ±2.13[d]
S. incanum	DCM	*S. aureus*	11.66 ±3.94[d]
T. indica	Water	*S. aureus*	9.73 ±2.61[de]
S. incanum	Water	*S. aureus*	7.79 ±1.24[e]
LSD			2.6133

[a] Means represented by the same letter are not significantly different at $\alpha = 0.05$. Water/ DCM represents extraction modes. LSD= Least Significant Difference.

Significant differences were also noted between the zones of inhibition produced by the control and the two plant species. However, there were no significant differences in zones of inhibition produced by *S. incanum* and *T. indica* at $\alpha = 0.05$. The control had larger zones (28.25 ±2.46 mm) compared to the *T. indica* (15.29 ±4.68 mm) and *S. incanum* (15.03 ±3.98 mm), as demonstrated in Table 5.

Table 5: A summary of the zone of inhibitions produced by the two plants and the control

Sample	Zones of Inhibition (mm ± SEM)
Control	28.25 ±2.46[a]
T. indica	15.29 ±4.68[b]
S. incanum	15.03 ±3.98[b]
LSD	1.0279

[a] Means represented by the same letter are not significantly different at α= 0.05. LSD= Least Significant Difference.

The effectiveness of the two species also varied between the bacteria strains used. *S. incanum* had highest inhibition zones against *E. coli*, while it was least effective against *S. aureus*. Similarly, *T. indica* was more effective against *S. typhi* and least effective against *S. aureus*. The data shows that the two plant species were more effective against gram-negative bacteria. However, despite the differences, the statistical analysis reported no significant differences between *S. incanum* zones of inhibition against *E. coli* and inhibition diameters produced by *T. indica* against the same bacteria at α= 0.05. Also, there were no significant differences in the effectiveness of the two plant species against *S. aureus*. More details of the efficacy of the plant species are summarized in Table 6 below.

Table 6: A summary of zones of inhibition of *S. incanum* and *T. indica* tested against three bacterial strains

Plant Species	Bacterial	Zones of Inhibition (mm ±SEM)
Control	*E. coli*	29.27 ±0.40[a]
Control	*S. typhi*	27.33 ±0.40[ab]
Control	*S. aureus*	24.83 ±0.42[b]
S. incanum	*E. coli*	18.12±2.50[c]
T. indica	*S. typhi*	17.68±1.67[c]
T. indica	*E. coli*	17.49±2.62[c]
S. incanum	*S. typhi*	17.25±2.25[c]
T. indica	*S. aureus*	10.70±2.52[d]
S. incanum	*S. aureus*	9.72±3.46[d]
LSD		2.71

[a] Means represented by the same letter are not significantly different at α= 0.05. LSD= Least Significant Difference

There were no significant differences in the zone of inhibition between the two extraction modes at α= 0.05. The DCM extracts of the two plants produced the highest zones of inhibition (15.66 ±4.13 mm) than the water extracts (14.65 ±4.89 mm). The extract from the two extraction modes was less effective than the control, which produced a mean of 28.25 ±2.46 mm. The information on the differences in zones of inhibitions produced by the two extracts is summarized in table 7 below.

Table 7: Mean Zones of Inhibition produced by Control, DCM and water extracts

Samples	Zones of Inhibition (mm ±SEM)
Control	28.25 ±2.46[a]
DCM	15.66 ±4.13[b]
Water	14.65 ±4.89[b]
LSD	1.0279

[a] Means represented by the same letter are not significantly different at α= 0.05.

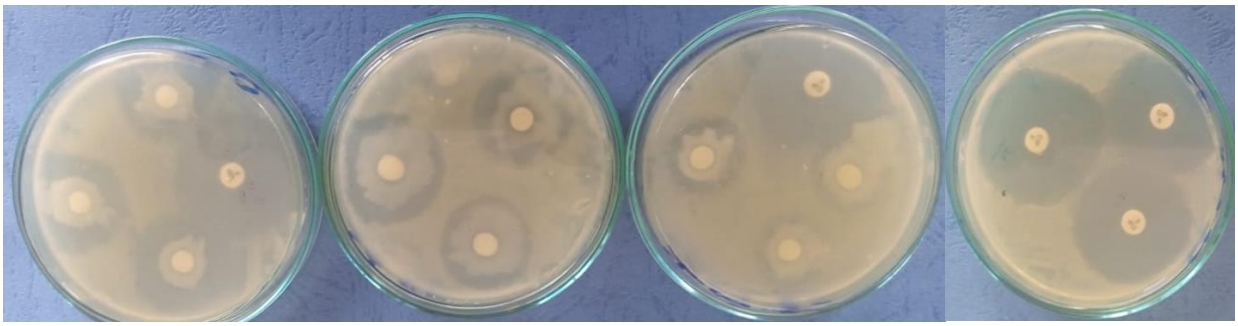
The assay demonstrated significant differences in zones of inhibition between the three concentrations for extracts and the two control. The positive control against *E. coli* had the largest zone of inhibition (28.25 ±2.46 mm), while 750 µg/mL dilutions had the value of the zones (12.67 ±4.17 mm), as demonstrated in the LSD Table 8 below.

Table 8: Zones of inhibition produced by the extracts at different concentrations

Concentration (µg/mL)	Zones of Inhibition (mm ±SEM)
Control	28.25 ±2.46[a]
3000	17.46 ±4.08[b]
1500	15.34 ±3.38[c]
750	6.37 ±0.39[d]

[a] Means represented by the same letter are not significantly different at α= 0.05.

Below are samples of plates with various zones of inhibition. At higher concentration, the zones were clear (as demo started by plates one and two) while at low concentration, the zones of inhibition were smaller (plate 3). The fourth plate represents the zones of inhibition of the positive control.

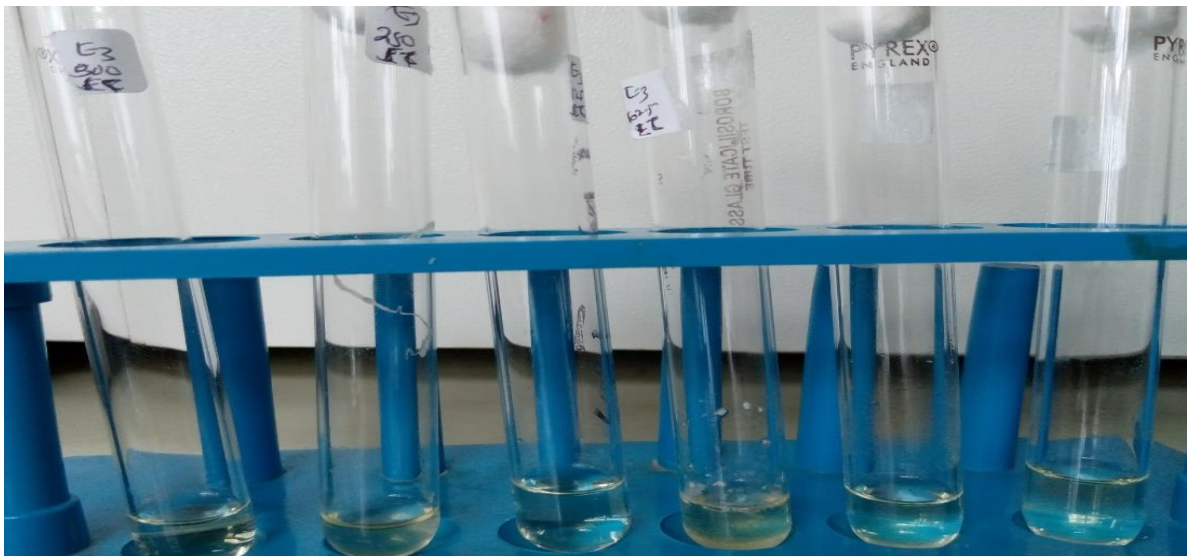


1 2 3 4

Figure 1: Images of Petri dishes with *E. coli* cultures exposed to varying concentration of *T. indica* DCM extract. The concentrations used were 3000 µg/Ml (Plate 1), 1500 µg/mL (Plate 2) and 750 µg/mL (Plate 3) respectively. Plate 4 was the control plate.

Minimum Inhibitory concentration

E. coli and *S. aureus* were subjected to the dilution method to determine MIC. The first extract (*T. indica* aqueous extract) had a 125 µg/mL MIC against *E. coli* and 125 µg/mL *S. aureus*. For extract two (*S. incanum* water extract), the MIC was recorded as 62.5 µg/mL against *E. coli* and 250 µg/mL and *S. aureus*. The *T. indica* DCM extract demonstrated an MIC of 125 µg/mL against *E. coli* and 125 µg/mL against *S. aureus*. *S. incanum* DCM extract has an MIC of 62.5 µg/mL against *E. coli* and 125 µg/mL against *S. aureus*. Figure 2 represents MIC dilution tubes for *T. indica* DCM extract against *E. coli*. From the setup, there was bacterial growth in tube 4, while tube 1 to 3 were clear. No bacterial growth on the positive control test tubes.

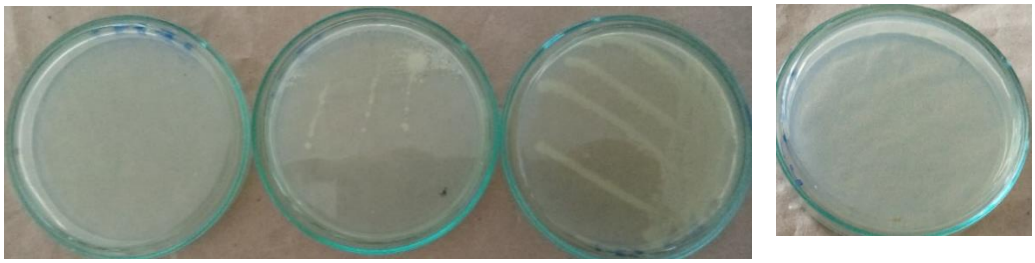


1 2 3 4 5 6

Figure 2: MIC dilution tubes for *T. indica* DCM extract against *E. coli.* The concentrations of the extracts were 500 µg/Ml (tube 1), 250 µg/Ml (Tube 2), 125 µg/Ml (Tube 3) and 62.5 µg/Ml (tube 4). The last two tubes (5 and 6) were the positive controls.

Minimum Bactericidal Concentration

Samples from tubes without visible turbidity were plated on nutrient agar, and MBC was recorded. The *T. indica* aqueous extract had an MBC value of 250 µg/mL against *E. coli* and 250 µg/mL against *S. aureus*. *S. incanum* water extract had an MBC of 250 µg/mL against *E. coli* and 500 µg/mL against *S. aureus* as demonstrated in figure 10 below. The images of the MBC plates for extract two are demonstrated in figure 3 on the next page. The *T. indica* DCM extract demonstrated an MBC of 125 µg/mL against *E. coli* and an MBC of 500 µg/mL against *S. aureus*. *S. incanum* DCM extract has an MBC of 125 µg/mL against *E. coli* and 250 µg/mL against *S. aureus*.



1 2 3 4

Figure 3: Images of MBC plates of *S. incanum* water extract against *S. aureus*. The dilutions were, 500 µg/Ml (Plate 1), 250 µg/mL (Plate 2) and 125 µg/Ml (Plate 3). Plate 4 was the positive control.

Determination of Anti-Inflammatory Activity of Plant Extracts

This assay evaluated the ability of the two plants (*S. incanum* and *T. indica*) extracted using two modes of extraction (aqueous and DCM extractions) to stabilize RBCs at different concentrations. The four extracts were tested at four concentrations (500 µg/mL, 1000 µg/mL, 2000 µg/mL and 4000 µg/mL). The essay demonstrates no significant difference in stabilization between *T. indica* DCM extract, *S. incanum* DCM extract, and the control at α= 0.05. In addition, there was no significant difference in stabilization between *T. indica* water extracts and *S. incanum* water extract. However, there were significant differences in stabilization between the DCM and water extracts of the two plants at α= 0.05. The mean stabilization of *T. indica* DCM extract was the highest, while *S. incanum* water extract had the lowest stabilization. In addition, the *T. indica* DCM had higher percentage stabilization than the control. The mean separation data for percentage stabilization of the four extracts and the control are represented in Table 9 below.

Table 9: A Representation of the Mean Stabilization of Four Extracts and the Control

Sample/ Control	Extraction Method	Percentage Stabilization ± SEM
T. indica	DCM	57.64 ±13.90[a]
Control	Water	55.33 ±0.08[a]
S. incanum	DCM	55.18 ±24.81[a]
T. indica	Water	33.54 ±2.39[b]
S. incanum	Water	19.06 ±14.43[b]
LSD		16.641

[a] Means represented by the same letter are not significantly different at α= 0.05. LSD= Least Significant Difference.

There were significant differences in stabilization between *S. incanum* and *T. indica*. From the data representations in Table 10 below, *T. indica* had a higher stabilization mean compared to *S. incanum*. However, the percentage mean stabilization for both plants was lower than the control.

Table 10: A Summary of Percentage Mean Stabilization of the Two Plant Samples and the Control

Sample	Percentage Mean Stabilization ±SEM
Control	55.33 ±0.08[a]
T. indica	45.59 ±27.09[b]
S. incanum	37.12 ±15.70[c]
LSD	0.547

[a] Means represented by the same letter are not significantly different at α= 0.05. LSD= Least Significant Difference.

The LSD mean separation demonstrated significant differences in percentage mean stabilization of the four extracts at different concentrations. All the four concentrations were significantly different from each other at α= 0.05. The mean stabilization of the control was also significantly different from that of the four extracts. A concentration of 1000 µg/ml had highest stabilization (48.05 ±25.99 %), while 500 µg/mL had the lowest percentage stabilization (27.33 ±11.00 %) as demonstrated in Table 11.

Table 11: A representation of Percentage Mean Stabilization of the Four Extracts at Different concentrations

Concentration (µg/mL)	Percentage Stabilization Mean ± SEM
Control	55.33 ±0.08[a]
1000	48.05 ±25.99[b]
4000	47.32 ±11.85[c]
2000	42.71 ±29.81[d]
500	27.33 ±11.00[e]
LSD	0.5359

[a] Means represented by the same letter are not significantly different at α= 0.05. LSD= Least Significant Difference.

The assay also showed significant differences in percentage stabilization between the two extraction modes at α= 0.05. The DCM extract had a higher stabilization mean (56.41 ±19.71%) compared to the control (55.33 ±0.08%) and water extract (26.30 ±12.53%). The summary of the differences is represented using the LSD Table 12 below.

Table 28: A Representation of the Mean stabilization of Two Modes of Extraction Used for the Two Extracts.

Sample	Percentage Stabilization ± SEM
DCM	56.41 ±19.71[a]
Control	55.33 ±0.08[b]
Water	26.30 ±12.53[c]
LSD	0.547

[a] Means represented by the same letter are not significantly different at α= 0.05. Water/ DCM represents modes of extraction. LSD= Least Significant Difference.

Determination of Cytotoxicity of the Plant Extracts

All the plant extracts had high toxicity thresholds. All the extracts had a higher toxicity threshold than the positive control (Vincristine Sulfate). *S. incanum* DCM extract had a LD_{50} of 2341 µg/mL. The probit analysis of the extract is represented in Table 13.

Table 13: A representation of the LSD Values of the Model Used in the RBC Stabilization Assay. The LD_{50} was determined at a 95% probability level.

Probability	Concentration (µg/mL)	95% Fiducial Limits	
0.10	2.056	0.000523	14.437
0.20	27.620	0.637	93.637
0.30	155.193	32.695	712.077
0.40	638.825	196.348	15769.00
0.50	2341.00	560.532	491144.00
0.60	8575.00	1379.00	17754360.00
0.70	35298.00	3470.00	938025872.00
0.80	198331.00	10347.00	1.22645×10^{11}
0.90	2662237.00	51949.00	1.93134×10^{14}

The *S. incanum* water extract had a lower toxicity threshold compared to *S. incanum* DCM extract. The regression analysis demonstrates that the extract had an LD_{50} of 1000 µg/mL. The summary of the regression analysis is represented in Table 14.

Table 14: A Summary of the regression model for S. incanum water extract. The LD_{50} was determined at a 95% probability level.

Probability	Concentration (µg/mL)	95% Fiducial Limits	
0.10	833.690	796.296	872.841
0.20	891.578	851.587	933.448
0.30	932.261	890.445	976.041
0.40	966.991	923.617	1012.402
0.50	1000.000	955.145	1046.960
0.60	1034.135	987.749	1082.699
0.70	1072.660	1024.546	1123.033
0.80	1121.605	1071.296	1174.277
0.90	1199.485	1145.682	1255.814

T. indica water extract had an LD_{50} of 1104.53 µg/mL. The toxicity threshold of the *T. indica* water extract was higher than *S. incanum* water extract. Therefore, the *T. indica* water extract is less toxic than *S. incanum* water extract. The results of the *T. indica* water analysis are represented in Table 15.

Table 15: A Summary of the regression model for *T. indica* water extract. The LD_{50} was determined at a 95% probability level.

Probability	Concentration (µg/mL)	95% Fiducial Limits	
0.10	913.844	864.093	966.459
0.20	980.051	926.696	1036.478
0.30	1026.690	970.796	1085.802
0.40	1066.571	1008.506	1127.980
0.50	1104.532	1044.400	1168.126
0.60	1143.844	1081.572	1209.701
0.70	1188.276	1123.585	1256.692
0.80	1244.823	1177.054	1316.495
0.90	1335.010	1262.331	1411.874

T. indica DCM extracts had the lowest LD_{50} values of 113.58 µg/mL. The results show that the *T. indica* DCM extract was more toxic than the *T. indica* water extract and *S. incanum* extracts. The summary of LD_{50} values of the extracts is summarized in Table 16 below.

Table 16: A Summary of the regression model for the *T. indica* DCM extract. The LD_{50} was determined at 95% probability level.

Probability	Concentration (µg/mL)	95% Fiducial Limits	
0.10	95.948	90.541	101.679
0.20	102.108	96.353	108.207
0.30	106.419	100.421	112.775
0.40	110.089	103.884	116.664
0.50	113.568	107.167	120.351
0.60	117.156	110.553	124.154
0.70	121.196	114.365	128.435
0.80	126.313	119.194	133.858
0.90	134.422	126.846	142.451

The positive Control had the lowest toxicity threshold. The positive control had an LD_{50} of 11.92 µg/mL. Therefore, the positive control is more toxic than the four extracts. The results of the analysis of the positive control are summarized in Table 17.

Table 17: A Summary of the regression model for the positive control (Vincristine sulphate). The LD_{50} was determined at a 95% probability level.

Probability	Concentration	95% Fiducial Limits	
0.10	3.620	1.138	5.711
0.20	5.620	2.549	7.971
0.30	7.528	4.253	10.185
0.40	9.567	6.266	12.858
0.50	11.920	8.548	16.661
0.60	14.853	11.056	22.767
0.70	18.875	13.940	33.586
0.80	25.285	17.798	56.086
0.90	39.254	24.828	125.593

DISCUSSION

Percentage Yield of the Extracts

The extraction process aims at obtaining and characterization of active compounds in plants. In this case, the extraction generated a crude extract of active compounds. A comprehensive extraction process is required because the concentration of various phytochemicals is low (Zhang *et al*., 2018). Water and DCM were selected as extraction solvents. Water is highly polar with a polarity index of 10.2, while DCM is less polar with a polarity index of 3.1 (Altemimi *et al*., 2017). The two solvents facilitated the extraction of phytochemicals with different polarities.

Several factors determine the yield of phytochemicals produced. The aqueous extraction protocol had a higher extract yield than the DCM methods. The higher yield through water extraction demonstrates that most phytochemicals in the leaves were polar. Wakeel *et al.* (2019) explained that the extraction efficiency is dependent on the polarity index of the phytochemicals and the miscibility of solvents used. The results on the yield of the extracts revealed a difference in concentration of selected phytochemicals in the two plants.

Qualitative Phytochemical Analysis

The initial phytochemical tests of the extracts demonstrated that the four extracts had phenols, saponins, flavonoids, alkaloids, and terpenoids. In addition, both *S. incanum* DCM extracts and T. indica water extracts did not have glycosides. Anthraquinones were absent in all four extracts. Belayneh *et al*. (2021) also reported that *S. incanum* leaf extracts did not contain anthraquinones. The chemical test results from the *T. indica* water extracts were similar to results published by Abdalla and Muhammad (2018). However, the researcher noted that the *T.indica* leaf extracts had significant amounts of anthraquinones, but this phytochemical class was absent in the extracts used in this study. The findings from qualitative phytochemical analysis of *S. incanum* extracts were similar to those reported by Sbhatu and Abraha (2020). In addition to this, the researchers also reported that *S. incanum* ethanolic leaf extracts had significant amounts of glycosides (Sbhatu and Abraha, 2020). The GC-MS results of the current studies were different from those reported by other authors. However, the analysis revealed several compounds that had similar chemical structures (with minor variations) to those identified by other researchers. For example, the *S. incanum* extract used in this study had 2-chloro-2-methyl-butane, while the study by Yetayih and Ravichandran (2020) found significant amounts of 2,3-butanediol.

A similar trend was noted in *T. indica* GC-MS results. The extracts had unique phytochemicals such as 1,2-Benzisothiazol-3-amine. However, there were other phytochemicals with similar chemical structures. For example, the *T. indica* extract had Phthalic acid, which is also present in other extracts (Sharma *et al.*, 2021). In addition, the plant had several esters with chemical structures similar to those identified by other researchers. Butyl tetradecyl ester from *T. indica* used in this study had a similar chemical structure to Butyl Octyl Ester, as identified by Sharma *et al*. (2021). The differences in phytochemicals present in the plants of the same species are influenced by climatic variation, interspecies interactions, soil properties, and solvent differences (Defossez *et al*., 2021; Wakeel *et al*., 2019; Silva *et al.*, 2018; Kumar *et al*., 2017). The solvents used have different polarities, with water being more polar than DCM (Abubakar and Haque, 2020). Due to this, phytochemicals present in the water extracts are more polar than those in the DCM extracts. The difference in solvents could have also contributed to the variation in phytochemicals identified using GC-MS. In most studies, the researcher used more polar solvents such as methanol and ethanol, which in this case, only the DCM extracts were subjected to the GC-MS analysis.

Determination of Antibacterial Activities of the Plant Extracts

The disc diffusion assay revealed significant differences in inhibition zones between the plant extracts used for the assay. However, no significant differences were noted when the extracts were tested against gram-negative bacteria alone. From the study, DCM and water extracts of *S. incanum* and *T. indica* had no significant differences in zones of inhibition when tested against *E. coli* and *S. typhi*. When tested against a gram-positive bacterium (*S. aureus*), the zones of inhibition of *S. incanum* DCM extract and *S. incanum* water extract were significantly different. There was no significant variation between *T. indica* DCM and water extract against *S. aureus*. The plant extracts had varying antibacterial activities, and thus the null hypothesis was rejected.

The minor differences in the antibacterial activities of the two plant species can be attributed to the similarities in the phytochemical composition of the extracts. From the preliminary chemical tests for the phytochemicals, all the four extracts have similar metabolites, apart from *S. incanum* DCM and *T. indica* water extract, which tested negative for glycosides. Several phytochemicals tested in the preliminary chemical analysis are known to possess antibacterial activities, and some are effective against MRSA (Okwu *et al*., 2019). All four extracts tested positive for phenols. Several studies have shown that phenolics are active against gram-positive and gram-negative bacteria. The compound inhibits bacterial growth by interfering with biofilm formation and inhibiting β lactamases (Mandal *et al*., 2017). The findings could be why other studies have identified that phenolics can be used to increase drug sensitivity among drug-resistant bacterial strains such as *S. aureus* (Miklasińska-Majdanik *et al*., 2018).

Saponins also have antibacterial activities against several bacterial strains. Sanfack *et al*. (2019) revealed that saponins extracted from *Albizia adianthifolia* were effective against gram-negative bacteria, with MIC values ranging from as low as 16 µg/mL to 128 µg/mL. Studies on specific flavonoid classes have also shown that this phytochemical class significantly affects bacterial growth (Farhadi *et al*., 2019). Farhadi *et al*. (2019) also explained that some flavonoids are more effective than standard drugs. For instance, Adamczak *et al*. (2019) reported that the MIC values of flavone against *S. aureus* were 1000 µg/mL, while its MIC against *E. coli* and *P. aeruginosa* was 500 µg/mL. Similar trends were noted with the four extracts used in this study. All the extracts were less effective against *S. aureus* and more effective against gram-negatives.

All the four plant extracts had a high alkaloid composition. Most alkaloids have high antibacterial activity against both gram-negative and gram-positive bacteria. Manosalva *et al*. (2016) reported that alkaloid extracts of *Berberis microphylla* had MIC values of 83-333 µg/mL and MBC values of 167- 717 µg/mL. However, some alkaloids are less effective, with MIC values as high as 1.67 mg/mL (Mabhiza *et al*., 2016). Plant phytochemicals have varying modes of action. The most common conclude DNA damage, inhibition of synthesis of bacterial proteins, losing ATP, disruption of cell walls and cell membranes which causes leakage in cell constitutes and direct interference with synthesis of cell walls and cell membrane (Khameneh *et al*., 2021). Also, some studies have shown that the phytochemicals often affect bacterial communication, biofilm formation, and the efficiency of efflux pumps. The pumps reduce the intracellular concentration of toxic compounds and metabolites (Khare *et al*., 2021). In addition, some phytochemicals, such as phenols, inhibit β- lactamases produced by various bacterial trains (Mandal *et al*., 2017). The ability to compromise the efficiency of efflux pumps and inhibit β- lactamases justify the efficacy of the extracts when used alongside conventional medications (Manosalva *et al*., 2016).

Several unique phytochemicals in the extracts also have antibacterial activities. Phthalic Acid Esters (PAE) produced by *T. indica* have been found to have antibacterial effects against *S. aureus, E. faecalis, P. aeruginosa* and *E. coli* (Huang *et al*., 2021). The *T. indica* extracts had significant amounts of diisooctyl phthalate has antifungal and antibacterial activities (Habib and Karim, 2009). The compound is effective against several bacterial species, including *S. aureus, E. coli, K. pneumoniae, P. aeruginosa* and *Streptococcus pyogenes* (Zellagui *et al*., 2012). Although 1,2-Benzenedicarboxylic acid concentration was the lowest among all compounds, the phytochemical has high antibacterial activity (Shoge *et al*., 2016). 1,2-Benzisothiazol-3-amine identified in *S. incanum*, and *T. indica* has significant antibacterial effects. Priyanka *et al*. (2015) revealed that the compound and other alkaloids were the reason for the high antibacterial activity of *Acacia karoo* against several bacterial strains. These unique compounds were the reason for the high antibacterial activity of the selected plant extracts.

Determination of Anti-inflammatory Activity of Plant Extracts

There were significant differences in percentage RBC stabilization between the four plant extracts. However, there were no significant differences in stabilization between the *T. indica* DCM extract, *S. incanum* DCM extract and the control. In addition, there were significant differences in stabilization between the water and DCM extracts of the two

plants. The study demonstrated that *T. indica* DCM extract was more effective than the four extracts, while *S. incanum* water extract had the least stabilization. The stabilization effects were associated with the differences in phytochemicals present in the extracts and their concentrations. The presence of the phytochemicals in each extract was affected by their polarity. Water has a higher polarity, attracting highly polar phytochemicals, while DCM is less polar and extracted less polar phytochemicals.

The findings from this assay support other studies conducted on the anti-inflammatory activities of plants of the same genus as *S. incanum* and *T. indica*. Anosike *et al*. (2012) reported that *Solanum aethiopicum*, the plant extract inhibited hemolysis of RBCs at all doses between 800 µg/mL to 100 µg/mL. These researchers reported percentage membrane stabilization of between 86.67 ± 3.06% and 46.53 ± 2.52%, with the highest stabilization noted at 800 µg/mL while the lowest stabilization was reported at 400 µg/mL. Stabilization at 100 µg/mL was higher than at 400 µg/mL. Benvenutti *et al*. (2021) demonstrated that *Solanum diploconos* hydroalcoholic extracts had anti-inflammatory activities at low concentrations. da costa *et al*. (2015) revealed that *Solanum lycocarpum* hydroethanolic extract had *in vivo* anti-inflammatory properties at dosages between 75 mg/kg and 150 mg/kg. *Solanum xanthocarpum* ethanolic extracts were also proven effective at 150 mg/kg (More *et al*., 2013).

While assessing the analgesic and anti-inflammatory efficacy of *T. indica* roots, bark, seeds stem and leaves, Komakech *et al*. (2019) noted that the extracts from the parts effectively managed inflammation at a low concentration. The researchers recommended that more research should be done on other plant parts. In addition, Borquaye *et al*. (2020) reported that ethanolic stem extracts of *T. indica* is effective at 154.5 ± 2.6 mg/kg, while the root extracts of the plant effectively managed oedema at 118.1 ± 1.9 mg/kg concertation. Sundaram *et al*. (2015) linked the efficacy of the *T. indica* seeds to the ability of the plant to manage arthritis.

Several phytochemicals present in the extracts have been shown to pose anti-inflammatory activities. The chemical tests reveal that all the extracts had significant amounts of terpenoids. Liu *et al*. (2021) reported that terpenes control inflammation by activating AMP-Activated Protein Kinase (AMPK). AMPK is a threonine/serine kinase which stimulates various energy metabolic pathways, such as lipid oxidative pathways (Miki *et al*., 2019). Terpenes also control inflammation by inhibiting pathways such as the NF-Kβ that lead to the production of inflammatory mediators such as IL-1 and TNF-α (Prado-Audelo *et al*., 2021). Also, Liu *et al*. (2021) reported that the terpenoids inhibit the production of LPS-induced inflammatory mediators. Studies on the mode of action of alkaloids have shown that phytochemicals of this class often inhibit the COX-2 enzyme (Hashmi *et al*., 2018). The enzyme is involved in the synthesis of PGE, which stimulates inflammatory pathways.

In addition to the inhibition of COX-2, alkaloids inhibit LOX-5, an enzyme involved in thromboxane production (Wang *et al*., 2021). Other studies have shown that alkaloids from various plant extracts can be used to manage IBD due to their inhibitory activity on MAPK and NF-κB signalling pathways (Yang *et al*., 2021; de Almeida *et al*., 2017). The major alkaloid identified in the *T. indica* DCM extract is 1,2-Benzisothiazol-3-amine. Alam *et al*. (2021) reported that the alkaloid and other isothiazole derivatives have anti-inflammatory properties. *S. incanum* also had a significant amount of isothiazole derivatives. In addition to 1,2-Benzisothiazol-3-amine, *S. incanum* also had a high concentration of propenamide derivatives, which are proven to have anti-inflammatory and anti-oxidant activity (Gökçe *et al*., 2009). The two compounds could be the reason for the high anti-inflammatory activity of the extract. Flavonoids and saponins also inhibit similar enzymes and signaling pathways. However, Lim *et al*. (2019) reported that, besides the activity of flavonoids against COX-2 and LOX-5, they also inhibit nitric oxide synthase, autophagy and inflammasome activation. Also, flavonoids affect other pathways such as Nrf2, PPAR, and AP-1 (Chen *et al*., 2018).

Determination of the Cytotoxicity of the Plant Extracts

Assessing the toxicity of plant extracts is essential in determining the safety of the plants. In traditional medicine, most traditional practitioners use plant extracts to treat various ailments without knowing the medically important concentration and concentration that can cause harm to the human body. The brine shrimp lethality test demonstrated different toxicity levels for the four extracts. In addition, the DCM extracts had lower toxicity compared to the water extracts. The difference in toxicity is dependent on the differences in phytochemicals present in extracts. Several phytochemicals have significant toxicity levels. For example, Seremet *et al*. (2018) demonstrated that pyrrolizidine alkaloids have high cytotoxicity levels in animal models. The chemical tests of plant extracts revealed that the four extracts contained alkaloids, which was confirmed using the GC-MS analysis. Flavonoids and sesquiterpenes also determine the toxicity levels of plant extracts (Butala *et al.*, 2021). The chemical tests demonstrated that all the plant extracts had a significant amount of flavonoids and terpenes. Besides this, the GC-MS revealed that the plant extracts

had several classes of flavonoids, most of them being phthalic acids. Other studies have also proven that crude saponin extracts are highly toxic to animal cells and can be used in cancer treatment (Sobolewska *et al*., 2020; Alam *et al*., 2017). The chemical tests demonstrated high amounts of saponins. Although the GC-MS analysis could not reveal the actual saponins present, this class of phytochemicals could have contributed to the toxicity of the plant extracts. Vu *et al*. (2019) reported that several glycosides have cytotoxic activities. *T. indica* DCM extracts and *S. incanum* water extracts contained glycosides that could have also contributed to the toxicity of the two plant extracts.

Studies on different parts of *S. incanum* revealed that the plant contains cytotoxic phytochemicals. For example, an *in-vitro* toxicity analysis of *S. incanum* hydromethanol root and leaf extracts demonstrated that the extracts were toxic at 2 g/kg (Belayneh *et al*., 2021). Feyera *et al*. (2017) demonstrated that *S. incanum* fruit extracts induced sub-acute toxicity at 400 mg/kg dosages. Thaiyah *et al.* (2011) reported that *S. incanum* fruits were toxic to sheep. Most sheep treated with the extracts died due to brain congestion, damage to hepatocytes and kidney cells and lung emphysema. In addition, the researchers noted increased necrosis of neurons and Purkinje cells. Although no *in vivo* tests on *S. incanum* were identified, other studies have shown that plants of the genus *Solanum* have varying toxicity levels (Niño *et al*., 2006). *Solanum ovalifolium* had LD_{50} values of 1.00 mg/mL, *Solanum leucocarpun* (LD_{50} 0.44 mg/mL), *Solanum deflexiflorum* (0.68 mg/mL) and *Solanum lepidotum* (1.00 mg/mL) (Niño *et al*., 2006). The study linked the high toxicity of the extracts against brine shrimps to the high steroids, triterpenes and saponins present in the extracts. In this study, *S. incanum* DCM extract had LD_{50} of 1000 µg/mL, close to the value reported in other plants within the *Solanum* genus.

Other studies have shown varying toxicity of *T. indica* extracts. Nwondo *et al*. (2011) demonstrated that *T. indica* ethanol extracts had LD_{50} levels of between 832 µg/mL and 5 019 µg/mL. The LD_{50} values reported in this study are within the range reported by Nwondo *et al*. (2011). Hasan *et al*. (2019) reported LD_{50} values of between 30 µg/mL and 100 µg/mL from *T. indica* seeds extracted using ethanol and methanol. The higher toxicity values could be due to the difference in the phytochemical present in the fruits and leaves of the extract. Shirisha and Varalakshmi (2017) showed that the toxicity of *T. indica* DCM bark extracts could help manage cancer. The researchers noted that the extracts induced apoptosis in PA-1 cells and HeLa cells. Besides this, the toxicity of various extracts of *T. indica* justifies its application in root canal treatment in endodontic procedures (Wulandari, 2008).

Researchers have identified several modes of actions linked with plant toxicity. For example, researchers reported that presence of ribosome inactivating metabolites interfere with rRNA N-glycosidase activity (Tumer, 2015). Inactivation of the enzyme affects translation process, which in turn causes cell death. Other studies have shown that some toxic metabolites interact with nucleic acid and biomembranes affecting their stability (Wink, 2015). Wink (2015) also reported that most terpenoids and phenolics interact with receptors of various neurotransmitters, which affects their function. The metabolites interact with various cellular elements through ionic, hydrophobic and hydrogen bond. Besides, the toxicity of some plants is linked with presence of elements such as lead, arsenic, Cadmium and Aluminum (Brima, 2017). Brima (2017) explained that, due to the presence of toxic elements in medicinal plants, the WHO decided to formulate guidelines to ensure that the population is not exposed to higher concentration of the toxic elements per dose.

The toxicity tests of the plants reveal that all four extracts were toxic at different concentrations. Although cytotoxicity of plant extracts is associated with negative effects in the human body, such as damage to neurons, kidney and liver cells, the toxic compound can also be effective in managing cancer. Yu *et al*. (2017) reported that cytotoxic phytochemicals in *S. incanum* induced apoptosis of cancer cells and can be used to treat different types of cancer. The study also reported that the extracts could minimize cancer metastasis. On the other hand, Hussein *et al*. (2017) reported that *T. indica* seeds induced cell death in several cell lines at concentrations between 0.1-1000 µg/mL. Due to this, the researchers reported that the extracts could effectively manage different types of cancer.

CONCLUSION AND RECOMMENDATIONS

S. incanum and *T. indica* produced significant amounts of phytochemicals after water and DCM extraction. *S. incanum* had a higher yield compared to *T. indica*. The chemical tests for the phytochemicals revealed that the four extracts contained most phytochemicals tested. The extracts were more effective against gram-negative bacteria (*E. coli* and *S. typhi*) and least effective against gram-positive bacteria (*S. aureus*). The MIC and MBC values varied between various extracts. The MIC and MBC values against *S. aureus* were higher than the gram-negative bacteria. *T. indica* DCM extract was the most effective in stabilizing RBCs, while *S. incanum* water extract was the least effective. Regardless of the extraction mode, *T. indica* was more effective than *S. incanum*. In addition, DCM extracts were

more effective than water extracts. All four extracts had varying toxicity levels. *S. incanum* water extract was more toxic than DCM extract, while *T. indica* DCM extract was more toxic than *T. indica* water extract.

Further studies should focus on fully identifying the phytochemicals present in the two plants. The studies can achieve this by using a specific standard for each phytochemical. Also, fractionation of various phytochemical classes to identify the actual class of phytochemicals with antibacterial, anti-inflammatory and cytotoxic effects followed by testing them against multi-drug resistant bacteria such as MRSA and resistant *E. coli* will improve scientific data on the two plants. Lastly, more studies should focus on using animal models for *in-vitro* testing of anti-inflammatory and cytotoxicity of the two plants.

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ON UNITARY QUASI-EQUIVALENCE AND PARTIAL ISOMETRY OPERATORS IN HILBERT SPACES

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ABSTRACT
Properties of almost similarity and unitary equivalence operators on different classes of operators have been established by various researchers in the recent past. On the other hand, unitary quasi- equivalence has been shown to preserve unitary, normality, hyponormality and binormality of operators. However, properties of unitary quasi-equivalence on partial isometric operators has not been fully established. This study therefore, determines properties of unitary quasi-equivalence on partial isometric operators.
Key words: Unitary quasi-equivalence, isometry, co-isometry, partial isometry, operator and Hilbert space.

INTRODUCTION

Let H be a complex Hilbert space and $B(H)$ be a set of bounded linear operators on Hilbert space H.
$A \overset{u.q.e}{\approx} B$ and $A \overset{a.s}{\approx} B$ denotes unitary quasi-equivalent and almost similar operators respectively. An operator $V \in B(H)$ is defined as a structure preserving map. For $V \in B(H)$, V^* is called the adjoint of an operator V. Two operators $A, B \in B(H)$ are said to be unitarily quasi-equivalent if there exists a unitary operator $U \in B(H)$ such that the following conditions are satisfied

$$A^*A = UB^*BU^*$$
$$AA^* = UBB^*U^*$$

Othman (1996) investigated unitary quasi-equivalence under the concept of near equivalence. This class of equivalence relation operators was later studied further by Kutkut (1998). Muteti (2014) established unitary quasi-equivalence to be an equivalence relation operator. Muteti (2014), also established that unitary equivalence implies unitary quasi-equivalence. However, the converse is not necessary true unless the operators are similar normal. Thereafter Muteti (2014) determined that unitary quasi-equivalence preserve normality of operators. Nzimbi & Wanyonyi (2020) further established that projection unitary quasi-equivalent operators imply that the operators are unitary equivalent. Nzimbi & Wanyonyi (2020) also established that unitary quasi-equivalence preserves binormality and hyponormality of operators. Nzimbi & Wanyonyi (2020), also established that unitary quasi-equivalence preserves unitary operator properties. That is, if two operators are unitarily quasi-equivalent and one is a unitary operator so is the other unitary. However, the same results have not been established for isometry, co-isometry and partial isometry operators. This study therefore determines properties of unitary quasi-equivalence on isometry, co-isometry and partial isometry operators.

Definition 1.1: A Hilbert space *H* (Berberian, 1999). A Hilbert space H is a complete inner product space.

Definition 1.2: (Halmos, 2017). An operator $T \in B(H)$ is said to be

i. unitary if $TT^* = T^*T = I$
ii. Isometry if $T^*T = I$.
iii. Co-isometry if $TT^* = I$.
iv. Partial isometry if T^*T is a projection or $T=TT^*T$.

From the above definitions, we have the following class inclusions:

i. Unitary operators ⊆ isometry operators ⊆ partial isometry operators.
ii. Unitary operators ⊆ co-isometry operators ⊆ partial isometry operators

Definition 1.3: Unitary quasi-equivalence operators (Kutkut, 1998). Two operators $A, B \in B(H)$ are said to be unitarily quasi-equivalent if there exists a unitary operator $U \in B(H)$ such that

$$A^*A = UB^*BU^*$$
$$AA^* = UBB^*U^*$$

METHODOLOGY

In achieving this objective, properties of partial isometry operators are useful. In addition, properties of unitary equivalence on partial isometry operators are also used. This study aimed to extend the following Lemmas to unitary quasi-equivalence.

Lemma 2.1: (Luketero & Khalagai, 2020): Let $A \in B(H)$ be a partial isometry and $B \in B(H)$ be any other operator such that, either $A = UBU^*$ or $A = U^*BU$ where U is unitary, then $B \in B(H)$ is also a partial isometry.

Proof:

(I) If $A = UBU^*$ then $A^* = UB^*U^*$.

Since A is a partial isometry, then we have $A = AA^*A$.

Therefore, $A = AA^*A = UBU^*(UBU^*)^*UBU^* = UBU^*UB^*U^*UBU^* = UBB^*BU^* = UBU^*$

Thus

$UBU^* = UBB^*BU^*$ … (i)

Now pre-multiplying by U^* and post-multiplying by U in (i) above, we obtain

$B = BB^*B$.

Therefore B is also a partial isometry.

(II) Again, if $A = U^*BU$ then $A^* = U^*B^*U$

Since A is a partial isometry, we have $A = AA^*A$.

It therefore, follows that $A = AA^*A = U^*BUU^*B^*UU^*BU = U^*BB^*BU = U^*BU$

thus $U^*BB^*BU = U^*BU$ … (ii)

Pre-multiplying by U and post-multiplying by U^*equation (ii) above,

$\Rightarrow BB^*B = B$ is obtained.

Therefore, B is also a partial isometry

Lemma 2.2: (Kiprop *et al., 2021).* Let $P, Q \in B(H)$ such that $P \overset{a.s}{\approx} Q$. If P^2 is a partial isometry and Q is self-adjoint, then $Q^2$is also partially isometric.

Proof

Since P^2 is a partial isometry, we have $P^2 = P^2P^{2^*}P^2$ and by projection property, we also have $PP^* = PP = P^2$.

Since $P \overset{a.s}{\approx} Q$, implies there exists an invertible operator N such that

$P^*P = N^{-1}Q^*QN$ ... (i)

$P^* + P = N^{-1}(Q^* + Q)N$ ... (ii)

Since Q is self-adjoint then $QQ^* = QQ = Q^2$,

then (i) becomes

$P^*P = N^{-1}Q^2N$.

Consequently, $P^*P = P^2$ and thus $P^2 = N^{-1}Q^2N$.

It follows that $Q^2 = Q^2Q^{2^*}Q^2$, which is equivalent to $Q^2 - Q^2Q^{2^*}Q^2 = 0$.

$\Rightarrow Q^2\left(1 - Q^{2^*}Q^2\right) = 0$.

Implying that $Q^{2^*}Q^2 = I$, or $Q^*Q = I$.

Using (ii), it follows that,$(Q^* + Q)^2 = Q^{2^*} + 2Q^2 + 2Q^2 = 4Q^2$. Hence, Q^2 is a partial isometry as claimed.

MAIN RESULTS

The following are results that were established.

Theorem 3.1: If $A, B \in B(H)$ are unitarily quasi-equivalent then A is isometry if and only if B is isometry.

Proof

Suppose that an operator A is isometry

Since $A \overset{u.q.e}{\approx} B$, by definition 1.3, (Kutkut, 1998), these operators satisfy the following conditions.

$A^*A = UB^*BU^*$ ... (i)

$AA^* = UBB^*U^*$ ... (ii)

But A is isometry thus by definition 1.2, Halmos, (2017).

$\Rightarrow A^*A = I$ ... (iii)

Substituting equation (i) in equation (iii)

$$\Rightarrow I = A^*A = UB^*BU^*$$

$\Rightarrow UB^*BU^* = I \ldots (iv)$
Pre-multiplying both sides of equation (iv) with U^* and post multiplying with U we get,
$U^*UB^*BU^*U = U^*IU$
$\Rightarrow U^*UB^*BU^*U = U^*U$
Since an operator U is unitary, then by definition 1.2, Halmos (2017),
Then, $U^*U = UU^* = I$
$\Rightarrow IB^*BI = I$
$\Rightarrow \quad B^*B = I$
Thus B is isometry.
Conversely, suppose that an operator B is isometry, and then by definition 1.2,
$B^*B = I.$
However, $A \overset{u.q.e}{\approx} B$ implies that equation (i) and (ii) holds.
Thus substituting $B^*B = I$ in equation (i),
$\Rightarrow A^*A = UB^*BU^* = UIU^*$
$\Rightarrow A^*A = UU^*$
Since an operator U is unitary then
$U^*U = UU^* = I$
$\Rightarrow UU^* = I.$
$\Rightarrow A^*A = I$
Thus by definition, an operator A is isometry.

Theorem 3.2: Let $V, W \in B(H)$ be unitarily quasi-equivalent operators, then an operator V is co-isometry if and only if W is co-isometry.
Proof
Since $V \overset{u.q.e}{\approx} W$, then by definition (Kutkut, 1998),
$V^*V = UW^*WU^* \ldots (i)$
$VV^* = UWW^*U^* \ldots (ii)$
Suppose S is co-isometry then by definition, (Halmos, 2017).
$< V^*x, V^*y > = < x, y >, \forall\, x, y \in H.$
$\Rightarrow VV^* = I$
Substituting $VV^* = I$ in equation (ii)
$\Rightarrow I = VV^* = UWW^*U^*$
$\Rightarrow UWW^*U^* = I \ldots (iii)$
Pre-multiplying both sides of equation (iii) with U^* and post multiplying with U,
$\Rightarrow U^*UWW^*U^*U = U^*IU$
$\Rightarrow U^*UWW^*U^*U = U^*U$
But $U^*U = UU^* = I$, since an operator U is unitary
$\Rightarrow IWW^*I = I$
$\Rightarrow \quad WW^* = I.$
Thus W is co-isometry.
Conversely suppose that an operator W is co-isometry,
Then by definition 1.2,
$WW^* = I$
Substituting $WW^* = I$ in (ii) implies that
$VV^* = UWW^*U^* = UIU^*$
$\Rightarrow VV^* = UIU^*$
$\Rightarrow VV^* = UU^*$
$\Rightarrow VV^* = I$. (Since $UU^* = I$)
Thus V is co-isometry.

Remark: Results 1 and 2 implies that unitary quasi-equivalence preserves isometric and co-isometric properties of operators.

Theorem 3.3: If $K, L \in B(H)$ are unitarily quasi-equivalent and K is partial isometry, then an operator L is also a partial isometry operator.

Proof
Since $K \overset{u.q.e}{\approx} L$, then by definition 1.3, (Kutkut, 1998),
$K^*K = UL^*LU^* \ldots (i)$
$KK^* = ULL^*U^* \ldots (ii)$
Since K is partial isometry, then by definition 1.2, Salhi & Zerovali. (2019), K^*K is a projection.
$\Rightarrow (K^*K)^2 = K^*K \ldots (iii)$
But by equation (i)
$K^*K = UL^*LU^*$
Replacing K^*K with UL^*LU^* in equation (iii)
$\Rightarrow UL^*LU^* = (UL^*LU^*)^2$
$\Rightarrow UL^*LU^* = UL^*LU^*.UL^*LU^*$
But $U^*U = I$
$\Rightarrow UL^*LU^* = UL^*LIL^*LU^*$
$\Rightarrow UL^*LU^* = UL^*LL^*LU^*$
But $L^*LL^*L = (L^*L)^2$
$\Rightarrow UL^*LU^* = U(L^*L)^2U^* \ldots (iv)$
Pre multiplying both sides of equation (iv) with U^* and post multiplying with U, we get,
$\Rightarrow U^*UL^*LU^*U = U^*U(L^*L)^2U^*U$
But $U^*U = I$
$IL^*LI = I(L^*L)^2I$
$\Rightarrow L^*L = (L^*L)^2$
This implies that L^*L is a projection thus by definition of partial isometry definition 1.2 it means that L is partial isometry.

Theorem 3.4: let $V, W \in B(H)$ be self-adjoint and unitary quasi-equivalence operators, if V^2 is partial isometry so is W^2 partial isometry.
Proof
Since $V \overset{u.q.e}{\approx} W$, the following conditions hold,
$V^*V = UW^*WU^* \ldots (i)$
$VV^* = UWW^*U^* \ldots (ii)$

But V, W are self adjoint unitary quasi-equivalent operators, Nzimbi & Wanyonyi. (2020), established that V^2, W^2 are unitarily equivalent. That is by (i) and (ii) and definition of self-adjoint operator,
$V^*V = VV^* = VV = V^2$ and $W^*W = WW^* = WW = W^2$
$\Rightarrow V^2 = UW^2U^*$

Since V^2 is partial isometry then by definition of partial isometry
$V^2 = V^2V^{2^*}V^2 \ldots (iii)$
But $V^2 = UW^2U^*$.

Replacing V^2 with UW^2U^* in equation (iii)
$\Rightarrow UW^2U^* = UW^2U^*(UW^2U^*)^*UW^2U^*$
But $(UW^2U^*)^* = UW^{2^*}U^*$
$\Rightarrow UW^2U^* = UW^2U^*UW^{2^*}U^*UW^2U^*$
$\Rightarrow UW^2U^* = UW^2IW^{2^*}IW^2U^*$, (since $U^*U = I$)
$\Rightarrow UW^2U^* = UW^2W^{2^*}W^2U^* \ldots (iv)$

Pre-multiplying both sides of equation (iv) by U^* and post multiplying by U,
We have
$\Rightarrow U^*UW^2U^*U = U^*UW^2W^{2^*}W^2U^*U$
But $U^*U = I$
$\Rightarrow IW^2I = IW^2W^{2^*}W^2I$
$\Rightarrow W^2 = W^2W^{2^*}W^2 \ldots (v)$
Equation (v) implies that W^2 is a partial isometric operator.

CONCLUSION

From the results established above, we can conclude that unitary quasi-equivalent operators preserves; isometry, co-isometry and partial isometric properties. That is if two operators are unitarily quasi-equivalent and one is isometry, co-isometry or partial isometry then so is the other operator isometry, co-isometry or partial isometry respectively.

RECOMMENDATION

From the findings of this study, this results can be extended to other equivalence relation operators such as quasi-similarity and metric equivalence for further research. Similarly since the study determined properties of unitary quasi-equivalence on partial isometric operators, similar research can be done to other classes of operators such as $\theta -$ operators by utilizing their properties.

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DEEP LEARNING IN AFRICAN LANGUAGES TRANSLATION: A REVIEW

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ABSTRACT
Machine translation (MT) is the use of computers to automatically translate one language to another. Africa has approximately 2,000 spoken languages, however, only 30 African languages have been machine translated. The main technical factor for the low-rate adoption of MT in Africa is the poor translation accuracy of existing machine translators from one African language into English. Currently, there are two approaches to MT in Africa. The first approach is the classical approach; this approach utilizes the direct mapping of input texts to produce a translated output. Examples of classical MT approaches include: statistical-based machine translators (SBMT), rule-based machine translators (RBMT) and hybridized machine translators (HMT). Classical approaches are the most widely adopted MT approach for African languages, the main reason for the wide adoption is the low cost of computing power in utilizing classical approach. However, classical approach has high-levels of inaccuracy due to language structures differentiation. The second approach is the use of Deep learning (DL) MT. Deep learning MT is a field in artificial intelligence concerned with the application of artificial neural networks to mimic the human brain learning process in language translation. Deep learning MT has the advantage of understanding phrases, complex sentence structures, and even slang when compared to classical MT approach. Deep learning has produced results 60-90% more accurate than the classical approach in translating structured languages such as French into English. However, DL has shortcomings in MT, including, high-costs of training and evaluating models, and, DL is data intensive. These review aims to analyze the current status of machine translation approaches in Africa and provide an output recommendation for universalizing applicable MT in African languages translation. The results of these review will be in both graphical and tabular format.
Keywords: Machine Translation, Classical Approach, Deep Learning, Artificial Neural Networks, Deep Learning

INTRODUCTION

Human language has evolved over the last 200,000 years (Baronchelli, 2012).This evolution originated with gesture basis from early humans, then primitive vocalizations and songs from Homo habilis humans, and eventually, the use of complex grammatical rules by modern humans. The modern world has over 7,117 languages (Eberhard, 2020) spoken by 7.8 billion people (Worldometer, 2021). The existence of so many spoken languages has led to the rise of a large machine translation (MT) services market valued at $800.0million (Statista Research Department, 2021) and projected to grow to $7.5billion by 2030. However, the vast majority of MT technology is focused on seven languages, namely English, Chinese, Urdu, Farsi, Arabic, French, and Spanish (Siavoshi, 2020). Africa's MT in language translation is underdeveloped, with a size of only $6.0million as of 2015 (Statista Research Department, 2016) despite Africa having 16.72% of the global population (Division, 2019) .The major reasons for Africa's low adoption of in MT in languages translation are, low accuracy in machine translation using classical approaches (Buliva, 2017) and the lack of adequate digitized African language datasets (Knowledge 4 All Foundation Ltd., 2020).

The large language translation services market has attracted a lot of attention from the information technology (IT) industry. This has led to many breakthroughs in the application of IT into human language translations (Junyoung, 2014). The latest breakthroughs are through the application of artificial intelligence in language MT called Deep learning (DL) MT technology, this technology utilizes artificial neural networks to perform translation, Deep learning MT has shown great promise in solving the challenges of the classical approach by applying machine learning (John, 2019b). Examples of DL MT include: Simple recurrent neural networks frameworks, Gated recurrent Unit frameworks and the Long Short-Term Memory unit frameworks (Rodriguez., & Fonollosa., 2020). However, DL MT adoption in Africa has been slow compared to the rest of the world, this is due to the fact that DL MT are complex to implement and expensive due to the large computing resources required, in addition, DL MT technologies are data-hungry (Mittal, 2019).

Thus, in this review, will seek to understand the current status of MT in Africa and analyze the classical and DL MT approaches adoption in the African languages market. The analysis will be based on verified secondary sources of data gathered from the internet open-sources. The conclusion of the analysis will provide insights into MT trends in Africa and assist researchers interested in pursuing DL-MT technologies research in the African languages translation sector.

METHODOLOGY

1) Data collection: The data gathered for this review is from 25 reputable online peer-reviewed publications, published research articles, open-source research papers that are peer-reviewed, corporate articles (2016-2022). All these papers have different data applications that has been studied and analyzed in this review. The attributes compared were MT used technologies, benefits and challenges in current MT approach, DL MT adoption approach and African continent area MT analysis.

2) Data inclusion criteria: To evaluate the data inclusion criteria a comparison table was drawn to include as the following attributes: Author, Sub vertical, Data collection measurements, Technologies, Benefits, Challenges, Solutions and Drivers of MT in Africa. Articles were excluded when selected attributes were not present. In our analysis, the number of classical MT approach, amount of DL MT approach, underlying technologies adoption was included since no information can find with all the peer-reviewed publications (2016-2022).

3) Data analysis: Oversampling method is utilized to analyze the 25 peer-reviewed articles, Oversampling is applicable due to the small size of available data on African MT. A higher sample selection of DL MT based data will be utilized.

The two metrics for analysis are:

i. BLEU (bilingual Evaluation understudy)

BLEU score is a metric for automatically evaluating machine translated texts.

Table 1 is of the BLEU score interpretation guideline.

Table 1: BLEU score interpretation from 0-100

BLEU Score	Machine Translation accuracy interpretation
< 10	Poor translation
10 – 19	Low quality translation
20 – 29	The translation is clear, but has significant grammatical errors
30 – 40	Understandable to good translations
40 – 50	High accuracy translations
50 – 60	Very high accuracy, adequate, and fluent translations
> 60	Machine translation accuracy is better.

ii. Conclusion from the peer-reviewed articles that provide analytical data terms such as adoption rates of MT technologies (high, low and medium).

The article sources are arranged in Table 2 with 8 columns, including:

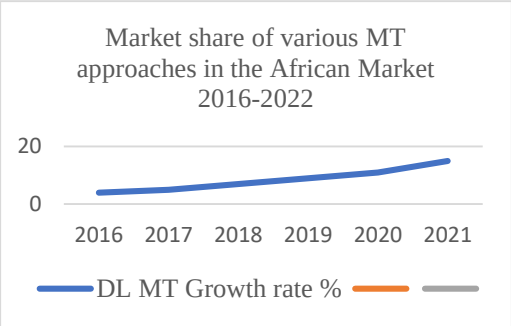
-Column 1-article number arranged alphabetically
-Column 2-article citation (APA sixth edition)
-Column 3-MT approach-classical or DL MT technology
-Column 4-Application area of MT approach e.g. Yoruba translation
-Column 5-Status of MT technology deployment e.g. prototype, widely used
-Column 6-Benefits of MT approach
-Column 7-Challenges of MT approach
-Column 8-Future Potential e.g. shutdown project, unknown

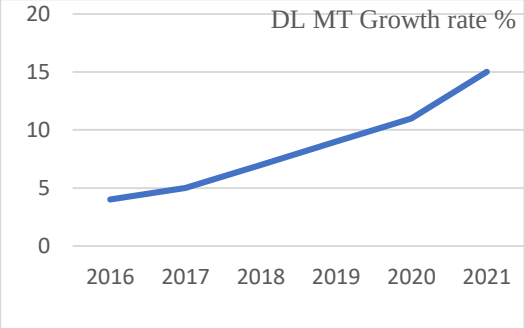
4) Data Results:

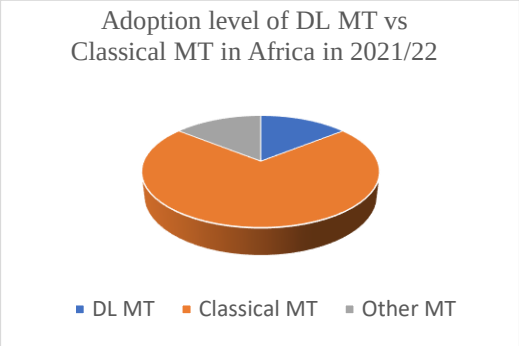
Results of analysis will be presented in Graphs and charts using the following parameters:

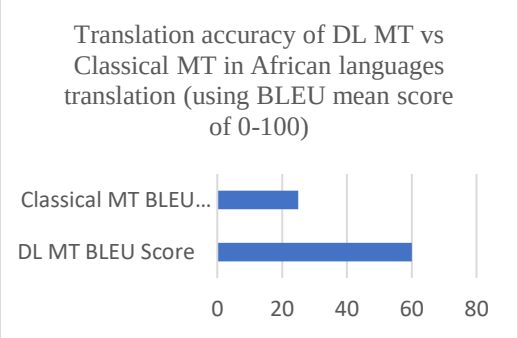
-Market share of various MT approaches in the African Market 2016-2022
-DL MT growth rate in the African MT market 2016-2022
-Adoption level of DL MT vs Classical MT in Africa in 2021/22
-Translation accuracy of DL MT vs Classical MT in African languages translation (using BLEU mean score of 0-100)
-Future application preference between DL MT and Classical MT

Analysis of Results:









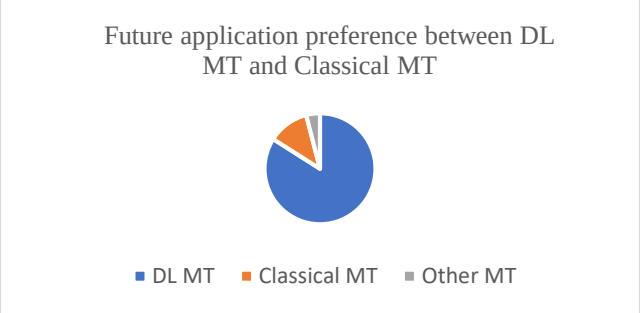


TABLE 2 MACHINE TRANSLATION ANALYSIS FROM 25 PEER REVIEWED SCIENTIFIC ARTICLES OF 2016-2022

No.	Article citation	MT Technological approach	MT technology Application Geographical Area	MT technology Current status	Benefits of MT Technology	Challenges of MT Technology Approach	Future interest of Approach

Note: -All BLEU scores are rounded off to whole numbers.

CONCLUSION

From our analysis of the 25 peer-reviewed publications (2016–2022) in reviewing MT approaches in the African automated translation industry, it was found that classical MT approach the most widely utilized, however, DL MT has the fastest growth rate. In addition, DL MT approach demonstrates a much higher translation accuracy of 60% plus for African languages. However, classical approach MT remains dominant in application. Finally, this analysis indicates DL MT approach has the highest future application preference to classical MT.

1	(Research, 2022)	MT market size, share and trends	Global	-Classical MT-70% world market share -DL NMT-15% world market share -Other MT approaches-15%	Benefits of Classical MT: -Easy to implement -Cheap to maintain -Open-source resources -Well tested Technology Benefits of DL MT: -Higher accuracy in translation -Ability to capture language differentiation nuances -Ability to self-learn and improve, hence easier to update with higher automation over classical (Siminyu, 2018)MT	Challenges of Classical MT: -Low-accuracy in translation compared to DL MT -Labor intensive in maintenance and updates -Low language structures differentiation capacity Challenges of DL MT: -High costs of resources such as cloud computing -Complex technical requirements in developing frameworks -Data hungry	-DL MT has higher investments than classical MT, thus, higher adoption rate in the future
2	(Ben Goertzel, 2021)	DL MT in Africa	-Sub-Sahara Africa	-Low-adoption	-Higher accuracy in Sub-Saharan African Languages Translation -	-High input costs of cloud computing and training frameworks -Lack of adequate Digitized datasets-Most Sub-Saharan languages (80%) have no written form	-DL MT has High potential for adoption
3	(Siminyu, 2018)	DL MT	Sub-Sahara Africa	-Bilingual DL MT development for ChiChewa and Kiswahili translation to English	-Higher accuracy	-High costs of framework -Inadequate digital dataset	-DL MT has High adoption for other African languages tranlslation
4	(Agbolo, 2022)	-DL MT called OBTranslate version 1.9.6	-Sub-Sahara Africa	-OBTranslate 1.1.1 cancelled BLEU score of 25	-Version 1.9.6 is 60% more accurate in translating Igbo compared to version 1.1.0	-Version 1.9.6 is 200% more expensive in cloud	-DL MT has High adoption potential with 20%

		released in 2022 -Classical MT called OBTranslate 1.1.1 released in 2020		-OBTranslate 1.9.6 in early adoption BLEU score of 51		computing costs compared to version 1.1.0 -Version 1.9.6 is taking 12 months longer to train,test and validate compared to version 1.1.0	greater market participation
5	(Masakhane open source project, 2019)	DL MT using Transformers neural network	Sub-Sahara Africa	-Pidgin dialect to English DL MT translator under development BLEU score of 60	-High accuracy compared to Classical MT translators of Pidgin dialect in Nigeria	-Lack of funding -Inadequate sized digital datasets	-DL MT has High adoption rate
6	(Knowledge 4 All Foundation Ltd., 2020)	DL MT vs Classical MT in Africa	Africa	-Classical MT 90% adoption -DL MT less than 9% adoption -Other MT 1% adoption	Classical MT has lower barriers of entry such as: -Low-cost -Easy to implement -open-source resources DL MT has higher accuracy	-Classical MT has low accuracy and is labour intensive -DL MT is resource expensive and has high data consumption rate	-High interest in DL MT in Africa
7	(Adepetun, 2022)	DL-MT	Sub-Sahara Africa	-High adoption in 55 African languages translation	-High accuracy -Digitized datasets availability	-Non-open source	DL MT has High adoption through Meta social media platforms
8	(Odoje, 2013)	-Classical MT -DL MT	-Nigeria	-Classical MT dominant adoption -DL MT nil adoption	Classical MT: -Low cost -Easy to implement DL MT: -High accuracy	Classical MT: -Low accuracy -Labour intensive DL MT: -Untested technology -High costs	DL MT has high possibility of future adoption
9	(Albarino, 2020)	DL-MT	Sub-Sahara Africa	-DL MT adoption	-High accuracy -Digitized datasets availability of 16 languages	-High costs of input resources	DL MT has High adoption
10	(Marivate, 2020)	DL-MT	Africa	-DL MT adoption	-High accuracy -Digitized datasets availability	-High costs of input resources	Resolving high costs to lead to high adoption of DL-MT in Africa

11	(INDABAX, 2021)	DL MT in Africa	Sub-Sahara Africa	-Low-adoption	-Higher accuracy in Sub-Saharan African Languages Translation -	-High input costs of cloud computing and training frameworks -Lack of adequate Digitized datasets-Most Sub-Saharan languages (80%) have no written form	-DL MT has High potential for adoption
12	(Burg Translations, 2022)	-DL MT vs Classical MT in Africa	-Africa	-Classical MT 90% adoption -DL MT les than 9% adoption -Other MT 1% adoption	Classical MT has lower barriers of entry such as: -Low-cost -Easy to implement -open-source resources DL MT has higher accuracy	-Classical MT has low accuracy and is labour intensive -DL MT is resource expensive and has high data consumption rate	-High interest in DL MT in Africa
13	(Quartz Africa, 2022)	DL-MT	-Sub-Sahara Africa	-High adoption in 65 African languages translation BLEU score 65	-High accuracy -Digitized datasets availability	-Non-open source	High adoption through Meta social media platforms
14	(LionBridge, 2022)	MT market size, share and trends	Africa	-Classical MT-90% Africa market adoption -DL NMT-9% Africa market adotion -Other MT approaches-1% adoption	Benefits of Classical MT: -Easy to implement -Cheap to maintain -Open-source resources -Well tested Technology Benefits of DL MT: -Higher accuracy in translation -Ability to capture language differentiation nuances -Ability to self-learn and improve, hence easier to update with higher automation over classical	Challenges of Classical MT: -Low-accuracy in translation compared to DL MT -Labor intensive in maintenance and updates -Low language structures differentiation capacity Challenges of DL MT: -High costs of resources such as cloud computing -Complex technical requirements	-DL MT has higher investments than classical MT, thus, higher adoption rate in the future

						in developing frameworks -Data hungry	
15	(Lim, 2022)	MT market size, share and trends	Global	-Classical MT-65% world market adoption -DL NMT-25% world market adoption -Other MT approaches-10% adoption	Benefits of Classical MT: -Easy to implement -Cheap to maintain -Open-source resources -Well tested Technology Benefits of DL MT: -Higher accuracy in translation -language differentiation nuances capacity -self-learning capacity and improve, hence easier to update with higher automation over classical MT	Challenges of Classical MT: -Low-accuracy in translation compared to DL MT -Labor intensive in maintenance and updates -Low language structures differentiation capacity Challenges of DL MT: -High costs of resources such as cloud computing -Complex technical requirements in developing frameworks -Data hungry	-DL MT has higher investments than classical MT, thus, higher adoption rate in the future
16	(Microsoft News Center, 2022)	DL MT	South Africa	-Launched in April 1,2022 for Zulu language translation BLEU score 58	-Higher translation accuracy compared to classical MT for Zulu language -Higher language differentiation fluency compared to classical MT	-Complexity in technology -Inadequate digitized Zulu data for model training, validation and testing	-High adoption
17	(Tomedes, 2022)	DL MT vs Classical MT	Africa	Analysis of 2022 Africa MT -Adoption rate 11% for DL MT And 88% for classical MT	DL MT advantages over classical MT in Africa: -High accuracy -Cost Efficiency -Scalability -Flexibility	Challenges of DL MT over classical MT in Africa: -Cost -Complexity -Lack of open-source framework shells	-High adoption rate
18	(Diden, 2022)	DL MT	West Africa	10 West African languages	-Higher translation accuracy	- Lack of open-sources -Cost	-High adoption rate

				under Google translate DL MT for translation to French BLEU score 53	-Ability to capture language differentiation nuances		
19	(Kevin Duh, 2020)	DL MT vs classical MT(SBMT)	Africa	-Swahili and Somali BLEU test scores show DL MT to be 75% and 50% more accurate than classical MT of the SBMT variant	--Higher translation accuracy -Better algorithm tuning,i.e.,DL MT is better at updates to souce code efficiency than SBMT	-Digitized Data inadequacy for African languages -	-High Adoption rate
20	(Allahsera Auguste Tapo, 2020)	DL MT	-Sahel region -DL MT in translating Bambara language in Mali into French	-DL MT applied to Bambara into French translation BLEU score 45	-Higher translation accuracy	-Training data scarcity -Training data pre-processing is costly -Lack of Smartphones to utilize the framework in Bambara	-Low adoption rate
21	(Muscleh, 2016)	DL MT	Sahara region	-Applied DL MT in medical translation for migrants from the Sahel heading to EU	-High accuracy -Flexibility	-Scarcity in training data -Low adoption due to low skills in utilizing technology by the migrants	-Medium adoption
22	(Liu, 2018)	DL MT vs Classical MT in 3 African languages	Sub-Sahara Africa	DL MT and Classical MT(SBMT) applied to Shona, Oromo and Burj translation to English BLEU Score of DL MT is 55,57 and 59 respectively, compared to SBMT at BLEU score of 17,27,40	-Higher accuracy of DL MT	Challenges of DL MT over classical MT in sub-Sahara Africa: -Cost -Complexity -Lack of open-source framework shells	-High adoption rate
23	(Maiei, 2020)	DL MT in Afrikaans,isi Zulu,N.Soth o,Setswana and Xitsonga	South Africa	DL MT applications in five South African languages to	-Higher accuracy		Low adoption

				English translation BLEU score of 33.3 for DL MT isiZulu translation			
24	(Martinus, 2020)	DL MT	South Africa	BLEU Scores for 10 South Africa languages translated by a DL MT platform to English: -Afrikaans-59 -Ndebele-24 -Xhosa-37 -Zulu-44 -Northern Sotho- 45 -Sesotho-42 -Setswana-47 -Swati-36 -Tshiveni-52 -Xitsonga-46	-Higher accuracy of DL MT	-High costs of implementation	-High adoption
25	(Z.Abbott, 2022)	DL MT	South Africa	DL MT application to translating English-to-Setswana BLEU score higher by 5 points above previous classical MT(SBMT) approach	DL MT has higher accuracy	DL MT is resource expensive and has high data consumption rate	-High interest in DL MT in South Africa

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ISOLATION AND CHARACTERIZATION OF ACTINOMYCETES FROM LAND USE SYSTEMS IN MERU SOUTH SUB-COUNTY, KENYA AND SCREENING THEIR ANTIBACTERIAL ACTIVITIES

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ABSTRACT
To combat the growth of multidrug resistance to existing antibiotics, the quest for novel bioactive compounds from *Actinomycetes* in virgin environments has become increasingly crucial. In this study, *Actinomycetes* were isolated, characterised, and tested for antibacterial activity from the land use system in the Meru South sub-county, Eastern Kenya. Using morphological, biochemical, and molecular techniques, *Actinomycetes* were described after being cultivated on Starch Casein Agar, Luria Bertani (M1), and International Streptomyces Project Medium (ISP-1 and ISP-4). The isolates were tested for their ability to combat the following six pathogenic bacterial strains; *Staphylococcus aureus* (ATCC 25923), *Listeria monocytogenes* (NCTC 11994), *Streptococcus mitis* (NCTC 12261), *Escherichia coli* (ATCC 25922), *Vibrio furnissii* (NCTC 11218), and *Rauotella planticola* (NCTC 19528). Further identification of potential isolates was done based on 16S rRNA gene sequence analysis. Phylogenetic analysis was done using Molecular Evolutionary Genetics Analysis (MEGA X), and a phylogenetic tree constructed using the Neighbor-Joining methodThe results for morphological characters showed that isolates' morphology colours ranged from grey to purple to pink to brown to yellow to red to cream-white. The biochemical examination revealed that the majority of them were gram-positive, capable of hydrolyzing starch, urea, casein, and lipase. Few isolates were positive for the cellulose and catalase test. The antibiotic activity of the *Actinomycetes* isolates against *Listeria monocytogenes* varied significantly (p=0.05) among them. In comparison to standard streptomycin (16.3mm), isolate L6 (16.23mm) demonstrated the strongest antagonistic activity against *L. monocytogenes*, followed by isolates C50 (15.5mm) and C52 (12.25mm) against *Raoultella planticola*. In the phylogenetic tree created using the combined sequences and neighbour joining, isolate P4 was shown to be associated with *Streptomyces celluloflavus*, isolate C45 with *Streptomyces griseobrunneus*, isolates Pxiv and C8 with *Streptomyces pratensis*, isolate P1b with *Streptomyces crystallinus*, and isolates C10b, C10a, and C3 (*Streptomyces eurocidicus*). This study shows that soil *Actinomycetes* obtained from land in Meru South has antibacterial activity and may be useful in biomedical applications.
Keywords: Soil *Actinomycete*s, 16SrRNA, Antibacterial Activity

INTRODUCTION
Due to the increased burden of multidrug resistance, there has been increasing interest in researchers searching for novel bioactive secondary metabolites to overcome the multidrug resistance of pathogens (Malison *et al*., 2020). The possible way to access new antibiotics is to find new bacteria and fungi isolating approaches and to search for new sites or environments for selection of microbes (Frieri *et al*., 2017). Soil is an important natural source for many microorganisms including *Actinomycetes* which produce many bioactive natural resources including clinically important drugs (Khebizi *et al*., 2018). *Actinomycetes* are Gram-positive microorganisms widely distributed in nature (Barka *et al*., 2016). The most dominant genus within Actinobacteria is *Streptomyces* belongs to the family Streptomycetacea which are highly abundant in different ecological niches (Hamid *et al*., 2020). *Streptomyces* genus contains Gram positive bacteria, having guanine cytosine (GC) rich (70%) genetic material (Cetinkaya, 2021).

Actinomycetes have more genes that encode for various enzymes that promote the production of bio-active secondary metabolites (Xia *et al*., 2020). Antibiotics are the most vital bio-active secondary metabolites for the treatment of infectious diseases. Since the last two decades, multidrug resistance (MDR) increased due to the absence of new antibiotics that is a basic challenge for effective treatment of infectious diseases (Ouchari *et al*., 2019). A continuous screening of potential bacterial taxa for production of secondary metabolites is crucial for discovery of novel compounds (Zothanpuia *et al*., 2017).

Molecular characterization of *Actinomycetes* for the production of secondary metabolites offers a strong research perspective. For the identification of novel strains, 16S rRNA sequence method is most prevalently used due to its presence in almost all bacteria and the function of 16S rRNA gene over time has not changed (Jand and Abbott, 2007).

Analysis of 16S-rRNA gene sequence amplification has been demonstrated to be a potential method for microorganism's phylogeny investigation. It is reported that 16S rRNA gene sequencing provides genus identification in most cases more than 90% (Guo *et al*., 2008). The current research study was designed to assess *Actinomycetes* for secondary metabolites production and also to characterize selected *Actinomycetes* using morphological, biochemical and molecular means.

MATERIALS AND METHODS

Study Site

The study was conducted using soil samples collected from Mt. Kenya forest (S0° 18.247' E37° 34.111'), farm lands (S0° 19.347' E37° 39.483') and solid waste dump site in Chuka (S0° 19.699' E37° 39.176') Sub County in Tharaka-Nithi County in Kenya. Tharaka-Nithi County lies between latitude 000 07' and 000 26' South and between longitudes 37 0 19' and 37 0 46' East with an elevation of 600–1500m (above sea sea level). Meru south sub- County is characterized by low and erratic rainfall as well as high evapotranspiration rate (Jaetzold *et al*., 2007). The bimodal rainfall ranges from 1200-1400mm and experiences temperatures range between 24^{o} C and 26^{o} C (Omondi *et al*., 2014). Majority of the smallholder farmers in these areas depends on rain-fed agricultural production system (Mugwe *et al*., 2009) and major crops in the area are; Tomatoes, maize, mangoes, sorghum among others. The predominant soil type is humic nitisols, typically deep and weathered soil with moderate to high fertility while the soil texture is predominant sand clay loam (Ngetich *et al*., 2014).

Soil Sampling

Soil samples were randomly collected from six different land uses. The soils were collected along a transect using zigzag soil collection technique. Soil collection regions included; uncultivated soils within the Mt. Kenya forest, cultivated soils outside Mt. Kenya forest, farm yard manure from Chuka University and soils from solid wastes from the dumpsite in Chuka town. Soil collection was carried out using spiral soil auger which was cleaned with 10% formalin to avoid cross-contamination of soil samples. The soils collected were labelled, packed in sterile ziplock bags and transported to Chuka University for further processing.

Pretreatment of soil samples

The composite soil samples were spread out on aluminium foil on the laboratory bench and allowed to dry for 4-6 days at room temperature, to decrease moisture-dependent bacteria and fungus **(**Zainal *et al*., 2016). The air dried soil sample were crushed to make fine powder soil sample. To effect the treatment, 0.1 g $CaCO_3$ was added to 10g of fine soil sample and subjected to hot air oven at 120 ºC for one hour. (Messaoudi *et al*., 2015; Zainal *et al*., 2016.

Isolation *Actinomycetes* from soil samples

One gram (1 g) of composite soil samples each from different land uses were separately added to a test tube containing 9 ml saline water and shaken vigorously at room temperature (25 ± 2°C), using an orbital shaker at 200 rpm for 10 min. The test tubes were considered as stock culture for the soil samples from which serial dilution preparations were made. Aseptically, 100 µl aliquot from the stock solution was transferred to a test tube containing 9 ml of sterile physiological saline and mixed well. From these test tubes, 100 µl of aliquot was again transferred and mixed with another 9 ml of distilled water to make 10^{-2} dilution factor. Similarly, dilutions up to 10^{-4} were made using serial dilution technique for all soil samples (Sujatha and Swethalatha, 2017).

After serial dilution, 0.1 ml of each sample was separately plated using spread plate technique in Luria Bertani Agar (M1), Starch Casein Agar and International Streptomyces Project (ISP-1) and (ISP-4) media. The plates were incubated at 28°C and observed from 5th day onwards for 7 days. After incubation, *Actinomycetes* isolates were distinguished from other microbial colonies by characteristics such as tough, leathery colonies which are partially submerged into the agar (Yaminisudha *et al*., 2015).

Phenotypic Characterization of *Actinomycetes* Isolates

Morphological characteristics of the selected pure isolates were studied by inoculating them into starch casein agar (Yang *et al*., 1995). Morphological characteristics such as colony characteristics, pigment production, presence or absence of aerial and substrate mycelium were characterized based on guidance by Shrilling and Gottlieb (1966). The gram stain test was carried out with the method described by Pooja *et al*., 2015.

Biochemical Characterization of Actinomycetes Isolates

The ability of the isolates to utilize D-Glucose, D-Fructose, sucrose, maltose, dextrose and lactose was tested. The isolates were mixed (1% w/v) with the basal medium followed by incubation at 30°C for 7 days (Pooja *et al*., 2015).

The proteolytic activity of selected isolates was studied using milk casein agar. The isolates were streaked on milk casein agar and incubated at 27 °C for 5-7 days. This loss of opacity was the result of a hydrolytic reaction yielding soluble, non-colloidal amino acids, and it represents a positive for casein hydrolysis (Salle, 1948).
Isolates were streaked on starch agar plates for the amylase test and incubated at 27 °C for 5-7 days. Then an iodine solution was poured all over the plates (Salle, 1948). Tryptophan's synthesis and the ability to generate hydrogen sulphide from sources such organic Sulphur and sulfur-containing amino acids were examined using Sulfur-Indole Motility (SIM) agar medium. Kovac's reagent was added to 48-hour cultures of each isolate to identify the presence of indole (Harold, 2002). After incubation, the medium lacked a black tint, which meant there was no hydrogen sulphide present (Cappuccino & Sherman, 2002).

Methyl red and Voges Proskaeur tests were carried out with the method described by Prescott *et al*. (1991). Catalase production was determined by the addition of 3% hydrogen peroxide to Tryptic Soy Agar (TSA) cultures of each isolate based on the methods outlined by Cappuccino and Sherman (2002). A positive reaction was indicated by the formation of bubbles, which indicated production of catalase activity. The citrate test is used to show the ability of a microorganism to utilize citrate as the sole carbon source (Harold, 2002). The utilization of citrate depends on the presence of an enzyme citrase produced by the organism. Isolates were also streaked on Simon's citrate slant agar and incubated at 30 °C for 7 days.

Screening of selected Actinomycetes for antagonistic activity against test pathogens
Primary Screening of Antimicrobial of Actinomycetes Isolates
The primary screening was done according to Bizuye *et al*., 2013; Zainal *et al*., 2016. The antibacterial activities of the isolates were determined on Starch casein agar media by the perpendicular streak method (Egorov, 1987). The recovered *Actinomycetes* isolates were cross-streaked as a single line on solidified starch casein agar media in a petri-dish and were incubated at 28°C for three days. The test organisms were then cross-streaked perpendicular to the original streak of isolates. The antibacterial activities of different cultures of *Actinomycetes* was determined against the bacterial strains which include; *Escherichia coli* (ATCC 25922), *Listeria monocytogenes* (NCTC 11994), *V. furnissii* (NCTC 11218), *R. planticola* (NCTC 19528), *Staphylococcus aureus* (ATCC 25923), *and Streptococcus mitis* (NCTC 12261*).*

The test bacterial suspensions preparation and turbidity standardization was done according to Ataee *et al*. (2012). The suspension from a test pathogen was taken using a sterile inoculating loop and it was streaked perpendicular to the *Actinomycetes* isolate on starch casein plate media. These were incubated at 37º C for 24 hours for antibacterial activity observation. The antibacterial activities of isolates against test pathogens were observed by visual detection and the inhibition zone (antibacterial activity) was measured using the graduated ruler. Control plates without Actinomycetes growth were also simultaneously streaked with test organism to study their normal growth.

Secondary Screening of Actinomycetes Isolates for Antibacterial Activity
The isolates showing positive results in primary screening were inoculated using the submerged fermentation procedure in boiling tubes containing 30 ml of sterile medium starch casein broth. The inoculated boiling tubes were incubated on rotary incubator shaker (Biotechnich India) at 28°C and 150 rpm for 7 days. The fermentation broth was centrifuged (Remi, RM12C, India) at 10,000 rpm and 4 °C. The supernatant was analysed for antimicrobial activity by disc method using the same test microorganisms used in primary screening (Pisano *et al*., 1986). The plates containing bacterial strains were incubated at 37ºC for 24 hours. Twenty-five (25) µl of Streptomycin (concentration of 10 µg) was used as positive control and 25 µl of Dimethyl sulfoxide (DMSO) as negative control and left at room temperature for 30 min to allow the compounds to diffuse through the agar. After incubation, the zone of inhibition was measured and expressed as millimetre in diameter (Mohanraj *et al*., 2011).

Isolation of genomic DNA
Isolates were inoculated in the starch casein agar media and incubated at 28°C for 7 days. Isolation of genetic deoxyribose nucleic acid (gDNA) was carried out using standard phenol-chloroform methods (Gumińska *et al*., 2018). For the identification of bacterial 16S rRNA sequence analysis was performed using universal primer 27F (5'-AGAGTTTGATCCTGGCTCAG-3') and 1429R (5'-GGTTACCTTGTTACGACTT-3'). The polymerase chain reaction (PCR) condition was set at initial denaturation at 94°C for 5 min; 30 cycles at 95°C for 30 secs, 55°C for 30 secs and 72°C for 120 secs; and a final extension at 72°C for 7 min. The PCR amplified products were analyzed by 0.7% agarose gel electrophoresis. The purified PCR products were sequenced using 27F and 1429R primer with Sanger sequencing methods at Genotech.

Sequence analysis
The 16S rRNA sequence of the isolates were deposited in the National Center for Biotechnology Information (NCBI) gene bank. The homology search of the partial DNA sequence of 16S rRNA of the isolates was performed using the NCBI database and multiple sequence alignment was performed using ClustalW and the phylogenic tree was plotted using MEGA version 6 software by the neighbor-joining methods with bootstrap values calculated from 1,000 replications.

Statistical analysis
Data collected on the phenotypic characteristics of the Actinomycetes isolates that included growth characteristics, colony colour, colony shape, margin type, elevation and sporulation was used to construct dendogram based on Euclidean distance in R studio. Data collected on Actinomycetes load from different areas (Land uses) were normally distributed and were therefore subjected to the analysis of variance (ANOVA) and significant means separated using Least Significant Difference at $\alpha = 0.05$ in SAS version 9.4. The data collected and recorded on diameters of zones of inhibition on antagonistic effect of pure cultures of Actinomycetes against test organism was subjected to one- way ANOVA in secondary screening. The data was then separated with LSD) with descriptive analysis type on different isolates against different test organism cultures using SAS 9.4 software. The results with at $\alpha = 0.05$ was considered to be statistically significant.

The colour of morphology varied among isolates from grey, purple, pink, brown, cream, yellow, red, green-yellow and cream-white. Colony reverse side had brown, yellow, pink or grey in colour. Further, most colonies had hard textures that were difficult to scrap off the agar. Some of the colonies were also dry, chalky, leathery and powdery. The mycelium of Actinomycetes showed varied colour colony. Lastly, all colonies possessed an earthy smell. Dendogram constructed based on Euclidean distance classified the Actinomycetes isolates in three clusters and eight subclades (Figure 1).

Biochemical characteristics of the selected *Actinomycetes* isolates was presented in Table 2 showed that all isolates hydrolyzed starch, while most isolates were positive for catalase test except isolate C50, C25 and P4XIV. Isolates C26 and C52 fermented all sugars used. The colony and microscopic characteristics of selected Actinomycetes isolates are shown in plate 2. The colonies ranged from having highly intertwined filamentous hyphae to branching hyphae. In some isolates, short filaments were also seen.

RESULTS

Morphological Characterization

The *Actinomycetes* generally were circular in shape with round margin and raised or flat elevation (Table 1).

Table 1: Morphological characterization of Actinomycetes isolates

Isolates	Colour	Size (mm)	Colony shape	Colony margin	Elevation	Sporulation	Pigments	Constituency	Gram stain
C2	Grey	3	Circular	Smooth	Raised	Grey	Brown	Powdery	+
C3	Brown	1	Circular	Smooth	Raised	-	none	Leathery	+
C5	Pinkish white	1	circular	smooth	Raised	pink	None	Leathery	+
C8	Pink	1	Circular	Smooth	Raised	Pink	Pink	Leathery	+
C10	Grey	3	Circular	Smooth	Raised	Grey	Brown	Powdery	+
C10b	White	1	Irregular	Smooth	Flat	White	yellow	Powdery	+
C20	Cream	1	Circular	Smooth	Flat	Cream	-	Leathery	+
C22	Grey	1	circular	Smooth	Raised	Grey	Cream yellow	Powdery	+
C25	Brown	3.5	circular	Smooth	Raised	Brown	-	Leathery	+
C26	Cream	2	circular	Smooth	flat	cream	Brown	Powdery	+
C27	Cream yellow	1.5	irregular	Serrated	flat	white	None	Powdery	+
C29	White	1	circular	Smooth	raised	white	None	leathery	+
C30b	Brown	1	irregular	serrated	flat	brown	none	powdery	+
C33	Brown	2	circular	smooth	raised	brown	brown	leathery	+
C34	White	3	irregular	smooth	raised	white	none	leathery	+
C40	Grey	2	irregular	serrated	flat	grey	none	powdery	+
C43	Light yellow	3	irregular	rough	raised	white	None	Powdery	+
C46	light-green	1	Irregular	serrated	flat	white	green	Powdery	+
C52	light green	2	Circular	smooth	raised	white	none	Leathery	+
C61	Grey	1	Circular	smooth	flat	grey	none	Powdery	+
P1b	Light brown	1	Irregular	rough	flat	white	none	Powdery	+
P1g	Light yellow	1.5	circular	smooth	raised	white	light yellow	Leathery	+
P1n	Cream yellow	2	irregular	rough	flat	cream	none	powdery	+
P4m	Cream-white	1.5	Circular	Smooth	Raised	White	None	Leathery	+
P4(I)	Brown	2	Circular	Serrated	Flat	Brown	Brown	Leathery	+
P4(ii)	Greyish red	1.5	Circular	Serrated	Flat	Grey	Red	Powdery	+
P4xiv	Orange	2	Irregular	Rough	Flat	orange	Orange	Leathery	+
L5	Yellow	1	Circular	Smooth	Flat	yellow	Yellow	Powdery	+
L6	Light green	1.5	Circular	Smooth	Raised	white	Green	Powdery	+
L14	Cream yellow	1	Regular	Rough	Flat	cream	None	Leathery	+

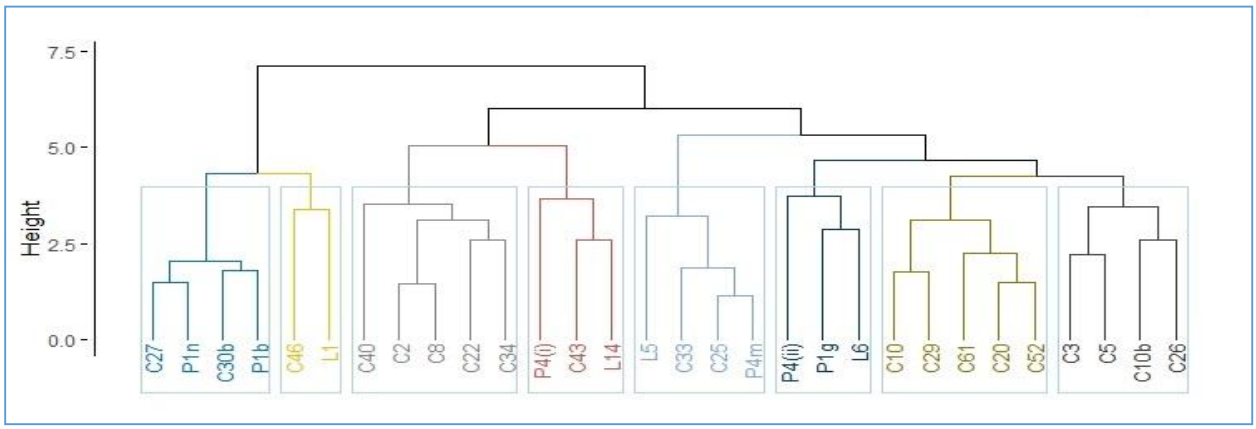


Figure 1: Cluster membership of Actinomycetes isolated from different soils samples in Meru South Sub-County based on Euclidean distance clustering

Biochemical characterization of Actinomycetes

Most of the selected active Actinomycetes stained purple in gram stain, showing that they were gram-positive (plate 1).

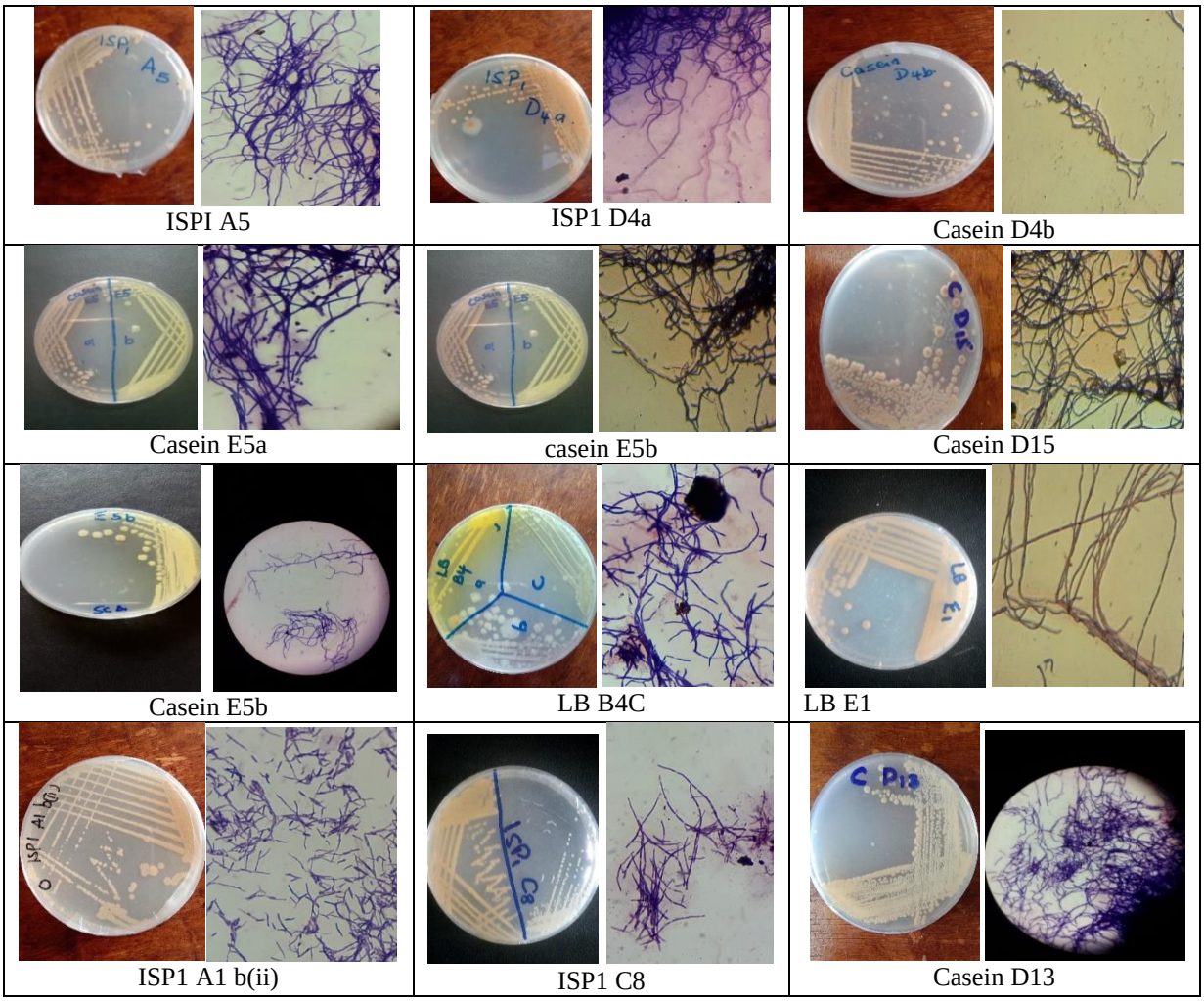


Plate 1: Colony and microscopic characteristics of selected Actinomycetes isolate at 400x magnification on light microscope

Table 2: Biochemical characterization of Actinomycetes

	C3	C8	C52	C10a	C10b	C42	C45	C34	C43	C50	C25	L6	L14	P1b	P4i	P4x	C26
Hydrolysis test																	
Casein	-	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	-
Amylase	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Catalase	+	+	+	++	++	-	+	++	+	-	-	+	++	+	++	-	++
Lipase	-	-	+++	++	+	+++	-	-	-	-	+	-	-	+	++	-	-
Urease	Y	P	P	Y	P	P	P	P	Y	P	Y	P	P	Y	P	P	Y
Bt	Y	P	Y	P	P	Y	P	Y	P	P	Y	Y	Y	Y	P	P	Y
Cellulase	-	-	-	-	+	+	-	+	-	+	-	-	-	+	-	-	-
Citrate	-	-	-	-	-	-	+	-	-	+	-	-	-	+	-	-	+
Sulfur	+	-	+	+	-	-	+	+	-	+	+	+	+	-	-	-	+
Indole	+	-	-	+	+	-	-	+	-	-	-	-	-	+	-	-	-
Motility	+	-	+	+	-	+	-	+	+	+	+	+	+	-	+	+	+
MR	-	-	-	-	-	++	++	+	-	++	+	+	-	-	+	+	+
VP	-	-	-	++	-	++	++	-	-	++	-	+	++	-	-	-	++
TSI-A	+	+	+	+	+	-	+	-	-	+	+	+	+	-	-	+	+
B	-	+	+	-	+	-	+	-	-	+	-	-	-	-	-	-	-
Sl	Y	P	P	Y	P	Y	Y	P	Y	P	Y	P	Y	Y	P	P	Y
Bt	Y	Y	Y	Y	P	Y	P	Y	Y	Y	Y	P	Y	Y	Y	Y	P
Carbon source																	
Glucose	+/-	+/-	+	+/-	+,g	-	+	-	-	+	+	+,g	-	+/-	-	+,g	+,g
Sucrose	-	-	+	-	+,g	-	+	-	-	-	+	+,g	+	+	-	+	+
Lactose	+	+	+	+	-	+/-	+	-	+	-	+	+,g	+	+	-	-	+
Fructose	+,g	+	+	+	+	+	+/-	-	+,g	+	+/-	-	-	+	-	-	+
Maltose	-	-	+	+,g	+	-	-	-	+	+	-	-	+,g	-	-	-	+
Dextrose	-	-	+,g	+	+	+	-	-	-	-	+,g	+	+	+,g	-	+	+

Notes: +++ = strongly positive; ++=moderately positive; += positive; +/- = doubtful; - = negative; g=gas production; Y=yellow; P=pink; Sl=slant; Bt= butt

Antibacterial Activity of Selected Actinomycetes

In the present study, selected Actinomycetes isolated from soil samples were observed to demonstrate inhibitory activity against test strains *Escherichia coli* (ATCC 25922), *Listeria monocytogenes* (NCTC 11994), *V. furnissii* (NCTC 11218), *R. planticola* (NCTC 19528), *Staphylococcus aureus* (ATCC 25923), *and Streptococcus mitis (*Table 3).

Table 3: Zones of inhibition (mm) of the selected pathogenic microorganisms in a secondary screening of the Actinomycetes isolates

	Test Organisms					
Isolates	Sa	Sm	Ec	Lm	Vf	Rp
CT(strept)	15.67^{a}	16.67^{a}	16.0^{a}	16.33^{a}	16.0^{a}	16.0^{a}
C52	12.25^{b}	10.0^{bcd}	6.0^{d}	11.0^{cde}	8.0^{fghi}	12.5^{cd}
L14	11.5^{bc}	10.75^{bc}	6.0^{d}	6.0^{i}	8.0^{fghi}	12.5^{cd}
C8	11.25^{bcd}	11.25^{bc}	7.5^{cd}	8.75^{ghi}	12.0^{bc}	11.0^{cde}
P4ixv	10.5^{bcde}	9.25^{bcdefghi}	7.5^{cd}	10.25^{defgi}	6.0^{i}	12.5^{cd}
P4i	10.5^{bcde}	9.75^{bcdefg}	6.0^{d}	11.5^{cd}	6.0^{i}	13.0^{bcd}
C33	10.5^{bcde}	8.0^{cdefgh}	7.5cd	7.5^{hi}	6.75^{hi}	6.75^{ij}
C5	10.0^{bcdef}	6.25^{fgh}	6.75^{cd}	12.5^{bc}	6.75^{hi}	6.0^{j}
C28	10.0^{bcdef}	8.75^{bcdefgh}	7.5^{cd}	12.5^{bc}	9.0^{fgh}	9.0^{cdefghi}
C40	10.0^{bcdef}	6.0^{f}	7.25^{cd}	9.5^{efgh}	9.5^{efgh}	8.5^{cdefghi}
C43	9.5^{bcdefg}	9.75^{bcdefgh}	8.25^{bcd}	11.5^{cd}	11.5^{bcd}	11.5^{cdef}
C50	9.5^{bcdefg}	7.25^{efgh}	6.0^{d}	12.5^{bc}	11.5^{bcd}	15.5^{a}
C22	9.5^{bcdefg}	11.5^{b}	7.75^{cd}	9.0^{efgh}	9.75^{cdefg}	13.0^{bcd}
C26	9.5^{bcdefg}	7.75^{efgh}	7.75^{cd}	7.5^{hi}	11.25^{bcd}	12.25^{cde}
C61	9.0^{cdefg}	7.75^{efgh}	6.5^{cd}	11.75^{bcd}	8.75^{efgh}	9.75^{cdefgh}
C3	9.0^{cdefg}	8.75^{bcdefgh}	8.25^{bcd}	7.0^{i}	10.5^{bcde}	8.75^{cdefghi}
L6	8.75^{cdefg}	8.25^{bcdefgh}	6.0^{d}	16.23^{a}	8.0^{cdefghi}	10.5^{defg}
C40	8.75^{cdefg}	7.0^{defgh}	7.0^{cd}	10.5^{defg}	12.5^{b}	12.25^{cde}
P4ii	8.5^{cdefg}	7.75^{defgh}	6.25^{d}	7.5^{hi}	10.75^{bcde}	8.75^{cdefghi}
L14	8.25^{defg}	9.0^{bcdefgh}	7.5^{cd}	11.0^{cde}	6.0^{i}	13.25^{ab}
C10b	8.25^{defg}	7.75^{defgh}	6.75^{cd}	8.75^{ghi}	9.75^{cdefg}	8.75^{cdefghi}
C27	8.25^{defg}	6.0^{f}	6.0^{d}	6.0^{i}	11.25^{bcd}	6.0^{j}
C10a	8.25^{defg}	7.5^{defgh}	8.0^{bcd}	7.0^{i}	10.5^{bcde}	11.0^{cdefg}
C46	8.0^{efg}	9.5^{bcdefg}	8.0^{bcd}	9.5^{efgh}	6.0^{i}	11.0^{cdefg}
C30b	7.75^{efg}	6.25^{fg}	7.0^{cd}	7.5^{hi}	7.75^{ghi}	7.75^{hij}
L3	7.75^{efg}	8.75^{bcdefgh}	8.75^{bcd}	6.0^{i}	10.0^{bcdef}	9.75^{cdefgh}
C2	7.5^{efg}	11.25^{bc}	10.25^{b}	9.0^{efgh}	6.0^{i}	6.0^{j}
P1b	7.25^{fg}	6.25^{fg}	7.7^{cd}	6.0^{i}	10.0^{bcdef}	9.25^{cdefghi}
C34	7.0^{fg}	8.5^{bcdefgh}	6.0^{d}	11.5^{cd}	6.0^{i}	6.0j
L1	6.75^{g}	7.0^{defgh}	7.0^{cd}	13.25^{b}	11.5^{bcd}	7.5^{hij}
C25	6.5^{g}	6.5^{efh}	6.0^{d}	10.25^{defg}	6.0^{i}	9.0^{cdefghi}
Mean	9.162	8.537	7.373	9.796	9.105	10.073
LSD	3.125	8.53	2.455	1.715	2.021	2.743
CV	1.986	1.986	1.986	1.986	1.986	1.986

[a]Means followed by the same letters are not significantly different at 5% probability level. Significant means were separated using Least Significant Difference at α= 0.05 in SAS version 9.4. Note: The same letters (a, b, c, d, e, f, g, h, i, j,) within a row are not significantly different. C=starch casein, L=Luria Bertani, P1 and P4=ISP-project media

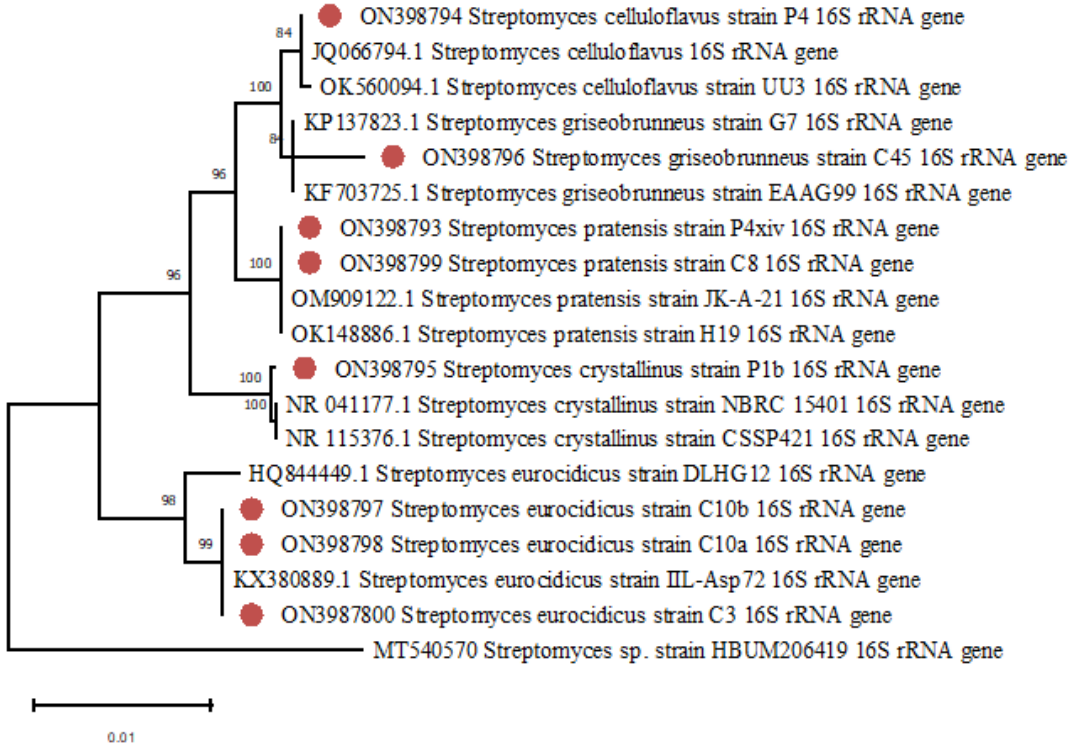
The mean value for antibacterial activity of study isolates against *Staphylococcus aureus* ranged from 6.5 mm to 12.25 mm in diameter. Isolate C52 (12.25mm) showed the highest antibacterial activity compared to isolate C25 (6.75mm) which had the least inhibition activity. All the isolates under study had antibacterial activity against *S. aureus.*

The mean value for the inhibition zone for *E. coli* ranged from 6.25 mm to 8.75 mm. However, isolate L3 (8.75 mm) registered the highest inhibition activity against the test organism (*E. coli*). There was a statistically significant difference (p>0.05) in the isolates under study.

There was a significant difference (p>0.05) among antagonistic isolates against *Listeria monocytogenes*. Isolate L6 (16.23mm) showed the highest antagonistic activity against *L. monocytogenes* compared to the standard; streptomycin (16.3mm). Moreover, *L. monocytogenes* showed resistance to isolates P1b, L3, and L14 (6.0mm). The difference among the isolates was statistically significant (p>0.05). The isolates C52, L14, C43, L6, and C8 exhibited the highest activity against *S. aureus, R. planticola, V. furnissii, L. monocytogenes,* and *S. mitis* respectively). These isolates were isolated from; chicken waste (C52, L14), waste dumpsite soil (C43), and cultivated soil (L6; C8). Isolate L3 that showed the highest activity against *E. coli* was isolated from cow dung waste followed by isolate C3 isolated from cultivated soil.

Molecular Characterization of the Bioactive Isolates

The 16S rRNA gene sequences of *Actinomycetes* from this study were aligned with sequences with similarity indices above 97% retrieved from the NCBI gene bank (https://www.ncbi.nlm.nih.gov), and identified up to species or genus level. The Neighbour Joining phylogenetic tree (Figure 2) built from the combined sequences showed that isolates P4 (Ac No. ON398794.1) was clustered with *Streptomyces celluloflavus* (Acc No. JQ0066794.1 and Ac No. OK56094.1) from the gene bank at 84% bootstrap support value. Isolate C45 (Accession No. ON398796.1) was identified as *Streptomyces griseobrunneus* (Accession No. KP137823.1 and Accession No. KF703725.1) at similar bootstrap support values. Isolates Pxiv and C8 (Ac No. ON398793.1 and Accession No. ON398799.1 respectively) were both clustered at 100% bootstrap support with *Streptomyces pratensis* (Ac Nos. OM909122.1 and OK148886.1). Isolate P1b (Ac No. ON398795.1) was identified as *Streptomyces crystallinus* and was clustered with strains NBRC 15401 (NR_041177.1) and CSSP421 (NR_115376.1) at 100% bootstrap support. Isolates C10b, C10a and C3 (Ac No. ON398797.1, ON398798.1 and ON398800.1) clustered with *Streptomyces eurocidicus* strains DLHG12 (HQ844449.1) and IIL-Asp 72 (KX380889.1) at 99% bootstrap. The evolutionary distances (Table 4) were computed using the Maximum Composite Likelihood method (Tamura *et al*., 2004).



DISCUSSION

The study was aimed to isolate *Actinomycetes* from forest, dumpsite, cultivated soil, farm yard manure and deforested regions and screen them for the production of secondary metabolites. Many studies have been done where *Actinomycetes* have been isolated from different places including soil, mountains, swamps and the marine environment (Guo *et al*., 2015; Kumar *et al*., 2013; Rao *et al*., 2012; Shakthi & Murugan, 2012). This has yielded good results where antibiotics against different gram positive and gram negative bacteria have been extracted. Pre-treatment of the samples with calcium carbonate and air drying them was done to enhance the rate of isolation and also inhibited the growth of common microbial species, allowing less abundant bacteria to be recovered. Antibiotics, nystatin (25 mg/mL) to reduce fungal contamination, and ampicillin (25 mg/mL) to eradicate gram-negative bacteria, were added to the selective media (Alferova *et al*., 1989). Sambamurthy and Ellaiah (1974) employed amphotericin B as an antifungal drug in a technique similar to this.

The results showed more isolates were recovered from starch casein agar compared to other media used in the study. According to Kim (2016), starch casein agar (SCA) has a high carbon-to-nitrogen ratio and contains refractory complex carbons like starch and casein, making it ideal for *Actinomycetes* separation because these organisms can use high molecular weight polymers. *Actinomycetes* isolated in International *Streptomyces* media (ISP-1 and ISP-4) were shown to be slow-growing, according to the study. Actinomycetes were isolated on the same media by Anderson and Wellington (2001), and their colonies were slow-growing, aerobic, glabrous or chalky, folded, and with aerial and substrate mycelia of various colours.

The majority of the isolates were more active against gram-positive bacteria than gram-negative bacteria, according to antibacterial activity results. The findings in this study were comparable to those reported by Ganesan *et al*. (2017) and Gebreyohaness *et al*. (2013), who found that isolated Actinobacteria strains have antibacterial activity against several bacterial test strains. Furthermore, the observed difference in susceptibility of Gram-positive and Gram-negative bacteria test organisms could be attributed to the strains' collective secretions of diverse metabolites endowing them with broad-spectrum action (Benhadj *et al*., 2019). In addition, the majority of the isolates were ineffective against *E. coli*. The findings of this study are comparable to those of Oskay *et al*., 2004 and Anasniriwittana *et al*., 2006. However, they were more active against *S. aureus*.

Actinomycetes molecular identification was successfully done through amplification of the 16S rRNA gene. The amplified region of 16S rRNA helped in the identification of Streptomyces strain (Cook and Meyer, 2003). According to literature, Actinomycetes species, 16 S rRNA gene are about 1250 base pairs while Streptomyces have 600 base pairs confirmed by actinomycetes specific primers and amplification of 16 S rRNA gene (Green and Barnes, 2010). Analysis of 16S-rRNA gene sequence amplification has been demonstrated to be a potential method for microorganism phylogeny investigation. It is reported that 16S rRNA gene sequencing provides genus identification in most cases more than 90% (Guo *et al*., (2008). For identification of novel strains, 16S rRNA sequence method is most prevalently used due to its presence in almost all bacteria and the function of 16S rRNA gene over time has not changed (Janda and Abbot, 2007).

The phylogenetic analysis of the 16srRNA gene showed that the isolates were members of the *Actinomycetes* group. The similarity values were between 84% and 100%. There was therefore no diverse group of Actinomycetes found in the present study. A previous study on soil samples from a reserved area in Kenya reported similar results (Nonoh *et al*., 2010) where five isolates with antimicrobial activity clustered with known *Streptomyces* spp. In the present study, only eight isolates were able to be amplified by *Actinomycetes*-specific primers used. This could be attributed to the fact that the isolates that were not amplified could belong to the rare genera of Actinomycetes and in the future, more pairs of primers should be used including genera-specific primers.

The NCBI-BLASTn analysis result indicate that the sequence of isolate P4i showed 84% sequence similarity with *Streptomyces celluloflavus*. The species produces aurethricin which has the ability to degrade cellulose (Blunt et al., 2008) and its role in pharmaceuticals is the production of poly amino acids (Shih *et al*., 2004). The isolates C10 and C3 showed 99% sequence similarity with *Streptomyces eurocidicus.* The strain produces Azomycin, eurocidin C, D, E, tertiomycin A and B and 2-nitroimidazole. Isolates P1b and C10b had 100% sequence similarity with *Streptomyces crystallinus*. The species produces hygromycin-B which is an aminoglycoside antibiotic that kills, bacteria, fungi, and higher eukaryotic cells by inhibiting protein synthesis (Afifi *et al*., 2012). The antibacterial activity of Hygromycin A (HA) arises from protein synthesis inhibition and is dependent upon a methylenedioxy bridged-aminocyclitol moiety.

CONCLUSION

Actinomycetes are one of the most prominent components of soil microbial communities, and they play an important role in the generation of antibacterial secondary metabolites. Actinomycetes were isolated successfully from soil samples taken in Meru South sub-county, Kenya. The selected Actinomycetes isolated from soil samples in were found to have antibacterial activity against the test pathogens. The molecular characterization of the eight isolates with antibacterial activity showed they belonged to *Streptomyces* spp. Bioactive metabolites from these Streptomyces sp. have to be purified and minimum inhibition concentration analysis of the isolates has to be done for discovering novel compounds which have commercial value. Further studies on these are underway.

RECOMMENDATIONS

1. New techniques should be used for isolation of those taxa that cannot be isolated by conventional methods. Metagenomics can be employed hence those taxa that cannot be cultured can be captured.
2. There is need for isolating *Actinomycetes* from other unique environment in Kenya.

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CHARACTERIZATION OF B-LACTAMASES AND MULTIDRUG RESISTANCE MECHANISMS IN ENTEROBACTERALES FROM HOSPITAL EFFLUENTS AND WASTEWATER TREATMENT PLANT

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ABSTRACT
Antimicrobial resistance presents a global challenge to the fight against infections in modern time. It is projected that, close to 2.4 million people are likely to die globally by the year 2050 due to infections linked to antibiotic resistance. Antimicrobials indiscriminately discharged into wastewater promote the emergence of antibiotic resistance, facilitated by selective pressure and transfer of resistance genes. This study aimed to determine the antimicrobial resistance profiles of enteric bacteria from wastewater and to establish the prevalence of plasmid borne β-lactamases and other mechanisms conferring multiresistance. Enteric bacteria, *Escherichia coli, Klebsiella pneumoniae*, *Klebsiella oxytoca*, *Enterobacter cloacae,* and *Citrobacter* species (n = 126) from hospital effluents and proximate wastewater treatment plant in the city of Pecs, Hungary, were assayed for susceptibility to four antimicrobial classes. The β-lactamase encoding genes harbored in plasmids were genotyped and the plasmid DNA was subjected to the next generation sequencing. A multidrug resistance phenotype was found in 72% (n = 58) of *E. coli* isolates, 70% (n = 43) of *Klebsiella* species isolates, and 40% (n = 25) of *Enterobacter* and *Citrobacter* species. 86% (n = 50) of *E. coli*, 77% (n = 33) of *Klebsiella* species and 25% (n = 4) of *Citrobacter* species isolates phenotypically expressed extended spectrum β-lactamase (ESBL). ESBL genes, $bla_{\text{CTX-M-27}}$ and $bla_{\text{TEM-1}}$ were found in *E. coli,* while *Klebsiella* species harbored $bla_{\text{CTX-M-15}}$, $bla_{CTX\text{-}M\text{-}30}$, *or* $bla_{\text{SHV-12}}$. Genes coding for aminoglycoside modifying enzymes, adenylyltransferases (*aadA1*, *aadA5)*, phosphotransferases (*aph(6)-1d*, *aph(3")-Ib)*, acetyltransferases (*aac(3)-IIa)*, (*aac(6)-Ib*), sulfonamide/trimethoprim resistant dihydropteroate synthase (*sul*), and dihydrofolate reductase (*dfrA*) were also identified. Mobile genetic elements namely; plasmids and integrons acquired via horizontal gene transfer are vehicles for multiresistance in enteric bacteria from wastewater. Monitoring wastewater from human sources for acquired resistance in clinically important bacteria may provide a cheaper alternative in regions facing challenges that limit clinical surveillance.
Keywords: hospital effluents; wastewater treatment plant; Enterobacterales; β-lactamases; multiresistance

INTRODUCTION
Antimicrobial resistance presents a global challenge to the fight against infections in modern time (Iakovlieva & Bahlai, 2020). Each year more than 670 000 infections are due to antibiotic resistant bacteria in the European Union/European Economic Area (EU/EEA) according to data from the European Antimicrobial Resistance Surveillance Network (EARS-Net), and approximately 33 000 people succumb to these infections (Cassini et al., 2019). It is projected that, close to 2.4 million people are likely to die globally in high-income countries by the year 2050 due to diseases caused by antibiotic resistant microorganisms (UN, 2019). The widespread use of antimicrobials in clinical practice to control infectious diseases, their application in veterinary medicine coupled with the discharge of non-treated pharmaceutical effluent into the environment results in selective pressure which is associated with the emergence and subsequent evolution of bacteria resistant to antibiotics (Islam, 2011).

Members of the order Enterobacterales, which bear similar biochemical and genetic characteristics are ubiquitous and form a major part of gut microbiota (Partridge, 2015). Some of them such as *Klebsiella pneumoniae, Escherichia coli, Proteus, Citrobacter* and *Enterobacter* cause infections including in the urinary tract, bloodstream, and respiratory tract (hospital and health-care associated pneumonia), as well as intestinal and intra-abdominal infections (Pitout & Laupland, 2008; Qin et al., 2008). Enterobacterales exhibit a wide range of resistance attributed to either mutations in chromosomal genes or mobile genes captured from different source species by various mobile genetic elements and transferred to plasmids, which can shuttle between cells and confer or enhance resistance to certain chemical classes of antimicrobials that are frequently used against multi-drug resistant microorganisms (Partridge, 2015). Fluoroquinolones and β-lactam antibiotics, which include the sub-groups of penicillins, cephalosporins and carbapenems are the most frequently prescribed antibiotics and preferred therapeutic choices against infections caused

by members of Enterobacterales (Damoa-Siakwan, 2005). Hospitals and other environments characterized by high amounts of antibiotics are associated with multidrug resistant Gram-negative bacteria that have demonstrated an increasing resistance to those compounds (Hocquet, Muller, & Bertrand, 2016). Antimicrobial resistant genes (ARG), such as genes coding for extended-spectrum β-lactamases (ESBLs) and carbapenemases harbored by Enterobacterales and other Gram-negative bacteria are clinically significant and have been reported from hospital effluents and WWTPs (Haller et al., 2018; Lamba, Graham, & Ahammad, 2017). These genes are typically encoded on plasmids which harbor mobile genetic elements such as transposons or integrons and genes known to encode resistance to other antimicrobial agents (Szczepanowski et al., 2009).

ESBLs are β-lactamases that are capable of hydrolyzing broad-spectrum cephalosporins and aztreonam, whose activity is inhibited by clavulanic acid (Paterson & Bonomo, 2005). More than 300 subtypes of ESBLs have been described and their evolution is believed to originate from common ancestral types: TEM-1, TEM-2, or SHV-1 (Bush & Jacoby, 2010). Mutations occurring in those genes resulted in new β-lactamases which can hydrolyze extended-spectrum cephalosporins and aztreonam (Slama, 2008; Smet et al., 2008). Enterobacterales are also known to express ESBLs different from TEM, or SHV related types, such as CTX-M-type β-lactamases which are encoded by genes captured on transferable plasmids and are among the most widespread ESBLs in Europe (Coque et al., 2008). Carbapenems (imipenem, doripenem, ertapenem and meropenem) are the most potent antimicrobials used to manage life-threatening infections caused by multiresistant Gram-negative bacilli and their efficacy has been diminishing since carbapenem-resistant Gram-negative strains have emerged following their extensive use (Codjoe & Donkor, 2018).

Carbapenemase producers are resistant to almost all β-lactams and to other classes of antibiotics (Woodford, Wareham, Guerra, & Teale, 2014). Their occurrence in the environmental matrices is increasing with hospital wastewater being reported as a key reservoir of carbapenemase-producing Enterobacterales (Zhang, Lu, & Zong, 2012). Data on the prevalence of β-lactamase producing multiresistant Enterobacterales of clinical importance in wastewater from human sources in southwest Hungary is unavailable since most studies are centered on the clinical environment. This study was aimed at bridging this knowledge gap and was therefore designed to: 1. Isolate enteric bacteria of clinical importance including *Klebsiella* species, *Escherichia coli,* and *Enterobacter* species from urban wastewater covering hospital effluents, municipal wastewater, and WWTP and determine their antimicrobial resistance profiles; 3. Molecular typing and sequencing of plasmid DNA to establish the prevalence of β-lactamase enzymes from the isolates and to unearth other mechanisms conferring multiresistance. In this context, the findings contribute to important knowledge and are applicable in planning effective strategies to minimize the spread of multiresistance in the environment.

MATERIALS AND METHODS

Study Sites and Sample Collection

This study was carried out in the city of Pecs, in southwest Hungary. Wastewater samples were drawn from four hospital wastewater discharge points, H1 (387 beds), H2 (106 beds), H3 (127 beds), and H4 (348 beds), a discharge point of a nursing home for the elderly (NH, 490 beds), municipal wastewater sewer lines (MWW), and a wastewater treatment plant (WWTP) (Figure 1). Effluent samples from the healthcare facilities were collected directly from two separate generation points serving different buildings before joining the main sewer pipe. A 30 mL sample was collected every 15 min by lowering a flask into the wastewater flow over a period of 4 h and the aliquots were pooled together to constitute a 480 mL composite sample in sterile 500 mL glass bottles. Samples from the WWTP were collected from the influent directly behind the grating screen. One grab sample was drawn from the activated sludge reactor and the digested sludge after thermophilic digestion. The municipal wastewater was collected 4 km upstream of the health care facilities (MWW1) and at a second spot upstream of the WWTP (MWW2), and was pooled. Samples were transported on ice to the laboratory and stored at 4 °C, before assaying within 6 h. The WWTP processes wastewater from the central business district, health care facilities, domestic wastewater, and some storm runoff and serves a population equivalent to slightly over 200,000 inhabitants. The study was conducted during 2018–2020.

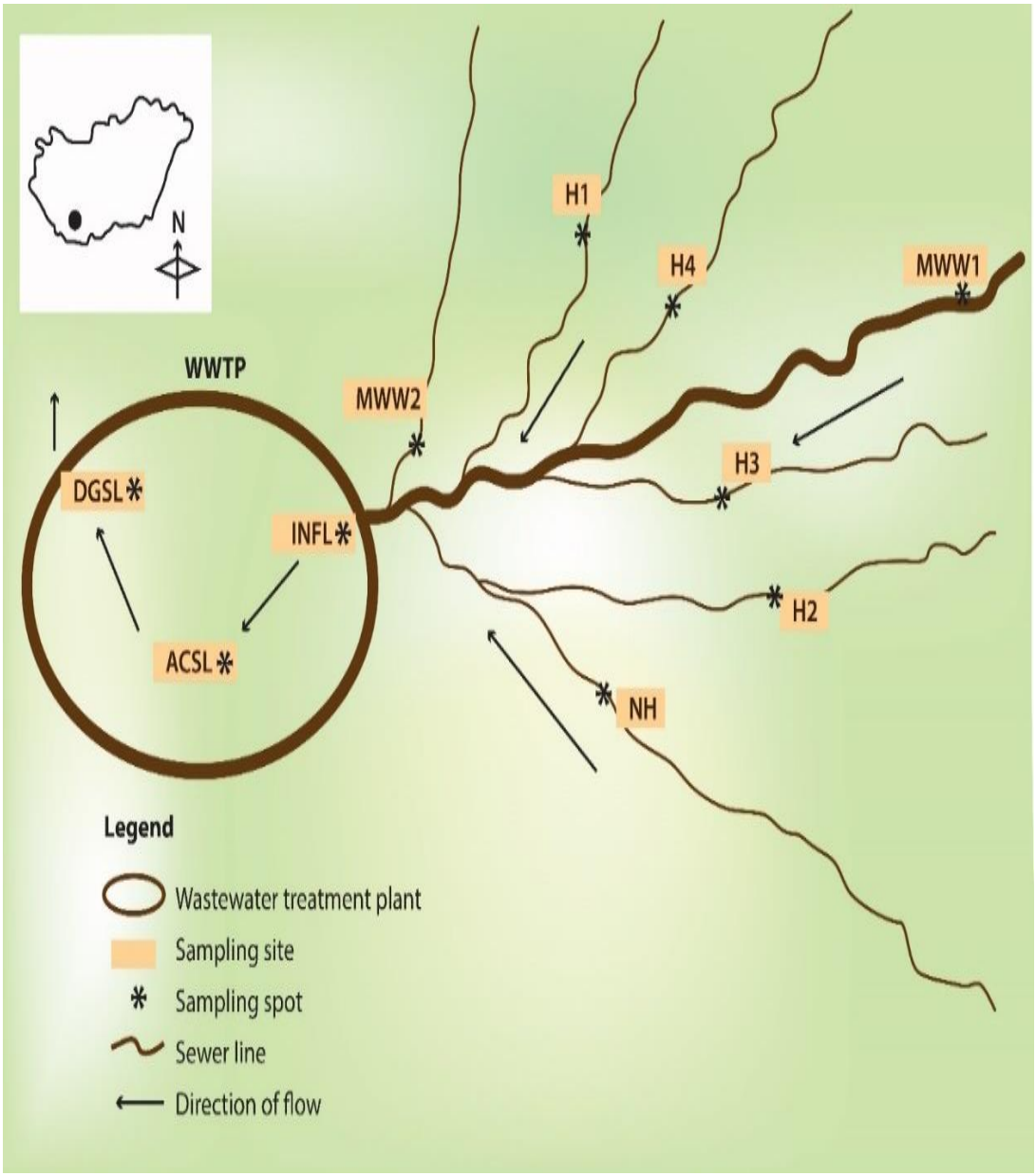


Figure 1. A schematic diagram depicting the sampling locations. H1–H4, hospital wastewater; NH, nursing home; MWW1 and MWW2, municipal wastewater; INFL, influent; ACSL, activated sludge; DGSL, digested sludge; WWTP, wastewater treatment plant.

Characterization of the Bacterial Isolates

On each sampling occasion, up to 5–10 lactose fermenting colonies of presumptive enteric bacteria representative of different colony morphotypes (colony contour, color, or size) were randomly picked from Eosin methylene blue plates. Typical green metallic sheen colonies were suggestive of *E. coli*, large mucoid pinkish colonies characteristic of *Klebsiella* species and pink to purple colonies typical of *Enterobacter* species (Cheesbrough, 1990). The isolates were sub-cultured on nutrient agar, incubated at 35 ± 2 °C for further 18–24 h and were identified with MALDI-TOF MS. Mass spectrometry was performed using a Microflex MALDI Biotyper (Bruker Daltonics, Bremen, Germany) equipment. MALDI Biotyper RTC 3.1 software (Bruker Daltonics, Bremen, Germany), and the MALDI Biotyper Library 3.1 were employed for the spectrum analysis. Score values of ≥ 2.0 were considered reliable identifications (Blondiaux, Gaillot, & Courcol, 2010). For further characterization, the cultures were preserved at −80 °C in nutrient broth supplemented with 20% glycerol.

Antimicrobial Susceptibility Profiles and Phenotypic Detection of β-lactamases

Antimicrobial susceptibility was established using the standardized disk diffusion method on Mueller Hinton agar (Biolabs, Budapest, Hungary) according to EUCAST 2018 guidelines. The standard antibiotic discs belonging to the following classes were used: (1) β-lactams; ceftriaxone (CRO, 30 µg), ceftazidime (CAZ, 10 µg), cefotaxime (CTX, 30 µg), cefpodoxime (CPD, 10 µg), cefoxitin (FOX, 30 µg), imipenem (IMP, 10 µg), and meropenem (MEM, 10 µg). (2) Aminoglycoside; gentamicin (GEN, 10 µg), (3) fluoroquinolone; ciprofloxacin (CIP, 5 µg), and (4) sulfonamide; sulfamethoxazole/trimethoprim (SXT, 1.25/23.75 µg) (Oxoid, Wesel, Germany). Quality control was performed using *E. coli* ATCC 25922, *Klebsiella pneumoniae* ATCC 180112, and *Enterobacter cloacae* ATCC 180083 as wild type negative controls while *E. coli* ATCC 151006, *Klebsiella pneumoniae* ATCC 180111, and *Enterobacter cloacae* ATCC 161002 were control strains with known resistance phenotype. Inoculum's concentration was standardized to 0.5 McFarland turbidity, and the plates were incubated for 18–20 h at 35 °C and evaluated for the formation of inhibition zones. The zone diameters were interpreted based on the European Committee on Antimicrobial Susceptibility Testing clinical breakpoints, version 8.1, 2018 (EUCAST, 2018).

Multidrug resistance among the strains was defined as resistance to three or more antibiotic classes. A combined disk test was used to screen for the production of extended-spectrum β-lactamase. Cefotaxime (CTX 30 µg) and cefpodoxime (CPD 10 µg) (Oxoid, Wesel, Germany) disks were placed next to the disks with cefotaxime/clavulanic acid (CTC, 30/10 µg, CTC, 40) and cefpodoxime/clavulanic acid (10/10 µg, CD, 01). Similarly, carbapenem resistant isolates were screened for metallo-β-lactamase (MBL) production using a combined disk of imipenem/ethylene diamine tetraacetic acid (IMP 10 µg / EDTA 292 µg—IEL 292) (Oxoid, Wesel, Germany) on Mueller Hinton agar plates (Biolabs, Budapest, Hungary) with an inoculum of 0.5 McFarland. An increase in the inhibition zone size to ≥ 5 mm with the combined disks compared to the disk of cephalosporin/carbapenem alone was considered a positive test for β-lactamase production (Oduro-Mensah et al., 2016).

Molecular Typing of ESBL and Carbapenemases

Plasmid DNA was isolated by the alkaline lysis method using the Monarch plasmid DNA miniprep kit according to the manufacturer's instructions (New England Biolabs T1010, Ipswich, Massachusetts, USA). DNA was isolated from freshly grown pure colonies transferred into Luria Bertani broth and incubated in an orbital shaker at 35 °C and 200 rpm for 12–16 h. All the centrifugation steps were carried out at 16,000 x g. DNA concentration and purity were determined using a Nanodrop spectrophotometer (NanoDrop 2000, Thermo Scientific, Wilmington, USA), and stored at –20 °C for subsequent PCR amplification. PCR reactions for selected genes belonging to $bla_{\text{CTX-M}}$, bla_{TEM}, bla_{SHV}, $bla_{\text{OXA-48}}$, bla_{KPC}, bla_{IMP}, bla_{VIM}, and bla_{NDM} families were performed in a final volume of 25 µL containing 12.5 µL DreamTaq PCR master mix (2x) composed of Dream Taq DNA polymerase, optimized 2x Dream Taq buffer, 4.0 mM, $MgCL_2$, 0.4 mM each of dATP, dCTP, dGTP, and dTTP (Thermo Scientific, Waltham, Massachusetts, USA), 1.0 µM, Forward primer, 1.0 µM, Reverse primer, 1 µL template DNA, and by addition of nuclease free water.

A conventional PCR assay was used and the amplification thermal profile was applied as follows: Initial denaturation at 95 °C for 2 min, 35 times repeated cycle of 95 °C for 30 s, 30 s at the appropriate primer annealing temperature for the specific primer, primer extension at 72 °C for 1 min, and final elongation at 72 °C for 10 min, with a holding step at 4 °C. Primers used and their corresponding annealing temperatures are as shown in Table 1. Gly238→Ser mutation associated with the hydrolysis of third-generation cephalosporins was identified through digestion of bla_{SHV} PCR product with *NheI* (New England Biolabs). Colony PCR was performed using OneTaq quick load Mastermix to determine the presence of chromosomally encoded metallo-β-lactamases among carbapenem resistant isolates. Individual colonies were dipped into the reaction tubes containing 25 µL One Taq master mix (New England Biolabs, Budapest, Hungary) PCR primers and nuclease free water.

Thermal cycling conditions were initial denaturation at 94 °C for 2 min, 35 times repeated cycle of 94 °C for 30 s, 30 s at the appropriate primer annealing temperature for the specific primer, primer extension at 68 °C for 1 min, and final elongation at 68 °C for 10 min, with a holding step at 4 °C. Post PCR analysis was performed in 1.5% (w/v) agarose gel stained with 2 µL serva DNA stain G (Bio-Connect, Begonialaan, Netherlands). Then, 5 µL of each DNA sample was mixed with 2 µL of 6x loading dye and electrophoresed in 1x Tris—EDTA (TAE) buffer at 100 V for 1 h and visualized under an ultraviolet transilluminator. Next, 10 µL of either phage Lambda DNA digested with *EcoRI/HindIII* and a low range molecular weight marker (Thermo Scientific, Waltham, Massachusetts, USA) or both, in some cases, were included in each run as DNA size markers. In each PCR run, a positive control consisting of a clinical isolate of a confirmed reference strain was included for each genotype. The control strains were well characterized clinical isolates kindly provided by the microbiology laboratory of the University of Pecs Medical

School (Melegh et al., 2014). For the robust colony PCR, 10 µL of each reaction was directly loaded onto an agarose gel alongside a PCR product from an appropriate reference strain and a DNA ladder.

Table 1. Sequences, annealing temperature, expected product sizes of primer pairs targeting specified β-lactamase genes.

Gene	Sequence (5′-3′)	Product Size (bp)	Annealing Temp (°C)	References
CTX-M-F CTX-M-R	TTTGCGATGTGCAGTACCAGTAA CGATATCGTTGGTGGTGCCATA	544	51	(Edelstein, Pimkin, Palagin, Edelstein, & Stratchounski, 2003)
SHV-F SHV-R	ATGCGTTATATTCGCCTGTG GTTAGCGTTGCCAGTGCTCG	865	49	(Wiegand, Geiss, Mack, Stürenburg, & Seifert, 2007)
TEM-F TEM-R	GCGGAACCCCTATTTG ACCATTGCTTAATCAGTGAG	963	56	(Olesen, Hasman, & Møller Aarestrup, 2004)
IMP-F IMP-R	GGAATAGAGTGGCTTAAYT TCGGTTTAAYAAAACAACCACC	232	52	(Poirel, Walsh, Cuvillier, & Nordmann, 2011)
KPC-F KPC-R	CGTCTAGTTCTGCTGTCTTG CTTGTCATCCTTGTTAGGCG	798	52	(Poirel et al., 2011)
NDM-F NDM-R	GGTTTGGCGATCTGGTTTTC CGGAATGGCTCATCACGATC	621	52	(Poirel et al., 2011)
OXA-48-F OXA-48-R	GCGTGGTTAAGGATGAACAC CATCAAGTTCAACCCAACCG	438	60	(Poirel et al., 2011)
VIM-F VIM-R	GATGGTGTTTGGTCGCATA CGAATGCGCAGCACCAG	390	52	(Poirel et al., 2011)

Plasmid DNA Library Preparation and Sequencing

Selected isolates (*E. coli* n=10, *K. pneumoniae* n=9, *K. oxytoca* n=1, *C. freundii* n=1) were subjected to NGS sequencing. The selection was based on antimicrobial susceptibility profiles and site of isolation. The library for NGS sequencing was prepared using Swift 2S Turbo DNA Library Kits (Swift Biosciences, Ann Arbor, Michigan, United States). Briefly, 100 ng genomic DNA was fragmented, end prepped, and adapter ligated. Magnetic bead size selection was performed to select 250-300 bp insert size fragments, followed by the library amplification according to the manufacturer's instructions. The quality of the library was checked on the 4200 TapeSation System using D1000 Screen Tape (Agilent Technologies, Palo Alto, California, USA) and the quantity was measured on Qubit 3.0. (Thermo Scientific, Waltham, Massachusetts, USA). Illumina sequencing was performed on the NovaSeq 6000 instrument (Illumina, San Diego, California, USA) with a 2x151 run configuration. Quality control (QC), trimming, and filtering of 150 pb paired-end raw reads were performed in the preprocessing step. The QC analysis was performed with FastQC (Andrews et al., 2010). The Phred-like quality scores (Qscores) were set to >30. Poor quality reads, adapters at the ends of reads, limited skewing at the ends of reads were eliminated by using Timmomatic (Bolger, Lohse, & Usadel, 2014). Since data contained genomic DNA debris, identification of plasmid-derived contigs was performed after de novo assembly of cleaned reads.

For plasmid identification, genes characteristically encoded in plasmids for each strain were determined based on literature and by aligning them for the contigs using locally the Blast+ (Altschul, Gish, Miller, Myers, & Lipman, 1990). Prokaryotic gene finding was performed by Glimmer using the Bacterial, Archaeal, and Plant Plastid Code. Glimmer uses Interpolated Markov Models (IMMs) to identify the coding regions and to distinguish them from non-coding DNA, which enabled identified genes to be annotated (Delcher, Harmon, Kasif, White, & Salzberg, 1999). Functional annotation and Gene Ontology (GO) analysis were carried out using OmixBox.Biobam as follows: sequences were blasted against the NCBI nr (non-redundant) database (taxID: 2Bacteria), applying blastn configuration locally. To retrieve GO terms associated with the 10 Hits obtained by the Blast search GO mapping and annotation were performed. GeneBank identifiers (gi), the primary blast Hit ids, were used to retrieve UniProt IDs making use of a mapping file from PIR (Non-redundant Reference Protein Database), including PSD, UniProt, Swiss-Prot, TrEMBL, RefSeq, GenPept, and PDB.

Accessions were searched directly in the dbxref table of the GO database. BLAST result accessions were searched directly in the gene-product table of the GO database; GO annotations were specified according to GO terms: molecular function, cellular component and biological process (Götz et al., 2008). For detection of antimicrobial resistance genes and identification of plasmid incompatibility groups ResFinder 4.1 and plasmidFinder 2.1 were used (Bortolaia et al., 2020; Carattoli et al., 2014). Each contiq of all isolates was aligned with MUMmer 4.0 in order to identify similar regions (Marçais et al., 2018). MUM indices were calculated pairwise and the resulting distance matrix was used to cluster the isolates with neighbor joining method (Deloger, El Karoui, & Petit, 2009). Visualization of clusters was done with splits 4 (Huson & Bryant, 2006).

Statistical Analysis

A descriptive statistical analysis was performed using Microsoft Excel 2013 (Redmond, WA, USA, Microsoft Corp.). OriginPro version 2016 (Northampton, Massachusetts, USA, OriginLab Corp.) was used for plotting and analysis. Shapiro–Wilk tests were performed to check the normality of variables, while one-way analysis of variance (ANOVA) was used to compare resistance rates among sampling locations. Pairwise t-test was performed to determine differences in resistance rates between hospitals and WWTP. A correlation matrix was used to examine the relationship between β and non-β-lactam antibiotic resistance. P values ≤ 0.05 were considered statistically significant.

RESULTS

Characterization of Antimicrobial Resistant Enterobacterales

A total of 126 isolates were recovered from the samples and identified with MALDI-TOF MS. The isolates belonged to *E. coli*, 46% (n = 58), *Klebsiella pneumoniae*, 20.6% (n = 26), *Klebsiella oxytoca*, 13.5% (n = 17), *Enterobacter cloacae*, 7.1% (n = 9), *Citrobacter freundii*, 11.11% (n = 14), *Citrobacter braakii*, 0.8% (n = 1), and *Citrobacter amalonaticus*, 0.8% (n = 1). The isolates were obtained from the following samples: 63.49% (80 strains) from the hospital effluents, 8.7% (11 strains) from nursing home, 20.6% (26 strains) from wastewater treatment plant, and 7.1% (9 strains) from municipal wastewater. Other isolates identified as not belonging to the Enterobacterales (*Stenotrophomonas maltophilia* n = 19, *Elizabethkingia meningoseptica* n = 7, *Elizabethkingia miricola* n = 6, and *Acinetobacter junii* n = 1) were not of interest for this study and were excluded from the subsequent analysis.

Antimicrobial Susceptibility Profiles and Multiple Antibiotic Resistance Indices

The enteric bacteria demonstrated variable susceptibility to the tested antibiotics, with isolates from the hospital effluents and the nursing home showing a relatively higher resistance rate than isolates from the WWTP and the municipal wastewater (Table 2). The multiple antibiotic resistance index (MAR index) for an isolate was calculated as *a/b* where *a* is the number of antibiotics to which an isolate was resistant, and *b* is the total number of antibiotics against which the isolate was tested. The MAR index for a site was calculated as *a/(b*c)* where *a* is the aggregate antibiotics resistance score of all isolates from a sample, *b* is the total number of antibiotics tested and *c* is the number of isolates from sample.

Table 2. The antimicrobial susceptibility of enteric bacteria in percentage in the samples from the various sites.

		Antimicrobial Susceptibility %										
Source	**n = 126**	**CRO**	**CAZ**	**CTX**	**CPD**	**FOX**	**IMP**	**MEM**	**SXT**	**GEN**	**CIP**	**MAR Index**
H1	27	100	81	100	100	19	20	4	57	44	78	0.596
H2	25	96	80	96	92	24	8	0	48	60	88	0.592
H3	6	100	100	100	100	50	0	0	100	33	100	0.683
H4	22	96	82	91	91	33	0	0	41	27	68	0.532
NH	11	100	100	92	82	18	0	0	91	27	82	0.591
INFL	9	100	100	78	67	22	0	0	56	22	56	0.500
ACSL	12	92	75	83	92	8	0	0	75	18	67	0.508
DGSL	5	100	100	100	100	40	0	0	40	40	40	0.560
MWW	9	100	78	100	100	33	0	0	11	11	22	0.444

Isolates from H3 had the highest resistance rate (MAR index 0.683) among the hospital effluents. Those from the digested sludge were the most resistant (MAR index 0.560) among the wastewater treatment plant isolates, while

municipal wastewater had the least resistant isolates (MAR index 0.444). *E. coli* demonstrated the highest MAR index (0.65) among the four genera, while *Citrobacter* spp. showed the lowest MAR index (0.39) (Table 3).

A high prevalence of resistance (>80%) was observed for the third generation cephalosporins (3GCs) ceftriaxone (CRO), ceftazidime (CAZ), cefotaxime (CTX), and cefpodoxime (CPD), while significantly lower resistance rates were measured for carbapenems, imipenem, and meropenem (IMP and MEM) compared to the other antibiotics. From H1 and H2 samples, resistance to IMP was found in 20% and 8% of *Klebsiella* and *E. coli* isolates, respectively, and 1 (4%) *Klebsiella* isolate from H1 was resistant to MEM. Gentamicin (GEN) resistance was the least frequent among the three non-β-lactams.

Antimicrobial agents; CRO, ceftriaxone; CAZ, ceftazidime; CTX, cefotaxime; CPD, cefpodoxime; FOX, cefoxitin; IPM, imipenem; MEM, meropenem; SXT, sulfamethoxazole/trimethoprim; GEN, gentamicin; CIP, ciprofloxacin; n, number of isolates. MAR index, multiple antibiotic resistance index. **Study sites:** H1–H4, hospital effluent; NH, nursing home; INFL, influent; ACSL, activated sludge; DGSL, digested sludge; MWW, municipal wastewate.

Table 3. Antimicrobial susceptibility of genus in percentage and multiple antibiotic resistance indices (n = 126).

Isolates	***E. coli* (n = 58)**		***Klebsiella* spp (n = 43)**		***E. cloacae* (n = 9)**		***Citrobacter* spp (n = 16)**	
Antimicrobial Agent	**R**	**S**	**R**	**S**	**R**	**S**	**R**	**S**
CRO	58 (100)	0 (0)	42 (98)	1 (2)	9 (100)	0 (0)	14 (86)	2 (13)
CAZ	51 (88)	7 (13)	31 (72)	12 (28)	9 (100)	0 (0)	16 (100)	0 (0)
CTX	58 (100)	0 (0)	40 (93)	3 (7)	7 (78)	2 (22)	11 (69.)	5 (31)
CPD	58 (100)	0 (0)	38 (88)	5 (12)	8 (89)	1 (11)	14 (88)	2 (13)
FOX	2 (3)	56 (97)	5 (12)	38 (88)	9 (100)	0 (0)	15 (94)	1 (6)
IMP	2 (3)	56 (97)	6 (14)	37 (86)	0 (0)	9 (100)	0 (0)	16 (100)
MEM	0 (0)	58 (100)	1 (2)	42 (98)	0 (0)	9 (100)	0 (0)	16 (100)
SXT	43 (74)	15 (26)	16 (37)	27 (63)	5 (56)	4 (44)	2 (13)	14 (86)
GEN	15 (26)	43 (74)	24 (56)	19 (44)	0 (0)	9 (100)	5 (31)	11 (69)
CIP	46 79)	12 (21)	29 (67)	14 (33)	5 (56)	4 (44)	7 (44)	9 (56)
MAR index	0.646		0.551		0.555		0.394	

Antimicrobial agents; CRO, ceftriaxone; CAZ, ceftazidime; CTX, cefotaxime; CPD, cefpodoxime; FOX, cefoxitin; IPM, imipenem; MEM, meropenem; SXT, culfamethoxazole/trimethoprim; GEN, gentamicin: CIP, ciprofloxacin; R, resistant; S, susceptible; MAR index, multiple antibiotic resistance index.

Resistance rates between β-lactams (ceftriaxone, ceftazidime, cefotaxime, cefpodoxime, cefoxitin, imipenem, and meropenem) and the non-β-lactams (sulfamethoxazole/trimethoprim, gentamicin, and ciprofloxacin) antibiotics were not significantly different (p = 0.8550). However, a positive correlation was found between resistance in the two groups. Ceftriaxone resistance was positively correlated to SXT and CIP, ceftazidime resistance to SXT, cefotaxime to GEN, SXT and CIP, and cefpodoxime resistance to SXT and CIP. Notably, the *E. cloacae* and the *Citrobacter* spp. isolates were resistant to cefoxitin (a cephamycin-second generation cephalosporin), unlike the other genera. Figure 2a,b,c illustrate the antibiotic resistance patterns of *E. coli*, *K. pneumoniae*, and *K. oxytoca*, *E. cloacae*, and *Citrobacter* species isolates in the hospitals, nursing home, wastewater treatment plant, and municipal wastewater samples.

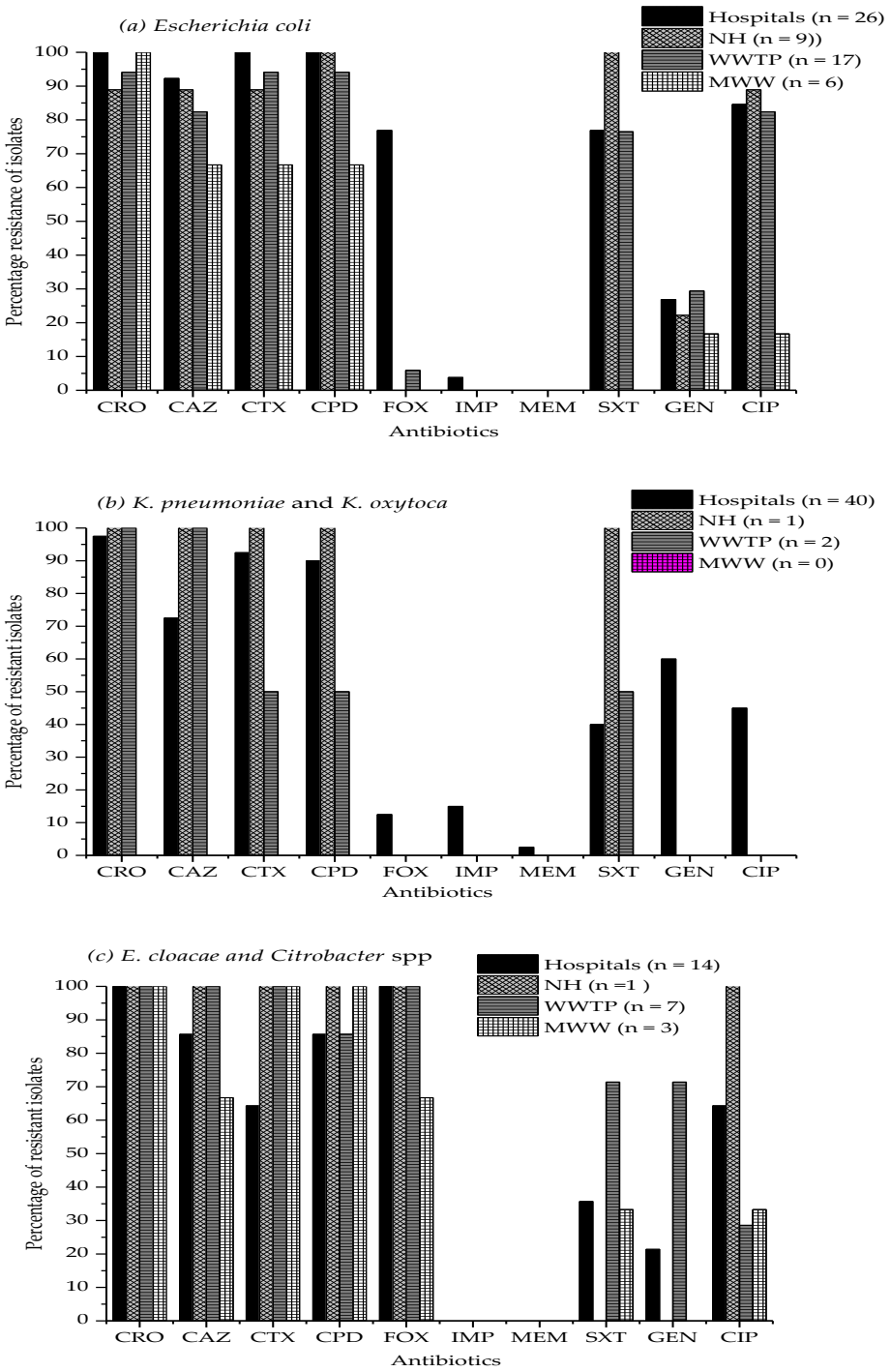


Figure 2. Antimicrobial resistance percentage of (**a**) *E. coli*, (**b**) *Klebsiella pneumoniae*, and *K. oxytoca*, (**c**) *Enterobacter cloacae*, and *Citrobacter* species isolates from four hospital effluents, nursing home, wastewater treatment plant, and municipal wastewater to ten different antibiotics. CRO, ceftriaxone; CAZ, ceftazidime; CTX, cefotaxime; CPD, cefpodoxime; FOX, cefoxitin; IPM, imipenem; MEM, meropenem; SXT, sulfamethoxazole/trimethoprim; GEN, gentamicin; CIP, ciprofloxacin. **Study sites:** NH, nursing home; WWTP, wastewater treatment plant; MWW, municipal wastewater. The absence of a bar indicates that no resistance was observed.

Phenotypic Expression of β-lactamases

Combined disc test of two different antibiotics and their β-lactamase inhibitor combinations were used to classify the isolates as extended-spectrum β-lactamase (ESBL) positive. Cefotaxime/clavulanic (CTC 40) and cefpodoxime/clavulanic acid (CD 01) markers defined 87 isolates (69.05%) as ESBL producers. 62.07% (n = 54), 25.3% (n = 22), and 6.9% (n = 6) of ESBL-positive isolates originated from hospital effluents, wastewater treatment plant, and municipal wastewater, respectively. All *Enterobacter cloacae* isolates were confirmed to be non-ESBL-producing and showed 100% resistance to cefoxitin, which is associated with AmpC cephalosporinase activity. Isolates resistant to imipenem and/or meropenem were confirmed to be metallo-β-lactamase negative by phenotypic test.

Molecular Characterization of ESBL and Carbapenemase Genes

The ESBL-positive isolates were confirmed to harbor $bla_{\text{CTX-M}}$ (100%) and bla_{TEM} 72.4% (n = 63) with PCR. The *NheI* digestion of the bla_{SHV} PCR product indicating the GLy238 → Ser mutation was positive in 17.2% (n = 15) of the samples (Table 4). Additionally, 69% (60 out of 87) of the isolates harbored both $bla_{\text{CTX-M}}$ and bla_{TEM}. This co-occurrence of $bla_{\text{CTX-M}}$ and bla_{TEM} was observed in *E. coli* (62%), *Klebsiella spp.* (49%), and *Citrobacter spp.* (19%). In 17.2% of *Klebsiella spp.* Isolates, both $bla_{\text{CTX-M}}$ and bla_{SHV} genes occurred simultaneously. Furthermore, 11.5% of the total isolates harbored the three groups of β-lactamase genes ($bla_{\text{CTX-M}}$, bla_{TEM}, and bla_{SHV}). The broad-spectrum β-lactamase producers were more widespread in hospital and the nursing home effluents (68.9%) than in wastewater from other sources (WWTP, 24.1%, and municipal wastewater, 6.9%). None of the carbapenemase genes bla_{VIM}, bla_{IMP}, bla_{KPC}, $bla_{\text{OXA-48}}$, and bla_{NDM} was detected in the plasmid DNA of the carbapenem resistant isolates (n = 2, *E. coli*, and n = 7, *Klebsiella* species). However, carbepenem resistant *K. oxytoca* isolates were shown to carry the bla_{VIM} gene in the genome by a robust colony PCR test (Figure S1).

Table 4. The number and percentage distribution and co-occurrence of bla_{CTX-M}, bla_{TEM}, and bla_{SHV} genes among the ESBL positive isolates.

ESBL Gene Family	*E. coli*	*K. pneumoniae*	*K. oxytoca*	*Citrobacter*	Total (% of ESBL Positive, n = 87)
$bla_{\text{CTX-M}}$	50 (86)	22 (85)	11 (65)	4 (25)	87 (100)
bla_{TEM}	39 (67)	16 (62)	5 (29)	3 (19)	63 (72)
bla_{SHV}	0 (0)	14 (54)	1 (6)	0 (0)	15 (17)
$bla_{\text{CTX-M}}$ + bla_{TEM}	36 (62)	16 (62)	5 (29)	3 (19)	60 (69)
$bla_{\text{CTX-M}}$ + bla_{SHV}	0 (0)	14 (54)	1(6)	0(0)	15 (17)
$bla_{\text{CTX-M}}$ + bla_{TEM} + bla_{SHV}	0 (0)	10 (38)	0 (0)	0 (0)	10 (11)
Total number (ESBL positive and ESBL negative)	58	26	17	16	126

Next Generation Sequencing of Plasmids

Selected isolates belonging to *E. coli* (n = 10), *Klebsiella spp.* (n = 10), and *Citrobacter spp.* (n = 1) were subjected to next generation sequencing and de novo assembly of plasmid sequences. Number, total length, and N50 of assembled contigs ranged between 17 and 64, 182 477–547 810 bp, and 11 403–62 343 bp, respectively (Table S1). According to maximal unique and exact match (MUM) indices the isolates were clustered into six groups, designated as G1–G6 (Figure 2). The two main groups contained the majority of *E. coli* (G1) and *K. pneumoniae* (G2) isolates and the four minor groups (G3–G6) enclosed single, unrelated isolates. Cluster G1 could be subdivided into 3 subgroups (G1-a, G1-b, and G1-c).

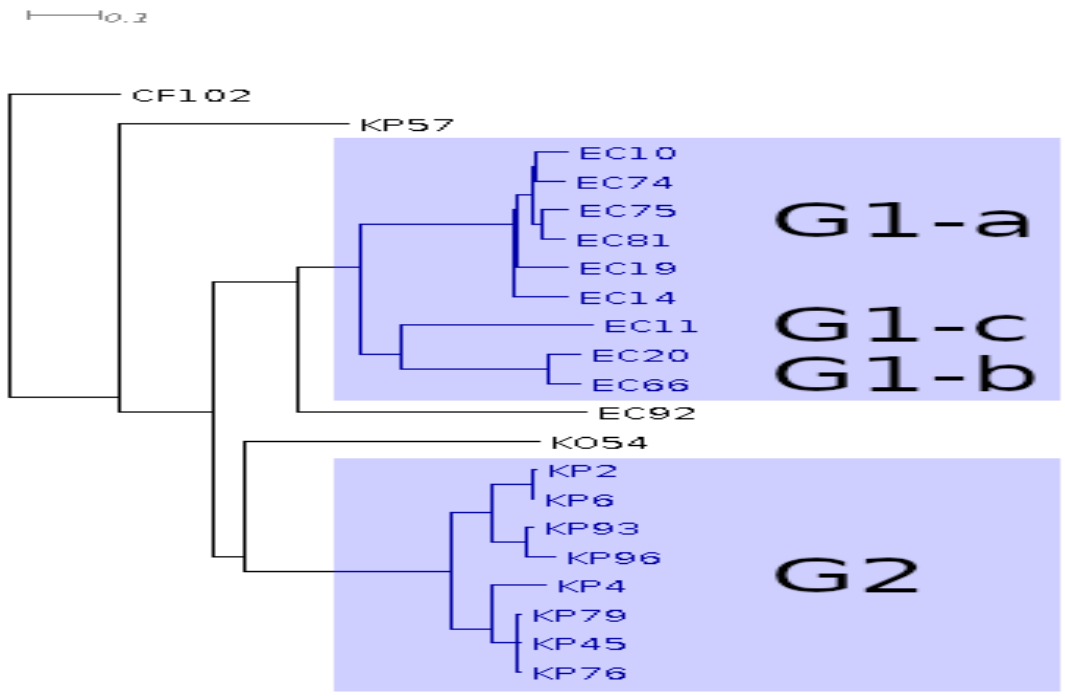


Figure 3. Representation of clusters based on MUMi distance of plasmid sequences. The major clusters are highlighted with blue

All isolates (n = 9) of G1 were identified as *E. coli* and were shown to harbor $bla_{\text{CTX-M-27}}$ type ESBL gene, aminoglycoside (*aadA5*, *aph(3″)-Ib*, *aph(6)-Id*), folate inhibitor (*dfA17*, *sul1*, *sul2*), tetracycline (*tet(A)*), macrolide (*mph(A)*), and quaternary ammonium compound (*qacE*Δ) resistance genes (Table S1). The *dfrA17*, *aadA5*, *qacE*Δ, and *sul1* genes were part of a class I integron. The integron and the *mph(A)* gene were co-located on identical contigs in each isolate (Table S2). Besides, *aph(6)-Id*, *aph(3″)-Ib*, and *sul2* were also found to be co-localized in all isolates, but the contigs carrying them differed according to the subgroups (Figure S2 and Table S2). In subgroup G1-a (Figure S2a–S2b), a *Tn*2 transposon carrying $bla_{\text{TEM-1}}$ was inserted between *aph(6)-Id* and *aph(3″)-Ib* and either *floR* or *tet(A)* was located upstream from this genetic structure. In subgroup G1b-G1c (Figure S2c and Table S2) *tet(A)* was located upstream from *aph(6)-Id*, *aph(3″)-Ib*, and *sul2*. The presence of *floR* and *tet(A)* was shown for subgroup G-1a and all subgroups of G1, respectively. Different plasmid incompatibility groups where characteristic for the three subgroups: in subgroup G1-a IncB/O/K/Z, IncFIA, IncFIB, and IncFII, in subgroup G1-b IncFIA, IncFII, and IncI, and in subgroup G1-c IncFIA, IncFIB, IncFII, and IncI was detected (Table S1).

Cluster G2 enclosed eight, closely related *K. pneumoniae* isolates. The presence of multiple β-lactamase genes (ESBL: $bla_{\text{CTX-M-27}}$, non-ESBL: $bla_{\text{TEM-1}}$, $bla_{\text{OXA-1}}$), aminoglycoside (*aac(6')-Ib-cr*, *aph(3″)-Ib*, and *aph(6)-Id*), chloramphenicol (*catB3*), folate inhibitor (*dfrA14*, *sul2*), and quinolone (*qnrB1*, *aac(6')-Ib-cr*) resistance genes was characteristic for all isolates of G2. The *dfrA14* was carried by a class I integron which lacked the 3′ conserved sequence. The contigs carrying the aforementioned resistance genes where highly identical in all isolates (Table S2). Additionally, three isolates also harbored *aac(3)-IIa* on identical contigs. Two plasmid incompatibility groups (IncFIB and IncFII) were identified in this cluster (Table S1). The four unrelated isolates, namely *C. freundii* CF102, *K. pneumoniae* KP57, *K. oxytoca* KO54, and *E. coli* EC92, were shown to harbor either $bla_{\text{CTX-M-15}}$, $bla_{\text{SHV-12}}$, $bla_{\text{CTX-M-30}}$, or $bla_{\text{CTX-M-1}}$ ESBL genes, respectively. Besides, a diversity in plasmid incompatibility groups and multiple antibiotic resistance genes (Table S1) were identified in these isolates, except for EC92 in which only the ESBL gene was detected. Genes *aac(6')-Ib*, *aadA1*, $bla_{\text{OXA-9}}$, and $bla_{\text{TEM-1}}$ were located on a transposon (*Tn*1331) in KP57 and KO54 (Figure S3). In addition to *Tn*1331, KP57 also harbored *aph(3″)-Ib* and *aph(6)-Id* aminoglycoside resistance genes. In CF102 *aac(3)-IIa*, $bla_{\text{OXA-1}}$, *catB3*, and *aac(3)-IIa* were identified on contigs that were highly similar to those found in *K. pneumoniae* isolates of G2 (Table S2). Moreover, CF102 also carried *aph(3″)-Ib*, *cmlB1*, and *tet(A)* genes as well.

DISCUSSION

Hungary ranks among the countries with the lowest antimicrobial drug consumption rate (defined daily dose per 1000 inhabitants per day) both in hospitals and in the community sector in the European Union/European Economic Area based on the annual European Surveillance of Antimicrobial Consumption Network (ESAC-Net) report (ECDC, 2020). Despite the low consumption, disposal of untreated hospital effluents containing antimicrobials or their metabolites may select for the development of antibiotic resistant bacteria based on our findings. We observed a more or less similar rate of resistance across the hospital and the nursing home effluents, measured by the multiple antibiotic resistance indices (MAR index), despite a huge variation in the bed capacity. H2 and H3, with the lowest bed capacities (106 beds and 127 beds, respectively), recorded high MAR indices (0.592 and 0.683). This may imply that the resistance rate largely depends on the regularly prescribed classes of antibiotics and the presence of different departments at each hospital as opposed to the number of patients accommodated in the facilities.

All the isolates and all the sites reported multiple antibiotic resistance index values higher than 0.2. MAR index values greater than 0.2 indicate a high level of antibiotic contamination at the source (Osundiya, Oladele, & Oduyebo, 2013). The elevated MAR index values observed in *E. coli*, *Klebsiella* species, *E. cloacae* and *Citrobacter* species are consistent with the MAR index values reported in the same members of Enterobacterales isolated from urinary tract infections in a tertiary-care hospital in Hungary in a surveillance study conducted between 2008-2017, where *E. coli* and *Klebsiella* species reported higher MAR index values compared to CES (*Citrobacter*, *Enterobacter* and *Serratia*)(Gajdács, 2019). Notably, there was an enrichment of the ARB in the sewage sludge after thermophilic digestion (MAR index 0.560, from 0.5000 in the activated sludge). The detection of increased antibiotic resistant bacteria in wastewater treatment plants' effluent has been reported in other studies, (Galler et al., 2014; Hocquet et al., 2016; White et al., 2016).

However, the increase in resistance development among susceptible bacteria facilitated by WWTP processes has not yet been established (Galvin et al., 2010). Available data suggest that β-lactam agents (especially penicillins and cephalosporins) are the most frequently used class of antibacterial agents across Europe in both hospital and community settings (Connor et al., 2017; Penalva et al., 2019). Although our study used ceftriaxone to screen for the β-lactam resistant bacteria, high resistance rate to other third-generation cephalosporins (cefpodoxime, cefotaxime, and ceftazidime) was attributed to cross-resistance. High levels of resistance to the same antimicrobial agents in Enterobacterales were found in effluents from WWTPs in Navarra, Northern Spain (Ojer-Usoz, Gonzalez, Garcia-Jalon, & Vitas, 2014). The $bla_{\text{CTX-M}}$ type extended-spectrum β-lactamase (ESBL) observed in *E. coli*, *K. pneumoniae* and *C. freundii* in this study was largely responsible for resistance to extended-spectrum cephalosporins as reported in previous studies (Coque et al., 2008). When comparing the plasmid sequences from 21 selected isolates, a cluster of $bla_{\text{CTX-M-27}}$ harboring *E. coli* and another group of $bla_{\text{CTX-M-15}}$ carrying *K. pneumoniae* isolates were revealed.

In Hungary, CTX-M-15 and CTX-M-27 are found to be the dominant ESBL types among clinical isolates of *K. pneumoniae* and *E. coli* respectively, which is in correspondence with our findings (Nagy et al., 2021; Tóth, Tóth, Kamotsay, Németh, & Szabó, 2022). Considering that the $bla_{\text{CTX-M-27}}$ harboring *E. coli* and $bla_{\text{CTX-M-15}}$ carrying *K. pneumoniae* isolates identified in the hospital and nursing home effluents can be of fecal origin from patients and nursing home residents, it can be presumed that their dominance in our samples resembles their prevalence among local inhabitants. The highly identical contigs shared within a cluster raises the possibility of clonal relatedness of the isolates. Unfortunately this question could not be addressed, because the DNA samples subjected to next generation sequencing was enriched for plasmids, and therefore the coverage of chromosomal fragments was too low to be suitable for MLST analysis. Besides the two major clusters, CTX-M-15 producing *C. freundii*, CTX-M-1 producing *E. coli*, SHV-12 producing *K. pneumoniae* and CTX-M-30 producing *K. oxytoca* were also detected in our study. The majority of the isolates carried multiple antibiotic resistance genes, and many of these genes occurred to be co-located on defined contigs.

These findings might explain the high frequency of associated/co-resistance and elevated MAR indices revealed in this study. The ESBL producers were observed more frequently in hospital effluents and WWTP, which appears to mirror similar observations made in South Africa, Tunisia, and Spain, reporting high rates of ESBL prevalence from hospital effluent and urban wastewater treatment plants (King, Schmidt, & Essack, 2020; Sghaier et al., 2019). The presence of a high proportion of ESBL producers observed among isolates from hospital effluents may suggest increased prescription of certain extended-spectrum ß-lactam antimicrobials. Hsu et al. observed a significant increase in prescription of certain extended-spectrum β-lactam antibiotics, which were associated with high levels of ESBL producers in hospital effluents in Singapore (Hsu et al., 2010). The *E. cloacae* species were non-ESBL producers and

showed resistance to cefoxitin (a cephamycin), which can be supported by the observation that ESBL-producing *E. cloacae* are less prevalent and hence rarely reported as most *Enterobacter* species carry AmpC cephalosporinases, which are not inhibited by clavulanic acid (Ojer-Usoz et al., 2014). Although carbapenemases were not reported in the plasmid DNA of our isolates, a bla_{VIM} gene was detected among the *Klebsiella oxytoca* isolates by colony PCR.

This is in support of certain reports regarding the emergence of carbapenemase-producing *Klebiella* spp. from environmental samples (Isozumi et al., 2012; Koh et al., 2012; Thomas et al., 2013). *Klebsiella* species harboring the bla_{VIM} gene have been previously reported among isolates at the Clinical Centre University of Pécs (Melegh et al., 2014), which is located within this same catchment area, suggesting that hospital effluents may be reservoirs of carbapenemase producers that can be linked to clinical sources. The high rate of susceptibility to meropenem observed in this study is consistent with a similar observation regarding low carbapenem resistance in Enterobacterales reported from wastewater treatment plants (Ojer-Usoz et al., 2014). Clinical surveillance data in a tertiary care hospital in Hungary among Enterobacterales for the period 2004-2015 reported zero resistance to carbapenems; imipenem, meropenem, and ertapenem (Magyar et al., 2017).

Fluoroquinolones hold the fifth position in the European antimicrobial market, with a maximum of 3.04 DDD (defined daily dose/1000 inhabitants) (Penalva et al., 2019). Our findings showed a high rate of resistance to ciprofloxacin, consistent with previously reported resistance to fluoroquinolones among isolates from various environmental compartments (Da Costa, Vaz-Pires, & Bernardo, 2006; Moore, Guzman, & McGee, 2008). Increased resistance to fluoroquinolones among Enterobacterales from urinary tract infections has been reported in clinical surveillance data (Gajdács, 2019; Magyar et al., 2017).

Consistent with our finding, a recent study in South Africa also found an increased rate of co-resistance between third-generation cephalosporins and fluoroquinolones in *Klebsiella* spp. (King et al., 2020). Other studies have demonstrated remarkable co-resistance to fluoroquinolones and broad-spectrum cephalosporins among *E. coli* and *K. pneumoniae* isolated from wastewater (Conte et al., 2017). The presence of the quinolone resistance protein *qnrB1* and the aminoglycoside modifying enzyme *aac(6')-Ib-cr* variant associated with low-level fluoroquinolone resistance identified in *Klebsiella* isolates indicates that acquired genes contribute to fluoroquinolone resistance among *Klebsiella* spp. from the environment. Ciprofloxacin resistance among *E. coli* was, however, mainly attributed to accumulation of double serine mutations in the DNA gyrase and topoisomerase IV genes, as reported by Fuzi et al. (Fuzi, Szabo, & Csercsik, 2017), since they did not carry acquired resistance genes.

Similarly, resistance to gentamicin in this study occurred frequently among *Klebsiella* strains, which is consistent with a previous observation in *Klebsiella* spp. from wastewater treatment plants and hospital effluents in KwaZulu-Natal, South Africa (King et al., 2020). $bla_{CTX\text{-}M}$ harboring plasmids are often known to carry other genes of resistance, particularly to aminoglycosides, tetracycline, sulfonamides, and trimethoprim, suggesting co-selection, co-expression, and hence co-resistance (Pai, Kim, Seo, Choi, & Oh, 2006). This finding can be linked to plasmid encoded aminoglycoside modifying enzyme encoding genes, *aph(3'')-Ib* and *aph(6)-1d* (phosphotransferases), *aadA1* and *aadA5* (adenylyltransferases) and *aac(3)-IIa* (acetyltransferase), which were identified in *E. coli* and *Klebsiella* spp, some of which are associated with gentamicin and tobramycin resistance.

An increased rate of resistance to sulfamethoxazole/trimethoprim among the isolates can be associated with sulfonamide resistance genes (*sul1* and *sul2*) and *dfrA* (*dfrA14* and *dfrA17*) expressing dihydropteroate synthase and dihydrofolate reductases responsible for target replacement, conferring resistance to sulfonamides and diaminopyrimidines. A recent clinical surveillance data on *E. coli* from urinary tract infections indicated a high resistance rate of sulfamethoxazole/trimethoprim (Gajdács, 2019), implying that the resistance observed in wastewater isolates may be clinical in origin. It is notable that even though the isolates originated from different spots of the wastewater system, they were found to carry more or less the same plasmids groups. The main plasmids were the IncF replicons and their subtypes (FIA, FIB, and FII) which were evident in all the sequenced isolates.

Acquired antibiotic resistance genes in bacteria are frequently carried on plasmids, with F plasmids being the most common conjugal plasmids in Enterobacterales linked to antibiotic resistance ("R factors") (Moran, Anantham, Pinyon, & Hall, 2015). According to Stephens et al. antibiotic resistance genes have been found in plasmids with a narrow host range, including IncI complex replicons (Z, B/O, K, or I1), but the majority of antibiotic resistance genes were associated with F replicons, and in most cases, multiple subtypes of F replicons were found on the same plasmids (Stephens et al., 2020). F- and I-complex replicons are frequently found in association with conjugating plasmids

(Stephens et al., 2020). ESBL genes, carbapenemase genes, genes coding aminoglycoside-modifying enzymes, and plasmid-mediated quinolone resistance (PMQR) genes are the most frequently described resistance genes on IncF plasmids (Rozwandowicz et al., 2018). Multiple antibiotic resistance phenotype occurred at high frequency in the hospitals and the nursing home where individuals are likely to be put on a treatment regimen on a regular basis. In a related study, the percentage of multiple drug resistance in *E. coli* was higher in a nursing home than in hospital effluents (Oberlé et al., 2012).

Co-resistance between cephalosporin and ciprofloxacin in this study was more frequent among isolates from the four hospitals, while that of cephalosporin and trimethoprim/sulfamethoxazole occurred more frequently among those from the nursing home. These findings may be related to antimicrobial drug prescriptions and demonstrate that antimicrobial drug resistant bacteria are likely to be selected in the human gastro-intestinal tract due to antimicrobial usage (Tenaillon, Skurnik, Picard, & Denamur, 2010).

The discharge of untreated hospital effluent into the urban wastewater network for co-treatment with the rest of municipal wastewater at the WWTP before releasing it into the environment, which is a general practice across many countries in Europe (Morris, Harris, Morris, Commins, & Cormican, 2016) may be directly linked to the high resistance rate observed in the hospital effluents. Isolates of clinical origin may disseminate resistance to environmental microbes, although resistant isolates from hospital effluents have not been correlated with those of clinical origin (White et al., 2016).

CONCLUSION

Our findings demonstrate that wastewater from human sources may serve as an important reservoir of multiresistant Enterobacterales, including ESBL and carbapenemase producers, and it may be likely that some of these strains could be traced to clinical sources. Notably, multiresistant Enterobacterales harboring plasmid-mediated extended-spectrum β-lactamases primarily of CTX-M, TEM, and SHV types that degrade broad-spectrum cephalosporins are more common in hospital effluents and their presence can be attributed to the development of resistance in the source population, and/or its buildup in the aqueous environment through selection pressure as well as resistance dissemination of the phenotype via horizontal gene transfer. Besides the plasmid borne β-lactamases, metallo-β-lactamase VIM also contributes to the resistance phenotype. Additionally, the interpretative readings of the inhibition zones of cephamycin suggest the possible presence of endogenous AmpCs β-lactamases. The findings present a clear indication that acquired genes contribute to multiresistance in Enterobacterales from the wastewater environment, contrary to certain reports linking acquired resistance only to clinical isolates. Monitoring wastewater of anthropogenic origin is a promising strategy for generating valuable data that can be correlated to the prevalence of clinically important resistant bacteria from the source population and may provide a cheaper alternative in regions facing challenges that limit clinical surveillance.

SUPPLEMENTARY MATERIALS: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/antibiotics11060776/s1, Table S1: Antimicrobial resistance profiles, antibiotic resistance genes and plasmid groups of enteric bacteria from the wastewater. Figure S1: Original gel images of the detected β-lactamase encoding genes.

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Data Availability Statement: The relevant data are provided along with the manuscript and additional information can be accessed at https://data.mendeley.com/datasets/j3mkwhzh84/1 Virág, Eszter; Mutuku, Christopher (accessed 4 May 2022), "Enterobacterales Plasmids", Mendeley Data, V1, doi: 10.17632/j3mkwhzh84.1 "Plasmid sequences (1).rar" contains the identified plasmids, and "Omicsbox_annot_table.zip" contains the localization and annotation of the genes found in the given plasmids.

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MASSIVE PROTOCLUSTER OF A PERIODIC MASER SOURCE G188.95+0.89

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ABSTRACT
We report the results of ongoing monitoring of the 6.7 GHz CH $_3$ OH masers associated with G188.95+0.89. In these observations, five features are periodically varying and at least two exhibit evidence of velocity drifts. It is not clear the cause of these velocity drifts. The spectra have varied significantly since detection in 1991. The 11.45 km s^{-1} feature has decreased exponentially from 2003. Complementary ALMA 1.3-mm continuum and line observational results are also presented. Eight continuum cores (MM1–MM8) were detected in G188.95+0.89. We derived the masses of the detected cores. G188.95+0.89 MM2 was resolved into two continuum cores (separated by 0.1 arcsec) in ALMA band 7 observations. Also, CH_3OH ($4_{(2,2)}$ -$3_{(1,2)}$) thermal emission associated with MM2 is double peaked. We propose the presence of multiple (at least binary) young stellar objects in MM2. SiO emission exhibits a bow-shock morphology in MM2 while strong emission of ^{12}CO at the east and west of MM2 suggests the presence of an east–west bipolar outflow.
Keywords: Masers – techniques: molecules – radio lines:stars. interferometric – stars: formation – ISM

INTRODUCTION
High mass star-forming regions (HMSFRs) is an ongoing topic of open debate as it relates to mass growth (Motte, Bontemps & Louvet 2018). The time-scales of phases associated with this process they state are of the order of 10^4 – 10^5 yr. Observation of such phases is very difficult. A unique property to HMSFRs is the presence of class II methanol (CH_3OH) masers in their early formative phases (Caswell, Vaile & Ellingsen 1995a; Breen et al. 2013). These class II CH 3 OH masers have proven to be a reliable signpost of the very early stages of high-mass star formation (Menten 1991; Caswell 1996). Recent results of monitoring related infra-red sources and class II methanol (CH_3OH) masers towards HMSFRs have identified significant accretion events. At present, only four accretion events have been detected, they are: S255IR-NIRS3 (Fujisawa et al. 2015; Caratti o Garatti et al. 2017; Szymczak et al. 2018b), NGC 6334I (Hunter et al. 2017, 2018; MacLeod et al. 2018), G323.46–0.08 (Proven-Adzri et al. 2019; MacLeod et al. 2021b), and G358.93–0.03 (Breen et al. 2019; MacLeod et al. 2019; MacLeod et al. 2019; Sugiyama et al. 2019; Burns et al. 2020).

Another important phenomena associated with HMSFRs are periodic methanol masers discovered by Goedhart, Gaylard & van der Walt (2003). Periodic masers are rare, there are only 25 known so far (Goedhart et al. 2003, 2009, 2014; Goedhart, Gaylard & van der Walt 2004; Araya et al. 2010; Szymczak et al. 2011, 2016, 2018a; Fujisawa et al. 2014; Maswanganye et al. 2015; Sugiyama et al. 2015, 2017; Szymczak, Wolak & Bartkiewicz 2015; Maswanganye et al. 2016; Proven-Adzri et al. 2019; Olech et al. 2020). Only the HMSFR source G323.46–0.08 is periodic and has experienced an accretion event (Proven-Adzri et al. 2019; MacLeod et al. 2021b).

The HMSFR G188.95+0.89 (also known as S 252 or AFGL 5180) is well studied at multiple wavelengths. Oh et al. (2010) reported the parallax distance as 1.76 ± 0.11 kpc, Perseus spiral arm (Reid et al. 2009). The 6.7-GHz CH 3 OH masers of this source were discovered by Menten (1991) and reported periodic, $\tau = 395 \pm 8$ d, by Goedhart et al. (2004, 2014). Kurtz et al. (2000) report an associated unresolved UCH11 region. Minier et al. (2005) did not detect the continuum radio source, but reported that the masers are projected on a bright mm source with an estimated mass in MM1 of 50 $M_\odot$. They also detected the presence of CH_3CN and $C^{18}O$ towards the G188.95+0.89 methanol maser site indicating that they are within hot molecular cores (HMCs) with a gas density $\geq 10^5$ cm^{-3} . In this paper, we present the results of ongoing 6.7 GHz CH_3OH maser monitoring for G188.95+0.89. Significant variations of maser features are analysed. Also high-resolution mm-wavelength dust continuum and molecular line emission observations are presented

OBSERVATIONS AND DATA REDUCTION

Single-dish Observations

The radio observations were made using the 26-m telescope of the Hartebeesthoek Radio Astronomy Observatory (HartRAO). The 4.5-cm receiver is comprised of dual, cryogenically cooled, Right Circular Polarization (RCP) and Left Circular Polarization (LCP) feeds. Each polarization was calibrated independently relative to Hydra A and 3C 123, assuming the flux scale of Ott et al. (1994). All observations employed frequency-switching (FS) and within 2 h of zenith. Observations completed with a 1-MHz bandwidth and recorded with a 1024-channel per polarization spectrometer (in FS 512 channels are saved). The velocity resolution achieved is 0.044 km s^{-1} and the typical 3σ root-mean-square (rms) noise per observation was ~1 Jy. This sensitivity is improved when across several channels, e.g. integration over 10 channels improves the sensitivity to ~0.3 Jy km s^{-1}. For all the epochs, half-power beam-width pointing correction observations were carried out. The rest frequency was corrected for the Local Standard of Rest (LSR) velocity v LSR = +10.0 km s^{-1}. Listed in Table 1 are the parameters of the telescope, receiver, and observation set-up for each epoch.

Observations were made between 2003 June 30 and 2021 January 18 with a cadence of between 10 and 20 d; the cadence varied during several flares. No spectroscopic observations were taken between 2008 September and 2010 December when the 26-m antenna underwent repairs (Gaylard 2010). The position employed at HartRAO is RA = 06^{h} 08^{m} $53.^{s}3$ and Dec. = $+21^{o}$ 38' 30" (J2000).

Parameter	Quantity
Receiver	4.5 cm
Maser transition	J = 5_1 - 6_0 A +
Rest frequency	6.668518 GHz
System temperature	57 K
Beam width	7 arcmin
Correlator bandwidth	1.0 MHz
Observing mode	Frequency-switching
Number of spectral channels	512
Velocity range	22.5 km s^{-1}
Correlator resolution	0.044 km s^{-1}
Central velocity	+10.0 km s^{-1}
Sensitivity 3σ rms	~1.0 Jy
Monitoring period	2003 Jun 30–2021 Jan 18
Down time for repairs	2008 Sept–2010 Dec

ALMA Observations

We obtained ALMA band 6 archival data on G188.95+0.89 (Project ID: 2015.1.01454.S) taken on 2016 April 23 (42 antennas of the 12-m main array), 2016 September 17 (38 antennas of the 12-m main array). Observations of G188.95+0.89 (phase tracking centre at $RA_{(J2000)}$ = 06 h 08 m $53.^{s}3$ and $Dec._{(J2000)}$ = $+21^{o}$ 38' 30") were carried out at 1.3 mm (230 GHz) with ALMA band 6 in 2015 using two different configurations. The total time on-source was 19 and 30 min, respectively, and the projected baselines ranged from 15–2600 m. The ALMA correlator was configured to cover nine spectral windows (spws). The raw visibility data were calibrated using the Common Astronomy Software Applications (CASA 5.4) standard calibration and imaging tasks. Bandpass and flux calibration were conducted using the sources J0510−1800 and J0750−1231, respectively. J0603−21591 was used as the gain calibrator. The calibrated visibility data from the two observation blocks were combined using CASA task CONCAT, and CLEAN was used to produce the images of the continuum (rms of 2.2 mJy beam $^{-1}$). Also images of molecular line emission (typical rms of 2.2 mJy $beam^{-1}$) with spectral resolution of 1 km s^{-1} are produced. In this paper, we will focus on the ^{12} CO (2-1), CH_3OH ($4_{(2,2)}$ -$3_{(1,2)}$), SiO (5-4), and $C^{18}O$ (2-1). For continuum subtraction, only line-free parts of the spectra were used. We used CASA to do all the calibration and imaging of the data cubes as well as self-calibration to remove residual phase and flux calibration errors. The line data were then imaged with a robust weighting of 0.5.

RESULTS

6.7-GHz CH_3OH masers variability

In Fig. 1, we present selected spectra from the 17 flare cycles (Fl n for n = 5 to 21) in the 6.7-GHz methanol maser observations associated with G188.95+0.89 studied here (the original four are published in Goedhart et al. 2004). The spectra presented are the maxima of three of these flare cycles (flare number Fl n for n = 6, 13, and 20). In this image, it can be seen the evolution of the spectral profile over the 18 yr of observations presented. This profile is certainly comprised of many line blended masers, in particular for + 10 < v LSR < + 11.3 km s^{-1}. A dynamic spectrum is the best way to visualize variability of these 6.7-GHz methanol masers associated with G188.95+0.89, see Fig. 2. Features have weakened others strengthened, most appear periodic and variations in velocity, velocity drifts, are apparent. For the purpose of analysis of these observations five features, two at v LSR = +10.44 and +10.70 km s^{-1} in the heavily line merged velocity regime, and others at v LSR = +8.42, +9.65, and +11.45 km s^{-1} are selected. Note, the former two features are likely comprised of multiple masers; the others less likely. Time series plots of the integrated flux density, F_{Int} 6.7, for each selected feature are shown in Fig. 3.

A time series plot of the total integrated flux density, F Int 6.7 (Total), is also shown. For each feature, in each epoch of observation, the velocity associated with the maximum flux density in the stated velocity extent is determined. Time series plots of the integrated flux density, F_{Int} 6.7 , for each selected feature are shown in Fig. 3. A time series plot of the total integrated flux density, F Int 6.7 (Total), is also shown. For each feature, in each epoch of observation, the velocity associated with the maximum flux density in the stated velocity extent is determined. Linear regression analysis is applied to each velocity time series to determine the velocity drift, and the results are included in this table. Two of the features have measurable velocity drifts, with 'goodness of fit' values R^2 > 50 per cent. The apparent drift seen in the v LSR = +10.70 km s^{-1} feature (see Fig. 1) may be the result of variations of heavily line merged masers contributing to the feature.The features at v LSR = +9.65 and +11.45 km s^{-1} are the best fit by a single Gaussian profile each; both possibly devoid of line merged features.

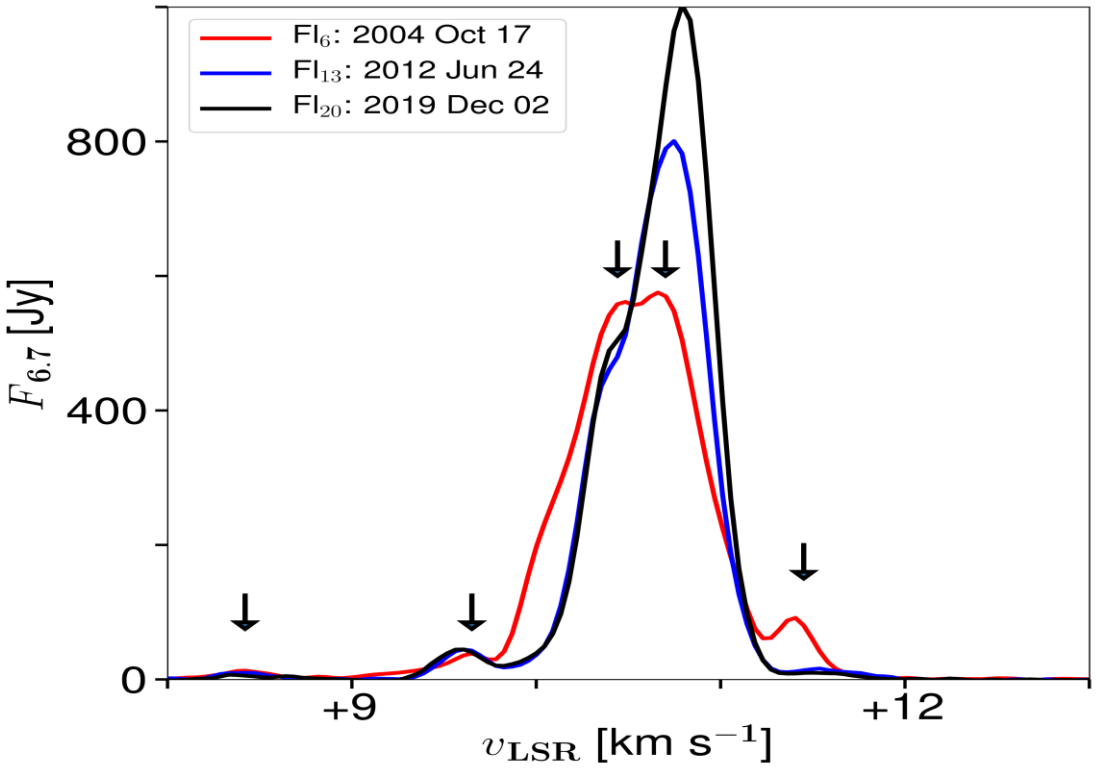


Figure 1. Spectra of the 6.7-GHz methanol masers associated with G188.95+0.89 observed at the maxima of Fl 6 , Fl 13 , and Fl 20 . Arrows mark the selected velocity features studied here.

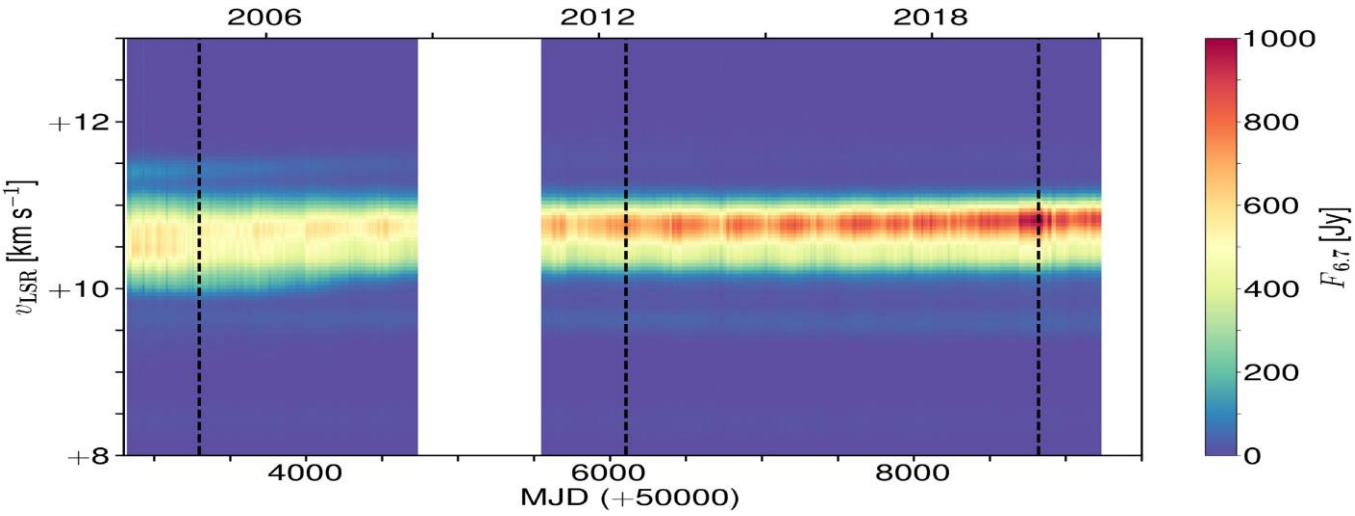


Figure 2. The dynamic spectrum of the 6.7-GHz methanol masers associated with G188.95+0.89. Dashed lines demarcate the spectra of the maximum in Fl $_6$, Fl $_{13}$, and Fl $_{20}$ and plotted in Fig. 1. No observations were taken between 2008 September and 2010 December during repairs.

All five features are periodic though it is not obvious for the feature v $_{LSR}$ = +11.45 km s^{-1} in Fig. 3. The period of each is determined using, first the programme Period04 developed by Lenz & Breger (2004) and secondly the Lomb–Scargle (LS) periodigram (Scargle 1982). The results are listed in Table 2. The average period for each method is included and are within 3σ standard deviation of each other, τ Period04 = 395 ± 1 d against τ LS = 397.6 ± 0.7 d. The v $_{LSR}$ = +8.42 km s^{-1} feature is decaying between 2003 and 2021 while the feature v $_{LSR}$ = +10.70 km s^{-1} is increasing in this period. The v $_{LSR}$ = +9.65 km s^{-1} feature appears flat in Fig. 3, however, its associated flux density of the central velocity channel in the velocity range (not plotted) is rising.

When first detected in 1991 (Menten 1991) the +10.44 km s $^{-1}$ feature was the brightest feature, here, it is second strongest and is decaying until MJD 5000, thereafter, it is flat or slightly increasing. The increase is possibly caused by contributions from the +10.70 km s^{-1} feature. Finally, for v $_{LSR}$ = +11.45 km s^{-1}, it is possible to fit an exponentially decaying function to the flux density time series, see Fig. 4. The fitted function is:

$$F_{int}6.7 = a \times e^{MJD/b} + C \quad (1)$$

where a = 150 ± 4 Jy km s^{-1}, b = −1380 ± 20, and c = 1.74 ± 0.05 Jy km s^{-1} . Goedhart et al. (2004) reported this feature reached a maximum on 2001 November 12 (MJD 2225), F $_{Int}$ ~45 Jy km s^{-1}. From equation (1), on MJD 2225, it is estimated F $_{Int}$ ~ 30 Jy km s^{-1}. The projected value is significantly lower than the actual value; they are outside estimated errors. The difference in velocity resolution, here it is 0.044 km s^{-1} while in Goedhart et al. (2004), it is 0.056 km s^{-1} , may account for this difference

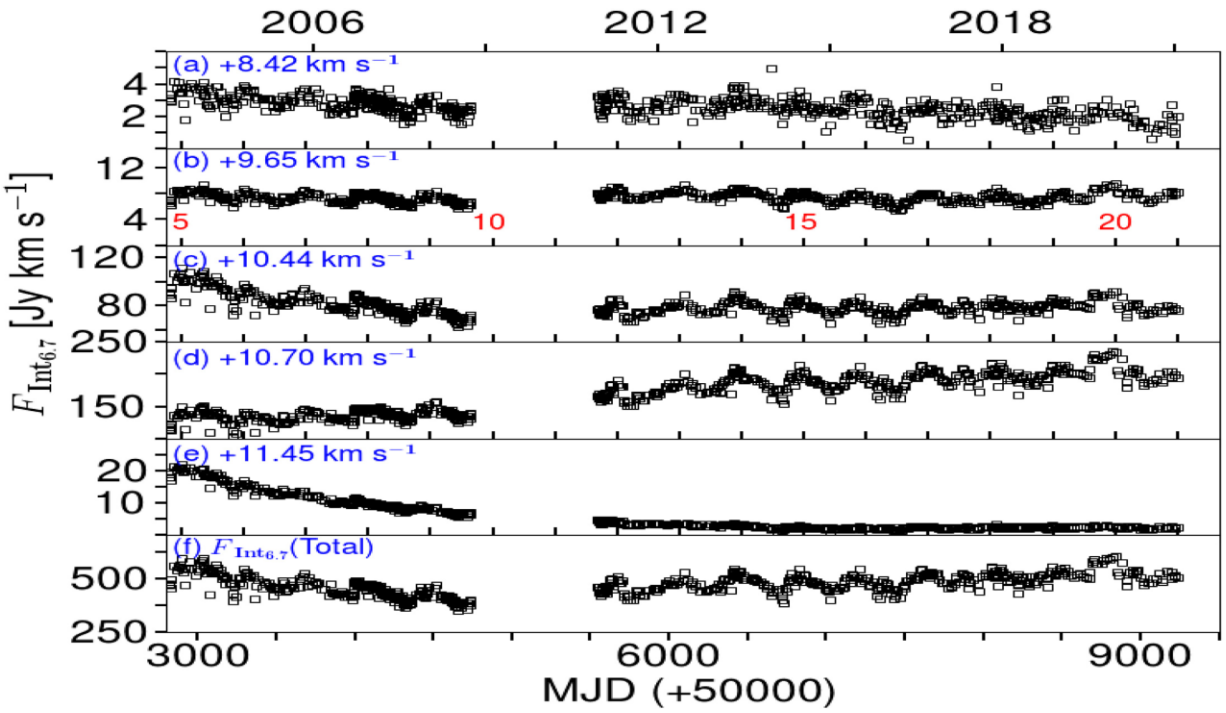


Figure 3. Time series plots of F Int 6.7 for five maser features identified in Fig. 1 and labelled in each panel. In (d), the total integrated flux density of all masers associated with G188.95+0.85 is plotted. Note the x-axis in (b) through (e) denote the estimated maxima of each flare, Fl n for n = 5–21 (for τ ~ 395 d).

Table 2. Information of individual 6.7-GHz maser features. Included are the feature central velocity of each, the velocity extent in which F Int is determined, the velocity drift (1σ standard deviation in parenthesis), its goodness of fit (R 2), the period determined from the Period04, and LS methods, and description of long-term variation. The average period for each method is presented (1σ standard deviation in parenthesis). Comments on velocity drift are given: uncertain (R^2 < 50%), blue-shifting, and red-shifting. Comments on general trends of the flux density of each feature are given (each are periodic)

Velocity				Period		Relative		Comments
Feature (km s^{-1})	Extent (km s^{-1})	Drift (× 10^{-5} km s^{-1} d^{-1})	R^2 (%)	τ Period04 (d)	τ LS (d)	Amplitude	Velocity	Flux density
+8.42	0.48	−1.18(7)	22.9	394.4	397.0	2.8	Uncertain	Slowly decreasing
+9.65	0.26	−2.38(3)	81.6	395.8	396.7	0.6	Blue-shifting	Slowly increasing
+10.44	0.18	+ 0.42(4)	30.4	393.5	398.3	0.1	Uncertain	Complex
+10.70	0.31	+0.39(5)	5.7	396.3	398.2	1.0	Uncertain	Increasing
+11.45	0.31	+1.88(4)	66.0	–	397.8	~1	Red-shifting	Exponential decay
Average				395(1)	397.6(7)			

Line-merged features may also be a factor. Some other features varied linearly and did not require de-trending for analysis. The complex varying feature v LSR = + 10.70 km s^{-1} will be analysed more elsewhere. After equation (1) is subtracted from the original time series the remaining residual, also plotted in Fig. 4, reveals its possible periodic nature. Note the slight increase after MJD 7500; possibly resulting from variations in the V LSR = + 10.70 km s^{-1} feature. The total integrated flux density plotted in Fig. 3 is seen first falling prior to MJD 5000 then rising suggesting the features decaying dominate prior to MJD 5000 thereafter brightening of the +10.70 km s^{-1} feature dominates.

The relative amplitude variation of each flare can be determined using R amp:

$$R_{amp} = \frac{F_{max} - F_{min}}{S_{min}} = \frac{F_{max}}{F_{min}} - 1 \quad (2)$$

Where F_{min} and F_{max} are the minimum and maximum flux densities for each flare cycle and each feature. The results of R amp for each velocity feature are included in Table 2. This value ranges from 0.1 to 2.8 for the five features. Note that $R_{amp} \sim 1$ for the $v_{LSR} = +11.45$ km s^{-1} feature; the amplitude is decreasing approximately proportionately during the decay. No phase lags between maser features were found. This may infer that the periodic features are located such that when the cause of variations occurs, it affects each nearly simultaneously. There may be lags shorter than our cadence that we cannot measure nor speculate about.

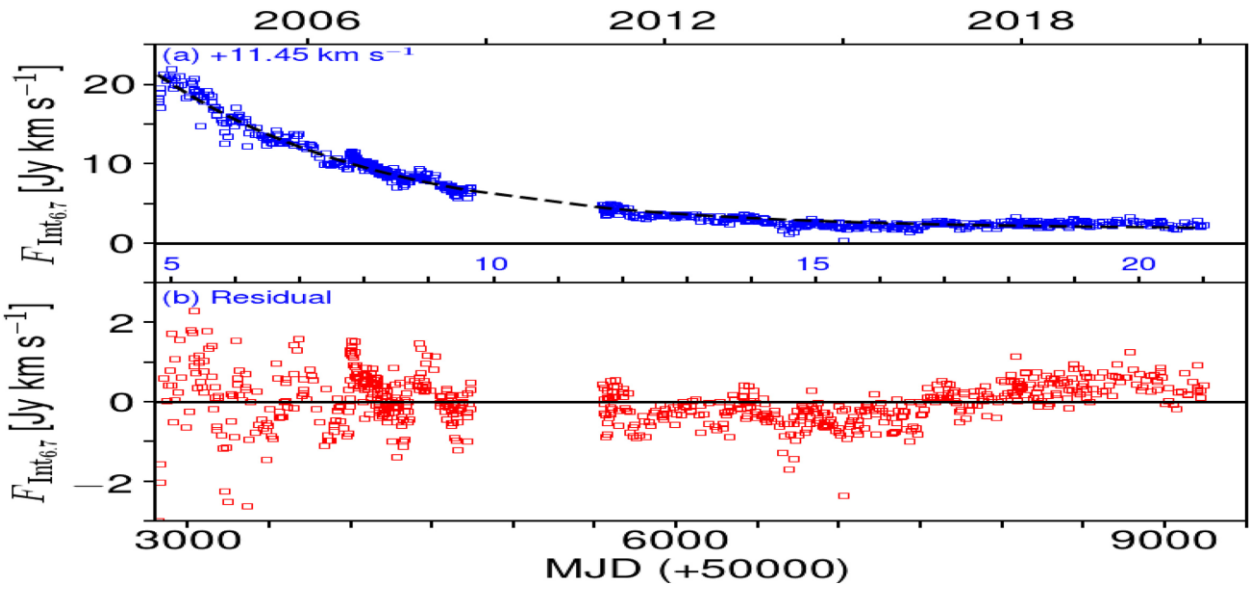


Figure 4. (a) Time series plot of F Int 6.7 for the $v_{LSR} = +11.45$ km s^{-1} feature. The fitted exponentially decaying function (black dashed line) is included. (b) The residual of the integrated flux density, raw data less the fitted exponentially decaying function, is plotted. Note the secondary x-axis in (b) denotes the estimated maxima of each flare, Fl n for n = 5–21 (for $\tau \sim 395$ d).

G188.95+0.89 continuum emission

In Fig. 5 (top panel), we show the composite image of G188.95+0.89 in WISE bands 1 (3.4μm: red), 2 (4.6 μm: green) and 3 (12 μm: blue), and ALMA 1.3-mm dust continuum emission. The WISE image shows a central infrared source (bright in all three bands) corresponding to the 850-μm SCUBA MM1 object, and a green (4.6 μm) dominant object south of the central object corresponding to the 850-μm SCUBA MM2 object (Minier et al. 2005). G188.95+0.89 is resolved into eight 1.3-mm objects (MM1– MM8) with ALMA. MM1–MM4 and MM5–MM8 objects (Fig. 5, bottom panel) are associated with 850-μm SCUBA MM1 and MM2 objects of Minier et al. (2005), respectively. ALMA 1.3 mm MM1 and MM2 are central objects (Fig. 5 bottom zoom-in) and MM1 (the brightest dust continuum object) is associated with the periodic 6.7-GHz CH_3OH maser source. Interestingly, a recent ALMA band 7 observations resolved the continuum core in MM1 into a single object but resolved MM2 into 2 continuum cores (grey contours of Fig. 5 bottom zoom-in). Details of the detected continuum sources and their masses are presented in Table 3. The dust mass M d in Table 3, can be estimated by assuming optically thin dust emission using Hildebrand (1983).

$$M_d = \frac{S_\nu D^2}{k_\nu B_\nu(T_d)} \tag{3}$$

The dust continuum flux density S ν is given in Table 3 at frequency, ν with D the distance to the source which is 1.76 kpc and $\kappa_{\nu\ the}$ dust opacity per unit mass, $\kappa_\nu = 0.33$ cm 2 g^{-1} for 230 GHz (Weingartner & Draine 2001). B_ν (T_d) is the Planck function at dust temperature,T_d . The temperature used in the dust mass estimations were obtained from Minier et al. (2005), for cores MM1–MM4 a temperature of 42 K is used and for cores MM5–MM8, 50 K is used. To obtain the mass of the cores, a gas-to-dust mass ratio 100 was used and the results are given in Table 3. The integrated flux densities for MM5–MM8, that were also used in the core mass estimates, are not primary beam corrected since MM5–MM8 are located close to the edge of the primary beam and will not be discussed in detail due to limited sensitivity.

Table 3. Parameters of the detected dust cores.

Object Name	RA (h m s)	Dec. (◦ ‘ “)	Peak flux (mJy beam^{-1})	Integrated flux (mJy)	V_{sys} (km s $^{-1}$)	Core mass (M_Θ)
MM1	06 08 53.33	21 38 28.9	71.7	71.1	5.0	8.2
MM2	06 08 53.49	21 38 30.5	22.5	41.3	2.0	4.8
MM3	06 08 54.13	21 38 34.4	5.6	9.4	3.0	1.1
MM4	06 08 52.86	21 38 29.5	3.2	3.8	4.5	0.5
MM5 ∗	06 08 53.35	21 38 11.6	8.3	14.2	2.0	1.4
MM6 ∗	06 08 53.42	21 38 13.7	1.9	3.6	4.0	0.4
MM7 ∗	06 08 53.23	21 38 09.7	9.8	16.7	-	1.6
MM8 ∗	06 08 52.97	21 38 11.1	5.8	6.0	4.0	0.6

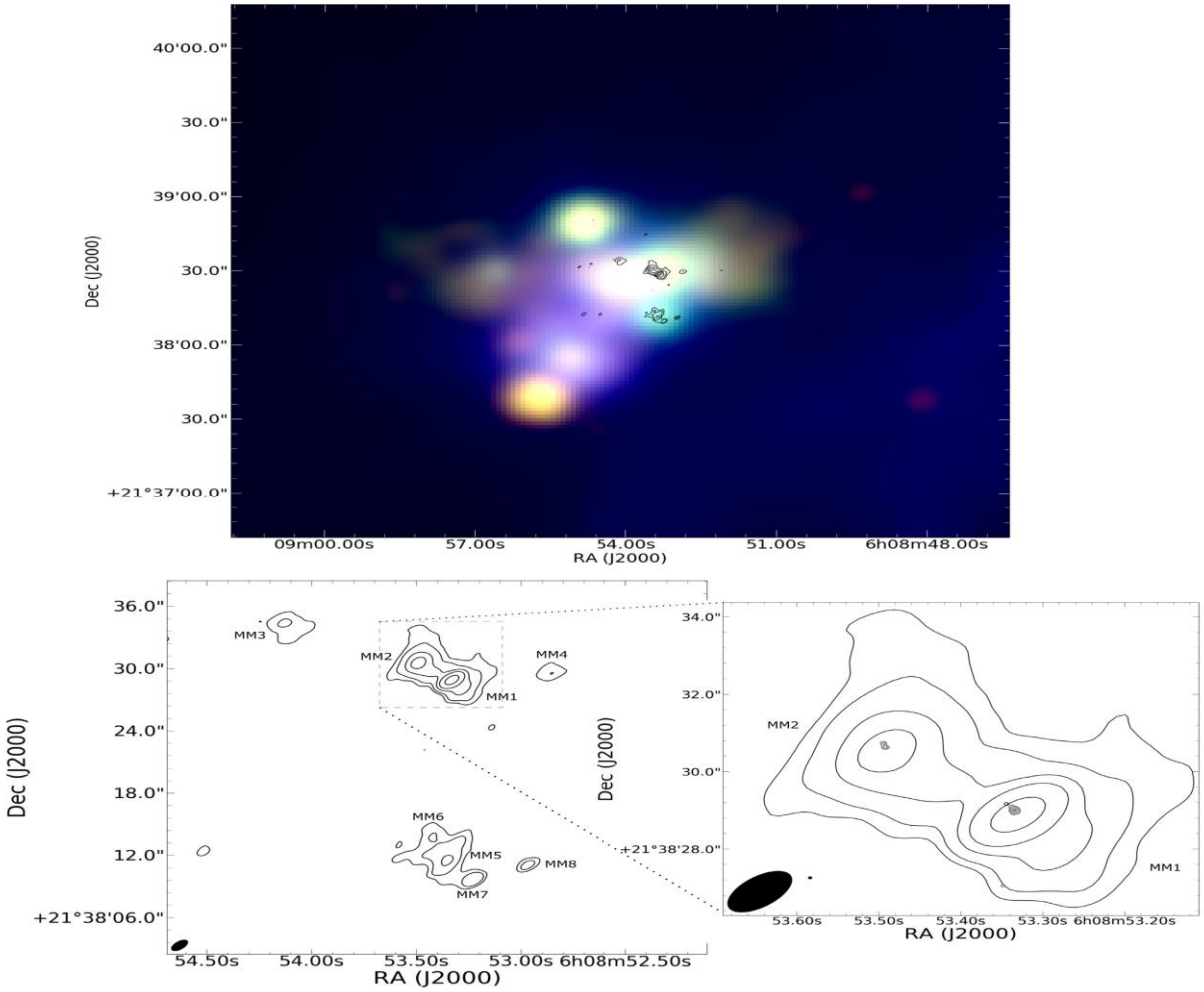


Figure 5. (Top) Composite three-colour WISE image of G188.95+0.89. WISE band 1 (3.4 μm), 2, (4.6 μm), and 3 (12 μm) are represented red, green, and blue. (bottom) ALMA band 6 (black contour, levels = [2, 4, 10, 20, 50] mJy beam $^{-1}$) and in the zoom-in, band 7 (grey contour, levels = [2, 4, 20, 60, 80] mJy beam^{-1}) dust continuum emission of G188.95+0.89. The filled ellipses on the bottom left-hand corner beams of the band 6 (larger ellipse) and band 7 (smaller ellipse). The open circle near MM1 peak indicates the position of the periodic 6.7-GHz CH_3OH masers.

G188.95+0.89-millimeter line emission

A number of thermal molecular lines were detected towards the eight millimeter continuum objects, however in this paper, we will focus only the CH_3OH ($4_{(2,2)} - 3_{(1,2)}$), SiO (J = 2 − 1), ^{12}CO (J = 2 − 1), and $C^{18}O$ (J = 2 − 1) as shown in Table. 4.

CH_3OH $4_{(2,2)}$ -$3_{(1,2)}$

Emission from the CH_3 OH ($4_{(2,2)} - 3_{(1,2)}$) line was detected towards all eight cores, see Fig. 6. The emission is strongest towards the southern MM5–MM8 and weakest towards MM4. The nature of the emission towards MM5–MM8 is contaminated by the effect of the decreased sensitivity towards the edge of the primary beam. Beyond detection or non-detection of an emission, no further discussions will be made for these objects.

Table 4. Columns are species, transition, rest frequency, energy of the upper level, and number of atoms present.

Observed molecular species				
Molecule	Transition	Rest Frequency (GHz)	E_L (K)	E_U (K)
SiO	2-1	217.10498000	20.84	31.26
C ^{18} O	2-1	219.56035410	5.27	15.81
CH_3OH	$4_{(2,2)}$ -$3_{(1,2)}$	218.44006300	34.50	45.46
^{12}CO	2-1	230.53800000	5.53	16.60

One interesting feature of the CH_3 OH ($4_{(2,2)}$ -$3_{(1,2)}$) emission towards MM2 is the presence of a double peak in the emission at the systemic velocity of MM2. There is CH_3 OH ($4_{(2,2)} - 3_{(1,2)}$) emission associated with MM1. Minier et al. (2005) indicated the temperature of the dust of the clump hosting the 1.3 mm ALMA MM1–MM4 sources to be ~150 K.

SiO (J = 2 − 1)

Emission of SiO (J = 2 − 1) is known to trace shocks especially in star-forming regions. The dominant SiO emission is observed in the north-west region of MM2. The emission has a bow-shock morphology in the channel corresponding to the systemic velocity of MM2. There are SiO emission (in some cases, very faint emission) associated with each of MM3–MM8, however, no SiO emission is detected towards the MM1 object.

^{12}CO (J = 2 − 1)

The CO (J = 2 − 1) emission in G188.95+0.89 is complicated owing to the effect of the strongly self-absorbed features seen in the line emission. The other plausible reason for the observed complex distribution is that all the millimeter objects may be driving outflows. If the strong emission east of MM2 observed in the −3 km s $^{-1}$ channel and the emission west of MM2 in the 9 km s^{-1} channel are both associated with MM2, then they may demarcate an east–west bipolar outflow in MM2, see Fig. 8. There is also some emission north of MM2 and could signify a second outflow emanating from the object; suggestive of multiple YSOs in MM2. The other mm objects are all associated with ^{12}CO (J = 2 − 1) emission.

$C^{18}O$ (J = 2 − 1)

We detected high density tracer, C ^{18}O (J = 2 − 1), towards all MM1–MM8. MM1 and MM2 are the dominant sources of the $C^{18}O$ (J = 2 − 1) emission. Interestingly, the brightest C ^{18} O (J = 2 − 1) channel (3 km s^{-1} channel) shows a distribution of the $C^{18}O$ (J = 2 − 1) emission to lie in the interface between MM1 and MM2 cores. The possible implication of this to the observed variability in the 6.7-GHz CH_3 OH masers will be discussed in Section 4.1

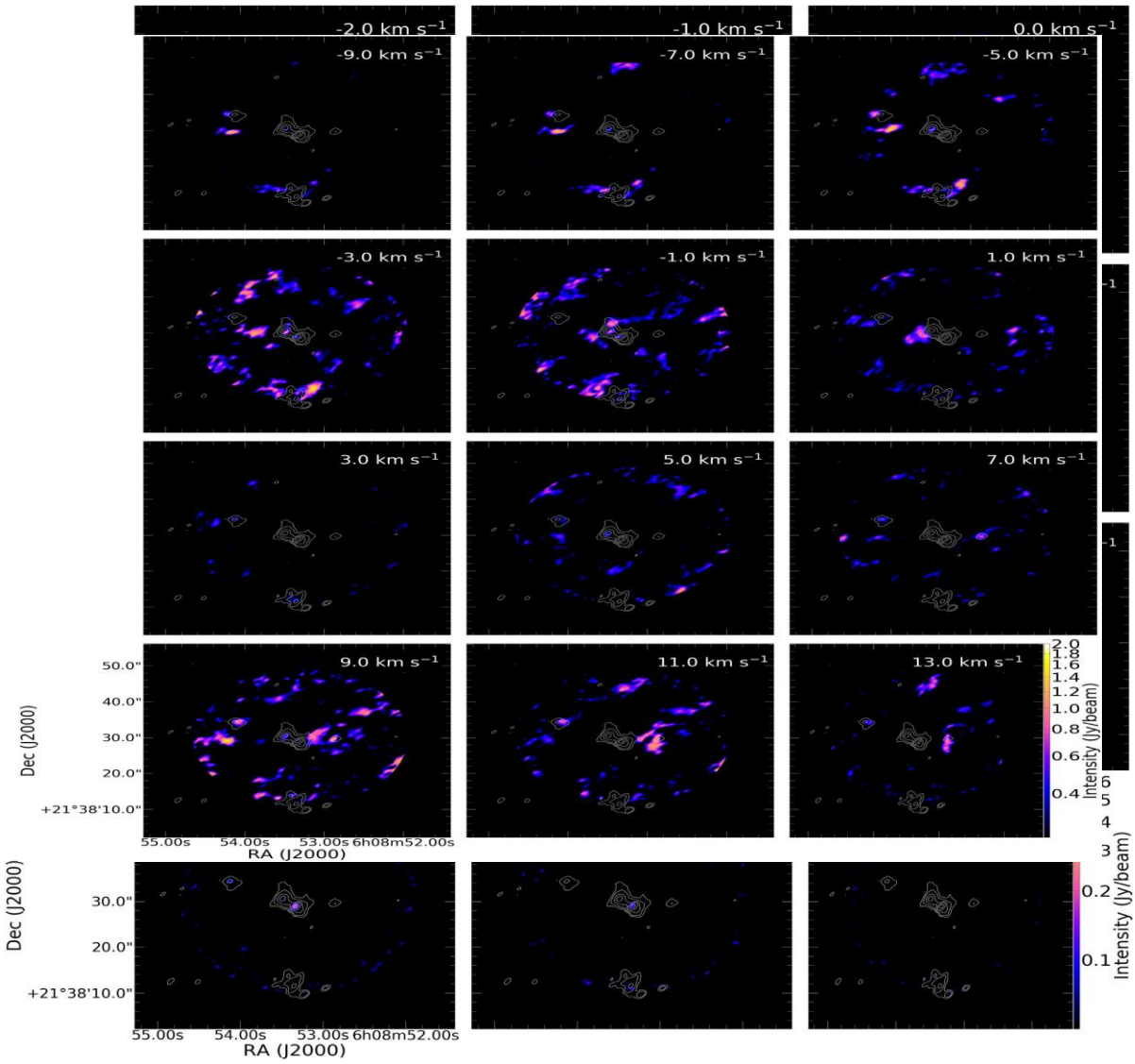


Figure 6. CH_3 OH 4(2,2)-3(1,2) thermal line channel map with dust continuum overlaid (black contour, levels = [0.002, 0.004, 0.02, 0.06, 0.08]

Jy beam $^{-1}$) dust continuum emission of G188.95+0.89. The colour scale is the intensity in Jy beam^{-1} .

DISCUSSION

Implications of the variability in the 6.7-GHz CH_3 OH Masers

Originally, Goedhart et al. (2004) reported the period of G188.89+0.89 was 416 d; this was revised in Goedhart et al. (2014 to 395 d. Here, using the longer time series and from two separate methods, the shorter period is confirmed (τ Period04 = 395 ± 1 d and τ_{LS} = 397.6 ± 0.7 d). Durjasz et al. (2021) also confirm, though observing fewer flare cycles, the shorter period, τ = 395 ± 8 d. Class II methanol masers are only found associated with high mass star-forming regions (Minier et al. 2003). Such regions experience accretion events (identified by flaring masers) such as those reported in S255IR-NIRS3 (Fujisawa et al. 2015; Szymczak et al. 2018b), NGC 6334I (MacLeod et al. 2018), G323.46–0.08 (Proven-Adzri et al. 2019; MacLeod et al. 2021b), and G358.93–0.03 (MacLeod et al. 2019; Sugiyama et al. 2019).

Figure 8. ^{12} CO (J = 2 − 1) channel map with dust continuum overlaid (black contour, levels = [0.002, 0.004, 0.02, 0.06, 0.08] Jy beam $^{-1}$) dust continuum emission of G188.95 + 0.89. The color scale is the intensity in Jy beam $^{-}$1.

However, three of the features in Table 2 are decaying, in particular, the v_{LSR} = + 11.45 km s^{-1} decays exponentially (Fig. 4). Interesting, historical observations suggest the originally detected peak flux density feature, v LSR ∼ +10.5 km s^{-1}, has varied markedly since detection, less than 500 Jy before 1993 (Menten 1991; Caswell et al. 1995b), greater than 600 Jy before 2009 (Goedhart et al. 2004; Green et al. 2012) to ~500 Jy on average here. Note at present the peak flux density is found at v_{LSR} = + 10.70 km s −1 and not +10.44 km s −1 . Caswell et al. (1995b) reported that the feature v_{LSR} = +11.2 km s −1 decreased slightly from 1991 (~250; Menten 1991) to 1993 (~230 Jy). In 1999 August, it was only ~100 Jy (Szymczak, Hrynek & Kus 2000) while reaching a maximum, ~160 Jy, in 2001 November (Goedhart et al. 2004); thereafter, the exponential decay is reported here. Above equation (1) cannot describe these variations, nor does it fit the maximum reported in Goedhart et al. (2004). It appears a weak flaring event, increasing by a factor of ~2.6 in flux density, occurred between 1999 August and 2001 November in the periodic feature at v LSR = +11.45 km s^{-1}.

This decaying periodic feature resembles that shown for decaying periodic maser features in G323.46−0.08 (MacLeod et al. 2021b). Further analysis of historical data, and data other transitions (e.g. 12.2 GHz CH_3OH and/or 22.2 GHz H_2O), are required to confirm. Spot maps of the 6.7-GHz methanol masers are shown in Minier, Booth & Conway (2000) and Hu et al. (2016); all features reside in a 180 × 180 au box assuming a distance of 1.76 kpc (Oh et al. 2010) about the bright reference feature (v LSR = + 10.33 km s^{-1}). The weakening features reside within ~50 au radius of the reference feature, v_{LSR} = +8.42 km s^{-1} slightly north while +11.45 km s^{-1} is slightly south of the reference maser. The strengthening feature (+10.70 km s^{-1}) is found ~90 au to the south-east from the reference maser. The non-varying feature, v_{LSR} = + 9.65 km s^{-1} is further south-east (~140 au). Minier et al. (2000) suggest that the masers surrounding the reference maser could be part of an outflow from the disc.

It is not clear whether velocity drifts, including those seen here, are caused by variability of spectrally blended masers (Szymczak, Wolak & Bartkiewicz 2014) or by motion of the gas (Goddi, Moscadelli & Sanna 2011). The accretion discs surrounding massive star-forming regions may experience infalling gas. Szymczak et al. (2014) report a velocity drifting feature in Cepheus A; they suggest it may be an artefact of variable line-merged features or the result of masers located in regions of infalling gas. MacLeod et al. (2021a) propose the inner radius of the accretion disc surrounding the protostar of G9.62+0.20E is infalling resulting in systematic velocity drifts of its associated methanol masers. However, they also state that it may be caused by masers in a precessing disc.

Above in Table 2, it can be seen that two features experience measurable velocity drift. The blue-shifted feature, v LSR = +9.65 km s^{-1} is blue-shifting (−2.38 ± 0.03 × 10^{-5} km s^{-1} d^{-1}) while the other, v_{LSR} = +11.45 km s^{-1} , is red-shifting (+1.88 ± 0.04 × 10^{-5} km s^{-1} d^{-1}). The drifts are of the order of those seen in G9.62+0.20E (MacLeod et al. 2021a), ranging from −6 to +3 × 10^{-5} km s^{-1} d^{-1} . However, an insufficient number of features with measurable velocity drift are found, thus, rendering any comparison to G9.62+0.20E indeterminate. These two features are found well-separated in the spot maps shown in both Minier et al. (2000) and Hu et al. (2016), by ∼200 au. Perhaps the central features are influenced by an outflow (Minier et al. 2000) and this motion may force the features at the edges to experience velocity drift. Even the now brightest feature, at v_{LSR} = + 10.70 km s^{-1}, is blue-shifting though this may be due only to variations of heavily line-merged features. All of these periodic masers are associated with MM1. More observation and analysis is required to explain these variations.

Binary system in G188.95+0.89-MM2

There are a number of indicators suggesting the existence of a binary system in MM2. First, the high-resolution ALMA band 7 dust continuum image resolves MM2 into 2 cores separated by 0.1 arcsec. Secondly, the CH_3 OH ($4_{(2,2)} - 3_{(1,2)}$) emission is coincident with the systemic velocity and the spectral profile of emission towards MM2 has two pronounced features (see 3 km s^{-1} channel of Fig. 6). In Fig. 9, the spectra of 12 CO (solid lines) and CH_3OH ($4_{(2,2)} - 3_{(1,2)}$) (dashed line) taken from MM2 using a 4 arcsec ellipse are presented.

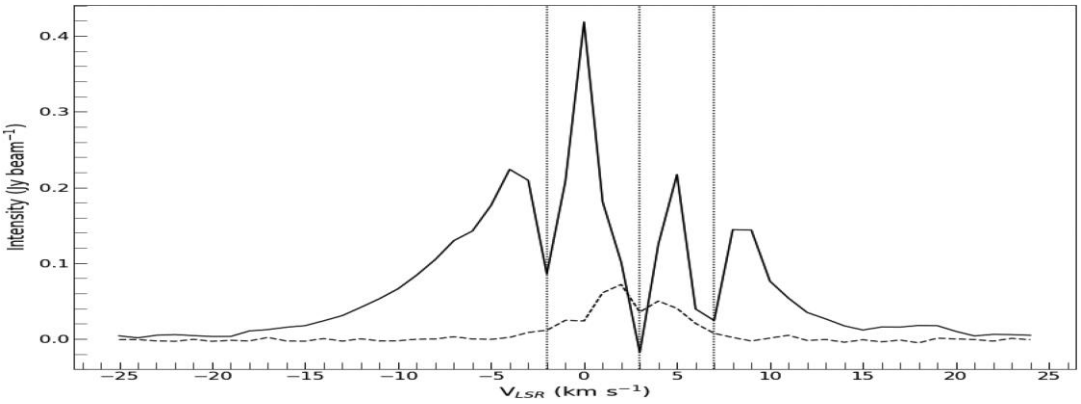


Figure 9. 12 CO (solid lines) and CH 3 OH (dashed lines) spectra (of G188.95+0.89 extracted with an ellipse of size ∼4 arcsec centred on MM2. The vertical lines indicate the observed absorption features in 12 CO line. The multiple absorption features in the 12 CO emission and the double peak feature in the CH 3 OH line point to multiplicity (or at least binary) of driving sources in MM2. Band 7 ALMA dust continuum detected 2 cores in MM2.

It is important to note that the ^{12} CO emissions are optically thick. In the ^{12} CO spectra (at least), self-absorption features are visible, implying the ^{12}CO emission is absorbed by cold foreground material in the region. The three vertical dotted lines in Fig. 10 indicate the prominent absorption feature (middle line at 3 km s^{-1}) and two absorption features (−2 and 7 km s^{-1}) one on each side of the prominent feature. We noted that missing flux issue can give rise to such spectral feature but in this case, the observed absorption feature is real.. The most prominent absorption feature in the ^{12} CO spectra corresponds in V LSR with the CH_3OH ($4_{(2,2)} - 3_{(1,2)}$) absorption feature separating the two resolved cores in MM2. All these observed features suggest multiple (or at least binary) young stellar objects in MM2. Our suggestion of the presence of at least a binary, or multiple, YSOs in MM2 is supported by the complexity of the orientation of the outflowing gas traced by ^{12}CO, see Fig. 8. An east–west outflow feature with an axis through the peak position of MM2, as well as a north-west and south-east outflow also intersecting with MM2, can be observed. These support the suggestion at least a binary system is present in MM2. High-resolution continuum and line observations will be required test the multiplicity of YSOs in MM2.

CONCLUSIONS

We presented results of 1.5 decades of monitoring observations of 6.7-GHz CH_3OH masers towards G188.95+0.89 and ALMA band 6 observational results and found the following:

(i) G188.95+0.89 protocluster is resolved into eight 1.3-mm objects (MM1-MM8). MM1 and MM2 are the central objects and MM1 (the brightest dust continuum object) is associated with the periodic 6.7-GHz CH 3 OH maser source.
(ii) MM2 hosts more than one YSO, likely a binary system.

(iii) Strong emission of 12 CO at the east and west of MM2 point to the presence of an east–west bipolar outflow in MM2. Emissions north of MM2 also suggest a second outflow emanating from the object, which could signal multiplicity of YSOs in MM2.

(iv) All five features are periodic, suggesting a common back-ground source of seed photon. The light curve shape of the maser features are similar to those of Mira variable stars and could suggest pulsation of the protostar as the possible driver of the periodicity (Inayoshi et al. 2013).

(v) Two CH 3 OH maser features are reported with measurable velocity drift.

(vi) Outflows are identified in 12 CO (2-1) line emission. While no direct detection of accretion discs was possible with the current observations, the detected outflows suggest the presence of accretion discs in the source. Accretion disc may experience infalling gas and velocity drifts may be due to an artefact of variable line-merged features or by infalling gas.

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DATA AVAILABILITY
(i) This paper makes use of the following ALMA data: ADS/JAO.ALMA 2015.101454.S. and can be accessed on the ALMA Science portal.
(ii) This publication makes use of data products HartRAO 26-m maser monitoring project and will be made available on a reasonable request.
(iii) The WISE data used in this publication can be access on the IRSA public data archive.

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EFFECTS OF AGRICULTURAL NUTRIENTS INFLUX ON WATER QUALITY IN THIBA RIVER BASIN, A SUB-CATCHMENT OF TANA RIVER BASIN IN KIRINYAGA COUNTY, KENYA

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ABSTRACT
Excessive enrichment of waters with nutrients and the associated adverse biological effects leads to eutrophication, which is one of the major environmental problems across the world. Various studies have revealed the overuse of inorganic fertilizers to increase agricultural productivity in Kenya, which contributes to pollution of water bodies. In order to meet increasing demand for clean water, sustainable use and conservation of available water resources is therefore paramount. This study was done to find out effects of agricultural nutrient pollution in Thiba River, a sub-catchment of Tana River Basin, located in Kirinyaga County, Kenya. The study area was divided into four distinct agro-ecological zones based on different anthropogenic activities. Ecological survey design was used in the study. Sampling was done during the wet and dry season. Water samples were analyzed for temperature, transparency, pH, electrical conductivity (EC), dissolved oxygen (DO), biological oxygen demand (BOD), phosphates, nitrates, nitrites, ammonia and toxic microalgae. All parameters showed both spatial and temporal variations with statistically significant differences. Temperature of the river ranged from 14.57 ^{0}C to 28.08 ^{0}C due to climatic changes along the agro-ecological zones. The pH ranged from 7.02 to 8.51. The DO values decreased from the highlands to lowland within the range of 9.00 mg/l at the reference site to 5.43 mg/l at the most polluted site. EC ranged from 20.54 µScm^{-1} at the reference site during the wet season to 251.2 µScm^{-1} at the rice irrigation scheme site during the dry season. Water transparency ranged from 15cm to 81cm. This was low during the wet season and high during dry season. The highest values of BOD (3.49 mg/l) were recorded at the rice irrigation scheme during the wet season and the lowest (0.22 mg/l) at the forest edge reference site. The lowest levels of NH_4, P, NO2 and NO3 were recorded at the forest edge reference site at 1.088 µg/l, 1.177 µg/l, 0.217 µg/l and 0.148 µg/l respectively during the dry season while the highest values for the same nutrients were recorded at the rice irrigation site at 11.439 µg/l, 4.933 µg/l, 1.518 µg/l and 2.721 µg/l in the same order. There was a high peak of all nutrient levels at the rice irrigation scheme zone which was attributed to the extensive use of inorganic fertilizers. Dam water samples were analyzed for members of Cyanobacteria group of microalgae which are bio-indicators of eutrophic waters. Out of the seven members of this group that were identified four were toxic genera. These were *Nostoc, Oscillatoria*, *Anabaena* and *Microcystis.* During the wet season *Nostoc* had the highest population followed by *Oscillatoria* and *Anabaena.* No *Microcystis* was observed during the wet season. There was a steady increase of all the genera during the dry season with *Microcystis* making appearance. *Microcystis* and *Oscillatoria* had a very high correlation. This study concludes that various anthropogenic activities especially agriculture are the main factors of Thiba River pollution hence a major threat to human, livestock and aquatic organisms. Environmental protection laws should be enforced by the government.
Keywords: Phytoplankton, Eutrophication, Nutrients, Cyanotoxins, Physico-chemical

INTRODUCTION
Agriculture is among the greatest contributor of non-point source pollution to water sources in various parts of the world where intensive agriculture occurs (Berka *et al*., 2001). Agricultural nonpoint sources and other anthropogenic inputs are important contributors of nutrients to the aquatic environment, especially nitrogen (N) and phosphorus (P) (Borbor-Cordova *et al*., 2006). Phosphorus found in fresh water bodies is mainly anthropological in origin with about 38% coming from agriculture. Excessive enrichment of waters with nutrients and the associated adverse biological effects leads to eutrophication, which is still one of the major environmental problems across the world water (Bøgestrand *et al*., 2005). Environmental consequences of nutrient pollution from agriculture may include the degradation of downstream water quality, the eutrophication of water bodies and elevated concentrations of nitrous oxide, a powerful greenhouse gas (Mozumder and Berrens., 2007). Pollution by nutrients affects the health of humans and aquatic organisms as well as increasing water treatment costs (USEPA, 2017).

Studies have revealed overuse of inorganic fertilizers to increase agricultural productivity in Kenya (Njuguna *et al*., 2017). This is evident in Kenyan inland lakes. For instance, the Kenyan side of Lake Victoria has the highest Biological Oxygen Demand, BOD (Peter *et al*., 2020). Large scale farming of cash crops has been identified as a major source of inorganic fertilizers that pollute water bodies in Kenya (Maghanga *et al*., 2013). Thiba River Basin, is part of the Tana River Basin. The water is used for domestic purposes and discharges into Kamburu Dam, one of

the five hydroelectric power generation dams in Kenya. Economic activities along the lake and the rapidly growing population, have mounted environmental pressure on this source of freshwater in central Kenya (Muriuki *et al.*, 2016). According to (Heisler *et al*., 2008) there is a relationship between nutrient pollution and harmful algal blooms. Phosphorus in water is a major driver of eutrophication. Eutrophic water is characterized by harmful algal blooms formed mainly by members of cyanobacteria group or blue green algae. These produce several types of toxins that are collectively called cynotoxins. These toxins are contained within the cell walls but are released into the water after rupturing of the cell wall upon death and lysis of the alga. Some species are believed to release the toxins extracellularly into the water while still living (USEPA, 2017).

MATERIALS AND METHODS

This study was carried out in Thiba River basin, in Kirinyaga County, Kenya. It lies between 0°34'23.43"S and 37°19'31.7"E (Fig. 1). The County has a total area of 1,478 square kilometers. The basin is characterized by intensive agricultural activities including large-scale cultivation of crops and the largest rice irrigation scheme in Kenya (Veldkamp., 2012). The river passes through the middle of the County and discharges into Kamburu Dam.

Study Design and Selection of Sampling Stations

The method adopted in the study was ecological survey design. Data was collected and analyzed without manipulation. The study area was divided into four distinct agro ecological zones (Jaetzold *et al*., 1982). The first station was at the forest edge (Kimunye) and served as the reference point (Fig. 1). The second station was Kutus Bridge in the highlands. In this zone is grown tea and coffee as cash crops. There is also dairy farming and small-scale agriculture for subsistence. The third station was at Ndindiruku Bridge in the midlands zone. It is characterized by extensive rice irrigation and horticultural farming. The rest of the stations were located in Kamburu Dam in the lowlands. It is characterized by high temperatures and insufficient rainfall. This zone is dominated by free range livestock keeping and subsistence rain-fed farming of food crops that are tolerant to drought. The three dam stations were equally spaced from the River mouth to the point of exit from the Dam. Sampling was carried out for one year covering both the wet and the dry seasons.

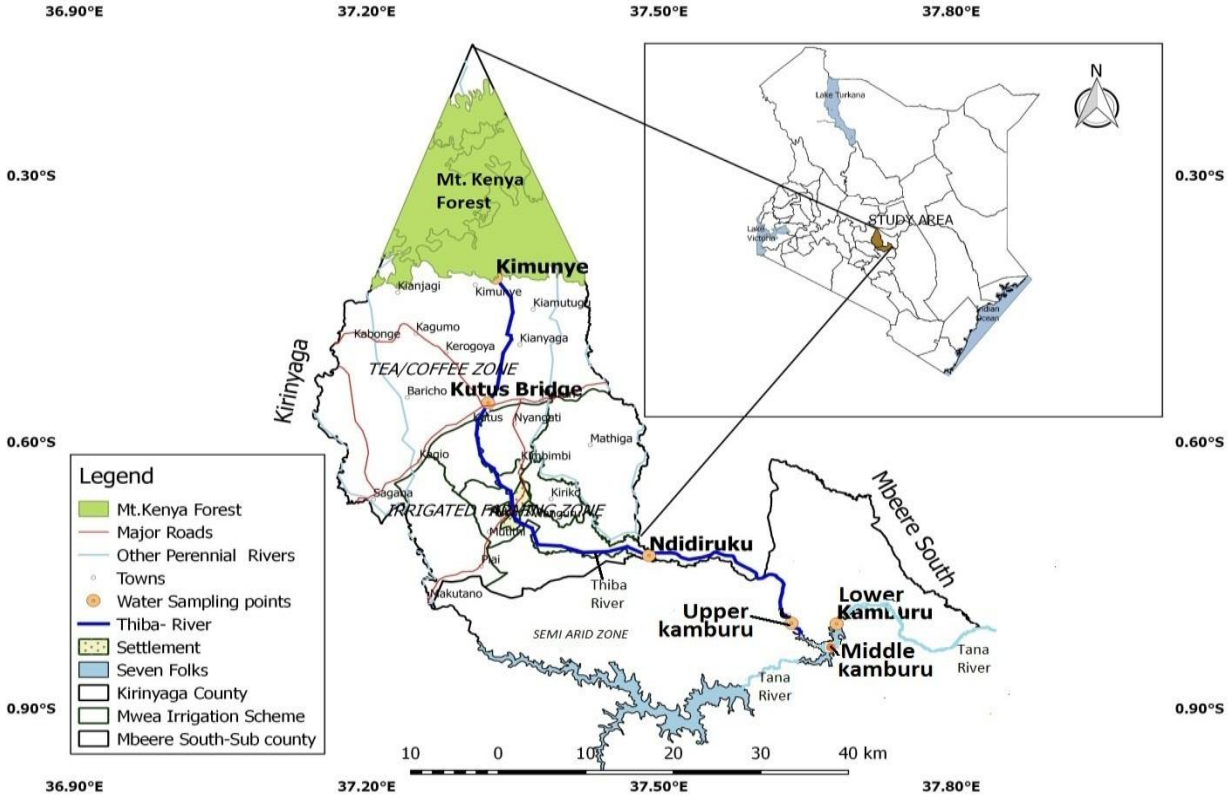


Figure 1: Map of the study site

Analysis of Water Samples

Water samples were collected according to Musselman and Robert (2012) in sterilized 250 ml plastic bottles and transported to the lab in an ice box at 4^0C. The physical-chemical parameters analyzed were temperature, transparency, pH, electrical conductivity, salinity, total dissolved solids and dissolved oxygen. These were recorded *in situ* using a digital meter model 605596-YSI-Proplus USA. Agricultural nutrients analyzed were Phosphates, Nitrates, Nitrites and Ammonia. These and BOD were done according to standard procedures as outlined Matsche and Kreuzinger, (2001) and APHA, (2012). Phytoplankton were collected by filtering 20lts of sample water through a 25µm mesh size cone shaped plankton net with a 50 ml concentrate bottle. Microalgae were examined under a phase contrast microscope using a bright field at a magnification of ×100 and ×400. Identification of the algae was done using keys based on standard morphological taxonomy (Stadtlander et al., 2013, Cilliers et al., 2021). Microalgae were counted using sedwick rafter chamber method. Data analysis was done using computer software SPSS version 22.0.

RESULTS

Analysis of Physico-chemical parameters

Analysis of variance (ANOVA) of the data showed highly significant differences of $p<0.01$ for all parameters in all sampling stations in spatial and temporal variations except DO. At Kutus Bridge DO did not show any significant difference in temporal variation at $p=0.39$. Machan'ga also did not show any significant difference in temporal variation of the same parameter at $p=0.59$. All the other sampling stations showed highly significant differences of $p<0.01$ for the parameter. For BOD there were highly significant differences of $p<0.01$ in both temporal and spatial variations for all the stations. There were highly significant differences of $p<0.01$ in both spatial and temporal variations for all the four agricultural nutrients in all the sampling stations.

The spatial temperature of the river ranged from 14.57 ^{0}C to 28.08 ^{0}C. The lowest temperature was recorded at the reference point near the forest edge during the dry season while the highest temperature was recorded at the middle of the dam during the wet season. There was a general increase in average temperatures from the forest zone towards the lowlands with the uppermost sampling point registering the coldest temperatures and the lower-most sampling points registering the warmest temperatures. The mean annual recordings were 14.57 ^{0} C at the forest edge, 18.6 ^{0} C at large-scale agriculture site, 22.72 ^{0} C at rice irrigation scheme site and a mean of 28.08 ^{0}C at the dam. The pH ranged from 7.02 at the reference site during the wet season to 8.51 at the dam during the dry season. The pH values increased as the river flowed from the highlands to the lowlands with the lowest values being recorded at the reference site and the highest at the upper part of Kamburu Dam. The pH values during wet season were 7.024, 7.490, 7.262, 7.87, 8.348 and 8.36 for Kimunye, Kutus Bridge, Ndindiruku Bridge, upper Kamburu, middle Kamburu and lower Kamburu respectively. The DO values showed both temporal and spatial variation within the sampling points (Fig. 2). The highest was recorded at the reference site (9.002 mg/l) during the wet season. The average values of DO decreased from the highland zone towards the lowlands zone. The annual same site averages were 8.587 mg/l, 7.840 mg/l and 6.403 mg/l for the reference point, large-scale agriculture point and rice irrigation scheme site, respectively. The annual averages within sampling points in the Dam were 7.357 mg/l, 7.416 mg/l and 7.718 mg/l for upper Kamburu, middle Kamburu and lower Kamburu Dam respectively. The average DO values for all Dam sites taken at different seasons showed that DO was lower during the wet season compared to the dry season

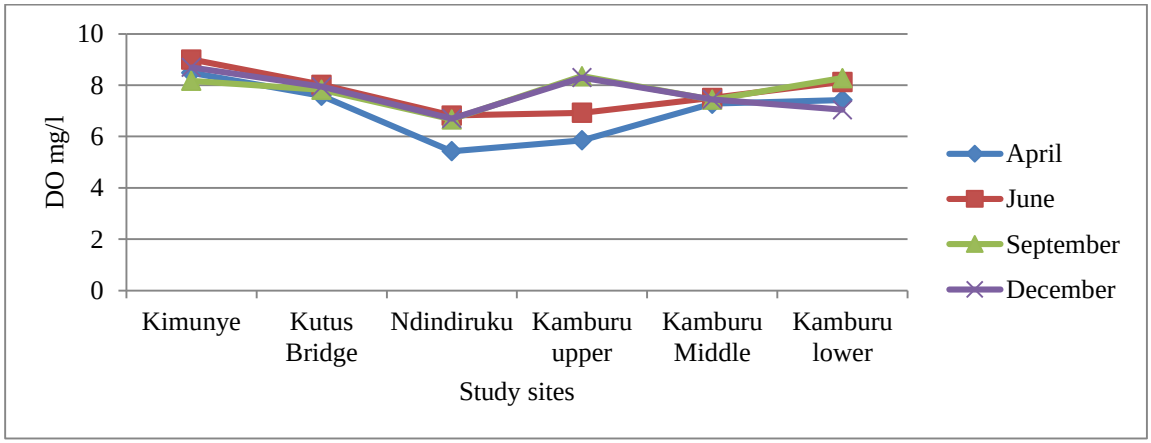


Figure 2: Spatial and temporal changes in DO values along the study site

There was wide temporal and spatial variation in Electrical Conductivity (EC) among the sites. The highest value was 251.2 µScm^{-1} recorded at the rice irrigation scheme site during the dry season while the lowest (20.54 µScm$^{-1)}$ was recorded at the reference site during the wet season (Fig. 3). The highest variation was 133.72 µScm^{-1} recorded between the dry and wet seasons at the irrigation scheme site of Ndindiruku. The lowest same site variation was 1.96 µScm^{-1} recorded at the reference site between the dry and wet seasons as well. The EC values also followed a similar pattern noted on other parameters of steady increase from upstream to downstream. Notably the increase was drastic at the rice irrigation site (Ndindiruku) during the dry season.

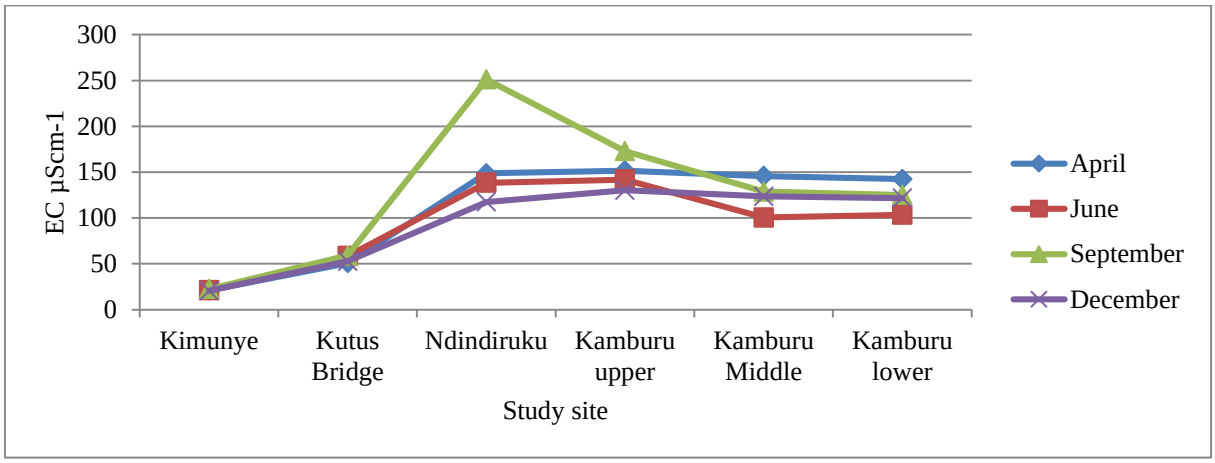


Figure 3. Spatial and temporal variations in EC values along the study site

Biological Oxygen Demand (BOD) showed a lot of spatial and temporal variations. The highest value of 3.49 mg/l ±0.192 was recorded at rice irrigation scheme area during the wet season. (Fig.4). The lowest BOD value was 0.22 mg/l ±0.10 recorded at the reference site during the wet season. Temporal variations of BOD were highest at the reference site. The lowest was in upper Kamburu. Unlike other parameters, BOD trends along the study site changed drastically between seasons. For instance, during the long rains, the BOD showed a downward trend from the forest edge through the large-scale agricultural area to the rice irrigation scheme with wide fluctuations at the dam. During the dry season the trend was reversed starting low at the forest edge and increasing downstream with wide fluctuations in the Dam. During the dry season BOD peaked at 3.49 mg/l ±0.192 in the rice irrigation area then took a downward trend downstream to 1.40 mg/l ±0.081at the lower end of the dam. BOD values were comparatively lower during the dry season except at upper Kamburu where the river discharged its water.

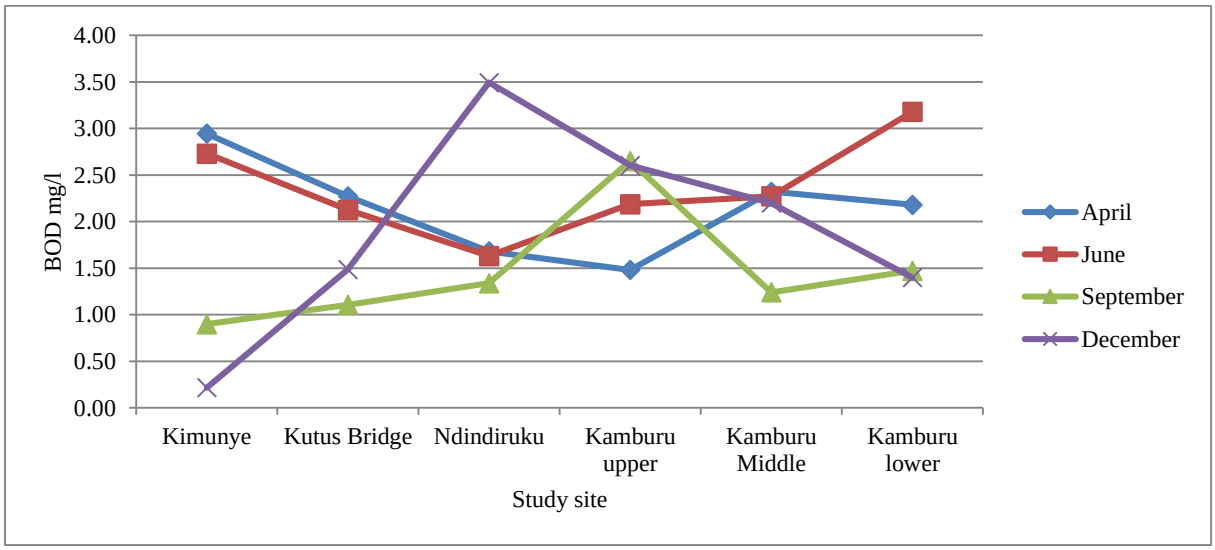


Figure 4. Spatial and temporal variation in BOD values along the study site

Correlation Analysis for Physico-Chemical Parameters

Correlation analysis showed that most of the parameters had similar correlation during both the wet season and dry seasons except for DO and pH that had negative correlation during the wet season (Table 1 and 2). DO showed negative correlation with all the parameters during the dry season but during the wet season it showed a strong correlation of 0.92 with water clarity. Water clarity and temperature were strongly correlated during the wet season at 0.86 but this became very weak during the dry season at 0.05. Water clarity and pH were also strongly correlated during the wet season at 0.902 but during the dry season the two become inversely correlated at −0.28. During the dry season the two become inversely correlated at −0.11. Water clarity and EC were also strongly correlated during the wet season but during the dry season the two became inversely correlated at −0.93. Ammonia and pH showed a weak correlation of 0.42 which increased to 0.63 during the dry season. Water clarity and agricultural nutrients are inversely correlated during both wet and dry seasons.

	temps	*pH*	*D.O*	*E.C*	*TDS*	*Salinity*	*Water clarity*	*PO4*	*NO2*	*NO3*	*NH4*
temps	1.0000										
pH	0.8832	1.0000									
D.O	-0.4723	-0.053	1.0000								
E.C	0.9259	0.6557	-0.7523	1.0000							
TDS	0.8929	0.5938	-0.8075	0.9960	1.0000						
Salinity	0.8713	0.5660	-0.8425	0.9852	0.9953	1.0000					
Clarity	0.8698	0.9025	0.9295	-0.9943	-0.9560	-0.8963	1.0000				
PO4	0.5005	0.0519	-0.9556	0.7641	0.8132	0.8307	-0.985	1.0000			
NO2	0.6500	0.2686	-0.9749	0.8745	0.9131	0.9372	-0.951	0.9369	1.000		
NO3	0.6287	0.2078	-0.9548	0.8652	0.9026	0.9122	-0.998	0.9809	0.973	1.000	
NH4	0.7863	0.4241	-0.9001	0.9556	0.9760	0.9788	-0.997	0.9164	0.966	0.973	1.00

Table1. Pearson correlation matrix for physico-chemical parameters during the wet season

	temps	*pH*	*D.O*	*E.C*	*TDS*	*Salinity*	*Water clarity*	*PO4*	*NO2*	*NO3*	*NH4*
temps	1.0000										
pH	0.8279	1.0000									
D.O	-0.3149	0.1878	1.0000								
Conductivity	0.7775	0.5077	-0.5825	1.0000							
TDS	0.7583	0.4798	-0.5903	0.9992	1.0000						
Salinity	0.7591	0.4782	-0.5813	0.9979	0.9993	1.0000					
Water clarity	0.0543	-0.2812	-0.1177	-0.9336	-0.9240	-0.8536	1.0000				
PO4	0.5934	0.3512	-0.6166	0.9523	0.9563	0.9479	-0.9796	1.0000			
NO2	0.5598	0.4112	-0.4948	0.9270	0.9310	0.9272	-0.7054	0.9648	1.0000		
NO3	0.6964	0.3948	-0.6747	0.9558	0.9557	0.9451	-0.9433	0.9727	0.8899	1.0000	
NH4	0.7917	0.6358	-0.4564	0.9750	0.9686	0.9636	-0.8206	0.9405	0.9400	0.9314	1.0000

Table 2. Pearson correlation matrix for physico-chemical parameters during the dry season

Analysis of Inorganic Nutrients

The nutrients had similar trends. The lowest levels of NH_4, P, NO_2 and NO_3 were recorded at the forest edge site at 1.088 mg/l, 1.177 mg/l, 0.217 mg/l and 0.148 mg/l respectively during the dry season. The highest values for the same nutrients were recorded at the rice irrigation site at 11.439 mg/l, 4.933 µg/l, 1.518 mg/l and 2.721 mg/l for NH_4, P, NO2 and NO3 respectively (Fig. 5 and 6). These levels remained high during the wet season but were slightly lower than those recorded on the same site during the dry season. There was a high peak of all nutrient levels in the rice irrigation site.

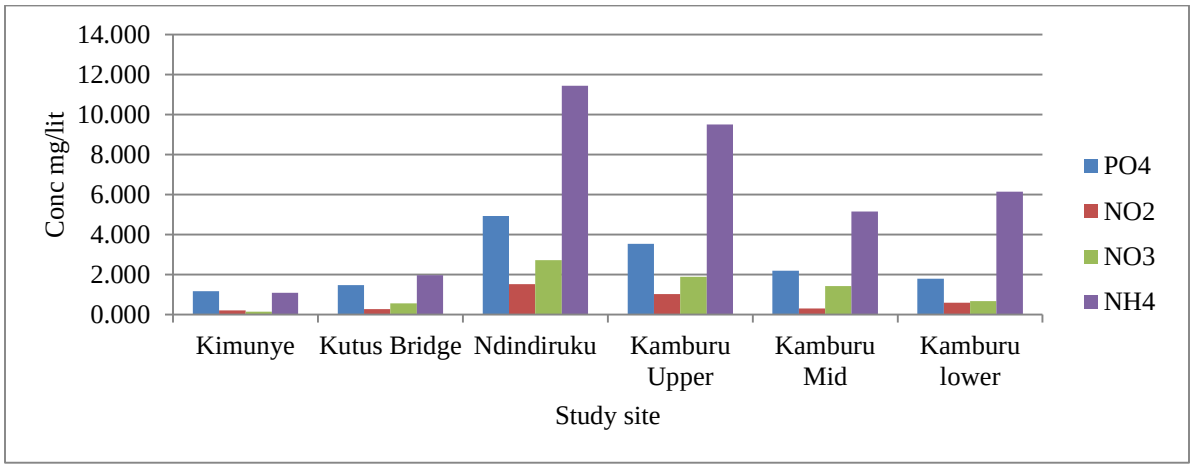


Figure 5: Inorganic Nutrient levels along the study site during the dry season

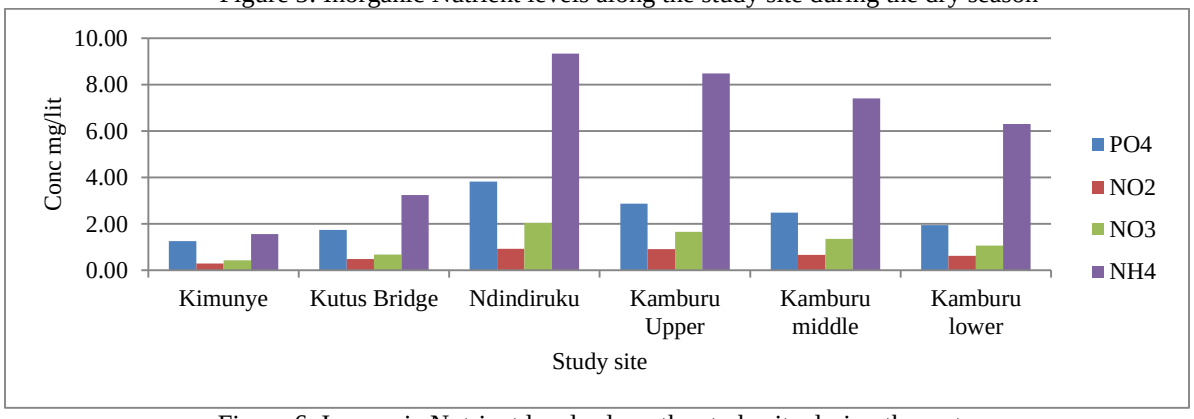


Figure 6: Inorganic Nutrient levels along the study site during the wet season

Characterization of microalgae from Kamburu Dam

Analysis of microalgae present in the water samples revealed a total of thirty two genera. Most of the microalgae were from Chlorophyta (12 genera), Ochrophyta (8 genera), Cyanobacteria (7 genera), Charophyta (3 genera) and Euglenozoa (2 genera). This study focused on the division of Cyanobacteria or blue green algae because it has toxic species that pollute water bodies and form harmful algal blooms. These produce cyanotoxins that are a health hazard to both humans and animals and therefore their presence is a water quality problem. Out of the seven genera in this division, four were found to be toxin producing species. These were *Microcystis*, *Anabaena*, *Nostoc* and *Oscillatoria* (Fig. 7). The population of these microalgae varied greatly between seasons. During the wet season the highest population belonged to *Nostoc* (950) followed by *Oscillatoria* (200), *Anabaena* (450) and none for *Microcystis*. During the dry season the population increased to 2,500, 1,050, 1,600 and 600 for *Nostoc*, *Oscillatoria*, *Anabaena* and *Microcystis* respectively. Generally the population of microalgae was lower during the wet season with no *Microcystis* being observed but increased considerably during the dry season.

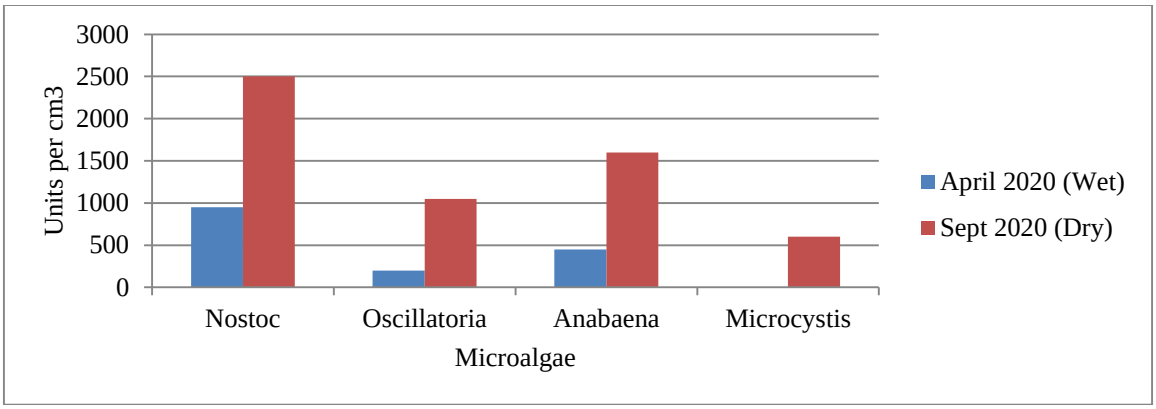


Figure 7: Seasonal variations in abundance of toxic algae in Kamburu Dam

On correlation analysis *Anabaena* and *Nostoc* were negatively correlated while *Microcystis* and *Oscillatoria* had a very high correlation with each other. In one of the samples *Oscillatoria* was observed to grow inside a colony of *Microcystis*. There was also a strong correlation between the microalgae and the four agricultural nutrients. For instance, there was a strong correlation between *Nostoc*, PO_4 and NH_4. For *Oscillatoria* and *Microcystis* the strongest correlation was with NO_2.

Table 3. Correlation analysis for toxic algae and nutrients within study site

	Nostoc	*Anaebaena*	*Oscillatoria*	*Microcystis*	*PO4*	*NO2*	*NO3*	*NH4*
Nostoc	1							
Anaebaena	-0.04	1.00						
Oscillatoria	0.31	0.54	1.00					
Microcystis	0.28	0.48	1.00	1.00				
PO4	0.78	0.55	0.75	0.71	1.00			
NO2	0.63	0.22	0.90	0.90	0.81	1.00		
NO3	0.65	0.72	0.51	0.45	0.91	0.50	1.00	
NH4	0.72	0.30	0.87	0.86	0.90	0.98	0.64	1.00

DISCUSSION

The temperature range of 13.6 ^{0}C – 28.84^{0}C recorded in the study site was notably wider compared to other tropical water bodies but falls within the normal range. Water reservoirs in central Kenya showed a mean range of 21.6 ^{0}C – 24.3 ^{0}C (Kitur, 2009). The wide temperature range recorded in this study is attributed to the geographically wide study area that cuts across several different ecological zones with the coldest temperatures being recorded at the forest edge. The results are comparable to those recorded in a study on Molo River, Kenya that found the range to be 14.02 ^{0}C - 31.5 ^{0}C (Chebet et al., 2020). In Nigeria it was found that surface temperatures for main rivers ranged from 22.6 ^{0}C – 31.0 ^{0}C which is much higher (Ajibade *et al*., 2008). The reference site is at the highest altitude (1,831.2 meters) and had the lowest annual average temperatures while lowermost site at 1,011.3 meters had the highest annual average temperatures. Water temperatures therefore reflected those of the air across climatic zones.

The pH range of the study site was 7.024-8.5 A study on Molo River in Kenya found the range to be higher at 7.90 – 9.66 (Chebet et al., 2020). The pH was lower during wet season compared to the dry season. This trend is similar to that observed in Asa inland lake, Nigeria that ranged between 7.3 to 8.1(Araoye, 2009). This is attributed to increase in chemical pollutants that make water more acidic during the rains. There was higher pH in the dam than in the river. This increase is attributed to higher algal growth in the dam due to accumulation of nutrients and more favourable conditions for algal growth. Carbon dioxide exists as weak carbonic acid in water. Photosynthetic activity by algae in the Dam extracts CO_2 from the water making it more basic. This is why pH is higher in the Dam than in the river where algae growth is less. According to Osman and Kloas, (2010) most fresh water bodies have a pH range of 6.0-8.0. A pH range of 6.5- 8.5 is considered safe for both humans and animals (EPA, 2002).

The DO is an important parameter for measuring water quality because it indicates the ability of a water body to support aquatic life. The amount of DO is influenced by temperature. Cold water holds more oxygen than warm water (Taseli, 2006). This is why the levels of DO are higher at the reference site where temperatures are low. Secondly at higher altitudes land gradient is steeper compared to the lowlands where it is gentle. Water flow is therefore faster in the highlands. There is more mixing of water with air more so with many rapids and cataracts created by the rocky bed that is characteristic of high altitude rivers.

According to Robert *et al*., (2019) gas transfer velocity in rivers varies spatially and is usually higher in rapids and lower in quiescent sections of the river. The ideal DO range for fresh water aquatic life is 6.5 mg/l – 8.0 mg/l hence the value of 5.43 mg/l recorded at the rice irrigation site is too low for aquatic life. This is the section of the river where agricultural activities were highest and pollution was highest. Rice processing in the study area produce large amounts of organic wastes. With no proper systems of disposal these eventually end up in the river through runoff. Aerobic microbial decomposition of these wastes depletes O_2 from the water and accounts for the abnormally low DO on this site. Improvement of DO levels in the Dam is attributed to photosynthetic activity of microalgae that consumes CO_2 and releases O_2 into the water.

Electrical Conductivity indicates the amount of dissolved substances in the water that releases ions. EC values in the showed a very drastic change increasing sharply downstream from 20.54 µScm at the reference site to 251.20 µScm at the rice irrigation site. This is considerably high compared to the range of Masinga Dam within the same basin whose range was narrower at 89.70 µScm – 168.83 µScm (Nzeve, 2015). The range for the study area is lower compared to that of Lake Naivasha which seems much more polluted at 270 µScm – 305 µScm (Mwamburi, 2013). The value of EC is dependent on the concentration of ions and temperature. The sharp increase of EC downstream is attributed to increase of ion releasing pollutants especially inorganic fertilizers from irrigation farming. The EC values increased steadily downstream to peak sharply at the irrigation site, a clear indication of increased water pollution at this area.

The BOD is one of the most important and widely used parameter for characterizing the organic pollution of water. It is indicates the amount of oxygen required by aerobic microorganisms to degrade the organic matter in the water to carbon dioxide and water (Sulivan *et al*., 2013). Sources of organic matter are natural decaying of plants and animals as well as anthropogenic activities such as agricultural runoff, urban runoff and industrial wastewater discharge. Occurrence of these pollutants in high levels may result in the aerobic microorganisms using all the oxygen in the water for their degradation creating anaerobic conditions that kill aquatic life and cause bad odours (Gary, 1999).

The wide variation in BOD recorded was as a result of both natural and anthropogenic causes. The sharp BOD raise at the irrigation site and upper Kamburu is attributed to pollution of the river by organic wastes from both agricultural and urban settlements. The BOD values recorded at the reference forest site during the rains is predominantly from natural origin. According to (Tatiana *et al*., 2016) large amount of dead plant material decomposing on the forest floor generates large amounts of water soluble organic substances such as humic and fulvic acids. These find their way to rivers and lakes through surface runoff and leaching during the rains where they cause large changes in BOD (James *et al*., 2014). According to Joaquim, (2010) BOD less than 4 mg/l is considered to be reasonably clean. BOD was highest at the irrigation site due to increased pollution

Ammonia exists in water as unionized ammonia (NH_3) or as ionized ammonia (NH_4^+). The proportion of these two forms of Ammonia in water is dependent on pH. The unionized ammonia is the toxic form and is dependent on temperature (Forrest, 2005). Ammonia in levels above 0.53 mg/ are considered toxic to fresh water organisms. Excessive and continuous input of nitrogen contaminants into rivers is the fundamental reason for high concentration of ammonia in rivers (Zhang *et al*., 2007). Very high levels of Ammonia were recorded at the rice irrigation site and downstream stations during both wet and dry seasons peaking at 11.439 µg/l at the irrigation site. The high levels are due to the intensive agricultural activities and use of fertilizers (Du *et al*., 2017). In the current study the high ammonia levels are attributed to widespread use of Diammonium Phosphate fertilizer (DAP) in irrigation agriculture. The decline in ammonia levels downstream is attributed to microbial activities by denitrifying bacteria taking place in the water being part of the nitrogen cycle.

Nitrates and Nitrites occur naturally as part of the Nitrogen cycle. The transformation of nitrite to nitrate is affected by temperature (Lizhi *et al*., 2016). Being unstable NO_2^- is more reactive and has serious health consequences in both humans and animals and therefore creates water quality problems. At high levels it creates nitrite toxicity which causes

fish mortalities and blue baby syndrome in humans (Tilak *et al*., 2007). Nitrites can also react with amines and amides in human bodies to form highly carcinogenic N-nitroso compounds (Parvizishad *et al*., 2017). Nitrates and Nitrites are discharged into water bodies mainly through surface runoff and leaching (Larry *et al*., 2002). Nitrate ions (NO_3^-) are loosely bound in soil and being water soluble they are easily carried by surface runoff and also leached into ground water during the rains (Larry *et al*., 2002).

Sources of phosphates in water are mainly non-point such as erosion and sedimentation, decomposition of naturally occurring minerals, atmospheric deposition and agricultural runoff (USEPA, 2017). Phosphorus may also be from point sources where industrial and organic wastes such as sewage are discharged into rivers. Phosphorus is critical in supporting aquatic life but is a major driver of eutrophication when in excess (Hossain *et al*., 2006). Temporal and spatial distribution of phosphates followed a similar pattern to that of nitrates although comparatively higher in quantities. Similar findings were reported by Adesuyi *et al*., (2015) in a study of Nwaja Creek, Nigeria. This strongly suggests that the phosphates and nitrates have common origin chiefly inorganic fertilizers from irrigation agriculture practiced around the study site.

Algae are good indicators of pollution owing to their wide temporal and spatial distribution, rapid reproduction rates and short life cycles (Wan, 2010). Algae species are specific and well correlated with particular types of pollution. Cyanobacteria which are toxic grow well in organically polluted water and their absence is an indicator of clean water (Bulent *et al*., 2013). *Oscillatoria* is tolerant to organic pollution and is a good indicator of organically polluted water. Excessive growth of toxic algae is largely caused by nutrient pollution particularly N and P (Donald *et al*., 2002). In high densities cyanobacteria are an undesirable component of fresh water ecosystems because they produce cyanotoxins that disrupt food webs by killing aquatic organisms (Karl, 2012). *Microcystis, Anabaena, Nostoc* and *Oscillatoria* produce microcystin and cyanopeptolin which are neurotoxins and hepatotoxins (Havens, 2008).

Cases of cyanotoxin poisoning have been reported in Kenya. In 1999, about 30,000 flamingoes died in Lake Bogoria, Kenya from cyanotoxin poisoning (Krienitz *et al.,* 2004). In addition, mass mortalities of fish along the Kenyan coast have been attributed to harmful algal blooms (Linet and Kiteresi, 2013). The presence of four toxic genera in Kamburu Dam is a matter of concern that requires immediate action to control nutrient pollution in Thiba River Basin.The increase in algal populations during the dry season is attributed to increased sunshine, warmer water temperatures and increased light penetration as a result of settling down of the suspended particulate matter all of which are favourable to algae growth (Chokchai *et al*., 2011). During the rains water transparency is reduced and light penetration low due to increased turbidity mainly from soil particles from a degraded catchment. This curtails photosynthetic activity hence the low algae population during the wet season.

CONCLUSION AND RECOMMENDATIONS

This study concludes that various anthropogenic activities especially agriculture along the study site is the main factor contributing to water pollution hence a threat to human, livestock and aquatic organisms. Values in physico-chemical properties varied along the site during both the wet and dry season while those of nutrients increased steadily from upstream to downstream. Major area of concern was at the rice irrigation scheme where high level of nutrient pollution was recorded rendering the site unsuitable for aquaculture. Pollution of Thiba River by agricultural nutrients from the irrigation scheme is responsible for the rapid growth of microalgae in Kamburu Dam. This poses an environmental threat to the reservoir if left uncontrolled. Another concern is the abundance of toxic microalgae in the dam that if left unchecked could make the Dam eutrophic and eventually an ecological disaster. To cub this trend, environmental protection laws in the County with particular emphases to water pollution should be strictly enforced. This would create a sustainable water resource that can be used for aquaculture for income generation and increased food security. Influx of nutrients into rivers can be controlled by using irrigation outflows to irrigate other food crops instead of directing it back to the river.

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EFFECT OF COOKING TEMPERATURE AND CLEANING METHODS ON LEVELS OF MANCOZEB AND ETHYLENETHIOUREA IN TOMATO

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ABSTRACT
Pests and diseases in vegetables are controlled using pesticides which include fungicides in the class of dithiocarbamates (DTCs) such as mancozeb which are injurious to the environment, animals and human at high concentrations. Cooking degrades DTCs to metabolites such as ethylenthiourea (ETU) known to be carcinogenic, while proper cleaning removes the residue considerably. This study determined the effect of temperatures achieved by cooking and cleaning methods on the residue levels of mancozeb and the metabolite ETU on tomato (*Lycopersicon esculentum*) sprayed with mancozeb. Samples were subjected to different temperature and cleaning treatments before extraction and method validation together with analysis by HPLC. The method of analysis had The R^2 values (0.948-0.999) and recoveries ranging from 91.26-95.89 %.The ETU residues rose from a mean of 9.43±0.03 mg/kg at 25℃ to a mean of 12.43±0.38mg/kg at 90℃, while mancozeb levels decreased from 5.23±0.02 mg/kg at 25℃ to non detectable levels at 60℃. The levels of ETU reduced from 46±0.71m/kg to 0.05± 0.00 mg/kg (99.9±0.00 %) when cleaned with sodium hypochlorite while, water alone reduced ETU to 0.27±0.08 mg/kg (99.4±0. 00%).Mancozeb levels in tomato cleaned with sodium hypochlorite, reduced by 95.2±0.00% while cleaning with water alone removed 16.3±0.64%. Cleaning with sodium hypochlorite showed a highly significant removal of fungicides compared to cleaning with water only. The results from this study indicates exposure of mancozeb and ETU in fresh and cooked tomato, hence a need for cleaning with chlorine and rinsing with water before consumption and a need for more alternatives of chemical cleaning.
Keywords: Mancozeb, Ethylenethiourea, Temperature, Residue, Tomato, Cleaning.

INTRODUCTION
Vegetable production is one of the major branches of horticulture, they are considered as an asset providing income to the growers and providing a vital part of human diet. Tomato is vegetables which are eaten raw or cooked as the fruit part. Tomato *(L. esculentum*) originated from South America. The tomato crop is affected by various fungal diseases such as leaf spot *(Septoria lycopersici)*, powdery mildew *(Leveillula taurica*), late bright *(Phytopthora infestans)*, early bright (*Alternaria Solani*), *Anthracnose* or ripe fruit rot caused by *(Colletotrichum capsici*) to a lesser degree and mainly (*Colletotrichum leosporioides)* among others and hence are usually sprayed for protection or for curative purpose [7]**.** Dithiocarbamates which are commonly used fungicides to control such diseases, are organosulphur compounds that exist as strong complexes with various metal ions in a polymeric form and include ethylenebis-dithiocarbamates (EBDCs) such as mancozeb, In contemporary agriculture over 30% of the produce does not reach the consumer market, and without use of chemical agents the loss would be doubled [7] and yield could drop by as much as a third while food prices could increase by as much as75% [18].World health organization (WHO) and other bodies have set maximum residue levels on vegetables when consumed, however farmers may apply more than the recommended pesticide quantities especially during wet seasons while some may not even wait for Post Harvest Interval (PHI) based on demand. Studies have shown that ethylenebisdithiocarbamates (EBDCs) are in the category of pesticides whose residues are more frequently found in raw agricultural products [12].

Levels ranging from 17.5mg/kg to 10.6 mg/kg have been found in tomatofrom Kenya [10] and varying concentrations in different parts of the world; Congo, 4.65mg/kg of mancozeb in tomato [16], Turkey 0.11mg/kg ETU [6] and many others including Spain [14]. Metabolites of dithiocarbamates have been shown to cause cancer while high toxic residues of the fungicides are injurious to the environment, birds and fish. ETU which is a metabolite of EBDCs has a half-life of 1-7 days in the environment, a long half life in the soil of between 5-10 weeks [14]. Globally there are over 18.1 million new cases of cancer with over 9.6 million deaths translating to over 13% of total deaths [4]. Some of the cancer cases may arise from diets containing carcinogenic compounds like ethylenethiourea. The residue of these fungicides is converted to ethylenethiourea (ETU) during storage. Foods cooked containing their residues decompose increasing levels of ethylenethiourea. In a study done, Thermal treatment of the dithiocarbamate maneb at 100 ºc showed conversion to Ethylenethiourea by 28 % while treatment at 121ºc resulted to a change of 32% [12]. Cleaning vegetables with water and other processing methods is known to affect the residue levels of pesticides. Studies of washing with chemicals like basic sodium hypochlorite (chlorine) have shown a reduction of the residues

of EBDCs and ETU considerably [8]. EBDCs such as mancozeb and propylenebis-dithiocarbamates (PBDCs) like propineb. Dithiocarbamates and the metabolites especially ethylenethiourea (ETU), have thyroid effect, are neurotoxic, mutagenic and teratogenic hence suspected to have carcinogenic effects on test animals and can enter through placental barrier hence affecting the unborn by increasing tumor development [17]. Dithiocarbamates in combination with nitrite arising from foliar application of nitrogenous fertilizers with nitrates is of health concern in that the nitrites formed by reduction in vegetables after cooking, in human saliva or in meats especially when cooked, can be converted to N-nitroso which may be a carcinogenic derivative. Such derivatives include N-nitrosodimethylamine (NDMA) and nitrosoethylenethiourea [3]. Mancozeb is also an example of cholinesterase inhibitors which affects the nervous system and also causes skin irritation) [14]. Mancozeb also causes spontaneous abortions in Rabbits at a dose of 80 mg/kg/day [13]. The main aim of the study was to investigate the effect of temperature and cleaning methods on the residue levels of mancozeb and the harmful metabolite ethylenethiourea in tomato.

MATERIALS AND METHODS

Sampling and Sample pre-treatment

Samples for temperature treatment and washing treatment were collected from the experimental gardens (Figure 1) sprayed with mancozeb by purposive sampling from all the plants one day after spraying in separate one kilogram samples. The samples were packed in a cold box then transported same day and stored in a deep freezer



Figure.1: Tomato at the experimental gardens

Cleaning of Glass apparatus

Glass ware was soaked for 10 hours using fresh hydrochloric acid, soaked in distilled and de-ionized water for 8 hours, rinsed with fresh distilled and de-ionized water then dried on a rack in an oven at temperatures of 100℃.

Chemicals and Reagents

All chemicals and reagents used in the study were analytical grade and above, they included,

- Analytical standard ethylenethiourea and mancozeb (purities; 98%,96.8%) respectively from Pestanal
- Acetonitrile, chloroform, dichloromethane and methanol HPLC grade ,from Chemoquip limited (Nairobi Kenya)
- sodium dodecyl sulphate, HPLC grade, Kobian Kenya limited (Nairobi Kenya)
- Water (distilled and deionized), HPLC grade.

Preparations of Standards and Mobile Phases

The stock solution of mancozeb standard was prepared by dissolving 10 mg in10 ml acetonitrile while ETU was made by dissolving 12.5 mg in 50 ml of acetonitrile and stored in a freezer. The mobile phases were,95% sodium dodecyl sulphate (SDS)+ 5% Acetonitrile made by adding 50 cm^3 of Acetonitrile to 950cm^3 of 0.1 molar sodium dodecyl sulphate, O.1 Molar SDS made by dissolving 57.676 Gram of sodium dodecyl sulfate per 2 liters of distilled water. Methanol and acetonitrile required no preparation.

Simulated cooking

A one-kilogram sample of tomato obtained from the plot sprayed with mancozeb was cut into small pieces with a knife and homogenized then divided into five equal portions of 200 grams. Each of the 200 gram portions was divided into two, 100 gram portions. From the first portion 3 small portions weighing 1.0 grams of the uncooked tomato were extracted and analyzed while the second portion of 100 grams were placed in a 250 ml round bottomed flask and connected to a vertical condenser. Heating using a mantle was done at 60 ℃ for 10 minutes followed by cooling. Extraction was done on one-gram sub samples in triplicate as shown in the extraction procedure. The procedure was repeated at different temperatures with intervals of 10 ℃ up to 100 ℃ . Solutions obtained were stored in amber colored vials in a deep freezer awaiting analysis. The study was done using three different samples.

Cleaning procedure

The study on the effect of different types of cleaning methods on residue levels involved use of three-kilogram tomato samples collected from the study garden sprayed with mancozeb. The sample was divided into three equal portions (1 kg each) for cleaning with distilled water, sodium hypochlorite solution and one to remain unclean. The first portion of tomato sprayed with mancozeb was cleaned by placing sample in a bowl containing five liters of distilled water for four minutes and rinsed twice. The sample was allowed to dry for one hour then cut into small pieces and homogenized. From the homogenized tomato six different one-gram sub samples were obtained and extracted according to the extraction procedure. The procedure was repeated with the second portion of tomato which was cleaned with five liters of a 1% sodium hypochlorite solution for 4 minutes and rinsed twice with two liters of distilled water. A third portion of tomato which was unclean was processed according to the extraction procedure. The procedures were repeated with six different samples.

Extraction procedure

The tomatoes were finely chopped using a knife. A 1.0-gram sub-sample was placed in a 50 milliliters beaker containing a volume of 3 milliliters of a mixture of acetonitrile, dichloromethane and chloroform in the ratio of 1:1:1. Extraction was achieved by 2 minutes of mechanical shaking. The suspension obtained was filtered through a filter paper in a Buchner funnel and rinsed with 2 ml of extractant followed by addition of 2 milliliters of methanol to filtrate. The mixture was then evaporated to dryness under a gentle stream of nitrogen gas at room temperature. Residues obtained were dissolved in 500 µl of a solution of acetonitrile and water in the ratio of 1:1. The solution was filtered through a Millipore 0.45 µm nylon syringe into sample vials then stored in a freezer before HPLC analysis [5].

Sample analysis using HPLC-DAD

The HPLC analysis was carried out at Jomo Kenyatta University of Agriculture and Technology, Department of Food Science and Technology using the instrument Shimadzu model LC-20A which had a Quaternary pump. The machine was connected to a computer with a software Shimadzu LC solution. The HPLC column used was NUCLEODUR Batch 34500033, which is a stainless steel analytical column packed with C-18 5µm particles and length 250 mm×4.6 mm internal diameter, obtained from Macherey Nagel Germany and supplied by Chemo quip Kenya limited. The mobile phases used were 95% sodium dodecyl sulphate (SDS) + 5% acetonitrile (pump A), 0.1 Molar SDS (Pump B), methanol (Pump C) and acetonitrile (Pump D).Other conditions include a flow rate of 0.9 ml/min and oven temperature of 40 ℃ . Quantification was by multiwavelength monitoring done with a band width of 4nm and absorbance spectra recorded from 200-400 nm. The elution program is shown on Table 1.

Table 1. The HPLC elution program

Time (min)	A %	B %	C %	D %
0	100	0	0	0
5	0	30	33	37
6	0	30	33	37
10	100	0	0	0

From Table 1, the 95% sodium dodecyl sulphate (SDS) + 5% acetonitrile started at 100 % decreasing steadily to 0 % and isocratic for a minute then increasing to a 100 % steadily, while the pumps B, C and D had followed a linear gradient to 30 % 0.1M SDS, 33 % methanol and 37 % ACN isocratic for a minute before decreasing steadily to 0%.

The detector end time was 10 minutes while the LC stop time was 15 minutes**.** The elution program has similarities with another study done on tomato for Maneb and ETU [5].

RESULTS AND DISCUSSIONS

The methods of analysis used were validated and discussed in this section together with chromatographic methods used and the results on the effect of temperature and cleaning on levels of mancozeb and ethylenethiourea in tomato are discussed in the following sections.

Method validation and recovery studies

The methods used in this study were validated by use of calibration curves for the different standards where regression equations, correlation coefficients and limits of detection were obtained. Recovery data, limit of blank and chromatogram separation data are also provided. The calibration curves for mancozeb and ethylenethiourea were obtained. The curve for ethylenethiourea (ETU) is shown in Figure 2.

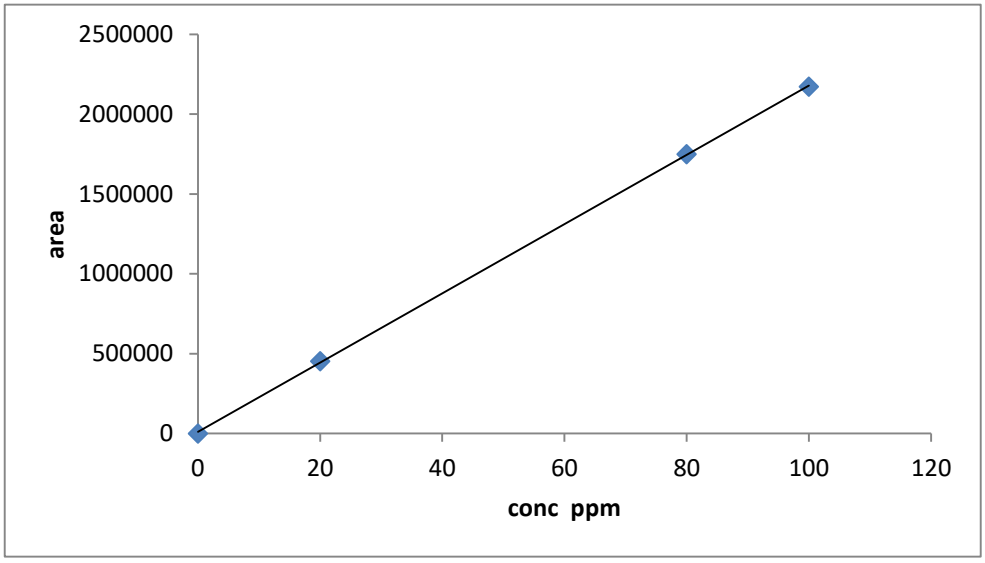


Figure 2: The standard curve for ethylenethiourea

The curve in Figure 2 shows a linear relationship within a range of different concentrations.
The regression equations and correlation coefficients for mancozeb and ETU are shown in Table 2.

Table 2: Calibration data and percentage recovery

Analyte	Reg.equation	R^2	LOD	LOB	% Recovery
Ethylenethiourea	Y=21706X+9159	0.999	0.0100	0.0085	95.89
Mancozeb	Y=2971X+5187	0.948	0.0990	0.0080	91.26

From Table 2, the R^2 values (0.948-0.999) correlates with other studies on same compounds [5, 6, and 9]. The correlation coefficients make the study appropriate for use in analysis of residue levels of dithiocarbamate fungicides and the metabolite The R^2 values indicate that the established calibration curves are linear over the respective range of concentrations, explaining that more than 94.8 % correlation between concentration and responses. Recovery studies were evaluated by recovery test, according to Equation 1 [2]

$$\% \textbf{ Recovery } = \frac{\mathbf{C_F - C_U}}{\mathbf{C_A}} \textbf{ x 100} \qquad \textbf{1}$$

Where $\boldsymbol{C_U}$ represents the concentration in unfortified sample; $\mathbf{C_A}$ is the concentration of fortification (spiking solution); $\boldsymbol{C_F}$ is the concentration determined in fortified sample after extraction. The % recoveries together with limits of detection (LOD) and limits of blank (LOB) are shown in Table 2. The percentage recovery lies within the range 91.26 % to 95.26 %. The recovery studies compare favourably with other studies where 94.15 % recovery for Maneb

and 96.46 % for ETU was achieved [6] which confirms the method fit for analysis of the above parameters. The limits of blank (LOB) and limits of detection (LOD) were calculated according to Equation 2 and 3[2].

$$\mathbf{LOB} = \mathbf{mean}\ \text{Blank} + 1.645\ (\text{SD blank}) \qquad 2$$

$$\mathbf{LOD} = \mathbf{LOB} + 1.645\ (\text{SD low concentration sample}) \qquad 3$$

The limits of blank ranged from 0.0085 mg/kg for ethylenethiourea (ETU) and 0.008 mg/kg for mancozeb while the limits of detection ranged from 0.01 mg/kg for ETU to 0.099 mg/kg for mancozeb. A study done on dithiocarbamates and the metabolites obtained the limit of detection (LOD) of 0.01 mg/kg for ETU and 0.1 mg/kg for maneb [1]. In another study done in Iran, the LOD of 0.1 mg/kg for mancozeb and propineb was attained, [9]. The values show that the method is robust for the analysis of the fungicides and the metabolite in vegetables studied, since results are consistent with other studies. The high pressure liquid chromatographic (HPLC) analysis of the two analyte of interest was done using a simultaneous analysis and peak identification. The retention time for ethylenethiourea (ETU) was 3.2±0.2 minutes while that of mancozeb was 8.7±0.2. The retention times achieved in this study are similar to other studies where; using a C18 column the retention time of ETU was 3.3 minutes, maneb was 4.1 minutes while that of mancozeb was 9.1 minutes [6]. Quantification was done by multiplying the amount obtained from the graph (using the regression equations for standard) with a dilution factor of 0.5 as shown in Equation 4.

$$\mathbf{Q}\left(\frac{\mathbf{mg}}{\mathbf{kg}}\right) = \left(\frac{\mathbf{P} - \mathbf{C}}{\mathbf{M}}\right) \times \mathbf{0.5} \qquad \mathbf{4}$$

Where Q (X) is the levels in mg/kg, P is the peak area (Y) from the table; C is the Y intercept while M is the gradient of the regression equation

Effect of temperature on ethylenethioure (ETU) and mancozeb residue in tomato

The results showing the effect of temperature on ETU and mancozeb residue in tomato are shown on Table 3 and discussed in this section.

Table 3 Effect of temperature on ETU and mancozeb residues in tomato

TEMPERATURE(℃)	**ETU** mg/kg ± SD **(**n=3)	**MANCOZEB** mg/kg ± SD (n=3)
25	9.43±0.03[a]	5.23±0.03
60	10.48±0.15[b]	BDL
70	11.57±0.09[c]	BDL
80	11.91±0.01[d]	BDL
90	12.43±0.38[e]	BDL
100	10.60±0.03[b]	BDL
P- value	0.003	

Mean values followed by the same small letter within the same column do not differ significantly from one another

From Table 3, on heating from 25℃ the residue levels of ETU in tomato increased from 9.43±0.03 to 12.43±0.38 at 90℃ and then decreased to 10.60±0.03mg/kg at 100℃ showing a conversion of 57.36 % of the initial mancozeb. On heating tomato from 25℃ to 60℃ levels of ETU rose from 9.43±0.03 mg/kg to 10.48±0.15 mg/ kg showing that some mancozeb was converted to ETU by 20.07% at that temperature.The results indicated a significant difference on comparing different temperature conditions.The ETU residues decrease at 100℃ due to decomposition of ETU at that temperature and there was also a complete decomposition of mancozeb to levels below detection limit from the initial 5.23±0.03 mg/kg at 25℃ when the tomato were heated to 60℃ .The results from this study compares favourably with other studies done such as [12] where it was found that there was no decline in ethylenethiourea recovery even on heating at high temperatures such as 90℃ even for upto 80 minutes however a conversion of dithiocarbamates to ethylenethiourea was as high as 32±1%. The results also compare with other studies which notes that mancozeb like other ethylenebisdithiocarbamates decomposes at cooking temperatures to very low levels while ETU levels rises[11].

Effect of cleaning on residue levels of mancozeb and ETU in tomato

The results showing cleaning effects are shown in Table 4 and discussed in this section.

Table 4 Effect of cleaning on residue levels of mancozeb and ETU in Tomato

CLEANING	MANCOZEB		ETU	
TREATMENT	mg/kg±SD (n=6)	% Reduction	mg/kg±SD (n=6)	% Reduction
UNCLEANED	5.23±0.02^{c}	0.0	46.71±0.71^{b}	0.0
WATER ONLY	4.37±0.06^{b}	16.3±0.64	0.27±0.08^{a}	99.4±000
CHLORINE	0.25±0.00^{a}	95.2±0.00	0.05±0.00^{b}	99.9±0.00
P-value	<0.001	-	<0.001	-

Mean values followed by the same small letter within the same column do not differ significantly from one another ($P< 0.001$, $\alpha=0.05$)

From Table 4, the levels of mancozeb residues in tomato decreased from a mean of 5.23±0.02 mg/kg in unclean tomato to 0.25±0.00 mg/kg in that cleaned with chlorine, removing a high amount of mancozeb totaling to 95.2±0.00 % while water cleaning reduced the residues to 4.37± 0.06 mg/kg translating to 16.3±0.64 % reduction. Ethylenethiourea (ETU) residues changed from a mean of 46.71±0.71 mg/kg in unclean tomato to 0.05±0.00 mg/kg in chlorine cleaned tomato which showed a reduction by 99.9±0.00%. Cleaning tomatoes with water reduced the mean residues of ETU to a mean of 0.27±0.08 mg/kg which indicated a reduction in residues by 99.4±0.00%. The results shows that cleaning with water and cleaning with detergent (chlorine) gave results which differed significantly for the two cleaning agents under study though the % removal of ETU was slightly higher than that of mancozeb most likely because ETU is more water soluble. The results indicate that chlorine wash reduced mancozeb and ETU residues on tomato more efficiently than water cleaning alone. The results from this study are further supported by other studies such as one done in Turkey where a reduction of the residues of mancozeb by 65 % on tomato was achieved with chlorine wash [15], while a reduction of 82 % of the residues of mancozeb on apples was achieved with chlorine wash [8]. Others include earlier work where water wash alone led to reduction of ETU residues on tomato by 70 % [11], while in another study washing tomato with 0.1 % sodium hypochlorite reduced residue levels of ETU by almost 100% [12]

CONCLUSIONS

The results of this study indicate that the residue levels of mancozeb and ETU in tomato are affected by cooking temperature with a detrimental consequence to consumers who should not just wash vegetables with water but use chlorinated water then rinse with boiled water to remove chlorine before consumption or processing. The Farmers, vendors and other value addition processors should wash the vegetables similarly with a recommendation for regular surveillance of residue levels at all levels and conditions in the consumer and processing chain.

Data Availability

The authors declare that the summarized data used to support the findings of this study are included within the article.

Conflict of Interest

The authors declare there are no conflicts of interest regarding the publication of this paper.

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HEALTHCARE PROVIDER PATIENT COMMUNICATION ENVIRONMENTAL CONTEXT ON DIABETES MELLITUS MANAGEMENT PRACTICES IN SELECTED HOSPITALS IN KENYA

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ABSTRACT
The purpose for this study was to investigate the effect of healthcare provider patient communication environmental context during interaction on diabetes mellitus management practices in selected hospitals Kenya.This was a causal comparative research study with application of quantitative methodology. The study was carried out at the outpatient diabetic clinics of Kenyatta National Hospital and MP. Shah Hospital. Systematic random sampling was used to sample the patients. A researcher administered questionnaire was used to collect data. The results were summarized using percentages and means or medians for categorical and continuous data respectively. Comparisons were done using chi square test of association for categorical variables and independent t-test for comparison of means. Linear regression and ANOVA were used to test for associations and hypothesis between healthcare provider patient environmental context and diabetes mellitus management practices. It was found that 400 patient participants were involved in the study and comprised of 313 patients at Kenyatta National Hospital (KNH) and 87 patients at MP Shah respectively studied between the months of February 2019 and November 2019. The rating of environmental context (EC) was not significantly different between MP Shah Hospital and KNH, p=0.123. However, environmental context had positively significant effect on diabetes mellitus management practices [β=0.45, (95% CI 0.35, 0.56), p<0.001] overall in Kenya; at Kenyatta National Hospital [β=0.50, (95% CI 0.39, 0.61), p<0.001] and MP Shah Hospital [β=0.45, (95% CI 0.27, 0.63), p<0.001]. The null hypothesis was rejected overall in Kenya; at KNH and MP Shah Hospital. Therefore, there was significant effect of environmental context on diabetes mellitus management practices in selected hospitals Kenya. Thus, environmental context had favourable impact and brought about improved DMMPs among patients whether in public or private hospitals. This means environmental context was conducive and hospitable to the patients in the course of care they received all along at these hospitals.This study demonstrated that environmental context is critical in enhancing diabetes mellitus management practices among patients. Therefore, there is need to evaluate environmental context and its various components to realize better communication, hence enhanced improvement on the management of diabetes mellitus. In addition, introduce healthcare provider patient communication environmental context in the medical education curriculum to be part and parcel in training institutions as a necessary requirement in medical practice; develop a standard healthcare provider patient communication environmental context model and with guidelines on its observance by healthcare stakeholders in provision of healthcare services.
Keywords Healthcare provider patient communication, Environmental context, Diabetes mellitus Management Practices, Patients, Healthcare providers.

INTRODUCTION

The context of communication is important in determining the amount of accuracy needed or possible between people in a given situation. How much clarity can be achieved is somewhat determined by their communication skills, the nature of their relationship, the number of communication channels available to the person sending, and how much repetition can be incorporated into the message. It is important, however, that whenever multichannel communication occurs, the messages are consistent across all channels or the results will be confusing for the listener (Pfeiffer, 1973). In the late 19th century, Florence Nightingale suggested that patients would recover more quickly if they were cared for in an environment that had natural light, ventilation, cleanliness and basic sanitation (Salonen & Morawska, 2013).

There are many environmental factors that influence communication between patients and their healthcare providers (O'Halloran, Worrall & Hickson, 2010). A study by the Picker Institute Europe revealed among the quality aspects, attention to physical and environmental needs (Kieft, de Brouwer, Francke and Delnoij, 2014). The language of the clinic allows access to the inner workings of the body but doesn't see beyond the body to patients' social worlds. Without attention to patients' contexts, providers may not know what type of support or assistance they need (Kruse, 2013). Communication problems may be exacerbated by the health care environment, in which physicians have little time for providing information or explanations (Ngo-Metzger, 2006).

Communication always takes place within a context: an environment that influences the form and the content of communication. The context of communication has at least four dimensions (DeVito, 2013): Physical dimension, the

room, workplace, or outdoor space in which communication takes place, the tangible or concrete environment, is the physical dimension. When you communicate with someone face to face, you're both in essentially the same physical environment; Social–psychological dimension, this includes, for example, the status relationships among the participants: The formality or informality, the friendliness or hostility, the cooperativeness or competitiveness of the interaction are also part of the social–psychological dimension; Temporal or time dimension, this dimension has to do with where a particular message fits into a sequence of communication events; Cultural dimension, the cultural dimension consists of the rules, norms, beliefs, and attitudes of the people communicating that are passed from one generation to another.

Physical environment working conditions include direct physical characteristics such as light, aesthetics, noise, air quality, toxic exposures, temperature, and humidity. This category also includes basic workplace design features, such as obstacles, physical layout, and distance from nursing stations (Hickam, Severance & Feldstein, 2003). The design of the physical environment clearly impacts patient confidentiality and speech privacy in healthcare settings even though few studies have focused on the role of unit design or architecture (Joseph & Ulrich, 2007). The environment alone may create conditions under which communication cannot take place effectively. A stuffy, warm room may make it impossible to send and receive messages accurately. A person's physical state may also be detrimental to communication (Pfeiffer, 1973). Previous research identified high levels of background noise and the lack of written information in accessible formats as creating barriers to communication for patients with hearing and vision impairments, respectively. One way to improve a person's ability to communicate is by providing a supportive communicative environment (O'Halloran, Worrall & Hickson, 2010).

Clinical environments designed for patient and clinician interaction should be designed to facilitate positive nonverbal interactions such as eye contact and social touch (Montague et al, 2013). Poorly designed environments can result in private conversations between patients and staff or between staff members being overheard by unintended listeners, resulting in unacceptable breaches of confidentiality. There is a definite need for additional studies to examine the impact of different types of room and unit layout and finishes on privacy and confidentiality breaches in patient rooms, unit hallways, nursing stations, reception areas, and waiting rooms in healthcare settings (Joseph & Ulrich, 2007).

A key element is the need for a peaceful environment with no external distractions, which will ensure appropriate confidentiality of the dialogue. Frequently seen is the phenomenon of serious discussions taking place in the middle of the corridor of the outpatient department or the nursing department, clinic, or in some office of the hospital, in which third parties unrelated to the care of the individual patient are coming in and out. In such an environment the patients are ashamed to express themselves freely. Even more than the comfort of space, communication with the patient requires ample time. Where there is a need for a separate and private discussion with someone from the patient's environment, we should be very careful of the place, manner and time of this communication, which should be independent of the discussion with the patient (Kourkouta & Papathanasiou, 2014).

The most obvious "cultural" barrier in a clinical and educational encounter is the inability to communicate in the same language. It may limit the patient's ability to ask questions, to verbalize important information and concerns, and to establish a natural and spontaneous relationship with the health care provider. Improving health care providers' cultural competence may help improve the quality of care provided to minority groups and may ultimately reduce health care disparities. Increased cultural competence may also improve patient provider trust and communication, as well as help patients adhere to prevention and treatment plans. Although no randomized clinical trial has been conducted to demonstrate that DM control and/or complications are improved by a group of health care providers with higher cultural competence compared with a group with a lower level, it appears clear that cultural competence can lead to a much more pleasant and productive health care provider patient interaction. In the field of DM, it may be particularly relevant because disease control is greatly determined by effective lifestyle and behavior modification, changes that are more likely to be implemented if the patient has developed a good rapport with health care provider (Caballero, 2007).

Objective: To investigate the effect of healthcare provider patient communication environmental context during interaction on diabetes mellitus management practices in selected hospitals Kenya.

Hypothesis: There is no significant effect of environmental context during healthcare provider patient interaction on diabetes mellitus management practices in selected hospitals in Kenya

Statement of the Problem

The communication process among patients, nurses and other health workers is still not considered to be very effective as difficulties are observed in clinical practice between professionals and patients, which strongly affect satisfaction, treatment adherence, and, consequently health outcomes (Damasceno et al, 2012). Physcians have grown used to

giving orders to diabetes patients without necessarily realizing the extra burden those orders place on the person with diabetes (Alzaid, 2014). Nurse communication plays a pivotal role in supporting patient health, unfortunately, less than 20% of T2DM patient reach all three targets for blood glucose (HbA1C), lipids levels, and blood pressure (Mulder et al, 2014).

The quality of the nurses' consultations is sub-optimal in about 75% of 85% consultations regarding aspects of consultation environment, care and information (Abdulhadi et al, 2006). Medical encounters are characterized by more of physicians' dominance and less of attention to the patients' concerns, expectations and role in their own diabetes management and self-monitoring (Abdulhadi et al, 2007). DM requires a complex assortment of time-sensitive communications activity and interventions to avert serious complications and the dominant unidirectional clinician-biased forms of communication employed by healthcare professionals were a major barrier (Forbes, Sidhu & Singh, 2011) and as many as 50% of patients leave the hospital visit not knowing what they are supposed to do to take care of themselves (Heisler et al, 2002).

Effective physician communication is significantly positively correlated with patient adherence and there is a 19% higher risk of nonadherence among patients whose physician communicates poorly than among patients whose physician communicates well (Zolnierek & DiMatteo, 2009). Despite the appropriate diabetic management practices, patients are noted to move from one healthcre provider to another or change facility with the belief that they will be be served better elsewhere. Again, diabetic patients in Africa have reported that the major concern in patient care is the lack of follow up (Azevedo & Alla, 2008). Though communication always takes place in healthcare provider patient encounters, its quality and effectiveness is of significance in regard to the desired health outcomes, as poor communication can negatively influence DM management(Campos, 2006). Often, providers are unaware of the communication needs of patients and do not tailor communication styles to fit patients' needs (Ngo-Metzger, 2006).

In spite of the great strides that have been made in the treatment of diabetes in recent years, many patients do not achieve optimal outcomes and still experience devastating complications that result in a decreased length and quality of life (Funnell & Anderson, 2004). Less than half of persons with diabetes meet the recommended levels of HbA1c, blood pressure and lipid control. Additionally, poorly managed diabetes is associated with serious complications including stroke, blindness, heart disease, kidney disease, nerve damage, amputations, and death (Alhodaib & Hala, 2014). The above studies show evidence that healthcare provider patient communication's place in the management of diabetes is critical. It is therefore important to examine the effect of healthcare provider patient communication on diabetes mellitus management practices in Kenya to understand how communication is used during the interaction between the healthcare provider and the patient as a tool to improve diabetes mellitus management practices.

LITERATURE REVIEW

A cross-sectional, explorative study of on-going practice in diabetes care noted that the performance of the primary health-care doctors and diabetes nurses needs to be improved. Improving the work situation mainly for the diabetes nurses and further improvement in the organizational efficiency of diabetes services such as lowering the number of patients in diabetes clinic, were suggested. Research methodology included patient interviews, focus group discussions with patients and providers, and the collection of metabolic parameters in Muscat region, Oman, by direct observations of 90 consultations between 23 doctors and 13 diabetes nurses concerned with diabetes management during their consultations with type 2 diabetes patients in six primary health-care centres, using checklists developed from the National Diabetes Guidelines. The consultations were recorded using audiotapes for corroboration of some of the verbal communication aspects of the observations. Consultations were assessed as optimal if more than 75% of observed aspects were fulfilled and sub-optimal if less than 50% were fulfilled. Overall 52% of the doctors' consultations were not optimal. Some important aspects for a positive consultation environment were fulfilled in only about half of the doctors' consultations: ensuring privacy of consultation (49%), eye contact (49%), good attention (52%), encouraging asking questions (47%), and emphasizing on the patients' understanding of the provided information (52%). The doctors enquired about adverse effects of anti-diabetes drugs in less than 10% of consultations.

The quality of the nurses' consultations was sub-optimal in about 75% of 85 consultations regarding aspects of consultation environment, care and information (Abdulhadi et al, 2006). Overall slightly more than half of the interactions between doctors and type 2 diabetes patients were not optimal, and that three out of four consultations with nurses were suboptimal. It has been suggested that good communication inevitably takes more time that can be compressed only at the cost of the quality of care. A good consultation and patient-doctor communication demand uninterrupted privacy and undivided attention to the patient. Encouraging the patient to ask questions allows the patient's point of view to guide the conversation which has been shown to be positively associated with health outcomes. The overall performance of the diabetes nurses in this study was sub-optimal. The reasons could partly be that in the studied health centres the diabetes nurses either shared the room with the doctors in three health centres or counselled the patients in the nurses' offices. Interruptions by other nurses and patients occurred in both situations, but

were more common in the nurses' offices than in the doctors' offices. Focusing on the health care providers' behaviours was considered as an important factor in the process of communication and care at the preliminary stage of the study would provide us with more information about an unknown situation in Oman. However, it has been argued that physicians appeared to make minimal efforts to foster patient involvement and autonomy that induce self-efficacy. Doctors' communication skills, hostility during interaction and training of health-care providers regarding interactions with patients and patient-centred care have been identified as crucial for effective health outcomes. The results can provide a basis for further studies concerning diabetes care at the primary care level in Oman and countries with similar health systems. The results can also be used as a material for educational interventions (Abdulhadi et al, 2006).

In a study that examined provider-level factors and reported discrimination in the healthcare setting where data analyzed patient-reported racial/ ethnic discrimination from providers, the primary exposures were characteristics of the primary care provider, including specialty/type, and patient provider relationship variables, including racial concordance. Patients seeing nurse practitioners as their primary care providers (PCP) and those rating their provider higher on communication were less likely to report discrimination, while those with more visits were more likely to report discrimination. Among diverse diabetes patients in managed care, provider type and communication were significantly related to patient-reported discrimination. Given potential negative impacts on patient satisfaction and treatment decisions, future studies should investigate which interpersonal aspects of the provider patient relationship reduce patient perceptions of unfair treatment. The study suggests that racial similarity between patients and their PCPs did not eliminate patient perceptions of racial/ethnic healthcare discrimination among diabetes patients within an integrated delivery system. More primary care visits, but not PCP gender or specialty, were also associated with patient reported discrimination. Data was analyzed from the Diabetes Study of Northern California (DISTANCE), a race-stratified, random sample of patients from the Kaiser Permanente Northern California Diabetes Registry. Because of the race-stratified survey design, DISTANCE had diverse patient representation across the largest racial/ethnic groups in Kaiser. The PCP of each survey respondent was identified in the year preceding the survey. The study captured the PCP information (age, gender, race/ethnicity) from administrative databases. Almost every patient is assigned to a PCP within Kaiser System, with only 0.2% of respondents having no identifiable PCP (Lyles et al, 2012).

A study result noted the importance of communication during the medical encounter, as provider communication scores were strongly associated with how patients perceived and ultimately reported racial/ethnic discrimination from healthcare providers. Improvement in the interpersonal aspects of the provider patient relationship are likely more critical among individuals with chronic diseases who have more intensive interactions with their provider to manage their illness. Furthermore, as racial/ethnic minority diabetes patients may face unique barriers to shared decision-making with their providers, additional provider training and/or education on interpersonal aspects of care may be influential in reducing patient perceptions of unfair treatment in the healthcare setting. This training would not be limited to cultural competency or diversity education, which is already a mandatory component of medical education for many healthcare settings, but more broadly focused on communications skills and patient-centered care. Qualitative research would be informative for understanding when and how patients perceive unfair treatment from providers, including the influence of provider type or race/ ethnicity, as these patient reports of discrimination could represent particularly negative experiences that would impact healthcare treatment (Lyles et al, 2012)

A cross-sectional survey study found that African Americans, Spanish-speakers, and less-educated patients reported patient provider communication that was as good as or better than that reported by less-vulnerable patients. Both general and diabetes-specific dimensions of communication were associated with self-care behaviors. Findings support the traditional advice to physicians to “treat the whole patient, not just their disease,” insofar as success across both dimensions of communication was associated with better self-care in a variety of critical areas. Providers in the study sites were communicating successfully with vulnerable patients. Seven hundred fifty-two diabetes patients were enrolled. Fifty-two percent were nonwhite, 18% had less than a high-school education, and 8% were primarily Spanish-speaking. Patients' assessments of providers' general and diabetes-specific communication were measured using validated scales. Self-reported foot care; and adherence to hypoglycemic medications, dietary recommendations, and exercise were measured using standard items. General and diabetes-specific communication reports were only moderately correlated and had differing predictors. In multivariate probit analyses, both dimensions of communication were independently associated with self-care in each of the 4 areas examined. Sociodemographically vulnerable patients reported communication that was as good as or better than that reported by other patients. Patients receiving most of their diabetes care from their primary provider and patients with a longer primary care relationship reported better general communication (Piette et al, 2003). Diabetes self-care behavior is notoriously difficult to measure, and self-report data may reflect both biases as well as random errors.

Patients who are more adherent with their self-care plans may be more likely to recall conversations regarding their diabetes self-care. Also, it is well known that patients tend to over-report their adherence to self-care activities. This over-reporting may differ across sociodemographic groups or may be more common among patients who receive more

intensive counseling regarding these issues. In the study, survey questions regarding patients' self-care behaviors, general communication, and diabetes-specific communication were asked at different points in the interview in order to minimize the likelihood of socially desirable responses. Both general communication processes and diabetes-specific communication were independently associated with patients' self-care, even when controlling for multiple indicators of patients' sociodemographic characteristics, health status, and other characteristics of their health care context. This finding should provide further support for including provider training in communication as a legitimate and important component of medical education and bolster efforts to develop novel strategies for increasing patients' access to effective diabetes education. Nevertheless, analyses of the relationship between communication and self-care should be interpreted with several caveats in mind. (Piette et al, 2003).

A study in Australia where the communications support model utilized the mapping of ontologies, a community Healthcare ontology dedicated to mapping a clinical taxonomy for T2DM national guidelines to Aboriginal English (AE) ontology where the knowledge representation outcome was achieved through formal semantics and syntax applications using the Web Ontology Language (OWL), showed evidence that patient-practitioner interactions was falling short due to a cultural disconnect leading to misunderstandings between clinicians and their Aboriginal patients. Since the management of the Type 2 Diabetes Mellitus (T2DM) requires a complex assortment of time-sensitive communications activity and interventions to avert serious complications, communications barriers arising from pervasive cultural misunderstanding in primary care go far beyond language differences and routine translation techniques. Practitioners and patients lacking the ability to share understanding in the examination and testing discourse need a culturally sensitive purpose-driven informatics system of support for the Patient-Practitioner Interview Encounter (PPIE). The dominant unidirectional clinician-biased forms of communication employed by healthcare professionals are a major barrier (Forbes, Sidhu & Singh, 2011).

The demands of self-management compete with a multitude of other demands of daily life. Despite knowing the importance of maintaining a healthy diet and regular exercise, patients generally find these to be the most difficult areas of self-management. A number of participants were caregivers for family members, making it more difficult to focus on their own self-care needs. Others engaged in lengthy problem-solving with their providers about specific barriers such as work schedules. Patients and providers may disagree on the relative importance of barriers. Dietitians placed more importance on portion control, while patients considered food selection and having to eat differently than others as bigger barriers. Helping patients' deal with their self-care in a social context is an important strategy, an invaluable component of diabetes management, and a skill that physicians would do well to master. Analysis of the interactions points to "parallel play" in which providers and patients articulate what is essentially the same problem in different ways (Kruse et al, 2013).

THEORETICAL FRAMEWORK

The theoretical premise of this study resided in uncertainty reduction theory and communication accommodation theory. Healthcare provider patient encounter is interpersonal communication and therefore familiarity with theories of interpersonal communication may reinforce existing best practices and lead to the development of novel communication approaches with patients (Bylund, Peterson, & Cameron, 2012). Uncertainty reduction theory (URT) generally concentrates on the reduction of the high level of cognitive uncertainty. It also distinguishes between a predictive component and an explanatory component (Berger & Calabrese, 1975). Communication accommodation theory (CAT) explores the various reasons why individuals emphasize or minimize the social differences between themselves and their interlocutors through verbal and nonverbal communication (Gregory Jr. & Webster, 1996). There are two main accommodation processes described by this theory; convergence that refers to the strategies through which individuals adapt to each other's communicative behaviors, in order to reduce these social differences and divergence that refers to the instances in which individuals accentuate the speech and nonverbal differences between themselves and their interlocutors (Gregory Jr. & Webster, 1996). Acts of convergence and divergence influence the patient-physician relationship, because converging statements signify a desire to gain approval, affiliate, establish rapport, and communicate meaning effectively, whereas diverging statements aim to separate, exert control, and generally downplay the statements of the partner (Haidet, 2007).

METHODOLOGY

Study population

The target population comprised of all persons with diabetes mellitus. The accessible population involved both the female and male patients with diabetes mellitus aged 18 years and over who had been attending Kenyatta National Hospital (KNH) and MP Shah Hospital outpatient diabetic clinics for twelve (12) month and over and healthcare providers attending to patients with diabetes mellitus at KNH and MP Shah Hospital outpatient diabetic clinics. The register for diabetes mellitus patients who attended the diabetic clinics at KNH and MP Shah Hospital was used to help in sampling. Systematic random sampling was used to sample the patients. The sample was from the total number

of patients that made up the clinic attendance register for the given period of sampling. Kenyatta National Hospital was allocated 313 and MP Shah Hospital 87 and all to make the total of 400 respondents.

Sampling Frame

The patient register for diabetes mellitus patients who attended the diabetic clinics at Kenyatta national hospital and MP Shah Hospital was used. The sampling frame is as depicted in Table 1 below.

Table 1: Healthcare providers / patients at diabetes mellitus clinics, Kenyatta National & MP Shah Hospitals

	KNH	MP SHAH HOSPITAL	TOTAL
PATIENTS	313	87	**400**

Source: Kenyatta National Hospital/ MP Shah Hospital Diabetic Clinics

Sample and Sampling Technique

Sample

The sample size was determined according to Fisher et al (1999) formulae:

(i) $n = \frac{Z^2 p q}{d^2}$

Since there were no estimates available of the proportion in the target population assumed to have the characteristic of interest, 50% was used as recommended by fisher et al, 1999. Therefore, since the target population with the characteristic is 0.50, the z-statistic is 1.96, and the desired accuracy is at the 0.05 level, the sample size would be:

If, Z – 1.96 P – 0.50 q - 0.50 d – 0.05

Then, $n = \frac{(1.96)2\ (0.050)\ (0.50)}{(0.05)2}$

n= 384

Given that a study on communication was done at Moi Referral and Teaching Hospital (MTRH), Eldoret, to describe perceived physician communication behaviors and its association with adherence to care among HIV patients in Kenya, whereby a convenient sample of 400 HIV adult patients, attending three Academic Model Providing Healthcare program (AMPATH) clinics in Eldoret, Kenya was surveyed between July and August 2011(Wachira et al, 2014), the present study did in regard to the calculated sample size above and to cater for any drop outs peg its sample to 400 patient participants.

Sample technique

This was by systematic random sampling, whereby the patients were picked as follows. The sample was from the total number of patients that made up the clinic attendance register for the given period of sampling and from this as per required sample size, the total number of patients was divided by the calculated sample size and hence every n^{th} Patient would then be sampled to make up the sample. The accessible population who were all the patients attending the outpatient diabetic clinic at K.N.H in a year was approximately 3726 (main clinic, done on Fridays only) and 5797(mini clinic, that runs on a daily basis). These were patient consultations as patients seen in the main clinic can end up being seen in the minor clinic on any other day of the week throughout the year. Therefore, there is repetition at the minor clinic. As such the figure of the main clinic (3726), as advised by the Kenyatta diabetes clinic was used as the accessible population from whom the participants were sampled. These figures were according to diabetic clinic attendance of January to December 2015. Too, all patients, approximately 2954 attending the MP Shah Hospital's diabetic clinic, which operates on a daily basis from Monday to Friday, formed part of the accessible population.

This figure was in regard to the diabetic clinic attendance of the year July 2017/ June 2018 whereby there were 1030 new patients and 1924 revisits. Therefore, the figure of new patients (1030) was used since this same patients did come back to be seen as revisits. To avoid double recruitment, the patient registration numbers were referred to throughout the whole research study exercise. To get the sampling interval, the accessible population of approximately 3726 (main clinic, KNH) and 1030 (MP Shah Hospital) was used, whereby each was divided by allocated proportionate samples of 313 patients' (KNH) and 87 patients' (MP Shah Hospital) of the total 400 to yield a sampling interval of 11.90415335 for KNH and11.83908046 for MP Shah Hospital, approximated to 12 respectively. Hence, every 12^{th} participant at every research centre was sampled to make up the sample size and was done till the total sample size was achieved.

As advised by the diabetic clinics to use the main (new patients) clinics attendance visits in the year, the rationale for the distribution of the respondents between KNH and MP Shah Hospital was in regard to the new visits in the year depicted by the main clinic attendance (new visits in the year) of 3726 at KNH and 1030 as new patients but actually being the first visit in the year at the clinic in MP Shah Hospital. The total volume of patients seen at both clinics, viz, 5797(KNH) and 2954(MP Shah Hospital) included both the new patients and the re-attendances. As such the new visits numbers was used to calculate the respective allocations of the sample size to each study area as follows. Since the total number of the main clinic (new) attendance for both study areas is 3726 + 1030= 4756 in a year which corresponded to the sample of 400 participants; to get the proportionate sample for each of the study area, the computations below was of essence:

Thus,
If, 4756 patients corresponded to 400 participants
Then, 3726(KNH) would correspond to; 3726 multiplied by 400 divided by 4756 = 313.372582 rounded off to 313, and 1030 (MP Shah Hospital) would correspond to 1030 multiplied by 400 divide by 4756 =86.627418 rounded off to 87. Therefore, KNH would be allocated 313 and MP Shah Hospital 87 and all to make the total of 400 respondents.

Data collection Instrument
To collect data, a researcher administered questionnaire for patients was used**.** It did seek information on their sociodemographic data, clinical characteristics, healthcare provider patient communication and diabetes mellitus management practices.

Research Design
This was a causal comparative research design study, with application of quantitative methodology. Quantitative methods emphasize objective measurements and the statistical, mathematical, or numerical analysis of data collected through polls, questionnaires, and surveys, or by manipulating pre-existing statistical data using computational techniques and focuses on gathering numerical data and generalizing it across groups of people or to explain a particular phenomenon (Babbie, 2010; Muijs, 2010).Causal comparative method is an ex post facto research design that seeks to find relationships between independent and dependent variables after an action or event has already occurred, by comparing two or more groups of individuals (Salkind, 2010). Ex post facto research is a method that can also be used instead of an experiment, to test hypotheses about cause and effect in situations where it is unethical to control or manipulate the dependent variable (Cohen, Manion & Morrison, 2007).

The design seeks to establish causal relationships between events and circumstances, to find out the cause of certain occurrences or non-occurrences. This is achieved by comparing the circumstances associated with observed effects and by noting the factors present in the instances where a given effect occurs and where it does not occur. Attempts are made to explain the consequences based on the antecedent conditions; determine the influence of a variable on another, and test a claim using statistical hypothesis testing techniques (Lord, 1973). Researchers can report only what has happened or what is happening, by trying to hold factors constant by careful attention to the sampling. The relationship between the independent variable and dependent variable is usually a suggested relationship because the researcher does not have complete control over the independent variable. As in the current study, the independent variable, healthcare provider patient communication had already occurred and its effect on the dependent variable, diabetes management practices had already taken place in the sample groups being studied. The groups though in healthcare settings differ by belonging either to a public or private healthcare setting; hence such circumstances could bear varying effects on them in regard to the study outcome.

Data Collection Procedure
The study was carried out at two sites; Kenyatta National Hospital, a public hospital and MP Shah Hospital, a private hospital. Data from these two sites was collected separately. At KNH, the researcher would visit on Fridays of every week when the main clinic is conducted to collect data. But since the registers and patient files are prepared a day prior to the actual clinic day, the researcher would visit the clinic a day prior, that is on Thursdays of every week to sample the participants to be recruited into the study as the clinic registers for patients were used for the purpose. At MP Shah Hospital, the researcher would visit the clinic daily from Monday to Thursday as clinic days are conducted daily from Monday to Friday. The recruitment of participants was done a week prior to the next week or the day prior to the next day at MP Shah Hospital, since according to the clinic, the registers and patient files are prepared a week/day prior, though booking of the patients for the specific clinic days would have been done at the previous clinic visit when they were attended to. Two research assistants were involved, with one of them coming daily from Monday to Friday and the other joining in on Thursdays and Fridays because of the MP Shah Hospital clinic on Friday since the clinic at KNH was conducted on the same day. Since the researcher had two research assistants, they would assist in the recruitment of the participants by visiting the sites together with the researcher except on Fridays when one research assistant would visit MP Shah Hospital to identify and physically recruit the participants by talking to them

and agree with them on when they could meet the researcher to be taken through data collection within the next week. This process would be done by the researcher and his assistants helped by the staff at the clinic. The assistants and the staff did undergo some training in regard to the study requirements. Once identified and recruited, consent was sought from the participants.

To ensure that there was no double participant recruitment, the clinic attendance registers and patient record files were used and the outpatient registration numbers of patients were noted throughout the sampling and data collection. Since the clinics began at 8a.m and ended at 5p.m; and since the registers were used to identify the participants, recruitment began immediately the patients arrived and as they waited to be attended to by the healthcare providers, and if they had already been attended to, they would continue with the process, though they would also be allowed to collect the prescribed drugs or go for any tests or investigations or medical procedures requested for by the healthcare providers. The data collection instruments and data collected for KNH and MP Shah Hospital was kept separately.

Consenting was done by the researcher, by first explaining to the participant about the nature of the research and why it is being done by taking them through the consent explanation form contents and any questions raised would be answered. The selection process of the participant would be explained to him or her so that he/she understood as to why he/she had been selected. Once this was done and he or she agreed to participate, the informed consent form would be provided to the participant to sign in the presence of the researcher and once signed he/she was recruited into the study. Those who declined to participate were not recruited into the study. Data collection would then commence afterwards. In all this the researcher was assisted by his research assistants. Data collection was done by the researcher only and this upon the participant consenting. The participants would be taken through the questionnaires. This took about 30 to 45 minutes to complete the questionnaire. Once data had been collected, the participant would be informed of the end of the exercise and how the information they had given was useful in the study. The researcher would thank the participant for agreeing and participating in the study. They would be informed of the confidentiality of their participation, the information they had given and the safe keeping of the research instrument. Once data had been collected, it was kept safely in a locker only accessible to the researcher.

Data Analysis

Statistical analysis was then done after data was posted by a computer data base developed using statistical package for social sciences (SPSS) in version 23.0. The results were presented in descriptive and inferential form. Patient characteristics were summarized using percentages and means or medians for categorical and continuous data respectively. Comparisons were done between private and public hospital patients using chi square test of association for categorical variables and independent t-test for comparison of means. Healthcare provider patient communication rating were scored and calculated as overall mean scores for nonverbal communicative behaviour. Healthcare provider patient communication rating between the hospitals was compared using independent t test. Similarly, diabetes mellitus management practices scores were summarized into means and compared between the two hospitals. Linear regression (simple linear regression and multiple linear regression model 1) as follows was used to test the relationship between healthcare provider patient communication ratings and diabetes management practices scores. Test of significance was done at a significant level of 0.05 at 95% confidence interval to test hypotheses.

Simple linear regression

This was by the following formula:

$$\boldsymbol{y = \beta_0 + \beta_1 x_1}$$

Where,

y – The dependent variable – diabetes mellitus management practices score

x – Independent variable (nonverbal communicative behaviour score)

Multiple linear regression model 1

The regression model was developed using the following formula:

$$\boldsymbol{y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4}$$

Where:

y – The dependent variable – diabetes mellitus management practices score

x – Independent variables 1, 2, 3 and 4 (verbal language score, nonverbal communicative behaviour score, noise score and environmental context score)

RESULTS

Response Rate

Table 2: Distribution of Study Participants (Patients at Diabetes Mellitus Clinics, Kenyatta National/ MP Shah Hospitals)

	Kenyatta National Hospital			MP Shah Hospital			Total		
	Target	Actual	Response rate (%)	Target	Actual	Response rate (%)	Target	Actual	Response rate (%)
Patients No.	313	313	**100**	87	87	**100**	400	400	**100**

Source: Field Data (2019)

A total of 400 participants, patients with diabetes mellitus aged 18 years and above at the diabetes and endocrinology Centre's of both Kenyatta National Hospital and MP Shah Hospital were involved in the study as is depicted in table 2. 313 patients at KNH and 87 patients at MP Shah respectively were studied between the months of February 2019 and November 2019. Overall, there were 166 (41.5%) male and 234(58.5%) female patients. A response rate of 100% was achieved overall as well as at KNH and MP Shah Hospital. 400 questionnaires were sufficiently completed. This high response rate at both study centers was achieved as a result of the researcher being involved at every stage of data collection from the time of issuing to collection of the questionnaires.

Socio Demographic Characteristics

Table 3: Socio demographic characteristics of patients at Kenyatta National Hospital

Variable	Overall (n=313) n (%)	Male (n=123) n %	Female (n=190) n %	P value
Gender		-	-	-
Male	123 (39.3)			
Female	190 (60.7)			
Age				
Mean (SD)	59.3 (14.0)	61.2 (14.4)	58.1 (13.7)	0.053
Min – Max	18 – 92	22-92	18-86	
Age groups				
18-27	6 (1.9)	4 (3.3)	2 (1.1)	**0.047**
28-37	12 (3.8)	2 (1.6)	10 (5.3)	
38-47	41 (13.1)	9 (7.3)	32 (16.8)	
48-57	71 (22.7)	29 (23.6)	42 (22.1)	
58-67	83 (26.5)	35 (28.5)	48 (25.3)	
>67	100 (31.9)	44 (35.8)	56 (29.5)	
Marital status				
Single	36 (11.5)	8 (6.5)	28 (14.7)	**< 0.001**
Married	228 (72.8)	113 (91.9)	115 (60.5)	
Separated	3 (1.0)	0	3 (1.6)	
Divorced	3 (1.0)	0	3 (1.6)	
Widowed	43 (13.7)	2 (1.6)	41 (21.6)	
Highest level of education	22 (7.0)	5 (4.1)	17 (8.9)	**0.010**
None	116 (37.1)	37 (30.1)	79 (41.6)	
Primary	116 (37.1)	55 (44.7)	61 (32.1)	
Secondary	40 (12.8)	14 (11.4)	26 (13.7)	
College/University	19 (6.1)	12 (9.8)	7 (3.7)	
Occupation				
Professional	76 (24.5)	34 (27.6)	42 (22.5)	**< 0.001**
Business personnel	118 (38.0)	44 (39.9)	75 (39.6)	
Technical personnel	19 (6.1)	15 (12.2)	4 (2.1)	
Skilled personnel	38 (12.3)	24 (19.5)	14 (7.5)	
Unskilled personnel	55 (17.7)	6 (4.9)	49 (26.2)	
Learner	4 (1.3)	0	4 (2.1)	
Religion				
Catholic	100 (31.9)	41 (33.3)	59 (31.1)	0.581
Protestant	201 (64.2)	79 (64.2)	122 (64.2)	
Muslim	5 (1.6)	2 (1.6)	3 (1.6)	
Other	7 (2.2)	1 (0.8)	6 (3.2)	

Source: Field Data (2019)

As in Table 3, three hundred and thirteen (313) diabetic patients with a mean age of 59.3 years (SD 14 years) were studied at KNH. There were 190 (60.7%) females with a mean age of 58.1years (SD13.7) and 123(39.3%) males with a mean age of 61.2 years (SD14.4), hence males being insignificantly older than females, p=0.053. The youngest

patient was 18 years and the oldest 92 years old. In regard to males the youngest was 22 years and the oldest was 92years and for females the youngest was 18 years and the oldest 86 years.

The majority of patients in age group distribution were 67 years and above (100(31.9%)) with more females (56((29.5%)) than males (44(35.8%)). This was followed by age group 58-67 years with more females (48(25.3%)) than the males (35(28.5%)). Except for the 18-27 year age group where males were significantly more than the female patients, there were significantly more female than male patients in the other age group distribution, p=0.047.

Majority of the patients were married (72.8%) being significantly higher in males (91.9%) than in females (60.5%), p<0.001. Overall, the highest level of education was mainly primary (37.1%) and secondary (37.1%) with significantly more males compared to females having secondary and university level of education, p=0.010. On the other hand significantly more females reported primary level, college level and no education than males, p=0.010. Occupation was mainly of professional work (24.5%) and business (38%). As regards professionals, business personnel, unskilled personnel and learners there were significantly more females than males and vice versa for the technical personnel and skilled personnel differences, p< 0.001. Majority of the patients were of Catholic (31.9%) and Protestant (64.2%) denominations with the female patients insignificantly more in each category than the male patients.

Table 4: Socio demographic characteristics for patients at MP Shah Hospital

Variable	Overall (n=87) n (%)	Male (43) n %	Female (44) n %	P value
Gender				
Male	43 (49.4)	-	-	-
Female	44 (50.6)			
Age				
Mean (SD)	55.5 (10.0)	57.5 (6.9)	53.5 (12.0)	0.061
Min – Max	19.0 – 79.0	34-72	19-79	
Age groups				
18-27	1 (1.1)	0	1 (2.3)	0.188
28-37	5 (5.7)	1 (2.3)	4 (9.1)	
38-47	5 (5.7)	1 (2.3)	4 (9.1)	
48-57	38 (43.7)	18 (41.9)	20 (45.5)	
58-67	31 (35.6)	20 (46.5)	11 (25.0)	
>67	7 (8.0)	3 (7.0)	4 (9.1)	
Marital status				
Single	10 (11.5)	0	10 (22.7)	**0.008**
Married	72 (82.8)	41 (95.3)	31 (70.5)	
Separated	1 (1.1)	0	1 (2.3)	
Divorced	1 (1.1)	1 (2.3)	0	
Widowed	3 (3.4)	1 (2.3)	2 (4.5)	
Highest level of education				
Primary	4 (4.6)	1 (2.3)	3 (6.8)	0.137
Secondary	10 (11.5)	4 (9.3)	6 (13.6)	
College	23 (26.4)	8 (18.6)	15 (34.1)	
University	50 (57.5)	30 (69.8)	20 (45.5)	
Occupation				
Professional	60 (71.4)	35 (85.4)	25 (58.1)	0.114
Business personnel	15 (17.9)	4 (9.8)	11 (25.6)	
Technical personnel	2 (2.4)	1 (2.4)	1 (2.3)	
Skilled personnel	4 (4.8)	1 (2.4)	3 (7.0)	
Unskilled personnel	2 (2.4)	0	2 (4.7)	
Learner	1 (1.2)	0	1 (2.3)	
Religion				
Catholic	22 (25.6)	9 (21.4)	13 (29.5)	0.109
Protestant	52 (60.5)	26 (61.9)	26 (59.1)	
Muslim	5 (5.8)	1 (2.4)	4 (9.1)	
Other	7 (8.1)	6 (14.3)	1 (2.3)	

Source: Field Data (2019)

At MP Shah as in table 4, 87 diabetic patients with a mean age of 55.5 years (SD 10 years) were studied; 50.6% were females and 49.4% males. Males were insignificantly older (mean age, 57.5 years) than females (mean age, 53.5 years), p=0.061. The youngest male was 34years with the oldest being 72years while for the females, the youngest

was 19 years and the oldest 79 years. In the age group distribution, the majority of patients were in the age group of 48-57 years, 38(43.7%) followed by those in the age group of 58-67 years, 31(35.6%). The majority of the males were in the age group of 58-67 years, 20(46.5%), followed with the ones in age group 48-57 years,18(41.9%).

Majority of the females were in the age group of 48-57 years, 20(45.5%), followed with the ones in the age group 58-67 years, 11(25%). No significant difference was noted by genders in the age group distributions. Majority of the patients were married and divorced which was significantly higher in males than females and vice versa for those who were single, separated and widowed p=0.008. Highest level of education was university education (57.5%) and the lowest was primary education (4%). Occupation of the patients was mainly professional work (71.4%). On religion, the majority of patients were of catholic (25.6%) and protestant (60.5) denominations. There were no significant differences between male and female patients in all categories of occupation and religion.

Table 5: Comparison of socio demographics between patients at Kenyatta National and MP Shah Hospitals

Variable	**KNH (n=313)**	**MP Shah (n=87)**	**P value**
Gender			
Male	123 (39.3)	43 (49.4)	0.090
Female	190 (60.7)	44 (50.6)	
Age, mean (SD)	59.3 (14.0)	55.5 (10.0)	**< 0.001**
Category, n (%)			
18-27	6 (1.9)	1 (1.1)	**0.009**
28-37	12 (3.8)	5 (5.7)	
38-47	41 (13.1)	5 (5.7)	
48-57	71 (22.7)	38 (43.7)	
58-67	83 (26.5)	31 (35.6)	
>67	100 (31.9)	7 (8.0)	
Marital status			
Single	36 (11.5)	10 (11.5)	**0.050**
Married	228 (72.8)	72 (82.8)	
Separated	3 (1.0)	1 (1.1)	
Divorced	3 (1.0)	1 (1.1)	
Widowed	43 (13.7)	3 (3.4)	
Highest Level of Education			
None	22 (7.0)	0	**< 0.001**
Primary	116 (37.1)	4 (4.6)	
Secondary	116 (37.1)	10 (11.5)	
College	40 (12.8)	23 (26.4)	
University	19 (6.1)	50 (57.5)	
Occupation			
Professional	76 (24.5)	60 (71.4)	**< 0.001**
Business personnel	117 (38.0)	15 (17.9)	
Technical personnel	19 (6.1)	2 (2.4)	
Skilled personnel	38 (12.3)	4 (4.8)	
Unskilled personnel	55 (17.7)	2 (2.4)	
Lerner	4 (1.3)	1 (1.2)	
Religion			
Catholic	100 (31.9)	22 (25.6)	**0.008**
Protestant	201 (64.2)	52 (60.5)	
Muslim	5 (1.6)	5 (5.8)	
Other	7 (2.2)	7 (8.1)	

Source: Field Data (2019)

Gender distribution among patients was not significantly different between KNH and MP Shah Hospital, p=0.090 as in table 5. On age, the patients at KNH were significantly older as compared to patients at MP Shah Hospital with an average age of 59.3years as compared to 55.5 years respectively (p<0.001). There were significantly more patients in the 18-27, 38-47 and >67years age group distribution at KNH than MP Shah Hospital and vice versa in the age groups of 28-37, 48-57 and 58-67years, p=0.009. Though with no significant difference in gender distribution between the two hospitals, there were more male patients in percentage ratio at MP Shah Hospital (49.4%) than those at KNH

(39.3%). The female patients were more in percentage ratio at KNH of 60.7% as compared to 50.6% female patients at MP Shah Hospital.

On the other sociodemographic characteristics, a higher proportion of patients were married at MP Shah Hospital than KNH, while those who were widowed were more at KNH (p=0.050). Education level was significantly higher among patients at MP Shah Hospital than at KNH (p<0.001) and they were more likely to be in professional work (p<0.001). Similarly, there were significantly higher proportions of Muslims and other religions at MP Shah than at Kenyatta National Hospital (p=0.008) and vice versa for catholic and protestant religious domination.

Healthcare provider patient communication environmental context during interaction on diabetes management practices in Kenya

Table 6: Healthcare provider patient communication on environmental context at Kenyatta National Hospital

Variable	**Overall(N=313) Mean (SD)**	**Mal (n=123) Mean (SD)**	**Female n=190) Mean (SD)**	**P value**
The hospital/healthcare providers' offices-physical environment / consultation room have everything needed to provide complete care	4.4 (0.7)	4.4 (0.7)	4.4 (0.8)	0.536
The healthcare providers were non-judgmental and treated me as they would want to be treated did not talk down to me and were personable.	4.4 (0.6)	4.4 (0.6)	4.4 (0.6)	0.645
The healthcare providers carried and introduced self in a respectful manner, used my proper name, obtained information in a systematic and orderly process.	4.2 (1.0)	4.2 (1.0)	4.2 (1.0)	0.639
The healthcare providers acted too businesslike, impersonal and in a carefree manner towards me.	4.1 (1.0)	3.9 (1.1)	4.1 (0.9)	0.052
The healthcare providers treated me in a very friendly, courteous manner and showed a compassionate attitude toward me.	4.5 (0.7)	4.4 (0.6)	4.5 (0.7)	0.701
The healthcare providers were cooperative as they did not ignore what I told them, provided reassurance and guidance if necessary.	4.5 (0.6)	4.5 (0.5)	4.5 (0.7)	0.732
Healthcare providers encouraged open communication, were patient and did not hold their view over mine and vice versa during interactions	3.9 (1.2)	3.9 (1.2)	3.9 (1.3)	0.958
The healthcare providers gave advice about the illness, the way to stay healthy and gave me all the information I was expecting to receive about my health.	4.5 (0.7)	4.5 (0.6)	4.5 (0.7)	0.765
The healthcare provider had respect for culture and their values/beliefs did not affect the communication with me.	4.3 (0.9)	4.2 (0.9)	4.4 (0.8)	0.128
Overall Environmental Context Score	**82.7 (15.3)**	**82.1 (14.2)**	**83.2 (16.0)**	**0.534**

Source: Field Data (2019)

At Kenyatta National Hospital as in table 6, the high overall mean score rating in relation to environmental context was 82.7(SD15.3), an indication that the patients at KNH found communication within the environmental context quite favourable during their interaction with the healthcare providers. The rating by the female patients (mean, 83.2 (16.0)) was slightly higher than that by the male patients (mean, 82.1 (14.2)) but with no significant difference, p=0.534.

The environmental context at KNH was rated high by patients with mean scores of more than 4.0 across all the nine (9) areas except on the area where the patients found that the healthcare providers encouraged open communication, were patient and did not hold their view over the patients and vice versa during the interactions as to the presence or

lack of competitiveness, mean score of 3.9(SD1.2), hence rated lower and consequently reflected similarly among the male and female patients. This does show competitiveness from the HCPs was not that high according to the patients.

Ratings were similar for both genders on almost all the areas of environmental context except on in the area where the healthcare providers acted too businesslike, impersonal and in a carefree manner towards patients, thereby depicting informality; the healthcare providers treated the patients in a very friendly, courteous manner and showed a compassionate attitude toward them, being a gesture of friendliness and the healthcare provider had respect for culture and their values/beliefs did not affect the communication with patients that concerned cultural dimension in which the female patients' ratings were higher than those for male patients.

Table 7: Healthcare provider patient communication on environmental context at MP Shah Hospital

Variable	**Overall (n=87) Mean (SD)**	**Male (n=43) Mean (SD)**	**Female (n=44) Mean (SD)**	**P value**
The hospital/healthcare providers' offices- physical environment / consultation room have everything needed to provide complete care.	4.7 (0.5)	4.7 (0.5)	4.8 (0.6)	0.523
The healthcare providers were non-judgmental and treated me as they would want to be treated did not talk down to me and were personable.	4.5 (0.6)	4.4 (0.7)	4.6 (0.5)	0.135
The healthcare providers carried and introduced self in a respectful manner, used my proper name, obtained information in a systematic and orderly process.	4.5 (0.7)	4.5 (0.6)	4.6 (0.8)	0.483
The healthcare providers acted too businesslike, impersonal and in a carefree manner towards me.	4.2 (1.0)	4.3 (0.8)	4.1 (1.2)	0.335
The healthcare providers treated me in a very friendly, courteous manner and showed a compassionate attitude toward me.	4.7 (0.7)	4.7 (0.5)	4.6 (0.9)	0.494
The healthcare providers were cooperative as they did not ignore what I told them, provided reassurance and guidance if necessary.	4.7 (0.6)	4.6 (0.5)	4.7 (0.6)	0.411
The healthcare providers encouraged open communication, were patient and did not hold their view over mine and vice versa during the interactions.	3.8 (1.3)	3.7 (1.4)	3.9 (1.3)	0.508
The healthcare providers gave advice about the illness, the way to stay healthy and gave me all the information I was expecting to receive about my health.	4.5 (0.8)	4.5 (0.7)	4.4 (0.9)	0.567
The healthcare provider had respect for culture and their values/beliefs did not affect the communication with me.	4.2 (1.1)	3.9 (1.1)	4.4 (0.9)	**0.015**
Overall Environmental Context Score	**85.5 (13.5)**	**84.4 (12.7)**	**86.6 (14.2)**	**0.452**

Source: Field Data (2019)

As shown in table 7, environmental context at MP Shah Hospital was rated high with an overall mean score of 85.5(SD13.5). The rating by the female patients (mean, 86.6 (SD 14.2)) was slightly higher than that by the male patients (mean, 84.4(SD 12.7))) but with no significant difference by gender, p=0.452. The mean score rating was more than 4.0 across all the nine (9) facets except on the area where the patients found that the healthcare providers encouraged open communication, were patient and did not hold their view over mine and vice versa during the interactions as to the presence or lack of competitiveness where the patients delivered a mean score of 3.8 (SD1.3) and was reflected on both gender with the male patients having a lower rating (mean score, 3.7(SD 1.4)) as compared

to the female patients (mean score, 3.9(SD 1.3)). This did show that the competitiveness from the HCPs was generally not that high according to the patients.

From the findings, it can be seen that the female patients' ratings were higher on almost all the areas of environmental context except in the area where the healthcare providers acted too businesslike, impersonal and in a carefree manner towards me depicting informality; the healthcare providers treated the patients in a very friendly, courteous manner and showed a compassionate attitude toward them being a gesture of friendliness and the healthcare providers gave advice about the illness, the way to stay healthy and gave me all the information the patient was expecting to receive about their health in regard to health information that were rated higher by the male patients. There was no significant difference in almost all the areas except where the healthcare provider had respect for culture and their values/beliefs did not affect the communication with patients as a cultural dimension where the score rating was significantly higher by the female patients (mean 4.4(SD 0.9)) than the male patients (mean 3.9(SD 1.1)), p=0.015. Even though on overall, cultural dimension area was scored highly by the patients, the finding on the female patients at MP Shah Hospital suggested that they found the healthcare providers more culturally competent unlike their male patient counterparts.

As seen in studies done previously, Caballero (2007) noted that improving healthcare providers' cultural competence may help improve the quality of care provided and may ultimately reduce health care disparities. The researcher further found out that increased cultural competence may also improve patient provider trust and communication, as well as help patients adhere to prevention and treatment plans. The study then concluded that cultural competence could lead to a much more pleasant and productive healthcare provider patient interaction. This does underscore the critical significance of cultural competence and the more reason as to why the lower rating by the male gender patients should be looked into to find out why it is so and therefore what could be done to improve on this area of communication in regard. Indeed, Patel, Datye & Jaser, 2018 established that a better understanding of patients' cultural beliefs, values, and traditions also improved communication and could increase disclosure of personal health information. However, the researcher highlighted the lack of culturally competent communication among healthcare providers and their patients required to provide optimal care among culturally diverse populations.

Table 8: Comparison of healthcare provider patient communication on environmental context

Variable	**KNH (n=313) Mean (SD)**	**MP Shah (n=87) Mean (SD)**	**P value**
The hospital/healthcare providers' offices- physical environment / consultation room have everything needed to provide complete care.	4.4 (0.7)	4.7 (0.5)	**<0.001**
The healthcare providers were non-judgmental and treated me as they would want to be treated did not talk down to me and were personable.	4.4 (0.6)	4.5 (0.6)	0.188
The healthcare providers carried and introduced self in a respectful manner, used my proper name, obtained information in a systematic and orderly process.	4.2 (1.0)	4.5 (0.7)	**0.010**
The healthcare providers acted too businesslike, impersonal and in a carefree manner towards me.	4.1 (1.0)	4.2 (1.0)	0.110
The healthcare providers treated me in a very friendly, courteous manner and showed a compassionate attitude toward me.	4.5 (0.7)	4.7 (0.7)	**0.011**
The healthcare providers were cooperative as they did not ignore what I told them, provided reassurance and guidance if necessary.	4.5 (0.6)	4.7 (0.6)	**0.006**
The healthcare providers encouraged open communication, were patient and did not hold their view over mine and vice versa during the interactions.	3.9 (1.2)	3.8 (1.3)	0.480
The healthcare providers gave advice about the illness, the way to stay healthy and gave me all the information I was expecting to receive about my health.	4.5 (0.7)	4.5 (0.8)	0.713
The healthcare provider had respect for culture and values/beliefs did not affect communication with me.	4.3 (0.9)	4.2 (1.1)	0.130
Overall environmental context score	**82.7 (15.3)**	**85.5 (13.5)**	**0.123**

Source: Field Data (2019)

In making comparisons between the two hospitals as in table 8, overall, environmental context was rated higher by patients at MP Shah Hospital as compared to those at KNH. There was no significant difference in the mean scores between the two hospitals, p=0.123, meaning that generally the patients at the two hospitals were satisfied on this aspect of environmental context of healthcare provider patient communication in the management of diabetes mellitus. Score ratings by patients at MP Shah Hospital were higher than those of KNH in most of the areas of environmental context. This were in the components in which the healthcare providers were non-judgmental and treated me as they would want to be treated did not talk down to me and were personable that relates to status relationships and the healthcare providers acted too businesslike, impersonal and in a carefree manner towards patients depicting informality in which there were no significance differences.

In addition, there were significantly higher mean scores by patients at MP Shah Hospital as compared to those given by the patients at KNH in the areas of: in the hospital / healthcare providers' offices-physical environment / consultation room had everything needed to provide complete care as regards physical (consultation room) environment, p<0.001; the healthcare providers carried and introduced self in a respectful manner, used my proper name, obtained information in a systematic and orderly process as in a show of formality, p=0.010; the healthcare providers treated the patients in a very friendly, courteous manner and showed a compassionate attitude toward them as a gesture of friendliness, p=0.011 and in the area where the healthcare providers were cooperative as they did not ignore what patients told them, provided reassurance and guidance if necessary as for cooperativeness, p=0.006.

The mean score ratings were similar at both hospitals in areas of: the healthcare providers gave advice about the illness, the way to stay healthy and gave me all the information I was expecting to receive about my health as for health information (mean, 4.5) whereas on the area of; the patients found that the healthcare providers encouraged open communication, were patient and did not hold their view over mine and vice versa during the interactions depicting competitiveness and the healthcare provider had respect for culture and their values/beliefs did not affect the communication with patients as on cultural dimension were rated higher by the patients at Kenyatta National Hospital than as by patients at MP Shah Hospital but with no significant differences.

The theoretical underpinning of accommodation processes of convergence and divergence of communication accommodation theory would be argued to come into play as concerns these findings. Convergence was realized between the patients and HCPs at MP Shah Hospital on formality, friendliness and cooperativeness including the aspect in the hospital/healthcare providers' offices- physical environment / consultation room have everything needed to provide complete care in regard to physical (consultation room) environment of physical environment (consultation room) and vice versa in regard to Kenyatta National Hospital. This findings as analysed above do then suggests that the patients at MP Shah Hospital found the physical (consultation room) environment more favourable, comfortable and inviting. Formality was well observed by the healthcare providers during the interactions, with friendliness being exhibited as well as noticed and cooperativeness was as forthcoming as anticipated by patients in comparison to what the patients at Kenyatta National Hospital reported as depicted by the ratings in the study finding.

In relation to past studies, Joseph & Ulrich, 2007 observed that poorly designed environments can result in private conversations between patients and healthcare providers being overheard by unintended listeners, resulting in unacceptable breaches of confidentiality and therefore affect communication dynamics between the patients and the HCPs. This is demonstrable and as the situation showed at KNH, the consultation rooms were mostly partitioned by curtains, small in size and appeared congested unlike at MP Shah Hospital where they are walled with a lockable door and additionally quite spacious.

The outcome on physical (consultation room) environment concur with findings by Kieft, de Brouwer, Francke and Delnoij (2014) in a study by the Picker Institute Europe which revealed that among the quality aspects was attention to physical and environmental needs. Indeed Salonen & Morawska (2013) documented that in the late 19th century, Florence Nightingale had suggested that patients would recover more quickly if they were cared for in an environment that had natural light, ventilation, cleanliness and basic sanitation, and hence, an environment that was conducive. This two study findings demonstrate the case for the contrasts between KNH and MP Shah Hospital as discussed above.

Regression Analysis

The relationship between environmental context and diabetes mellitus management practices was analysed to find out how significant the association was between the independent and dependent variables. This was first done in regard to all the patient participants of the study sample and then at the two separate hospitals to get the outcome at each of them. This was by simple linear regression and y multiple linear regression model 1.

Simple Linear Regression

Simple linear regression was performed to establish the relationship between environmental context and diabetes mellitus management practices; was the independent variable a predictor of the dependent variable in regard to the association outcome between them.

Healthcare Provider Patient Communication (HCPPC) and Diabetes Management Practices in overall

Table 9: Simple linear regression between HCPPC and DMMPs in overall

Variable	β (95% CI)	P value
Environmental context	0.56 (0.48, 0.65)	< **0.001**

N=400

a. Dependent Variable: Diabetes mellitus management practices

Significant at the 0.05 level (2-tailed).

Source: Field Data (2019)

In Table 9, the environmental context (EC) was found to be significantly and positively associated with diabetes mellitus management practices among patients, [β=0.56 (95% CI 0.48, 0.65), p<0.001]. These findings on association are of the indication that environmental context not only favourably and positively influenced but also had positively significant effect on diabetes mellitus management practices among patients during communication with the healthcare providers. A unit increase in EC had corresponding increase in DMMPs among the patients. Therefore, the IV was an independent significant predictor of the response variable.

Healthcare Provider Patient Communication (HCPPC) and Diabetes Management Practices by Hospital

Table 10: Simple linear regression between HCPPC and DMMPs by Hospital

Variable	KNH		MP Shah	
	β (95% CI)	P value	β (95% CI)	P value
Environmental context	0.59 (0.50, 0.68)	< **0.001**	0.45 (0.27, 0.63)	< **0.001**

N=400

a. Dependent Variable: Diabetes mellitus management practices

Significant at the 0.05 level (2-tailed).

Source: Field Data (2019)

As in Table 10, when the analysis was stratified in regard to Kenyatta National Hospital and MP Shah Hospital patients, significant positive association was found in regard to diabetes mellitus management practices and environmental context, β =0.59 (0.50, 0.68), < 0.001 at KNH and β = 0.45 (0.27, 0.63), < 0.001 at MP Shah Hospital. A unit increase in EC brought about improvement in DMMPs. The current study outcome on EC are in line with O'Halloran, Worrall & Hickson, 2010 report of there being many environmental factors that influence communication between patients and their healthcare providers. Salonen & Morawska, 2013 elucidated that patients would recover more quickly if they were cared for in an environment that was conducive with Kieft, de Brouwer, Francke and Delnoij, 2014 study having revealed among the quality aspects, attention to physical and environmental needs.

Therefore, environmental context in healthcare provider patient communication had favourable and positive influence on DMMPs. As such had positive significant effect on diabetes mellitus management practices at Kenyatta National Hospital and MP Shah Hospital respectively. Again as in the overrall outcome above, by hospital, the IVs independently predicted the response variable. Considered individually, the predictor variable was responsible for patients good performance in the DM management practices overall and at either of the two hospitals.

Multiple linear Regression model 1 (Adjusted – communication variables)

In this section, the healthcare provider patient communication variables of verbal language use, nonverbal communicative behaviour, noise and environment context as predictors were all considered together in the multiple linear regression model 1 analysis in order to determine their level of influence on diabetes mellitus management practices as well as the independent predictors on the response variable.

Healthcare provider patient communication (HCPPC) and diabetes Management practices in overall

The model was further adjusted for the healthcare provider patient communication variables to determine the independent predictors of DMMPs among patients (model 1) overall. Forward stepwise regression method was used to generate the model. Thus, the independent effect of the predictor variables was brought in the analysis as follows:

Table 11: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.579[a]	0.335	0.328	12.29705

a. Predictors (Constant): verbal language use, nonverbal communicative behaviour, noise, environmental context

Source: Field Data (2019)

From Table 11, the value of R was 0.579, an indication that verbal language use, nonverbal communicative behaviour, noise and environment context as predictors had an influence on DMMPs. From these results, 33.5% variations of DMMPs were as a result of the four independent variables. An analysis of variance (ANOVA) was also done to ascertain whether the four independent variables were significant predictors of DMMPs as summarized in Table 12 as follows.

Table 12: ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	30062.880	4	7515.720	49.701	**0.000[b]**
	Residual	59730.870	395	151.217		
	Total	89793.750	399			

a. Dependent Variable: Diabetes mellitus management practices

b. Predictors: (Constant), verbal language use, nonverbal communicative behaviour, noise, environmental context

Source: Field Data (2019

From Table 12, the ANOVA findings [F (4, 395) =49.701, P<0.05)] of the significance value of p= 0.000 depicted that there existed significant influence of the predictor variables, nay, verbal language use, nonverbal communicative behaviour, noise and environment context on the response variable, nay diabetes mellitus management practices.

Table 13: Multiple regression model 1 (Adjusted communication variables) between HCPPC and DMMPs in overall

Variable	β (95% CI)	P value
Environmental context	0.45 (0.35, 0.56)	**<0.001**

Dependent Variable: Diabetes mellitus management practices

Source: Field Data (2019)

From further regression analysis as in Table 13 above, environmental context [β=0.45, (95% CI 0.35, 0.56), p<0.001] was statistically significant on adjustment using stepwise method (model 1) overall in Kenya. This means the variable had statistically significant positive effect on diabetes mellitus management practices overall in Kenya. There was positive improvement in DMMPs as depicted by the regression coefficients with every unit increase in environmental context.

Healthcare Provider Patient Communication and Diabetes Management Practices by Hospital

The model was further adjusted for the healthcare provider patient communication variables to determine the independent predictors of DMMPs among patients (model 1) by hospital. Forward stepwise regression method was used to generate the model. Thus, the independent effect of the predictor variables was brought out in the analysis as follows.

Table 14: Model Summary

	R	R Square	Adjusted R Square	Std. Error of the Estimate
M.P.Shah Hospital	0.483[a]	0.233	0.195	11.39921
KNH	0.603[b]	0.363	0.355	12.52436

a. Predictors: (Constant), verbal language use, nonverbal communicative behaviour, noise, environmental context

Source: Field Data (2019)

From Table 14, the value of R was 0.483 for MP Shah hospital an indication that verbal language use, nonverbal communicative behaviour, noise and environment context as predictors had influence on diabetes mellitus management practices and that a 23.3% variation of DMMPs were as a result of the four independent variables. The value of R of 0.603 for KNH revealed that the four independent variables as predictors had influence on DMMPs and hence a 36.3% variation of diabetes mellitus management practices were as a result of independent variables. An

analysis of variance (ANOVA) was done to ascertain whether verbal language use, nonverbal communicative behaviour, noise and environment context were a significant predictor of diabetes mellitus management practices and the results were summarized as in Table 15 that follow.

Table 15: ANOVA[a]

Clinic	Model		Sum of Squares	df	Mean Square	F	Sig.
M.P.Shah Hospital	1	Regression	3234.988	4	808.747	6.224	**0.000[b]**
		Residual	10655.242	82	129.942		
		Total	13890.230	86			
KNH	1	Regression	27590.145	4	6897.536	43.973	**0.000[c]**
		Residual	48312.731	308	156.860		
		Total	75902.875	312			

a. Dependent Variable: Diabetes management practices

b. Predictors: (Constant), verbal language use, nonverbal communicative behaviour, noise, environmental context

Source: Field Data (2019)

From Table 15, the ANOVA finding of [F (4, 82) =6.224, p=0.000)] at MP Shah with the significance value of p=0.000 and [F (4,308) =43.973, p=0.000)] at KNH with the significance value of p=0.000. This depicted that there existed significant influence of the predictor variables of verbal language use, nonverbal communicative behaviour, noise and environment context on the response variable of diabetes mellitus management practices. All the independent variables were then correlated to the dependent variable to determine the predictor variables value on diabetes mellitus management practices overtime and this is summarised in Table 16 that follow.

Table 16: Multiple regression model 1 (Adjusted-communication variables) between HCPPC and DMMPs by Hospital

Variable	**KNH**		**MP Shah**	
	β (95% CI)	**P value**	**β (95% CI)**	**P value**
Environmental context	0.50 (0.39, 0.61)	**<0.001**	0.45 (0.27, 0.63)	**<0.001**

Dependent Variable: Diabetes mellitus management practices

Source: Field Data (2019)

As in Table 16, environmental context at Kenyatta National Hospital [β=0.50, (95% CI 0.39, 0.61), p<0.001] and at MP Shah Hospital [β=0.45, (95% CI 0.27, 0.63), p<0.001] was statistically significant on adjustment using stepwise method (model 1). Therefore, EC had positively significant effect, hence influence on DMMPs at KNH and at MP Shah Hospital. The outcome on EC reinforces the argument that the environmental context at the two hospitals led to improvement in DMMPs. As such, none of the facilities could be said to be better than the other on this aspect of HCPPC, though it is apparent from the regression coefficients that for a unit increase in the predictor variable, there was marginally better improvement in the response variable a KNH.

The case for KNH in regard to the significant effect of the environmental context could be explained by the relocation of the diabetic center to a more spacious stand-alone unit with almost all the services touching on DM available. This is unlike the DM clinic previous location that was in the main hospital setup and was shared with other different clinics and as such was always congested. For MP Shah Hospital, the diabetic center is spacious, mainly for diabetes mellitus patients with almost all services given within it. This aspect at both hospitals could be the more likely reasons as to why patients rating of EC were significant effect on the DM management practices.

Abdulhadi et al, 2006 argued that improving the work situation and further improvement in the organizational efficiency of diabetes services positively impacted diabetes management. The study outcome found in overall 52% of the doctors' consultations were not optimal and that some important aspects for a positive consultation environment were fulfilled in only about half of the doctors' consultations: the quality of the nurses' consultations was sub-optimal in about 75% of 85 consultations regarding aspects of consultation environment, care and information. This finding by the researcher though not indicating whether there was significant effect or not does underscore the critical importance of environmental context in diabetes management. According to O'Halloran, Worrall & Hickson, 2011 in regard to the current study findings, environmental factors influence communication between patients and their healthcare providers in hospitals and this seen more on the ability of patients and healthcare providers to communicate.

There is paucity of information on previous studies specific to the HCPPC aspects and DMMPs on the occurrences of better outcome at public hospitals in comparison to private hospitals in some instances as found in this study. Though the case, related past studies on communication were found to largely contrast with this finding. Adhikary, 2018 study found the satisfaction level to be highest among patients for the healthcare givers in private facilities than in the public facilities. Also Soysal & Yağar, 2017 study determined that in general, practioner participants observed a better level of communication in private hospitals compared to public hospitals. The researcher however observed that patients in public institutions had higher level of satisfaction in the level of communication with the doctors which to some extend mirrors the outcome in the current study. The study also found that the physical structures (environmental context) of public hospitals and private hospitals were assessed almost the same, a finding that concurs with the present study at the two hospitals.

Hypothesis Testing

From the hypothesis; Ho: There is no significant effect of environmental context during healthcare provider patient interaction on diabetes mellitus management practices in selected hospitals in Kenya. On simple linear regression, environmental context had positively significant effect with diabetes mellitus management practices, $p < 0.001$ overall in Kenya which was less than the set significance level of $\alpha=0.05$. This scenario also obtained at Kenyatta National Hospital and the MP Shah hospital where the significance level was, $p < 0.001$. Consequently, multiple regression model 1(adjusted-communication variables) showed that there was significant effect of environmental context on diabetes mellitus management practices, $p<0.001$ overall in Kenya, at KNH, $p<0.001$ and MP Shah Hospital, $p<0.001$. Therefore, the null hypothesis was rejected overall in Kenya; at KNH and MP Shah Hospital. Therefore, there was significant effect of environmental context during healthcare provider patient interaction on diabetes mellitus management practices in selected hospitals in Kenya.

CONCULUSION

Healthcare provider patient communication environmental context had favourable impact and brought about improved performance in diabetes mellitus management practices among patients whether in public or private hospitals. This means the healthcare settings environmental context was conducive and hospitable to the patients in the course of care they received all along.

RECOMMENDATIONS

There is need to evaluate various components of environmental contexts to realize enhanced improvement on them for better communication in the course of the management of diabetes mellitus to align to the needs of the patients especially at public healthcare settings. This would be in areas of consultation (physical environment) rooms, formality, friendliness and cooperativeness in which MP Shah Hospital; a private hospital had significantly better performance than KNH, a public hospital. Develop programmes on how to improve on these areas at public hospital setting would be of critical necessity. The gender variations on the environmental context domain should also be addressed adequately by being sensitive to sartle gender differences that go unnoticed during communication. There is also need for introduction of healthcare provider patient communication environmental context in the medical education curriculum to be part and parcel in training institutions as a necessary requirement in medical practice. In addition, a standard healthcare provider patient communication environmental context model need to be developed and anchored through training/practice and guidelines given on its observance by healthcare providers and equally in regard to the patients as consumers of health services for their benefit.

SUGGESTIONS FOR FURTHER STUDIES

Suggestions are made for research on the specific component areas of physical (consultation room) environment, formality, friendliness, cooperativeness, competitiveness, cultural dimension and health information. This would be to realize the possible cause of differences in regard to gender and by type of health facility as it would clearly set to plug the gaps where they exist. Regression analysis though statistically significant at both hospitals, the regression coefficient was marginally higher at KNH than at MP Shah Hospital, an indication of better DMMPs and therefore the probable underlying circumstantial explanations for this require further research. Future research is also needed to determine how to effectively remove environmental barriers so as to enhance environmental facilitators to provider patient communication in the diabetic centers to ultimately demonstrate if and how these changes could further improve patient care.

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MIDWIVES' KNOWLEDGE AND PRACTICE OF MIDWIFERY-LED CARE MODEL IN EMBU COUNTY

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ABSTRACT
Globally, there is great threat to midwifery practice that compromises maternal and neonatal health outcomes. This is due to limited autonomy of midwives in various health institutions. This threat is not different in Embu county and Kenya at large despite the rich evidence that midwife-led care is the most crucial factor in attaining improved maternal and neonatal health outcomes. There is no reliable literature on knowledge and practice of midwifery led care model in Embu county. This poses the need to evaluate knowledge and practice of midwifery-led care model among midwives in Embu county. Therefore, the study objective was to determine the midwives' knowledge and practice of midwifery-led care model in Embu county. The study sites were Siakago and Runyenjes level four hospitals. A survey study design was adopted. Target population comprised midwives offering maternal and child health care services in the two hospitals. A sample size of 60 midwives was used in the study with response rate of 92.0 %. Questionnaires, interviews, observation checklists and secondary sources were used to collect data. Pretesting was done at Ishiara level four hospital. Quantitative data were analysed using Statistical Package for Social Science (SPSS) software for windows version 28.0. Descriptive statistics to include frequencies and percentages were used in data analysis. Chi-square test and regression analysis, were used to draw inferences. Qualitative data were analysed by content analysis through grouping data into themes according to the study objectives. Results were presented in form of narratives and tables. Permission to undertake the study was obtained from Chuka University Ethics and Research Committee. A research permit was obtained from the National Commission for Science, Technology and Innovation (NACOSTI). Relevant authorities in Embu county health department, Siakago, Runyenjes and Ishiara level four hospitals were informed for study authorisation. All the relevant ethical considerations were adhered to during the study. The study revealed that a high percentage 76.4% of midwives had poor knowledge on midwifery led care model. There was a very high percentage 90.6% of midwives who had not heard about midwifery led care model before. Majority of the midwives 93.8% were not aware of benefits of reflexology, dimming of lights and music refreshments during labour. Among the midwives, 81.9 % demonstrated poor practice of midwifery-led care model. Care given to low risk mothers 87.3% was a shared responsibility by midwives, doctors and other health professionals. There were no midwifery led care units where midwives are solely in charge of maternal and neonatal care 85.4%. Variety of mechanical pain relief options such as labour in water, visualization and other hypnobirthing 100% were not practiced. The null hypothesis was rejected; therefore, there was statistically significant relationship at 0.05 level of significance with 1 degree of freedom between midwives' knowledge and practice of midwifery-led care model. Using pearson and spearman's rho correlations, the relationship between knowledge and practice was statistically significant at the 0.01 level (2-tailed). After running a linear regression model, midwives' knowledge level was found to affect their midwifery practice (95% CI 0.846 – 1.011), P=000. The study concluded that there were gaps in knowledge and practice of midwife-led care model in Embu county. The study recommended an intervention for educating midwives about midwifery led care model and subsequent introduction of the model in this county aiming to strengthen midwifery for improved maternal and neonatal health outcomes in Embu County.
Keywords: Midwives, Knowledge, Practice, Midwifery-led, care, model

INTRODUCTION
The global situation currently is that there is threat to midwifery practice related to limited autonomy with poor maternal and neonatal health outcomes (Nove et al, 2021). In the Italian context midwifery models respond to quality and the needs of women not only during the pregnancy but also during the post-partum phase (Ricchi et al, 2019). Lack of knowledge on what midwifery led care model entails, hinders midwifery led care practices (Dharni et al., 2021). Midwives need to understand factors that hinder and promote initiation of this model. Autonomy in care decision making is one of the key aspects of midwifery led model. Midwives have always struggled in systems that do not allow midwives' independent operations hence denying them a voice in care decisions. In some studies, midwives report frustrations by policies that deny them autonomy and narrowing their scope of practice (Hastings et al., 2021). Cultural awareness of individual responsibility and family role influence, social and system hindering factors, conflicting midwifery care expectations and language are some of the hindering factors in midwifery led maternity care practices (Shefaly et al 2021). Providing unclear feedback on components of their services inhibits progressive improvement of compliance with best practices. Providers operating in challenging environment with limited resources and support (Haghdoost et al., 2021). Time constraints, shortage of staffing and poor administrative support has been reported as a barrier to performance in midwifery practices within a standardised approach team.

Midwifery led care model has not been fully adopted in the sub Sahara Africa that comprises low and middle income countries. Lack of clear guidelines on this model in most countries is a contributing factor (Eri et al, 2020). Adequate knowledge on midwifery model of care with autonomy in care decision making and administrative support and empowerment of midwives facilitates midwifery led care services (Dharni et al., 2021). Midwives feel competent working in systems that allow them independent operations and giving them a voice in making care decisions. In some studies, midwives report satisfaction by policies that allow them to work with autonomy and expanding their scope of practice (Hastings et al., 2021). Cultural, social and system enabling factors, harmonised midwifery care expectations and language are some of the enabling factors in midwifery led maternity care practices (Shefaly et al., 2021). Provider's access to clear feedback on contents of their health care services promotes progressive improvement of adherence with good midwifery practices. Poor interpersonal and communication skills between midwives themselves and between midwives and the mothers (Haghdoost et al 2021). Adequate numbers of staffing and good administrative support were also reported as enablers to implementing midwifery practices within standard approach teams. Adequate care to mothers should be considered important to minimise maternal and neonatal deaths. Global deaths of mothers are approximately 289,000 happening in pregnancy and birth. Offering good maternal and birthing care services would control 1.3 m newborn deaths, 531,000 fresh and macerated still births as well as 113,000 deaths of mothers (Nove et al., 2021). The SDGs target to minimise maternal deaths worldwide up to approximately under 70 per 100,000 live births during 2016-2030 (UNDESA 2019).

Midwives' practices include holistic monitoring of physical, psychological, and social wellbeing of the mother throughout the labour pregnancy and labour process. Midwifery led care model will result to spontaneous onset of labour, it is client centered and uses mechanical pain relief techniques. Providing clients with individualized health education, psychological continuous hands on support during the labour process and identifying women who require obstetrical attention for referral. These practices have been proven to reduce perineal birth injuries, operative births hence positive birth experiences (Bartuseviciene et al., 2018). Contrary, in biomedical model onset of labour is in most cases induced, the model is system centered and uses technological interventions such as pharmachological pain relief (Nilsson et al., 2019). In midwifery model of care midwives must have autonomy in decision making. Various factors influence midwives' practices either by facilitating or by hindering practice efforts. Consequently, this results to either negative or positive maternal and neonatal health outcomes.

There is inadequate literature and no guidelines in Kenya on midwifery led care model. Midwifery practice guidelines are very crucial in directing and defining parameters for midwifery care (Tharpe et al., 2021). Documentation is one of the key requirements to validating quality of midwifery care, therefore documentation skills are mandatory to quality midwifery practice. Complete and correct documentation is a legal record of services that have been offered. Guidelines to standardise the documentation format will help the midwife to concentrate on the content of what is to be documented. Clinical practices may vary depending on client's needs and values. Guidelines will acknowledge safety in such individual variations in practice and therefore help define common principles to follow in providing safe and effective midwifery care. Clear guidelines on the whole process of midwifery model of care and specifying when to consult other health care providers is needed to effectively implement the model (Tharpe et al., 2021).

Promoting maternal and neonatal well-being remains a priority healthcare for attainment of the Sustainable Development Goal number 3. (Every woman Every child, 2016). Literature indicates that the global strategies towards women's and their newborns health are access to critical interventions and effective health workers (Nove et al., 2021). The threat to midwifery practice is not different in Embu county and Kenya at large despite the rich evidence that midwife-led care is the most crucial factor in attaining improved maternal and neonatal health outcomes. There is no reliable literature on knowledge and practice of midwifery led care model in Embu county. This poses the need to evaluate knowledge and practice of midwifery-led care model among midwives in Embu county. Therefore, the study objective was to determine the midwives' knowledge and practice of midwifery-led care model in Embu county

Purpose of the Study

The purpose of this study was to assess midwives' knowledge and practice of midwifery led care model in Embu county, Kenya.

Objectives of the Study

i. To assess midwives' knowledge on midwifery led care model in Embu county
ii. To assess midwives' practice of midwifery led care model in Embu county

Hypotheses

There is no statistically significant relationship between knowledge and practice of midwifery led model care model in Embu county.

Significance of the Study
Findings of this study shows low levels of knowledge on midwifery led care mode and poor midwifery practices in Embu county. This evidence will guide in policy formulation in all maternity units to introduce midwife led care in the entire county health facilities with the aim of promoting maternal and neonatal health outcomes.

METHODOLOGY

Study Site
The study was done in two level four hospitals of Embu county, that is Siakago level four hospital and Runyenjes level four hospital. Siakago level four hospital is situated in Mbeere North sub-county. Runyenjes level four hospital is situated in Runyenjes sub-county. Embu county has one level 5 hospital, 4 level four hospitals, 11 level 3 hospitals, and 77 second level hospitals. This provides 93 health centers with Mbeere South sub-county having the largest number of health facilities followed by Runyenjes sub-county with 25, Manyatta sub-county with 23 and Mbeere North Sub County with 17 community health centers. Embu county Global Positioning System (GPS) coordinates are 0.6560° S, 37.7238° E

Study Design
A survey study design was adopted.

Target Population
The study population was made up of midwives offering preconception, antenatal, natal and postnatal services in the two hospitals.

Sample Size Determination
A census was used to recruit midwives into the study.

Sampling Procedure
Two level four hospitals were selected purposively for inclusion into the study. The two hospitals were considered suitable because they have high number of midwives compared to other level four hospitals in Embu county.

Inclusion Criteria
Midwives who were willing to take part in the study.

Exclusion Criteria
Midwives on rotational clinical placement were excluded

Data Collection Procedure
Data were collected for a period of three months, from July to September 2022. Self-administered questionnaires were given to midwives to gather quantitative data. Interviews were also conducted to collect qualitative data. Secondary data sources and observation were also used to collect data that was not available through the interviews and questionnaires. The questionnaires had three sections; first section for demographics, second section assessed knowledge and practice of midwifery led care model in Embu county represented by the two hospitals.

Data Collection Instruments
Structured questionnaires, interview guides, secondary sources and observation checklist were used to collect data.

Pretesting
Data collection tools were pretested in Ishiara level four hospital. This is because health care services offered and midwives' characteristics are more comparable with those in Siakago and Runyenjes level four hospitals. Ambiguous questions detected were rephrased appropriately to improve clarity. The pretest sample was 10% of the study sample (Mugenda & Mugenda, 2019). Therefore 6 participants were selected for pretesting (6 midwives). This forms 10% of 60 that was the final sample size.

Data Analysis
Data were analysed using Statistical Package for Social Science (SPSS) software version 28.0. Descriptive statistics were carried out for quantitative data and thematic analysis for qualitative data. For inferential statistics, chi-square test and regression analysis were used to draw inferences on the relationship between midwives' knowledge and practices of midwifery led care model.

Ethical Consideration

Authorization to undertake the study was obtained from Chuka University Ethics and Research Committee. A research permit was sought from the National Commission for Science, Technology and Innovation (NACOSTI). Relevant authorities in Embu county health department, Siakago, Runyenjes and Ishiara level four hospitals were informed about the study and gave authority of data collection in their institutions. Participants were explained on the purpose of the study and that participation in the study is voluntary. Participants were given freedom of withdrawal at whatever stage of research when they no longer intended to participate. Informed consent was sought from participants in form of verbal and written consent before they started answering the research questions. Information obtained from study participants was treated with ultimate confidentiality. Literature sources were acknowledged appropriately. Truthful data was generated and presented for feedback and publication

RESULTS

Table 1. Midwives' knowledge of midwifery led care model (n-55)

Item	**YES (%)**	**NO (%)**
Do you know what midwifery led care model is all about?	8 (9.4)	47 (90.6)
Knowledgeable on labour and birth related topic(s) that the woman/partner/significant other may wish to discuss	9(18.8)	46(81.3)
Have information on birthing preference(s) including water birth	10(12.5)	45(87.5)
Know the importance of mobilising and changing positions during childbirth	35(68.8)	20(31.2)
Aware of benefits of rest, massage, including reflexology, consider environment e.g. dimming of lights, music refreshments - Light diet/isotonic fluids	5(6.2)	50(93.8)
Aware of pain relief options e.g. labour in water, Transcutaneous electrical nerve stimulation (TENS), hypnobirthing, visualization	10(15.6)	45(84.4)
Choices for third stage management of labour are well known	5(9.4)	50(90.6)
Importance of skin-to-skin contact is understood	26(50.0)	29(50.0)
Conversant with timing of cord clamping	11(21.9)	44(78.1)
Summary of knowledge	**Good**	**Poor**
	13 (23.6%)	42 (76.4%)

Table 1 indicates a general summary of poor knowledge (76%) of the midwives on midwifery led care model. Majority of the midwives (90.6%) said they do not know what midwifery led care model entails while a few of them (9.4%) said that they knew what the model is all about

Table 2. Likert scale on level of information the midwives have regarding midwifery led care model (n=55)

Item	Strongly agree N (%)	Agree N (%)	Disagree N (%)	Strongly disagree N (%)	Not sure N (%)
I have adequate knowledge on variety of upright and preferred birthing positions for mothers	7(12.7%)	19(34.5 %)	28 (50.9%)	1 (1.8%)	0
Midwifery led care model views pregnancy, birth and puerperium as normal physiological process	2(3.6%)	18(32.7 %)	7(12.7%)	5(9.2%)	23(41.8 %)
In midwifery led care model, the midwife is the lead professional in planning, organising for care to low risk pregnancy from prenatal to post natal.	4(7.3%)	5(9.1%)	16(29.1%)	2(3.6%)	28(50.9 %)
Unnecessary care interventions like episiotomy, instrumental birth, caesarean section and pharmachological analgesia are reduced	2(3.6%)	13(23.6 %)	4(7.3%)	2(3.6%)	34(61.8 %)
Appropriate referrals of mothers requiring different specialist care are done by midwives	3(5.5%)	2(3.6%)	7(12.7%)	40(72.7%)	3(5.5%)
Low risk pregnancy, birthing process and postnatal care can be offered by midwives safely	41(74.5%)	6(10.9%)	5(9.2%)	2 (3.6%)	1(1.8%)
Summary	**Well informed**		**Poorly informed**		
	20 (36%)		35 (64%)		

Midwives who strongly agreed and those who agreed were group together as having good information on the model 36 % and those who strongly disagreed, disagreed and those not sure were considered to be poorly informed 64 %. The Likert scale in Table 2 indicates that majority of the midwives are poorly informed about the information regarding midwifery led care model.

Table 3. Midwives' practice of midwifery led care model (n=55)

FACILITY	**YES N (%)**	**NO N (%)**
Labour and birth related topic(s) that the woman/partner/significant other may wish to discuss are taught	16 (31.2)	38(68.2)
Various birthing option(s) including water birth are offered	0	55(100)
Mobilising and changing positions during labour and childbirth are done	25(43.8)	30(56.2)
Massage, including reflexology considering environment e.g. dimming of lights, music refreshments - light diet/isotonic fluids are practiced	7(9.4)	48(90.6)
Pain relief options offered e.g. labour in water, Transcutaneous electrical nerve stimulation (TENS), hypnobirthing, visualization	0	55(100)
Choices for third stage of labour management discussed with the mother and partner	0	55(100)
Skin-to-skin contact is practiced	47(87.5)	8(12.5)
Timing of cord clamping is appropriate	13(21.9)	42(78.1)
Summary of practice	**Good**	**Poor**
	14 (25%)	41 (75%)

Table 3. Shows that majority of midwives demonstrated poor practice of midwifery led care 75% while a few 25% demonstrated good practice of midwifery led care model

Table 4. Midwives' practice of midwife-led care model by midwives (n = 55)

FACILITY	**Frequency (N)**	**Percentage (%)**
Is midwifery led care model practiced in this hospital?		
No	45	81.8%
Yes	3	5.4%
Not sure	7	12.8%
If not practiced, what are the hindering factors?		
Lack of knowledge on the model	40	72.7%
Lack of autonomy in midwifery generally	11	20%
Lack of support	4	7.3%
What possible strategies would you suggest for introduction of the model in the hospital?		
Train midwives about the model	39	70.9%
Empowering midwives by giving them autonomy to make care decisions	11	20%
Expand midwives' scope of practice	5	9.1%
What is your experience in your daily midwifery care services?		
I feel highly motivated due to autonomy and professional fulfillment	5	9.1%
I feel highly demotivated due to lack of autonomy and professional fulfillment	38	68.2
Subordinate practice	3	5.4%
Over worked and burnout	9	17.3%
What is the availability of evidence informed maternal and neonatal health care policies and guidelines?		
Readily available	3	5.4%
Available	7	12.8%
Sometimes available	7	12.8%
Rarely available	27	49%
Not available	11	20%
Maternal positions of birthing mostly practices		
Upright	7	12.8%
lithotomy	32	59.9
dorsal	13	21.9%
others-lateral	3	5.4%

Majority of the midwives 81.8% confirmed that midwifery led care model is not practiced in their health facilities while 12.8% were not sure whether the model is in practice or not. The Main hindering factor being lack of knowledge on the model 72.7%, followed by lack of autonomy in midwifery generally 20% and lack of support 7.3%. Majority 70% recommended training of midwives as one strategy of introducing the model into their facilities. Others 20% proposed empowerment of midwives by giving them autonomy to make care decisions while 9.1% suggested expansion of midwives' scope of practice. Majority of midwives 68.2% expressed lack of motivation due to limited autonomy and professional fulfillment 17.3% felt over worked and suffered burnout. Most of the midwives 49% said evidence informed maternal and neonatal health care guidelines are rarely available while 20% said the evidence based care guidelines are not available at all. Very few midwives 12.8% practice upright maternal birthing positions while majority are practicing the lithotomy 59.9% and 21.9% dorsal positions (Table 4)

Table 5. Likert Scale on the level of midwifery led care practices (n=55)

	Totally agree N (%)	Agree N (%)	Disagree N (%)	Totally disagree N (%)	Don't know N (%)
Midwives autonomously give care during prenatal, birth and postnatal periods to low risk pregnancy	3(5.5)	3(5.5)	5(9.1)	38(69.0)	6(10.9)
There is a midwifery led care unit where midwives are solely in charge of maternal and neonatal care	0	3(5.5)	3(5.5)	47(85.4)	2(3.6)
Care given to low risk mothers is a shared responsibility by midwives, doctors and other health professionals	48(87.3)	5(9.1)	2(3.6)	0	0
Summary	**highly practiced**		**low practice**		
	21(38%)		**34 (62%)**		

Table 5: Summarises that there is low level of midwifery led care practice. There is lack of autonomy in midwifery practice. Majority of Midwives 69% totally disagreed that they autonomously give care during prenatal, birth and postnatal periods to low risk pregnancy. There are no midwifery led care units where midwives are solely in charge of maternal and neonatal care as indicated by 85.4% of midwives. Midwives totally agreed 87.3% that care given to low risk mothers is a shared responsibility by midwives, doctors and other health professionals

Hypotheses Testing

Null: There is no statistically significant relationship between knowledge and practice of midwifery led care model in Embu county. By using the Chi square test, the findings indicated a statistical relationship between midwives' knowledge and practice of midwifery led care model, where calculated X^2 of 7.05 was greater than the critical X^2 of 3.841 significant at 0.05 with degree of freedom at 1. Therefore, the null hypothesis was rejected. This showed that there was a significant relationship between midwives' knowledge and practice of midwife led care model in Embu county

Table 6: Cross tabs correlation for midwives' knowledge and practice of midwifery led care model

Correlation		Practice	Knowledge
Practice	Pearson Correlation	1	.952**
	Sig. (2-tailed)		.000
	N	55	55
Knowledge	Pearson Correlation	.952**	1
	Sig. (2-tailed)	.000	
	N	55	55
**. Correlation is significant at the 0.01 level (2-tailed).			

Correlation			practice	Knowledge
Spearman's rho	Practice	Correlation Coefficient	1.000	.952**
		Sig. (2-tailed)	.	.000
		N	55	55
	Knowledge	Correlation Coefficient	.952**	1.000
		Sig. (2-tailed)	.000	.
		N	55	55
**. Correlation is significant at the 0.01 level (2-tailed).				

Table 7: Linear Regression Analysis for midwives' knowledge and practice of midwifery led care model

Coefficients[a]								
		Unstandardized Coefficients		Standardized Coefficients			95% Confidence Interval for B	
Model		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound
1	(Constant)	.143	.074		1.938	.058	-.005	.291
	Knowledge	.929	.041	.952	22.663	.000	.846	1.011
a. Dependent Variable: practice								

DISCUSSION

Midwives' knowledge on midwifery led care model

Results in Table 1 indicate a general summary of poor knowledge (76%) of the midwives on midwifery led care model. Moreover, majority of the midwives (90.6%) said they do not know what midwifery led care model entails while a few of them (9.4%) said that they knew what the model is all about. This is similar to other studies that found out that lack of knowledge on what midwifery model of care entails, hinders midwifery led care practices (Dharni et al., 2021). Additionally, there is evidence of lack of knowledge on the model using a likert scale. Midwives who strongly agreed and those who agreed were grouped together as having good information on the model 36 % and those who strongly disagreed, disagreed and those not sure were considered to be poorly informed at 64 %. The Likert scale in Table 2 indicated that majority of the midwives were poorly informed about the information regarding midwifery led care model. This is in congruent with the study in Ethiopia that identified a relationship between knowledge and practice of care providers (Abayneh et al, 2022)

Midwives' practice of midwifery led care model

Findings of this study in Table 3 indicate that majority of midwives demonstrated poor practice of midwifery led care 75% while a few 25% demonstrated good practice of midwifery led care model. To add to this, majority of the midwives 81.8% confirmed that midwifery led care model is not practiced in their health facilities while 12.8% were not sure whether the model is in practice or not. The Main hindering factor being **l**ack of knowledge on the model 72.7%, followed by lack of autonomy in midwifery generally 20% and lack of support 7.3%.

The results are supported by some studies where midwives reported frustrations by policies that denied them autonomy and narrowing their scope of practice (Hastings et al., 2021). Majority 70% recommended training of midwives as one strategy of introducing the model into their facilities. Others 20% proposed empowerment of midwives by giving them autonomy to make care decisions while 9.1% suggested expansion of midwives' scope of practice.

Majority of midwives 68.2% expressed lack of motivation due to limited autonomy and professional fulfillment 17.3% felt over worked and suffered burnout. Most of the midwives 49% said evidence informed maternal and neonatal health care guidelines are rarely available while 20% said the evidence based care guidelines are not available at all. Very few midwives 12.8% practice upright maternal birthing positions while majority are practicing the lithotomy 59.9% and 21.9% dorsal positions (Table 4). The findings in this study agree with the study in Ethiopia that identified a relationship between knowledge and practice of care providers (Abayneh et al, 2022).

Table 5: Summarises that there is low level of midwifery led care practice. There is lack of autonomy in midwifery practice. Majority of Midwives 69% totally disagreed that they autonomously give care during prenatal, birth and postnatal periods to low risk pregnancy. There are no midwifery led care units where midwives are solely in charge of maternal and neonatal care as indicated by 85.4% of midwives. Midwives totally agreed 87.3% that care given to low risk mothers is a shared responsibility by midwives, doctors and other health professionals

CONCLUSION

The study concluded that there were gaps in knowledge and practice of midwife-led care model in Embu county. Also the study concluded that lack of knowledge on what midwifery model of care entails, hinders midwifery led care practices. The study recommended an intervention for educating midwives about midwifery led care model and subsequent introduction of the model in this county aiming to strengthen midwifery for improved maternal and neonatal health outcomes in Embu County.

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CONFLICTS OF INTEREST

No conflicts of interest

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EFFECT OF INFORMATION SHARING PRACTICES ON PERFORMANCE OF FOOD PROCESSING FIRMS IN NAIROBI COUNTY, KENYA

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ABSTRACT
The information sharing practices account to about fifty percent of the profitability and better performance of any firm. The food processing subsector performance has been declining thus its contribution to the Gross Domestic Product has reduced to 10% thus leading to operation inefficiency. The objective of the study was to probe the effect of information sharing practices on performance of food processing firms in Nairobi County. The study was premised on the Complexity theory in logistics. Descriptive research design was employed. A population of 172 food processing firms and a sample size of 120 firms was determined. Stratified and simple random sampling were used to select specific firms while data were collected using structured questionnaires. Descriptive statistics aided in describing the primary characteristics of the data. Regression analysis aided to ascertain the effect of information sharing practices on performance of food processing firms with the aid of SPSS version 28. T-statistics were used to gauge the significance of individual objectives at 5% confidence level while F-statistic was used to establish the overall significance of the model. The study established information sharing practices was found to be positively correlated to performance, (regression coefficient regression coefficient 0.247, p-value 0.029). The study concluded that information sharing practices had substantial impact on performance on Food processing firms and recommends that food processing firms should firms should invest more in information sharing platform such as the EDI to enhance free flow of information.
Keywords: Information Sharing Practices, Performance and Food Processing Firms.

INTRODUCTION
Information sharing practices entails the informal and formally agreed methods of disseminating relevant information within the supply chain by the actors to improve collaboration within logistics management. Wardaya (2013). The fruitful incorporation of information in an enterprise is a robust driver for reducing expenses, enhancing productivity and improving client service Information. Indeed, Kazi (2012) notes that one of the five cornerstones of a robust supply chain relationship is sharing information. Further, the author maintains that knowing the data needs of the organization and having a strong information sharing policy in within the organization increases the competitive advantage of the firm. High level of information sharing within the SCM improves the success of supply chain and contributed to better performance of organizations. Marinagi *et al*., (2015) established that information sharing among entities or parties across the supply chain and having a proper integrated information system facilitates higher overall performance. Khalil *et al*., (2019) found that information sharing quality had a negative influence on organizational productivity. However, the above studies did not reflect on information exchange policy, integrated information and data needs.

Manufacturing firms are the backbone of economic progress for countries by promoting industrial expansion. They contribute significantly to economies by fostering job prospects and anchoring large industries (Anuar & Yusuf, 2011). To sustain these contributions, manufacturing firms ought to embrace top-notch SCMPs in addition to advancing their technology and manufacturing processes. Sandhu, Helo and Kristiano, (2013) opine that SCM practices in a company are seen as operational activities and central business operations, that affect how efficient and effective the supply chain is. The major intention of SCM is to improve supply chains and firm performance competitiveness in the long-run through integration with partners, of activities, operations and processes both internally and externally.

The partners are clients, industrialists, manufacturers, distributors and suppliers (Kim, 2006). SCM includes a variety of activities for instance all logistic management functions with partners, outsourcing, coordination, planning and procurement (Soosay *et al.,* 2008). Existing studies underscore that the definitive aim of SCM is to boost the productivity of firms (Li *et al.*, 2005, 2006; Chen & Paulraj, 2004; Min and Mentzer, 2004).

Kenya is an emerging economy that is averagely industrialized with a robust manufacturing sector in the African Continent (KAM, 2014). The Kenyan economy benefits greatly from the food processing industry. Companies that process food and drinks in Kenya are categorized under the manufacturing industry. The industry contributes for close

to 10 percent of GDP, with the majority of goods, approximately, 95% being food and beverages, building materials and basic chemicals (KIPPRA, 2018).

The Kenya Association of Manufacturers (2018) establishes that agricultural produce processing enterprises are the biggest contributor in regard to volume of production and employment in industrial and allied sector in the country. Agricultural firms therefore have the ability to boost economic growth by supplying raw materials and market for produce in bulk as well as acting as catalysts for expanded farm produce production. The segment is a key prolific sector of the economy projected to back the achievement of Vision 2030 due to its immense potential in poverty eradication, job creation and wealth establishment. In Kenya, food and beverage processing segment is a relatively well-developed sector with products ranging from dairy products, canned vegetables, bakery products, sugar and confectionary, fish, oil and fats among many other products (Kariuki, 2016).

Food and beverage processing firms in Nairobi vary from small-family-informal firms to large formal enterprises quoted in the Nairobi Securities Exchange. Others include subsidiaries of foreign and multinational companies. Multinational food and beverage processing firms have established operations in Kenya either as foreign companies or as joint ventures (Muteshi *et al*., 2017). The performance of food processing firms in Nairobi County has been declining, according to the World Bank report due to the unstable operating climate thus declining profitability over the past five years (World Bank, 2020). The subsector performance has also been declining as compared to other sectors for example according to the (KNBS, 2015) the agriculture output increased by 15.8%, building and construction increased by 13,1%, transport and storage increased by 13.7% while the input of food processing companies to GDP reduced from 15% to 10%. Thus leading to operation inefficiency. According to hanse (2020), the current food production in the food processing firms does not meet the demand thus leading to uncertainty of the sector to meet one of the big four agendas in the county which is food security.

A study on information exchange and performance of supply chain by Fawcett *et al*.(2008) employed survey and partially-structured interviews in data pooling. They carried out the study in 124 manufacturing firms and used simple random sampling to obtain a sample size. The results exhibited that most firms typically do not benefit fully from information exchange because they frequently place much effort on connectivity and too little on willingness. Additionally, establishing connectivity right is a serious barrier that most businesses encounter in their attempt to boost performance. Integrating willingness and connectivity seem to enhance performance. When connectivity and willingness were put together, they seem to be a useful tool that improves the performance of the organization.

A study by Ristovska *et al*. (2017) in Macedonia on the effects of information exchange practices on performance of textile firms used a sample size of 36 textile firms. Data were pooled using questionnaire and analysis done with the aid of SPSS 22.t-test was used to determine the significance of each specific variable while f-test was used to determine the significance of the overall model. Multiple linear regression model was used to determine the relationship between the dependent and the independent variable. The researchers found that the relevance, timeliness and accuracy of information within and outside the company make it possible to achieve opportune and timely decision making.

Both Fawcett, (2007) and Ristovska *et al*, (2017) held that general information sharing positively affects the performance. The preciseness of data prevents making erroneous decisions and incurring pointless expenses, as well as whether the data is prioritized, then data processing time will be reduced and enable make critical decisions more rapidly. Fawcett (2007) and Ristovska *et al*. (2017) support Hübner, (2016) that electronic databases offer access to information whenever it is needed and the possibility for use over temporal and spatial distance when making crucial timely decisions and thus cause a decrease in lead time which will make the firm to meet its operation efficiency through complete management of information, pertinent data selection and monitoring, speedy transmission and apposite use of information thus increasing its success. However, both studies were based on supply chain performance while the current study will be based on operation performance.

Sharing information across supply chain partners permits them to synchronize their operations and streamline supplier-client relations. Since patented and private information is usually shared along the supply chain, maintaining the integrity of the shared information is an important concern. Against this background, Marinagi *et al*., (2015) examined the intervening role of information exchange on information quality and supply chain performance. A structured questionnaire was used in the field study comprising of a cross-sectional sample of firms in Central Greece. The sample consisted of 200 manufacturing SMEs obtained from ICAP database with 10 to 250 employees. The outcome reaffirmed and supported the mediating function of information exchange in Greece. The findings implied to managers that information exchange in the supply chain allows improved general performance occasioned by implementation of supply chain management principles that raise the dependability and quality of information. The current study bridges the gap by using information sharing practices as an independent variable to assess its effect on performance

Previous studies on SCM advocate that information sharing appears to be a substantial source of competitive edge. Koçoğlu *et al*., (2011) investigated the effect of supply chain integration on information exchange and enhancing performance of supply chain. The hypotheses were verified using data from 158 in top 500 Turkish Manufacturing companies manufacturing companies in Turkey that are listed Istanbul Chamber of Commerce. The results suggested that supply chain integration (SCI) which strengthens connectivity, collaboration and coordination among SC members performs a crucial role in information sharing process. In addition, findings offered helpful intuitions on how firms might use information exchange to boost the efficiency of their supply chains. The current study will bridge the gap by using food processing firms in Nairobi County, Kenya.

In Ghana, Baah *et al*., (2021) investigated how information exchange in supply chains affected organization performance by studying the functions of supply chain agility, collaboration and visibility. A descriptive research design and quantitative approach were used by the study. Furthermore, the partial least square structural equation modeling (PLS-SEM) was adopted in data analysis and interpretation owing to its potential in predictive research models. The results show that information exchange considerably and favorably affected the visibility, performance and agility of supply chain. While visibility of the supply chain had a substantial impact of performance, collaboration and agility largely influenced performance of the supply chain. The study outcomes underscored that information exchange is chief to boosting competitive gains and robust supply chain performance. The current study will employ descriptive research design and used of multiple regression model

Studies on information sharing practices and performance of supply chain have also been carried out in Kenya, though to a limited extent. Kimitei *et al*., (2015) sought to investigate how information sharing affected the association between performance and supply chain linkages among Nairobi County's flower companies. The study used explanatory research methodology and data gathered using a census approach on target population of procurement staff members of 34 flower farms that are under the registration of Kenya Flower Council in the County of Nairobi. Structured questionnaires were used to collect data, and data analysis also included the application of descriptive and inferential statistics. Pearson correlation was utilized to gauge correlation of variables whilst multiple regression model was espoused to analyze data to test the hypotheses. The study concluded that information exchange to a large extent moderated the link between performance and client linkages, supplier linkage and performance, and performance with internal linkages. The current study will use stratifies sampling, simple random sampling and use questioners for data collection.

Nyagah *et al.,* (2015) studied e-procurement and performance of supply chain while focusing on New KCC in the dairy sector in Kenya. Descriptive design was espoused. The study established that a positive association between e-procurement measured as ERP, electronic order processing, information exchange and e-supplier evaluation and supply chain performance. Similarly, Mutangili (2019) performed a study on e-procurement practices and performance of supply chain focusing on Kenya Airways. The study utilized a desk-study review method where existing empirical studies on e-procurement were reviewed and results related to the airline industry. The study established that information sharing together with, e-order processing and e-supplier evaluation largely impacted supply chain performance. It was also determined that the correctness of data is raised by the electronic transfer of procurement information leading to better decision-making process. Furthermore, having access to correct data that improves customer relations is vital for management of enterprises that need to promptly respond to client demands. This study filled the gap by determining how data need and integrated information affects the performance of food processing firms.

Wairingu (2015), sought to establish the effects of information sharing on supply chain performance of manufacturing firms in. Nairobi County, Kenya. To evaluate the broad goal of the investigation, a descriptive research design was chosen. 463 manufacturing businesses with locations in Nairobi County made up the research's target population. A proportionate stratified random sampling procedure was used to select a sample of 100 businesses. Utilizing questionnaires that were distributed using the drop-and-pick approach afterwards, primary data was gathered. Utilizing both descriptive and inferential statistics, the acquired data was examined. Data analysis was aided by the use of a statistical tool for the social sciences. Tables and figures were used to present the results. The study established that customer and supplier firm relationships, sharing of sales information, sharing of order information, sharing of delivery information, and sharing of delivery information all significantly impacted supply chain performance in the manufacturing firms in Nairobi County, Kenya.

Regression study revealed a favorable link between the independent variables and supply chain performance. The study found that information sharing helped manufacturing companies set up market exchanges, which facilitated advance planning for on-time delivery and quick reaction. Additional conclusions included the fact that sharing order information kept businesses informed of changes to purchase orders, allowing for the formulation of highly accurate and dependable order plans that lower supply chain costs. The study suggests that, in order to strengthen sharing,

management of manufacturing enterprises should implement more sales information sharing techniques and technology level. The current study aims to bridge the above gaps by carrying out the study in different context, (food processing firms in Nairobi County), using different dimensions (information sharing policy, integrated information system and data need) to determine how they affect the performance of food processing firms.

The objective of the study was to investigate the effect of information sharing practices on performance of food processing firms in Nairobi County. The null hypotheses were that there is no statistically significant relationship between information sharing practices and performance of food processing firms in Nairobi County.

METHODOLOGY

The study adopted descriptive research design since it facilitated in choosing and grouping of the components and features of object. The study covered 120 food processing firms out of 172 firms in Nairobi County. Stratified Simple random sampling was used to come up a sample size of 120 food processing firms. Data was collected using a questionnaire. Descriptive and Inferential statistics were used to analyze data. Simple and Multiple linear regression analyses were then conducted using SPSS software version 28.0 in order to address study objective. Assumption of linear regression model of normality, multicollinearity and heteroskedasticity were tested before analyzing data.

RESULTS AND DISCUSSIONS

Diagnostic Tests

Test for Normality

Shapiro-Wilk Test was used to test for normality (Aczel & Sounderpadian, 2002). The p-value of Shapiro Wilk Test was 0.944 which is greater than 0.05 (insignificant) hence a conclusion that the residual was normally distributed.

Multicollinearity Test

Incidence and degree of multicollinearity if any was tested using Variance Inflation Factor (VIF). The VIF value was 1.166 less than 10 therefore, multicollinearity was absent. Multicollinearity may lead to wrong results due to its effect of inflating the predictor variables (Cooper & Schindler 2003).

Heteroskedasticity Test

This study used P-P plot to determine if the residuals had constant variance because they are best in the presentation of spread of residuals. The results indicated no specific pattern and the widths were neither increasing nor decreasing as the variables rise. Therefore, heteroskedasticity is absent.

Information Sharing Practices and Performance

Information Sharing Practices was measured in terms of information sharing policy, integrated information system and data needs. Performance was measured using low level of Wastages, maximum utilization of resources and cost reduction. Descriptive statistics such as mean, standard deviation, range, minimum and maximum for information sharing practices and performance were carried out. The summary of descriptive statistics is shown in Table 1.

Information sharing practices had a mean of 3.5750 which implies that food processing firms benefit from information sharing practices. As shown in Table 1 above, the mean for performance was 3.9450 for all the food processing firms which represents the average performance of the food processing firms.

Pair Wise Correlation between the Study Variables

Correlation determines the direction of a relationship between any two variables (Table 2). The results also show that information sharing practices had a Pearson correlation of 0.244 and a p-value of $0.029<0.05$ implying a positive and statistically significant relationship between performance and information sharing practices. This is because sharing of information enhances performance of food processing firms. This suggests that an increase in information sharing practices would lead to statistically significant increase in performance.

Multiple Linear Regression

This study determined the significance of information sharing practices on performance of food processing firms in Nairobi County. A multiple linear regression was used to examine the relationship between information sharing practices and performance. A multiple linear regression analysis is represented in Table 3.

Table 29: Descriptive statistics

	ISP	P
Mean	3.5750	3.9450
Standard Deviation	0.6096	0.6770

Where: ISP-Information Sharing Practices
P-Performance

Table 30: Pearson correlation between study variables

Variables	P	ISP
P	1	0.244
ISP	0.244	1

Table 31: Coefficients estimates of Information Sharing Practices and Performances

Model		Unstandardized Coefficients		Standardized Coefficients		Sig.
		B	Std. Error	Beta	T	
1	(Constant)	3.058	.404		7.568	.000
	Information Sharing Practices	.247	.112	.218	2.210	.029

R^2=0.047

Table 3 above shows that the regression coefficients of information sharing practices was 0.247 with a p-value of 0.029<0.05 hence information sharing practices had a positive and statistically significant effect on performance. The R^2 of the model was 0.047 indicating a model where 4.7 % of the changes in performance could be accounted for by information sharing practices, while 95.3% of the changes would be attributed to other factors not included in the study and the error term. This means a unit increase in information sharing practices would result to 0.247 units increase in performance holding other factors constant. Therefore, the null hypothesis was rejected and this implied that there is a statistically significant relationship between information sharing practices and performance.

The study adopts the view that information sharing practices was an important consideration that need to be made when determining the performance of food processing firms in Nairobi County. These results are consistent with Ristorska (2017) who carried out a study in Macedonia on the effects of information exchange practices on performance of textile firms. The researchers found that the relevance, timeliness and accuracy of information within and outside the company makes it possible to achieve opportune and timely decision making. The findings also reflect those of Manangi *et al*. (2015) who found out in their study on intervening role of information exchange on information quality and supply chain performance that information exchange in the supply chain allows improved general performance occasioned by implementation of supply chain management principles that raise the dependability and quality of information. These results also match with those reported ealier by Kocoglu *et al*., (2011), whose findings offered helpful intuitions on how firms might use information exchange to boost the efficiency of their supply chains. The results further corroborate the findings of Baah *et al*. (2021) which showed that information exchange is chief to boosting competitive gains and robust supply chain performance.

However, the findings of the current study do not agree with the previous research of Kimitei *et al*., (2015) who found that information sharing practices affected performance negatively. Theoretically, these findings fail to concur with Julong Deng 1985 on the grey system theory that there is no free flow of information and complete messages.

The present findings suggest that information sharing practices could significantly improve the performance of the food processing firms since most of the supply chain managers opined that their firms do generate data that could be shared across the supply chain as the needs arises. The simple regression model for effect of information sharing practices on performance is therefore presented by the equation below.

$Y=3.058+0.247\ X_1$

CONCLUSION

The study concludes that an increase in information sharing practices leads to an increase in performance. Therefore, food processing firms should develop strategies to ensure free flow of information to enhance performance of the food processing firms.

RECOMMENDATIONS

It is recommended that food processing firms should transfer information inside the organization and to maintain the organization's operations, enterprises must promote information exchange procedures. Firms should also invest more in the information sharing platforms such as the EDI to enhance free flow of information.

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INFLUENCE OF FLEXIBLE WORK ARRANGEMENT ON ORGANIZATIONAL PERFORMANCE IN THE BANKING INDUSTRY IN KENYA

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ABSTRACT
Customer satisfaction and customer service being the prime work in the banking sector has evoked changes which consequently have brought changes in work setups. For example, employees in the banking sector in Kenya are more involved in their jobs, working longer hours more than 48 hours (ILO 2020) hence making it difficult for employees to keep a balance between job, family and other personal issues. This has resulted in work life conflicts which has been found to be associated with mental health issues like stress and depression. The study objective was to determine the influence of flexible work arrangement on organizational performance in the banking industry in Kenya. This study adopted across sectional survey. The target population covered 43 banks focusing on branches in Nairobi. Primary data was collected using questionnaires that had both structured and unstructured questions. On data analysis, multiple regression analysis was used to regress relationship between flexible work arrangements and organizational performance. It was found that work place flexibility initiatives are increasingly seen as a critical component of a result-driven workplace. More and more organizations are recognizing how flexible work arrangements can be used to meet their business objectives and facilitate employee effectiveness on and off the job. The study concluded that consideration of flexible work arrangement aspects that pertains to employees, can greatly influence organizational performance in banks in Kenya. Child care issues, dependent care and employees having more time with the family had a positive and significant linear relationship on organizational performance which were customer satisfaction, target standards, employee satisfaction. The study recommends that managers should provide flexible work arrangements considerations such as giving employees flexibility on when to begin and end work as long as they meet the target since this influences organizational performance.
Keywords: Influence, Flexible Work Arrangement, Organizational Performance, Banking

INTRODUCTION
For many employees today both male and female lives are becoming more consumed with a host of family and other personal responsibilities and interests in addition to demands of the workplace (Grantol-Vallore & Donaldson, 2001). There is therefore a perceived imbalance between the demands of current lives and people's abilities to adequately cope with them and this may lead to an experience of stress (World of Work Report, 2011). In the current global work environment, there is intense competition for talented employees and for market share based on higher product quality and lower prices in order to realize strategic advantage. Competition also requires organizations to take into account diversity of employee's needs, work life values, cultural influences in the areas where the companies operate as well as the diversity of working relationships in order to attract, retain and fully engage the employee.

As many organizations come to terms with these challenges of attracting and retaining the best talent coupled with the emerging issues of work life conflicts, it is important that managers employ a variety of human resource practices to attain organizational goals (Mclean& Collins, 2011).Three major factors contribute to the interest in and importance of serious consideration of flexible work arrangement: global competition, renewed interest in personal lives, family values and an aging workforce. Concerns have always been raised regarding policy and debates on flexible work arrangement from perspectives of the quality of working life when weighed against the broader family matters. However, the challenge has been how employees would adopt good flexible work arrangement practices and the organizations to adopt policies to tackle conflicts that ensue from the interface of family or social pressures and work stress.

Statement of the Problem
The fast pace of economic development in the 20th century across the globe has created new endeavors for the organizations. Globalization has changed the world into a global village where this change has pushed the organizations like the banking sector to strive hard to gain and sustain their competitive advantage. Customer satisfaction and customer service being the prime work in the banking sector has evoked changes which consequently have brought changes in work setups (Korir, 2015). For example, employees in the banking sector in Kenya are more involved in their jobs, working longer hours more than 48 hours (IL0, 2010) hence making it difficult for employees to keep a balance between job, family and other personal issues (Muhammadi et al., 2009). Hence this has resulted in work life conflicts which has been found to be associated with mental health issues like stress and depression (Beck & Davis, 2004) which in the long run affects performance of the organization. International labour organizations

global report on flexible work arrangement of 2010 rates Kenya among those with the highest prevalence of long working hours more than 48 hours per week (ILO, 2010). Moreover, the banking sector in Kenya is said to be the most affected by work life imbalances ranking 3 in a list of 24 industries (ILO, 2010) raising concerns from key stakeholders in the country because of work life conflict and life work conflicts. Research has shown that WLB is associated with reduced levels of stress and somatic complains, increased job satisfaction and reduced labor turnover as well as organizational performance (Rathi & Barath, 2013). Little research has been done on Flexible work arrangement programs as a way of improving performance among commercial banks in Kenya (Kamau et al., 2015)

Research Objective

The study objective was to determine the influence of flexible work arrangement on organizational performance in the banking industry in Kenya.

Hypothesis

H01: There is no significance influence of flexible work arrangement on organizational performance in the banking industry in Kenya.

Scope of the Study

The study covered all the 43 banks registered by Central Bank of Kenya focusing on branches in Nairobi. Specifically, the study sought to determine the influence of Flexible work arrangement programs on organizational performance on organizational performance in the banking industry in Kenya.

LITERATURE REVIEW

Component Theory

The theory emphasizes balance as a direct formative latent construct (Edwards and Bagozzi, 2000), which means that flexible work arrangement consists of multiple facts that precede balance and give meaning (Grzywacz & Carlson, 2007). According to Greenhaus et al., (2003), flexible work arrangement consists of time, involvement balance and satisfaction balance. Work life balance consists of time balance, involvement balance and satisfaction balance of which time balance refers to equal time devoted, involvement balance refers to equal psychological effort and presence invested and satisfaction balance refers to equal satisfaction expressed across work and family roles According to Frone, (2003), in turn , flexible work arrangement consists of work life conflict and work life facilitation (corresponding with role conflict and enhancement respectively).The advantage of the component approach over the overall appraisals approach to flexible work arrangement is that one can use conceptually based measures of balance that tap into the different aspects of flexible work arrangement. These aspects form the overall evaluation of how well an individual is meeting role related responsibilities (Grzywacz & Carlson, 2007). The advantage of the component approach over the overall appraisals approach to work life balance is that one can use conceptually based measures of balance that tap into the different aspects of work life balance. These aspects form the overall evaluation of how well an individual is meeting role related responsibilities (Grzywacz & Carlson, 2007).

Empirical Review

Flexible Work Arrangements

Hill et al., (2001) investigated the extent to which flexible hours and flex place arrangements resulted in benefits for individuals (more satisfactory work family balance) and organizations (longer work hours). They reported that given a reasonable work week which they considered to be between 40 and 50 hours) per week, employees who perceived flexibility in the timing and location of their work, had less difficulty with work-family balance. Moreover, Hill et al., (2001) reported that employees with perceived flexibility in the timing and location of work could work longer hours.

Organizational Performance

Firm performance is the outcome achieved in meeting internal and external goals of a firm (Lin et al 2008). Performance has several outcomes including growth, survival, success and competitiveness. Better performing employees at work become more committed to their organizations and ultimately contribute to increased organizational performance as well as growth of the economy. To achieve this flexible work arrangement is important. Availability of flexible work arrangement practices have also been related to increased affective commitment and decreases turnover intentions among all employees not just users of the practices (Grover & Crooker 1995). Organizations offering flexible work arrangement practices enjoy increased profit rates. Consequently, WLB helps employees improve relationships with family and friends. Employees will enjoy better physical and mental health by managing work life properly. The existent literature suggests that W.L.B practices generally have a positive impact on individuals and organizational productivity Pfizer Canada reported a 30% productivity increase in its translation department when employees were provided with flexible work arrangement and specifically telecommuting. Focusing on customer service specifically KPMG has reported that allowing employees to take emergency time off to attend to care responsibilities has been a driving force behind their retention and superlative services provision (Ioan, 2010)

RESEARCH METHODOLOGY

This study adopted a descriptive survey research design using both qualitative and quantitative approaches. Quantitative approach because it places emphasis on methodology, procedure and statistical measures to test hypothesis and make predictions. (Mugenda, 2003, Saunders, 2009). Qualitative approach was also used because it provides greater depth to response and understanding which forms a link with respondents (Berg, 2001).This research design has been used in previous studies by Baughman, DiNardi & Holtz (2003); Mukanzi, Gachunga, Karanja & Kihoro (2014).

The target population consisted of 43 registered banks by the central bank of Kenya (CBK, 2015). These consisted of banks located in Nairobi because major banks have their busiest and main branches in Nairobi and most of their headquarters are in Nairobi with a target population of 36,212 employees (Bank Supervision Annual Report, 2015).

The sample size was determined by use of the following formula;

$$n = \frac{Z^2 pq}{e^2}$$

n adjusted = $\frac{N\ n}{N+\ n}$

$$n_{adjusted} = \frac{Nn}{N+n}$$

Where

n = number of samples, N=Total population and e= precision level 0.05.

z=Standard normal distribution set at 1.96 corresponding to a confidence level of 95%

p=probability of success (0.5)

q=probability of failure

In this case the target population being 36,212 at 0.05 level of significance, the sample size was:

$$\frac{0.96\times 36{,}212}{0.05^2(36{,}211)+0.96}$$

$$\frac{34{,}763 2.52}{91.4875}$$

379.9

= ~380 Respondents

But to cater for discrepancies such as uncollected or incomplete questionnaire and for accuracy of the study more than 400 questionnaire were distributed in the field and precisely 450 questionnaires. Salant and Dillman (1994) noted that the sample size should be increased when using stratified samples to maintain necessary precision . This is an evidence from the study to show that more questionnaires above the sample size can be distributed for accuracy.

The multiple regression model for this study was:

$Y = \beta 0 + \beta 1X1 + e$

Y Organizational performance

X1 Flexible work arrangements
Bo Constant
e Stochastic term (error

RESULTS AND DISCUSSION

Regression Analysis of Flexible work arrangement and Organizational Performance

Test to determine the amount of variation on dependent variable explained by the independent variable flexible work arrangement were carried out. Results in table 1a, 1b, 1c below shows. The amount of variation on the dependent variable explained by the independent variable. The **results of regression analysis revealed that there is a significant positive relationship (β = 0.262,** p< 0.001) between flexible work arrangement and organization performance. This means that increase in the use of flexible work arrangements in the organization will lead to increase in organization performance in the banks in Kenya. The independent variable reported R value of 0.262 and R^2=0.068 which means that 6.8% of corresponding variations in organization performance can be explained/ predicted by flexible work arrangements. The rest of the variation 93.2 % could be explained by other variables not included in the model. The model is performance =1.979+ 0.165 (flexibility work arrangement index).

The F test gave a value of F (1,411) =30.223, p < 0.001) which is relatively large enough to support the goodness of fit model explaining the variations in the dependent variables. This validates that flexibility is a useful predictor of organizational performance. The results of regression analysis revealed there was significant positive relationship (0.262, p<0.001) between flexible work arrangement and organizational performance. This implies that employees who experience higher levels of flexible work arrangement tend to have higher performance. Respondents indicated that when provided with leave, not working during weekends, creating more time for personal matters, reducing working hours will ensure they have a fulfilled flexible work arrangement. Therefore, H01 of the study is supported which states that there is no significance influence of flexible work arrangements on organizational performance in the banking industry in Kenya; hence we reject the null hypothesis. This shows that the regression model has less than 0.001 likelihood (probability) of giving a wrong prediction. Hence the regression model has a confidence level of 95%

Discussion of Findings for Flexible Work Arrangement on Organizational Performance

The objective for this study was to determine the influence of flexible work arrangement on organizational performance in the banking industry in Kenya. The coefficient for flexible work arrangement was 0.158. This means that unit change in flexible work arrangement will result to a change in organizational performance by a factor of 0.158 at 5% significant level. The results of regression analysis revealed that there is a significant positive relationship (β = 0.262, p <0.001 (see table 1 c) between flexible work arrangement and organization performance. Baltes et al., (1999) also found positive effects of flexible work schedules on productivity in their meta-analysis.

In reviewing the results from studies conducted by Newstrom (1982; 1983), Kossek and Ozeki (1999) concluded that a more limited amount of flexibility was optimal in predicting improved performance, with employees specifying in advance what hours they would work, rather than varying their schedule on an ad hoc basis. Findings by Porter (2008) argued that flexible work arrangement and demand for services have substantially increased. As work become more flexible, they demand new management skills, hence better and reliable service delivery, as well as more responsive services; As a consequence, to improve flexible arrangements on e.g. day off, annual leave and night outs, workers needs and expectations satisfy them hence provide excellent services to the employer. These results also agree with Tumi (2005) who argued that understanding the nature of the flexible work one provides to the employer allows for an appreciation of how the workers see the services provided.

According to De-Tumi (2005), in any work flexibility, the employee's performance is crucial to one's ability to ensure that they are satisfied beyond expectation. This helps to give employees not what is obvious but also fulfill a multitude of less obvious employee's needs (De-Tumi, 2005). This results again agrees with findings by Christopher (2014) where the respondents indicated that having the opportunity to adapt their work schedule according to their own needs brings along positive attitudes not only in their personal life but also in their work-life. The study showed that flexible working hours offered respondents the opportunity to put in the necessary effort and energy in their work during the moments that counted most.

Figure 1. Conceptual Framework

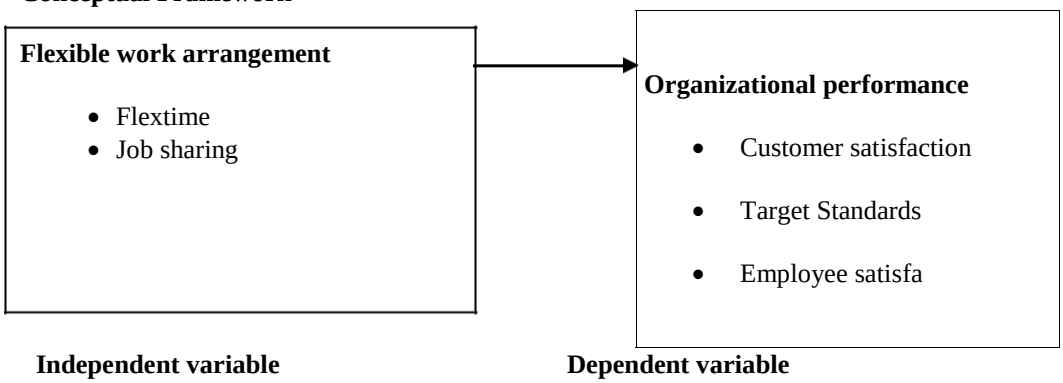


Table 1a Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.262[a]	.068	.066	.41616

Table 1 b ANOVA[b]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	5.234	1	5.234	30.223	.000[a]
	Residual	71.182	411	.173		
	Total	76.416	412			

Table 1c Coefficients[a]

		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	T	Sig.
1	(Constant)	1.979	.080		24.879	.000
	Flexible work arrangement	.165	.030	.262	5.498	.000

a. Dependent Variable: Organizational performance

Chow and Keng-Howe's (2006) study of workers in Singapore revealed that the more flexible their schedules, the greater their self-reported productivity. With regard to contextual performance, the perceived usefulness of available practices has been found to predict increased organizational citizenship behavior (Lambert, 2000). The findings of

this study from the qualitative data indicated that employees desired to have more considerations on flexible work arrangements and avoiding reporting to work early would ensure they do not leave the organization hence they desired the organization to adopt such practices for increased performance. Informants also noted that their organizations should offer scholarship and support further education as part of flexible work arrangements hence this would ensure increased performance for their part. Reduction of working hours was also sated as a way in which the banks would enable employees had quality time with family, personal, leisure and work which would enable them to increase their performance.

SUMMARY

Work place flexibility initiatives are increasingly seen as a critical component of a result-driven workplace. More and more organizations are recognizing how flexibility can be used to meet their business objectives and facilitate employee effectiveness on and off the job. The way organizations handle issues of flexibility means that organizations may struggle to attract and retain top talent, lose out to other more innovative companies and experience reduced profits. The research attempted to establish whether the organization allowed employees flextime, flexible career paths and job sharing as some of the ways to ensure flexible work arrangement. Based on the findings of this study, flexible work arrangements had a significant effect on the organizational performance of banking industry in Kenya.

Organizational performance in the banking industry in Kenya when measured in terms of customer satisfaction, target standards and employee satisfaction was positively influenced if employees were allowed flexible work arrangements. The predicting power of R square when flexible work arrangements was introduced in the regression model was statistically significant(R^2=0.068) implying that flexibility had influence on organizational performance in the banking industry in Kenya and therefore the null hypothesis H03 was rejected. The results of regression analysis revealed there was significant positive relationship p<0.001) between flexible work arrangement and organizational performance. This implies that employees who experience higher levels of flexibility tend to have higher performance.

Respondents indicated that when provided with leave, not working during weekends, creating more time for personal matters, reducing working hours and reducing early reporting to the place work would ensure they have a fulfilled flexible work arrangement. Therefore, taking into consideration that flexible work arrangements practices were provided for to some extent by the banking industry in Kenya that were sampled in this study, it is then likely that these practices can help increase organizational performance in the banking industry in Kenya.

The study showed that flexible working hours offered respondents the opportunity to put in the necessary effort and energy in their work during the moments that counted most. The study gave evidence that those organizations and managers who are result oriented are more open to flexible working benefits since their main goal is the end result rather than the method used to achieve.

CONCLUSIONS

Based on the results of this study, it can be concluded that consideration of flexible work arrangements aspects that pertains to employees, can greatly influence organizational performance in banks in Kenya. Child care issues, dependent care and employees having more time with the family had a positive and significant linear relationship on the measures of organizational performance which were customer satisfaction, target standards, employee satisfaction. The multiple regression results of this study indicated that there is linear relationship between flexible work arrangement and organizational performance.

RECOMMENDATIONS

The study recommends that managers should consider flexible work arrangements considerations since this influences organizational performance. Flexible career paths and encouraging job sharing as a form of flexibility is important in increasing performance of and organization. The research recommends that organizations should diagnose employees flexible work arrangement practices needs and develop practical solutions by implementing them so as to be able to achieve business goals.

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EFFECT OF CONTRACT COST CONTROL ON OPERATIONAL EFFICIENCY OF COMMERCIAL STATE CORPORATIONS IN KENYA

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ABSTRACT
Commercial state corporations are formed to offer essential goods and services to the general public. Despite government efforts to improve their effectiveness, commercial state corporations have continued to perform dismally characterized by poor resource utilization leading to massive losses, increased customer complaints and frequent bailouts by the government over defaulted loans. Some studies have associated this with poor contract cost control however the magnitude of its effect on operational efficiency has not been established. The objective of the study was to establish the extent to which contract cost control affects operational efficiency of commercial state corporations in Kenya. Descriptive Cross-sectional research design was used. The target population of this research comprised thirty-three commercial state corporations in Kenya and a census was undertaken. The study utilized primary data. A questionnaire was used to collect primary data among the thirty-three commercial state corporations in Kenya. Multiple linear regression analysis was used to examine the relationship between variables and t-statistic at 5% significance level was employed in testing hypothesis. The overall significance was tested using F-test. The study established a positive significant effect of contract cost control on operational efficiency with regression coefficient of 0.181 with a p-value of 0.006. Corporations that implement contract cost control are able to prevent cost overruns and complete contracts within the agreed budget thus providing rational utilization of resources and minimizing wastage thus increasing operational efficiency. The study recommends that to ensure effective contract cost control and guarantee that contracts are fulfilled within the set contract price, anticipated costs should be assessed and included in the budget.
Keywords: Contract cost control, Operational Efficiency and Commercial State Corporations

INTRODUCTION
According to Abobakr (2018) contract cost control entails the means of determining and lowering a firm's operating costs in order to boost revenues with an aim of optimizing the use of resources to provide maximum advantage to all stakeholders involved. Commercial state corporations should carry out contract cost control so as to achieve cost savings by revealing possible sources of economy in contract implementation, thus delivering the contract within the approved budget while avoiding cost overruns (Akeem, 2017). Commercial state corporations handle high value contracts which should be delivered at a specified cost within a given deadline thus contract cost control is vital (Presidential Taskforce on Parastatal Reforms (PPTR), Mohammed & Awuondo, 2013). Control of costs for any contract is essential since any delay in completion or cost escalations may lead to cost overruns (Yegon, 2018). Thus it is vital to carry out contract cost control so as to minimize on the contract costs incurred in the contract execution and help ensure the contract is implemented for the amount agreed-upon thus providing efficient utilization of resources (Akeem, 2017). Poor contract cost control can lead to cost overruns which necessitates channeling of more resources for contract completion and delay in completion which would in turn hamper customer service provision.

Information Communication Technology(ICT) integration was used as a moderating variable and it involves collaborative communication and the integration of telecommunication and software tools including visual and storage programs which allow different people to access, distribute, record, and manipulate information (Atieno,2014). ICT integration can be evaluated by presence of relevant ICT infrastructure in a firm and ICT competence of the staff involved. A firm that adopts ICT in its operations will control costs effectively as compared to those that lack ICT.ICT integration provides a set of built in monitoring tools and automates the cost management systems which help to monitor contract costs thus reducing aspects of cost overruns and ensuring rational utilization of available resources (Igwe et al., 2020). Organizations that invest in ICT could reduce their operating costs and improve service quality (Muthuri, 2014; Gakuubi, 2018).

Operational efficiency can be measured using assets turnover, capital investment yield, sales turnover and equity return (Ndolo, 2015), customer satisfaction (Akinriola, 2019), resource utilization (Khan & Shireen, 2020) and waste management (Nasra, 2014). This study measured operational efficiency in terms of customer satisfaction, resource utilization and waste management since from previous research these are the most critical aspects that entails

operational efficiency. When an organization is able to maximize outputs and minimize inputs, cut down on wastages and enhance its capacity to offer customers high-quality goods and services it is deemed to be operating efficiently.

Akeem (2017) examined the effect of cost control and cost reduction techniques in organizational performance of companies in Nigeria. The study used purposive sampling to select a sample size of 50 respondents. A descriptive research design was used and a case study technique was employed. The study established that cost control and cost reduction techniques have a positive impact on organizational performance. This study used purposive sampling and focused on organizational performance while the current study conducted a census and focused on operational efficiency.

Ayodele et al., (2014) studied the effect of contract cost control on building projects delivery in Nigeria. The study sought to determine the effects of cost control techniques on building projects delivery. The study adopted bill of quantities, cost documenting and cost records as the cost control techniques. The study adopted descriptive research design. Both primary and secondary data was used. The study observed that the use of bill of quantities as a cost control measure, cost documenting and keeping of cost records helped in cost regulation. High costs were a result of the emergence of variations and fluctuations in the original plan. The above study used bill of quantities, cost documenting and cost records as the measures of contract cost control whilst the current study considered different measures of contract cost control which included cost budgeting, cost management system and cost documenting and assessed their effect on operational efficiency of commercial state corporations in Kenya.

An analysis of the determinants of procurement contract management on organizational productivity was done by (Ochola & Kitheka, 2019) in Kenya. It aimed to establish the significance of contract documentation, cost control, and contract monitoring for the productivity of the company. A case study research approach was applied and 70 respondents made up the sample. Structured questionnaires helped in obtaining primary data which was processed through quantitative techniques of information analysis and presented in terms of percentages and frequencies. Regression analysis was carried out sing SPSS version 21. The study used cost budgeting, cost management system and performance measures as the indicators of contract cost management. The results indicated that contract cost control displayed a moderate effect on efficiency within firms. In the aforementioned study, a case study research design and sample size of 70 respondents was used for research while the current study utilized a descriptive cross sectional study approach and considered a population of 33 respondents.

Matto et al., (2021) examined the influence of procurement contract management on value for money procurement in Tanzania. The study examined the effect of contract cost control, contract time management, contract quality control and contract formation on value for money procurement. The study used cost budgeting and cost documenting as the measures of contract cost control. The study applied a cross sectional research design. Random sampling technique was used to select a sample size of 164 respondents. The study concluded that contract formation and contract quality control were significant predictors of value for money while contract cost control and contract time management were not significant aspects that predicted value for money. This study used value for money as the dependent variable and considered a sample size of 164 respondents and concluded that contract cost control did not affect value for money while the current study was carried out in all the 33 commercial state corporations in Kenya using operational efficiency as the dependent variable to check whether different results will be obtained.

Lakayisenga and Mulyungi (2018) examined the impact of cost control on the performance of commercial banks in Rwanda: a case study bank of Kigali. The study sought to determine the effect of operational costs on performance. The study utilized a descriptive research design. Primary data was collected using interviews and questionnaires. The population of this study was 305 employees of Bank of Kigali from which a representative sample size of 75 respondents was selected. The researcher concluded a significant positive correlation between operational cost control and performance of bank of Kigali. The above study was carried out among commercial banks in Rwanda , adopted a descriptive research design on a sample size of 75 respondents whereas the current study was carried out among the 33 commercial state corporations in Kenya using a descriptive cross sectional research design.

Rasheli (2016) investigated procurement contract management in Tanzanian local municipalities. The main aim was investigating the transaction costs incurred when handling procurement contracts in upper and lower level municipal governments. A multiple case study methodology and secondary data were both employed. The sample size was five local government authorities. The study observed that the lower level municipal governments incur excessive transaction costs which is attributed to their inability to manage procurement contracts among wards. This study used

secondary data, applied a case study design and the sample size was five respondents whereas in this analysis primary data was employed and a census was adopted on a population size of 33 respondents in assessing how contract cost control affects the operational efficiency of commercial state corporations in Kenya.

Gichuki (2014) examined the effect of cost management strategies on the financial performance of manufacturing companies listed on the Nairobi securities exchange. This study sort to find the effects of selected strategies namely; cost of labor, cost of distribution and cost of stock and their effects on financial performance of manufacturing companies. The study use causal research design specifically multi – variance linear regression model. Study population was six out of eight manufacturing companies listed, on Nairobi security exchange. The study findings revealed that cost of labor, distribution and stock were positively related to financial performance of the manufacturing companies. This study adopted cost of labor, cost of distribution and cost of stock as the indicators of cost control while the current study used cost budgeting, cost documenting and cost management system as measures of contract cost control in assessing its effect on operational efficiency of commercial state corporations in Kenya.

Siyanbola and Raji (2013) carried out a study on the impact of cost control on manufacturing industries profitability. The study considered budgeting as the basic tool for achieving effective cost control. Data was collected using direct interviews, observations and the use of questionnaire. A representative sample of 74 respondents was drawn from the employees of West African Portland Cement company. Pearson correlation model was used in analyzing the data and the hypothesis tested revealed that cost control had a positive effect on profitability of industries.

The study further concluded that budget as a tool, can only help ensure effective cost control, when actual costs expended are compared with planned cost and the variances are analyzed to see their causes in order for the management to take corrective actions. The study observed that Cost control had a positive impact on business profitability through reduction of wastages and losses; effective utilization of materials; labor resources and other inputs in the production cycle. The above study used cost budgeting while the current study adopted cost documenting, cost management system and cost budgeting as measures of contract cost control to check whether different results would be obtained.

Malkanthi et al., (2017) analyzed the impact of cost control techniques on cost overruns in construction projects. The study sought to determine the effect of cost estimating, cost budgeting and cost controlling. A questionnaire survey was conducted to collect the data. The data collected was analyzed by converting it into quantitative values using percentage analysis and weighted score analysis. A sample size of 23 respondents was selected using random sampling method. The study findings indicated that the cost controlling practices were important in minimizing the cost overruns in order to reduce over budget and overheads while securing anticipated profits. The above study used a sample size of 23 respondents and used cost overruns as the dependent variable while the current study was conducted in all the 33 commercial state corporations in Kenya using operational efficiency as the dependent variable to check whether different results would be obtained.

Lucy (2018) carried out a study on cost control measures on the performance of industries in Kampala District, Nakawa Division: A Case Study of Steel and Tube. The study considered having a cost management system as the measure of cost control and assessed its effect on firm performance. Exploratory research design was used A representative sample of 130 respondents was used in the study. Primary data was collected using questionnaires and interviews. The study findings revealed that there was a positive effect of cost control on firm performance. The study further found out that the organization had a costing system in place and therefore costs incurred in the organization were systematically controlled leading to high performance of the organization. The above study used exploratory research design while the current study used a descriptive cross sectional research design and adopted ICT integration as the moderating variable in investigating the effect of contract cost control on operational efficiency of commercial state corporations in Kenya.

A study on integrating procurement contract management practices into the achievement of value for money was conducted by Mchopa (2015) in Tanzania. The study considered contract cost control as a procurement contract management practice and assessed its effect on the achievement of value for money. Cost control was measured in terms of use of contract budget. Purposive sampling technique was used to pick a sample of 48 respondents. Both primary and secondary data was used and the study did not use a moderating variable. This study used both primary and secondary data and applied case study research design whereas the current study only used primary data, adopted

ICT integration as a moderating variable and descriptive cross sectional research design to determine effect of contract cost control on operational efficiency of all commercial state corporations in Kenya.

Mwangi (2020) investigated impact of contract management techniques on how county governments performed in Kenya. The study examined the effect of contract cost control and contractor relationship management. The study adopted a descriptive survey design and chose a population of 96 respondents using random sampling. Primary data was utilized and was collected using questionnaire. The study adopted cost flexibility, cost budgeting and cost management system as the measures of contract cost control. The research showed that contract cost control impacted the performance of county governments positively. The above study adopted descriptive research methodology and concluded that cost control affected performance while in this study a census technique was used in analyzing whether different results would be obtained in determining how contract cost control affects operating efficiency of commercial state corporations in Kenya.

Kipkemoi and Makori (2021) examined the influence of procurement contract management practices on operational efficiency of state corporations in Kenya. The study sought to investigate the effect of contract cost control, contract quality management and contract time management on operational efficiency. The study adopted descriptive research design. The target population comprised of head of departments in state corporations in Kenya which totals to 162. This study was a census survey of all 162 state corporations in Kenya. Primary data was collected using questionnaires. The response rate of the study was 80%. The study conducted a correlation analysis to establish the strength of the relationship between the independent and the dependent variable and positive and significant relationships were established. The study found that procurement contract management had a positive effect on operational efficiency where the relationship between contract cost control and operational efficiency was significant. The above study was conducted in all the state corporations and used a population size of 162 respondents. Based on the above study a methodological gap was identified. Thus, the current research sought to address this gap by using representative sample of 33 respondents and focusing only on commercial state corporations.

Yegon (2018) examined the determinants of procurement contract management in selected commercial state corporations in the county of Nakuru. The main objective of the study was to determine how contract requirements compliance, contract monitoring, cost management, and contract documentation affected procurement contract management. The study adopted a descriptive research methodology and the representative sample was 10 state corporations. Primary data was used and was collected using questionnaires. Regression analysis was used to evaluate the collected data obtained in the research. The study employed budgetary control, cost control, and cost management system as the indicators of cost management. The study found that there was a moderate impact of cost management on contract management. The above study was restricted to 10 corporations in Nakuru County however, the present study assessed all of Kenya's commercial parastatals. In the current research different indicators of contract cost control namely cost budgeting, cost documenting and cost management system were used in exploring the effect of contract cost control on operational efficiency.

While past studies have not used a moderator in variable linkage, this study conceptualized that the effect of contract cost control on operational efficiency could differ for firms with different level of ICT integration and hence use of ICT would bridge a significant gap in literature. Therefore, this research established the effect of contract cost control on operational efficiency and the moderating effect of ICT to this relationship.

Objective of the Study

The objective of the study was to determine the effect of contract cost control on operational efficiency of commercial state corporations in Kenya

$H0_1$: There is no statistically significant relationship between contract cost control and operational efficiency of commercial state corporations in Kenya

METHODOLOGY

The study adopted descriptive cross sectional research design since it facilitated in choosing and grouping of the components and features of object. The study covered all the 33 commercial state corporations in Kenya. Census technique was used since the population was small. Primary data was collected using a questionnaire. Descriptive and Inferential statistics were used to analyze data. Simple and Multiple linear regression analyses were then conducted

using SPSS software version 28.0 in order to address the study objective. Assumption of linear regression model of multicollinearity, homoscedasticity, normality and autocorrelation were tested before analyzing the data.

RESULTS AND DISCUSSIONS

Contract Cost control and Operational Efficiency

Contract cost control was measured in terms of terms of heads of procurement function views which were based on a five point Likert scale ranging from 1-strongly agree to 5- strongly disagree. Selected statements captured contract cost control indicators based on the literature reviewed. The respondents were requested to indicate the extent at which they agreed or disagreed with the listed statements under contract cost control.

Table 1: Descriptive Statistics

Descriptive Statistics

	N	Min	Max	Mean	Std. Dev
The process of budget development ensures non value adding costs are eliminated	33	2.00	3.00	2.214	.414
The organization has a cost management system	33	1.00	3.00	1.929	.375
The organization performs cost budgeting to ensure predefined costs are maintained	33	1.00	3.00	2.000	.381
Budgets are used a s a monitoring tool	33	1.00	2.00	1.964	.187
Anticipated costs are estimated and incorporated into the budget	33	2.00	5.00	1.365	.705
Cost Documenting is carried out throughout the contract implementation process	33	1.00	4.00	2.268	.863
Composite mean and standard deviation				1.957	0.488
Valid N (listwise)	33				

Source: Primary Data, (2022)

As shown in Table 1 the study sought to determine whether budgets eliminated value adding costs where an average of 2.214 and standard deviation of 0.414 with responses ranging from 2-3 was seen. This implied that respondents agreed that budgets eliminated value adding costs. On cost management system and cost budgeting, responses ranged from 1-3 with variable mean of 1.929 and 2.00 and variable spread of 0.375 and 0.381 respectively. This indicated that the organizations had a cost management system and cost budgeting was done to ensure procurement contracts are completed within the budget. On whether budgets are used as a monitoring tool an average of 1.964 and deviation from the mean of 0.187 with responses ranging from 1-2. This showed that respondents agreed that budgets were used to monitor the costs of the contract.

On whether anticipated costs are incorporated into the budget. The item mean was 1.365 and standard deviation of 0.705 with responses ranging from 2-5 which showed that the respondents generally agreed that in the budget preparation process anticipated costs were included and incorporated in budgets. Cost documenting had a mean of 2.268 and a standard deviation of 0.863 with responses ranging from 1-4 implying that respondents agreed that costs incurred in the contract implementation process were recorded. The overall mean of 1.957 and standard deviation of 0.488 showing that respondents agreed that contract cost control was implemented in commercial state corporations.

Pearson Correlation between the Study Variables

Correlation determines direction of a relationship between any two variables. Correlation was presented in Table 2.

Table 32**:** Pearson Correlation between Study Variables

Variables	Operational Efficiency	Contract Cost Control
Operational Efficiency	1	0.322
Contract Cost Control	0.322	1

Contract cost control and operational efficiency had a correlation coefficient of 0.322 with a p-value of 0.015< 0.05 thus indicating a statistically significant positive relationship between contract cost control and operational efficiency. This implies that an increase in a unit of contract cost control would result to a statistically significant increase in operational efficiency. This is because contract cost control would minimize on the contract costs incurred in the contract execution and help ensure the contract is implemented for the amount agreed-upon thus providing efficient

utilization of resources. Contract cost control ensures that all cost expenditures are done in accordance with the budget thus eliminating unnecessary expenditures that would lead to more resource use than budgeted

Multiple Linear Regression

This study determined the significance of contract cost control on operational efficiency. A multiple linear regression was used to examine the relationship between contract cost control and operational efficiency. A multiple linear regression was represented in Table 3.

Table 33: Coefficients Estimates of Contract Cost Control on Operational Efficiency

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	1.098	0.387		2.835	0.007
Contract Cost Control	0.181	0.063	0.340	2.858	0.006

R^2=0.246

Results in Table 3 above shows the regression coefficients of contract cost control was 0.181 with a p-value of 0.006<0.05 hence contract cost control had a positive and statistically significant effect on operational efficiency. The R-squared obtained was 0.246. The R-squared indicates that 24.6% of operational efficiency fluctuations may be attributed to the independent variable contract cost control, whereas 75.4% of operational efficiency variations can be attributed to random error term or other factors not included in the model. This means that a unit increase in contract cost control would result to 0.181 units increase in operational efficiency holding other factors constant. Therefore, the null hypothesis was rejected and this implied that there is a statistically significant relationship between contract cost control and operational efficiency. The findings of this study shows that heads of procurement function agreed that budgets were developed and monitored to prevent cost overrun and this ensured that the contract was delivered within the agreed budget thus minimizing on the contract costs incurred thereby providing efficient utilization of resources leading to a rise in operational efficiency.

These results agree with (Ayodele *et al*., 2014) who stated that cost management methods contributed to cost regulation leading to delivery of building projects within the set budget and that high costs were as a result of deviations and fluctuations with the original budget. The findings also concurred with those of (Mwangi, 2020) who concluded that contract cost control impacted the performance of Kenyan county governments positively. Therefore, commercial state corporations should develop policies to ensure contract cost control is carried out for all contracts. These findings concur with transaction cost theory where contract cost control protects organization from opportunistic suppliers who could give them inflated cost charges that would increase their cost of operations and hinder their ultimate goal of achieving operational efficiency.

Test of the Moderating Effect

Information Communication Technology Integration was hypothesized as moderating variable. When a moderating variable is introduced, the direction or strength of the link between the two variables is altered. The test of significance of moderating variable is summarized in Table 4.

Table 34: Model Summary

Model 1	Coefficients	Std error	t-statistic	p-value
(Constant)	1.204	0.428	2.813	0.007
ICT	0.143	0.117	1.224	0.226
CCC	0.388	0.174	2.225	0.030
Model 2				
(Constant)	11.531	4.486	2.570	0.013
ICT	-4.522	2.021	-2.237	0.030
CCC	-4.831	2.264	-2.134	0.038
ICT*CCC	2.358	1.020	2.312	0.025

R^2 for model 1=0.108

R^2 for model 2=0.191

The results in Table 4 above show that model 1 is significant at 5% significance level without the interaction effect that it had a t-statistic of 2.813 and a p-value of 0.007<0.005. Model 2 had a t-statistic of 2.570 and a p-value of

0.013<0.05 also significant at 5% significance level. Model 2 accounts for more variance in the interaction between ICT integration and contract cost control. The R squared change had a p-value of 0.011<0.005 indicating that there is potentially significant moderation of ICT integration on the relationship between contract cost control and operational efficiency. The effect of the interaction between contract cost control and ICT integration is positive. This implies that an increase in contract cost control will lead to a rise in operational efficiency. Therefore, the effect of contract cost control on operational efficiency of commercial state corporations depends on ICT integration. Conversely the effect of ICT integration on operational efficiency of commercial state corporations is dependent on contract cost control.

Table 5: Summary of Regression Model

Model	R	R^2	Adjusted R^2	F change	Sig F change
1	0.329	0.108	0.075	3.218	0.048
2	0.437	0.191	0.145	4.102	0.011

The results in table 5 above indicate that ICT integration alters the relationship between contract cost control and operational efficiency.

The regression equation for the two models are:
Model 1 $Operational\ Efficiency = 1.204 + 0.143ICT + 0.388CCC$
Model 2 $Operational\ Efficiency = 11.531 - 4.522ICT - 4.831CCC + 2.358ICT * CCC$

The adjusted R^2 of the model without moderation was 0.075 whereas the adjusted R^2 of the model with interaction effect between contract cost control and ICT integration was 0.145 signifying there is an increase in the adjusted R^2. This implies that ICT integration adds a predictive value to the model. Therefore, ICT integration had a positive effect on the relationship between contract cost control and operational efficiency. This implies that an increase in ICT integration will result to a positive effect of contract cost control on operational efficiency.

DISCUSSION

Contract cost control was noted to exert positive and statistically significant influence on operational efficiency of commercial state corporations in Kenya where it had a coefficient of 0.181 and a p-value of 0.006 at 5% significance level. This concurs with transaction cost theory where contract cost control protects organization from opportunistic suppliers who could give them inflated cost charges that would increase their cost of operations and hinder their ultimate goal of achieving operational efficiency.

CONCLUSION

Contract cost control had a positive and statistically significant effect on operational efficiency hence the null hypothesis that contract cost control has no statistically significant effect on operational efficiency of commercial state corporations was rejected at 95% degree of confidence. This may be attributed to the fact that when commercial state corporations carry out contract cost control they are able to keep track of their expenditure. Contract cost control ensures that contracts are executed within the approved budget thus ensuring resources are well utilized and wastage minimized thus affecting operational efficiency.

RECOMMENDATIONS

Commercial state corporations should develop budgets for all their contracts and regularly monitor their cost management system to avoid cost overruns. To ensure effective contract cost control and guarantee that contracts are fulfilled within the set contract price, anticipated costs should be assessed and included in the budgets of all commercial state corporations. The commercial state corporations should integrate ICT in their operations and leverage on new technology to reduce operating costs.

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INFLUENCE OF INNOVATIVENESS ON PERFORMANCE OF FOOD AND BEVERAGE MANUFACTURING ENTERPRISES IN NAIROBI CITY COUNTY

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ABSTRACT
Increase in global competition, ever-changing technologies and unstable business environment as a result of globalization, market liberalization and Covid 19 impact on businesses, have made firms search for other means of survival and growth. Food and beverage manufacturing enterprises are also experiencing these challenges. This is demonstrated by the decrease in contribution to GDP, ranging from 13.6% in the early 1990s to 7.6% in 2020, thereby raising doubt on whether the sector is capable to meet the goals of Vision 2030. Different studies around the world have suggested the adoption of entrepreneurial practices as part of the solution. However, the findings of these studies have been inconclusive. The objective of this study was to establish the influence of Innovativeness on performance of food and beverage manufacturing enterprises in Nairobi City County. Descriptive survey research design was adopted. The target population was one hundred and thirty-eight food and beverage manufacturing firms registered under KAM by 2020. A census was conducted and data was obtained using a questionnaire. Data was analyzed using simple and multiple regression analysis with the help of SPSS version 25.0. Hypothesis was tested using t-statistic at 5% significance level. The study found that innovativeness had a positive influence on performance (regression coefficient 0.446, p-value of 0.000). The study recommends that firms should assess their ability to embrace new ideas and processes that will lead to development of new products, services, markets or technologies. Innovativeness plays an essential role in doing away with challenges associated with businesses.
Keywords: Food and beverage manufacturing enterprises and Kenya Association of Manufacturers.

INTRODUCTION
Innovation represents the extent into which a firm takes part in or welcomes new ideas, products, services or processes (Gathenya, 2011; Wang et al., 2008). By outlining the process of creative destruction, Schumpeter (1942) stressed the importance of innovation in the process of entrepreneurship. When market systems are disturbed by the entry of new goods or services, this process takes place. According to Onyango and Ngahu (2018), the main aspect in entrepreneurship has been proven to be the innovation as it is a consistent theme used in literature. Innovations can differ in their magnitude and innovativeness represents a fundamental inclination towards withdrawing from technologies or practices that have been used formerly and venturing beyond them (Lin & Ho, 2008; Kimberly, 1981). There are many ways to categorize innovations, but among the most important ones are technological innovation, market innovation, process innovation, and product innovation. This can be accredited to the fact that all other classifications of innovation can fall under these three major categories (Mwaura et al., 2015; Callaghan, 2009; Lumpkin & Dess, 1996).

Innovativeness can take on many different forms, such as embracing novel concepts, doing research and development to create new goods, entering untapped areas, or implementing cutting-edge technology to the firm's advantage (Wiklund & Shepherd, 2003). Additionally, Lin and Ho (2008) suggest that innovation is important for the creation of new products and the dissemination of information for advancement in the future. Accordingly, high levels of technology, product and market innovation reflect an essential gauge for SMEs performance (Avlonitis & Salavou, 2007). Lee and Lim (2019) posit that firms which are innovative and apply creativity will create remarkable performance and economic growth (Ritala & Laukkanen, 2013; Kraus et al., 2012). Majority of studies advocate that, innovativeness is one of the essential strategic orientation firms can use to attain success in the long run and better their performance (Brettel & Rottenberger, 2013).. Innovations can differ in their magnitude and innovativeness represents a fundamental inclination towards withdrawing from technologies or practices that have been used formerly and venturing beyond them (Lin & Ho, 2008; Kimberly, 1981). There are many ways to categorize innovations, but among the most important ones are technological innovation, market innovation, process innovation, and product innovation. This can be accredited to the fact that all other classifications of innovation can fall under these three major categories (Mwaura et al., 2015; Callaghan, 2009; Lumpkin & Dess, 1996).

In Kenya, one of the top three production industries is usually manufacturing (KNBS, 2016). Manufacturing firms are those entities that engage in physical activities or processes that add value to a product or raw material (Pycraft et al., 2010). Kenya's manufacturing industry contributes 65 percent of all industrial sectors' GDP. One of the important

industries identified in Kenya's Vision 2030 that can promote economic growth is this one (Kirungu, 2012). Under the Big 4 Agenda of Agro-processing, the Government targets to improve manufacturing from 16% to 50% in terms of how it contributes to GDP, create 1000 SMEs and generate 200,000 jobs. According to GOK (2015), the manufacturing sector contributed 11% of the Kenyan income and according to World Bank Group (2018) it has hence been on a downward spiral. By the year 2016, the sector contributed 9.3% of GDP, 26% merchandise exports and 280,000 job opportunities (KNBS, 2017). A significant tradable sector and a driver of economic expansion is the manufacturing industry (Rotich & Wanjau, 2011). However, this sector has been experiencing low growth rates which average to 4% over the last decade (KAM, 2016). In 2000 (CCG, 2008), manufacturing was the second-largest economic subsector; however, in 2010 it ranked fourth (World Bank, 2013). So, from 13.6 percent in the early 1990s to 9.3 percent in 2016, 8.7 percent in 2017, 8.4 percent in 2018, 7.9 percent in 2019 and 7.6 percent in 2020, it has decreased its contribution to GDP (KNBS, 2021).

Food and beverage is one of the biggest sectors in the world (McGrath, 2016). It comprises of all the firms involved in processing of raw food materials and converting them into finished products. Nationally, most of them have their headquarters in Nairobi City County and are privately owned (KAM, 2020). According to Mutunga and Minja (2014), food and beverage manufacturing sector has growth prospects. This is highly attributed to the fact that Kenya is an agricultural country which provides them with more opportunities for manufacturing locally produced products. The contribution of food and beverage manufacturing sector is big. In the year 2017, the food and beverage sector contributed to 41% of the GDP of the manufacturing sector which in turn contributed to 11.4% of the country's GDP (KNBS, 2018). About 3.5 percent of the GDP and Ksh 254,686 million in exports were attributed to food, beverage and tobacco in 2017 (KAM, 2018; Kenya Business Guide, 2018). The food and beverage manufacturing sector directly impacts the overall economy. However, despite the various interventions that the government has instituted to uplift the sector including government spending in line with the medium-term plan 3 (MTP 111) geared towards empowering the sector to achieve its objectives of Big 4 Agenda, Vision 2030 and Kenya industrial transformation programme, the sector is still stagnant.

According to Kenya's Economic Survey (2020), the value added by food and beverage manufacturing sector has been declining from 41% in 2017, 40.5% in 2018, 39.8% in 2019 to 37.9% in 2020 (World Bank, 2021). This sector has been facing several challenges leading to declining margins and contribution to the overall economic growth. This has been a growing industry that has experienced a rapid growth from the early 80's until recently. The high competition has resulted in a flooded market with products from other countries taking up a large market share of Kenyan local market (Kenya, 2008). In comparison to other countries, the sector's contribution is still low. In Sudan the contribution of the food and beverage sector was 51.44%, 45.6% in Ethiopia and Iran 43.1% in 2019 (KAM, 2020).

Performance is an outcome of enterprise activities. According to Lamine and Lakhal (2018), performance is an analysis of the firm's activities to confirm if it is working towards achieving goals. Financial performance, market performance, and shareholder return on investment are all facets of performance (Neely, 2002). Richard et al. (2009), noted that despite firm performance being commonly used, it is rarely defined or measured consistently. The goal of this study was to find out the extent into which entrepreneurial orientation affected performance.According to Behn (2003) different purposes required different measures for them to be meaningful while Venkatraman and Ramanujam (1986) posit that, by broadening the performance measures, the researcher will face challenges when collecting data. Several measures have been adopted by different researchers to measure performance in relation to entrepreneurial orientation. It is in this regard, that the current study adopted sales growth, profitability and market share growth as the dimensions to measure performance. These dimensions were in line with the research objectives and have previously been adopted by other researchers (Mburu, 2019; Kithaka, 2016).

In order to ascertain the connection between EO and performance of SMEs in Labuan, Baba and Elumalai (2011) carried out a study. According to the study, different types of competitive aggressiveness, proactiveness, risk-taking, and innovativeness have their own unique relationships with organizational performance. The study looked at entrepreneurial inclination as a multidimensional phenomenon. As a result, additional studies on the influence of entrepreneurial orientation as a unidimensional construct are required, which is one of the study's main foci.

Yoon et al. (2012) established that, there was positive impacts on performance in relation to overall entrepreneurial orientation of start-ups in South Korea. Overall EO effect on firm performance was significantly notable in early stage and in growth stage. However, for pro-activeness, performance effect of entrepreneurial orientation was only significant in the growth stage and not for early stage. In growth stage, the performance effect of innovativeness was

found to be significant, but insignificant for risk-taking. The study concluded that, entrepreneurial orientation effect patterns are contingent on the stage of growth and are not universalistic. They suggested that, multidimensional aspect of entrepreneurial orientation seems to be more realistic than overall entrepreneurial orientation when displaying the degree of development of entrepreneurship. This is in contrast with studies done by other scholars such as Miller (1983) and Lumpkin and Dess (1996), thus the need for more research.

Ali and Abdel (2014) did a study in order to ascertain the impact of entrepreneurial orientation on the efficiency of Somali women-owned businesses A sample of 200 firms was purposefully chosen to complete the questionnaire. Innovativeness was measured using products line changes and service line changes. The results showed a weak but significant positive relationship. By conceptualizing innovation differently, the current study sought to establish whether different results will be obtained.

According to a study by Atalay et al. (2013), technological innovation had a significant and positive impact on firm performance, but non-technology innovation had no impact on firm performance. The purpose of this investigation was to see if similar findings could be obtained by concentrating on the Kenyan environment and use other innovativeness indicators.

Hilgers (2011) did a study in the Netherlands to investigate the connection between international entrepreneurial orientation and performance. Six family-owned manufacturing companies were the target respondents. The study used a multiple-case approach, and data were collected through interviews. The findings showed that innovativeness significantly improved performance when compared to pro-activeness, risk-taking, competitive aggressiveness, and autonomy. This study used a census to see if it would yield different results that may be due to the limited sample size of those interviewed.

A 2007 study by Keh et al. sought to determine the effects of entrepreneurial orientation and marketing knowledge on the success of SMEs in Singapore. Data was obtained from a sample of 2239 firms but only 294 responses were usable from retail and service sectors. The study found that innovative SMEs who always to take advantage of new opportunities achieve better performance. The responses were too few from the sample used and thus unrepresentative. By adopting a census survey of the target population, this study sought to determine whether it will yield more generalizable results by improving on the response rate.

In a study by Zerenler et al. (2008), which aimed at evaluating the impact of innovativeness on SMEs' performance in the Turkish automotive supplier business, it was discovered that innovation was strongly associated to SMEs' ability to grow. Similar findings were made by Wu et al. (2008) who investigated the mediating influence of innovation on the growth of SMEs in Taiwan's manufacturing and non-manufacturing industries. They discovered that these effects are present at a level of significance that is acceptable. These studies conceived innovation differently and evaluated its impact on SMEs. In the current study, innovation's impact on performance was evaluated both alone and in conjunction with other aspects of entrepreneurial orientation.

Similarly, Avlonitis and Salavou (2007) did a study on product innovativeness and performance among SMEs in Greece. Data was obtained from 143 SMEs from food, beverage and textile sectors. Data was analyzed using ANOVA. The results indicated that more innovative SMEs have a considerably higher performance. The study established the need for more and similar studies on the same in other countries and industries so as to validate the empirical data with theory.

In a study conducted by Khalili et al. (2013), the authors utilized confirmatory factor analysis to test their research hypotheses and analyze the data on the effects of entrepreneurial orientation on innovative performance in Iranian petroleum businesses. The findings showed that the research variables had a good association. The methodologies for data analysis in the current study included descriptive statistics, regression, and correlation.

Kimani (2016) conducted a study in Kenya to determine whether financial innovation adoption enhanced SME performance in Kenya. 487 SMEs that were registered with KRA made up the sample. The findings indicated a beneficial association between performance and financial innovation. Therefore, the current study sought to ascertain whether the same findings would hold true if the manufacturing of food and beverages were the primary emphasis.

Objective of the study

The general purpose of the study was to establish the influence of innovativeness on performance of food and beverage manufacturing enterprises in Nairobi City County.

$H0_1$: Innovativeness has no statistically significant influence on the performance of food and beverage manufacturing enterprises in Nairobi City County.

METHODOLOGY

The study adopted descriptive survey research design because it describes the state of affairs, as it exists at present in the study. The study targeted 138 food and beverage manufacturing enterprises in Nairobi city county that are registered under Kenya Association of Manufacturers (2020). Census technique was used to improve the reliability of the results. Data was collected from the general managers using a questionnaire. Descriptive and Inferential statistics were used to analyze data. Simple and Multiple linear regression analyses were then conducted using SPSS software version 25.0 in order to address study objective. Assumption of linear regression model of multicollinearity, homoscedasticity, normality and autocorrelation were tested before analyzing the data.

RESULTS AND DISCUSSIONS

Innovativeness and Performance

Innovativeness was measured in terms of new products and services, new technology and research and development. Performance was measured using sales growth, profitability and market share growth. Descriptive statistics such as mean, standard deviation and frequencies were carried out. The summary of descriptive statistics is shown in Table 1.

Table 35: Descriptive Statistics

	1	2	3	4	5	Mean	S. D
	%	%	%	%	%		
The organization regularly introduces new products	0	6.2	19.6	54.6	19.6	3.88	.794
The organization regularly introduces new services	0	1.0	25.8	53.6	19.6	3.9175	.70223
The organization places a strong emphasis on new innovative processes.	0	2.1	23.7	55.7	18.6	3.9072	.70832
The firm has increased the number of products offered during the past two years.	0	0	22.7	51.5	25.8	4.0309	.69901
The business places a strong emphasis on continuous improvement in products.	0	0	23.7	47.4	28.9	4.0515	.72702
The organization is willing to work towards technological leadership	0	0	20.6	49.5	29.9	4.0928	.70832
In the organization there is a strong relationship between the number of new ideas generated and the number of new ideas successfully implemented	0	3.1	16.5	51.5	28.9	4.0619	.76123
The firm emphasizes on market research and development	0	2.1	18.6	46.4	33.0	4.1031	.77034
The firm has a culture of adopting new technology	0	2.1	17.5	50.5	29.9	4.0825	.74540
The organization supports development of new technology	0	1.0	19.6	41.2	38.1	4.1649	.77299
We have a widely held belief that innovation is an absolute necessity for the organization's future.	0	2.1	15.5	43.3	39.2	4.1959	.77243
Valid N (listwise)	97					4.044	.50652

The results show the mean of the items was 4.044 meaning that, majority agreed to a great extent with the statements and there was no high variation of responses since the standard deviation falls within 0.699 and 0.794. These results imply that, most food and beverage manufacturing firms have incorporated innovative practices into their operations and are aware of the benefits of innovation to their enterprises. According to Covin and Miles (2011 innovation is an essential aspect in entrepreneurship and entrepreneurship cannot exist without it.

Pearson Correlation between the Study Variables
Correlation determines direction of a relationship between any two variables. Correlation was presented in Table 2.

Table 2: Correlation between innovativeness and performance

		Performance	Innovativeness
Performance	Pearson Correlation	1	.354**
	Sig. (2-tailed)		.000
	N	97	97
Innovativeness	Pearson Correlation	.354*	1
	Sig. (2-tailed)	.000	
	N	97	97

**. Correlation is significant at the 0.01 level (2-tailed).

The Pearson correlation was used to determine the relationship between innovativeness on performance. The correlation coefficient was 0.354 with p = 0.000 which was found to be significant at 5% significance level. This implies that there exists a strong positive relationship between innovativeness on performance. An increase in innovativeness will lead to an increase in performance. This means that, if innovativeness is improved by a unit, the level of performance would improve by 0.354 units. The null hypothesis that stated innovativeness has no statistically significant influence on performance of food and beverage manufacturing enterprises in Nairobi City was rejected.

Multiple Linear Regression
A multiple linear regression was used to examine the relationship between innovativeness and performance (Table 3).

Table 36a: Summary of regression model for Innovativeness

					Change Statistics					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	.354[a]	.125	.116	.5996	.125	13.631	1	95	.000	2.026

a. Predictors: (Constant), innovativeness
b. Dependent Variable: performance.

Results in Table 3a shows the model explanatory power as measured using R squared (coefficient of determination). The R^2 is 0.125. This implies that innovativeness explains 12.5% of the variation on performance of food and beverage manufacturing enterprises while the remaining 87.5% can be explained by other factors excluded in the model.

Table 3b: Analysis of variance for Innovativeness

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	4.900	1	4.900	13.631	0.000[b]
	Residual	34.151	95	0.359		
	Total	39.051	96			

a. Dependent Variable: performance
c. Predictors: (Constant), innovativeness

Results on Table 3b, shows the results of analysis of variance (F=13.631, p=0.000). The P value is less than the acceptable level of 0.05. This indicates that the model testing the impact of innovativeness on performance was statistically significant. This means that the model is fit for prediction purposes.

Table 3c: Regression Coefficient for innovativeness

		Unstandardized Coefficients		Standardized Coefficients			Correlations			Collinearity Statistics	
Model		B	Std. Error	Beta	t	Sig.	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	2.379	.492		4.832	.000					
	Innovativeness	0.446	.121	.354	3.692	.000	.354	.354	.354	1.000	1.000

Results in Table 3c show the regression coefficients which indicate that, there is a positive and significantly linear association between innovativeness and performance (B = 0.446, p value = 0.00). This means that a unit increase in innovativeness boosts performance by 0.446 units. The research discovered a constant of 2.379 with a slope of 0.446. The t-statistic was 4.382, with a P value of 0.000 indicating that the relationship is significant. The equation below depicts the simple regression model for innovativeness.

$$Y = 2.379 + 0.446\ X1$$

As a result of the findings, the null hypothesis stating that innovativeness has no statistically significant influence on performance of food and beverage manufacturing enterprises in Nairobi City County was rejected.

DISCUSSION

The objective of this study was to examine the influence of innovativeness on the performance of food and beverage manufacturing enterprises in Nairobi City County. Descriptive analysis revealed that majority of them have placed a strong emphasis on innovative processes, regularly introducing new products and services as well as adopting new technology. However, only a small percentage support development of new technology and conduct market research. Correlation analysis revealed a positive and significant relationship between innovativeness and performance. Similarly, regression analysis showed a positive and significant relationship between innovativeness and performance whereby, innovativeness explained 12.5% of the changes in performance. In order to realize good performance which is sustainable, an organization must come up with innovative strategies that will ensure that they continually improve on their products as well as come up with new updated ones. They must also buy the technology that is most efficient, effective and cost cutting so as to give their customers quality goods and services.

CONCLUSION

The study concluded that, there is positive relationship between innovativeness and performance. Innovativeness is a critical entrepreneurial trait that has a positive and significant impact on performance. Innovativeness is a company's capacity to embrace fresh concepts and creative processes that may result in new products, markets or technical procedures. Entrepreneurship cannot exist without innovation, which is a critical component of strategy. Innovation plays a vital role in resolving corporate difficulties and challenges regardless of market volatility, allowing organizations to prosper. Therefore, it is important to examine the innovativeness employed by food and beverage manufacturing enterprises. They should adopt measures aimed at gathering knowledge and adopting technologies that are geared towards developing new products, improving customized products, enhancing customer satisfaction and lowering the production costs.

RECOMMENDATIONS

Food and beverage manufacturing enterprises should assess their ability to embrace new ideas and processes that will lead to development of new products, services, markets or technologies. Innovativeness plays an essential role in doing away with challenges associated with their businesses. As a result, the study advised that food and beverage manufacturing companies prioritize the innovation process in their organizational strategy today more than ever. Shorter product life cycles, increased client tastes, preferences and expectations, as well as fierce competition force organizations to constantly innovate in order to remain competitive.

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INFLUENCE OF EMPLOYEE COMMITMENT ON RETENTION IN PRIVATE SECURITY FIRMS IN NAIROBI CITY COUNTY, KENYA

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ABSTRACT
The challenge of employee retention is a global problem that affects organizations in both developing and developed countries. Even though a lot has been done towards addressing the problem, the situation has continued to be experienced among private security firms in Nairobi City County, Kenya. The main objective of this study was to determine the influence of employee commitment on retention in private security firms in Nairobi City County, Kenya. The work environment was used as a moderating variable. The study adopted a descriptive research design. The target population of this research was 50 private security firms in Nairobi City County registered with Kenya Security Industry Association. Primary data was collected using a close-ended questionnaire. Data was analyzed with the aid of SPSS version 25.0 and presented using descriptive and inferential statistics. Simple and multiple regression analysis was used to establish the relationship between variables and the t-statistic at a 95% significance level was adopted in testing the hypothesis of the study. The overall significance was tested using F-test. The study established a positive significant effect of employee commitment on retention with a regression coefficient of 0.799 and a p-value of 0.000 implying that employee commitment affected retention. The interaction between work environment and employee commitment had a regression coefficient of 2.330 and a p-value of 0.025 implying that work environment positively altered the relationship between employee commitment and retention. The study recommends that private security firms ought to put strategies that encourage employees to be committed to their work, to ensure increased retention. The findings of the research will contribute to theory, policy making, and understanding of human resource management practices to ensure an increase in employee retention.
Keywords: Employee Commitment, Retention and Private Security Firms

INTRODUCTION
Employee commitment is termed as the amount of passion a worker holds towards the duties allocated to them at their workplace (Meyer, & Herscovitch, 2001). It is also defined as a sense of obligation that an employee holds to the vision, goals, objectives, and mission of the firm they are working for (Mercy, 2014). Engaged employees are said to be committed when they identify themselves with their organization and are not willing to leave. An employee is termed to be committed when he is completely dedicated to his duties, reliable, and aligned to organizational goals, vision and mission (Ibrahim & Falasi, 2014). Employee commitment is influenced by numerous factors for instance; the time of life an employee has been in the company, leadership, and job design (Luthans, 2000). For organizations to ensure employee commitment they should be dedicated to ensuring employee empowerment, open and free communication, strong work ethics, and a culture of trust and innovation (Janssen, 2004).

Cesário and Chambel (2017) displayed three major types of employee commitment; an affective commitment which is, workers' emotional closeness and engrossment with the company, continuance commitment which is, the prolongation of the period of service stimulated by the expenses connected with exiting the firm, and normative commitment that is, dedication to staying at the workplace coming up from pressure exerted from the outside. Employees with sentimental commitment can be considered most desirable for the company since they are most likely to stay longer and contribute to the firm's performance. Princy and Rebeka (2019) did a study on employee commitment to organization performance and resolved that commitment had an impact on organizational performance. This study focused on performance whereas the current study focused on retention.

Work environment comprises all factors that affect employee productivity. It is the relationship that occurs between the worker and their work environment (Nasidi *et al.,* 2019). The work environment is made up of factors such as organizational support, supervisory support, peer support, and rate of pay (Cromwell & Kolb, 2004). A conducive supportive work environment is important in ensuring employees remain engaged and work in the organization for an extended period (Rhoades *et al.,* 2001). A conducive work environment ensures employees stay engaged with an increased intention to remain in the firm for long, it improves the commitment and loyalty of employees in return, strengthening the workers' mental connection with their organization (Rhoades *et al.,* 2001). Past research has revealed that good organizational support results in increased employee involvement, and a firm's commitment which further results in a decreased rate of turnover (Eisenberger *et al.* 2002). The study further concluded that negative

supervision is related to employee low retention rate. It also stated that if employee perceives that organization value their contribution and that the management takes care of them, then they will be engaged and willing to stay for a longer period in their place of work. Chidiebere *et al.* (2017) in their study stated that the rate of pay affects employee engagement and willingness to remain in the organization. The study concluded that pay rate positively affected employee commitment, performance, loyalty, and job satisfaction.

In a study by Mandhanya (2015), it was established that the work environment positively affected employee retention. The study also revealed that a conducive and responsive environment when provided at the place of work it enhances retention. A study by Bibi *et al.* (2016) revealed that the workplace environment altered the rate of pay and retention relationship. It was concluded that pay and security of tender had an imperative connection with employees' retention. The current study adopted the work environment as a moderator.

Retention of workers is an important aspect of a firm's success (Ali *et al.*, 2019). It is the process whereby workers are encouraged to continue working for their organization for a long time possible or pending the organization's completion of its objectives and goals (Singh & Dixit, 2011). The Corporate Leadership Council (2004) in their research concluded that employee engagement reduces workers' intention to leave. The study concluded that a great number of engaged workers were 87% less probable to move out of their current organization. The same study found that a hundred workplaces with a conducive environment had a normal voluntary exit that averaged a 13% rate as related to the average of 28.5% of extra firms in the same industries. Retention of employees is a great challenge to most organizations worldwide such that, organizations face increased costs, for example, recruitment costs, training, and development cost, increased organizational brain drain that is loss of well-experienced employees which may result in lowered morale for the remaining employee (Yazinski, 2009).

Lowers and Associates (2019) reported a global employee turnover rate at 9.6 %, with the highest turnover in the functions of finance 12.7%, sale12.6 %, and HR 12.6 %. In Kenyan, more than 68% of organizations are experiencing retention problems with a greater number of employees moving from one organization to another (PWC, 2013). Due to the continued competition in the labor markets and high demand for talents, the management is faced with the obligation of designing strategies to ensure increased retention. Sutanto & Kurniawan, (2016) stated that an employee retention rate of 90% or more is termed good for the organization. Khalid and Nawab (2018) concluded that employee participation influences employee retention positively. A study by Bala (2017) stated that employee involvement, training, motivation, good employee-employer relationship, conducive environment, and job security positively affected workers' retention.

Private security companies were registered in Kenya in the 1960s on large industrial sites. Increases in insecurity rates coupled with incapability of public safety services to ensure enough protection have been the two key contributing aspects toward the massive growth of private security firms (Abrahamsen & Williams, 2005). Mkutu and Sabala (2016) in their study, indicated that there are nearly 2000 private security companies in Kenya, with many of them based in Nairobi City County Kenya. A study by Zheng and Xia (2021) approximated that there exist around 300,000 private security workers employed by around 600 firms that are actively operating in Kenya. According to Kenya Security Industry Association (2020), Nairobi City County, Kenya has 50 security firms being the county with the largest number of registered firms with the association.

Despite the continued progress of the security sector, there remains an outstanding low retention rate of private security employees who view their occupation as a stepping stone for absorption into different jobs. The employee retention rate in these firms remains below 5% per year. This low rate of retention has caused private security firms to offer poor services while others have been forced to close down due to poor performance (Zheng & Xia 2021).

According to Kenya National Private Security Workers Union (2020), employee retention in these firms remains below 5% with Nairobi City County, Kenya not being an exemption. In Kenya, 50% of private hospitals experienced a high challenge of staff turnover, Kenyan banks 10-15% annually (PWC 2013) while the teacher's service commission of Kenya reported 45% of teacher's intention to quit (Oduor 2015). Private security employees' unconducive working environments with minimal wages has brought about decreasing rates of employee retention by security firms (Minnar & Ngoveni, 2004). Nasir and Mahmood (2018) stated that an employee can remain and be loyal, committed, and accountable if they feel valued by the management of the firm they are working for. A low employee retention rate leads to increased operating costs for the organization, low morale for remaining employees, loss of customers, and poor performance and productivity. The retention of well-qualified employees guarantee continued improved

performance, customer fulfillment, contented workmates, and timely achievement of organizational goals and objectives. In addition, it encourages operative succession planning, leading to an engaged organization (Shivangee & Pankaj, 2011).

Kenya plant health inspectorate service (KPHIS) corporation. The research used a case study design and primary data was gathered from 100 employees. Factor analysis; median, central tendency and standard deviation was employed to analyze the information collected. This study highlighted factors such as education, duration of service, and job category to influence employee commitment which further may result to worker's desire to exit or remain at the place of work. The research was restricted to identifying the aspects that influence the organizational commitment of workers at KPHIS in Kenya. This study was done in a different operating environment and organizational setup. This study adopted a case study while the current study employed a descriptive research design to investigate whether the findings will be different.

In a study on the elements that affect the commitment of workers and its impact on organizational performance in Kenya Airport Authority (Kamau, 2015), it was concluded that historical success of the authority, salary, team cooperation, training, and development, were among the factors that influenced staff commitment. The study also concluded that individual factors such as the desire for individual progress, demographic aspects, staff work satisfaction, participation of staff in making choices on matters that touch them, and stress level caused by the job greatly influence staff commitment. This study focused mainly on factors that impact a firm's commitment to employees necessitating the present research to explore the impact of employee commitment on retention.

Similarly, Shubaka (2014) examined the connection between staff retention tactics and commitment in Kenyan insurance companies and recommended the need to appraise retention approaches. The research employed a research methodology of descriptive in nature and analyzed the primary data gathered from 46 insurance companies in Kenya by use of SPSS and represented in charts and tables. The research concluded that exceedingly committed workers are a great asset to the organization. This study focused on the connection between retention tactics and commitment whereas the current study concentrated on the impact of staff commitment on retention and the influence of work environment on this relationship as a moderator.

Islam and Rahman (2016) researched the connection between firm's commitment, job satisfaction, and turnover intentions on unionized bank workers in selected Banks in Bangladesh. Descriptive research approach was used. A purposive sampling method was employed. Data were analyzed using multivariate analysis techniques, specifically factor analysis. Descriptive statistics were employed. The results of the research were that representations, an excellent promotional system, a fair rewarding system, support in a personal emergency from the organization, and workplace flexibility in performing tasks were the most influential factors on job satisfaction and firms' commitment. This research suggested that employees' firm's commitment will increase when fairly paid and their working environment is conducive which will lead to reduced turnover meaning there will be an increase in employee retention. This context of the study was a bank setting and used a purposive sampling method whereas the current study focused on private security firms and used a census technique.

Mandago (2014) researched on the influence of contract of service on worker's engagement and staff commitment of workers in the coffee board of Kenya and posited that, defined terms of service results in increased worker's engagement and staff commitment. It was also established that inadequate pay for overtime hours worked, negatively affected staff dedication and workers' commitment. The research collected data from 50 employees of the coffee board of Kenya by use of questionnaires. The research used a descriptive survey design and data was analyzed via regression analysis. This research focused on terms of service on employee engagement and staff commitment while the current research focused on employee commitment and retention and work environment as a moderator

In a study by Maliku (2014) to explore the alleged connection amongst worker retention strategies and firm performance of National Oil Corporation of Kenya, it was revealed that 80% of staff retention strategies investigated were temporarily used which led to decreased employee performance. The research employed descriptive survey design and consensus techniques to base its results on the opinions of the entire population. Data was gathered using a structured questionnaire and examined by use of descriptive Statistics consisting of frequencies, mean, standard deviation and distribution percentages. A study by Mokaya (2014) sought to explore the impact of staff retention policies on performance of Kenya Power and Lighting Company Limited and concluded that having proper retention practices improves employee commitment and thus organization performance. The two studies determined the

relationship between staff retention approaches and organization performance hence the need to examine the effect of employee commitment on retention. These studies used employee retention as an independent variable while the current study used retention as the dependent variable.

The objectives of the study were to investigate the effect of employee commitment on retention of private security firms in Nairobi County and to assess the moderating effect of work environment on the relationship between employee commitment and retention of private security firms in Nairobi County. The null hypotheses were that there is no statistically significant relationship between employee commitment and retention of private security firms in Nairobi County and that there is no statistically significant moderating effect of work environment on the relationship between employee commitment and retention of private security firms in Nairobi County.

METHODOLOGY

The study adopted descriptive research design since it facilitated in choosing and grouping of the components and features of object. The study covered all the 50 private security firms in Nairobi County. Census technique was used. Data was collected using a questionnaire. Descriptive and Inferential statistics were used to analyze data. Simple and Multiple linear regression analyses were then conducted using SPSS software version 25.0 in order to address study objective. Assumption of linear regression model of normality, multicollinearity and heteroskedasticity were tested before analyzing data.

RESULTS AND DISCUSSIONS

Diagnostic Tests

Test for Normality

Shapiro-Wilk Test and coefficient of skewness were used to test for normality (Aczel & Sounderpadian, 2002). The p-value of Shapiro Wilk Test was 0.987 which is greater than 0.05 (insignificant) hence a conclusion that the residual was normally distributed.

Multicollinearity Test

Incidence and degree of multicollinearity if any, was tested using Variance Inflation Factor (VIF). The VIF value was 1.563 less than 10 therefore, multicollinearity was absent. Multicollinearity may lead to wrong results due to its effect of inflating the predictor variables (Cooper & Schindler 2003).

Heteroskedasticity Test

This study used P-P plot to determine if the residuals had constant variance because they are best in the presentation of spread of residuals. The results indicated no specific pattern and the widths were neither increasing nor decreasing as the variables rise. Therefore, heteroskedasticity is absent.

Employee Commitment and Retention

Employee Commitment was measured in terms of dedication to duty, reliability and alignment. Work environment was measured using organization support, supervisor's support and rate of pay while retention was measured using length of service, rate of voluntary exit and termination rate. Descriptive statistics such as mean, standard deviation, range, minimum and maximum for employee commitment, work environment and retention were carried out. The summary of descriptive statistics is shown in Table 1.

Table 37: Descriptive statistics

	EC	WE	R
Mean	4.0668	4.0837	3.8334
Standard Deviation	0.7669	0.5980	0.7114

Where: EC-Employee Commitment
WE-Work Environment
R-Retention

Employee commitment had a mean of 4.0668 which implies that private security firms benefit from committed employees. As shown in Table 1 above, the mean for retention was 3.8334 for all the private security firms which represents the average private security firm's retention. Work environment had a mean of 4.0837 and a standard deviation of 0.5980 implying less deviation from the mean thus, an increase in work environment positively affects the relationship between employee commitment and retention.

Pearson Correlation between the Study Variables
Correlation determines the direction of a relationship between any two variables (Table 2).

Table 38: Pearson correlation between study variables

Variables	R	EC
R	1	0.
EC	0.730	1

Where: R-Retention
EC-Employee Commitment

The results show that employee commitment had a Pearson correlation of 0.730 with a p-value of 0.000<0.05 implying a positive and statistically significant relationship between retention and employee commitment. This is because when employees are committed to their job they will be more willing to remain long in their jobs. This suggests that an increase in employee commitment would lead to statistically significant increase in retention.

Multiple Linear Regression
This study determined the significance of employee commitment on retention in private security firms in Nairobi County. A multiple linear regression was used to examine the relationship between employee commitment and retention. A multiple linear regression analysis is represented in Table 3.

Table 39: Coefficients estimates of Employee Commitment and Retention

	Unstandardized Coefficients				Correlations			Collinearity Statistics	
Model	B	Std. Error	T	Sig.	Zero-order	Partial	Part	Tolerance	VIF
(Constant)	.764	.468	1.632	.110					
Employee Commitment	.799	.114	7.001	.000	.730	.730	.730	1.000	1.000

R^2=0.533

The results in Table 3 shows that the regression coefficient of employee commitment was 0.799 with a p-value of 0.000<0.05 indicating that, employee commitment had a positive and statistically significant effect on retention. The R^2 was 0.533 indicating that, 53.3% of the changes in retention could be accounted for by employee commitment while 46.7% of the changes would be attributed to other factors not included in the study and the error term.

The results show that there is a significant relationship between employee commitment and retention. This implies that a unit increase in employee commitment leads to an increase of retention by a factor of 0.799. The null hypothesis that there is no statistically significant relationship between employee commitment and retention rate in private security firms in Nairobi City County, Kenya is not supported in the current study and therefore the null hypothesis is rejected. This infers that employee commitment positively influences retention in private security firms in Nairobi City. This is an indication that the respondents agreed that employee's commitment affects retention rate. The simple regression model for effect of employee commitment on retention can be presented by the equation below.

$Y=0.764+0.799\ X_1$
Where:
Y= The dependent variable (retention)
X_1 =Employee Commitment
$0.764 = y -$Intercept (constant). Estimate the expected value of retention rate when employee commitment is zero (Constant).
0.799 = an estimate of the expected increase in retention rate in response to a unit increase in employee commitment.

The study found constant of regression was 0.764 implying that when other factors are held constant retention is equal to 0.764 units. The slope of regression model obtained was 0.799 and it implies that an increase in employee commitment by one-unit results to 0.799 units surge in retention rate. The relationship between employee commitment and retention rate was statistically significant with a regression coefficient of 0.799. The argument is that employees

that are reliable, dedicated to their duty and aligned to organizational goals tend to remain longer in their firms compared to those who do not. Also, the management will not be willing to terminate their services. These results concur with Kahn' theory of employee engagement implying that human resource managers agreed that employee commitment affects worker's intention to remain in their firm. These results are consistent with Islam and Rahman (2016) and Lady *et al* (2018) who found that employee commitment affected retention.

Test of the Moderating Effect

Work environment was hypothesized as a moderating variable. Moderation implied an interaction effect, where introducing a moderating variable changes the direction or magnitude of the relationship between the two variables. The test of significance of the moderating variable is presented in Table 4. The results in Table 4 show that model 1 is significant at 5% significance level without the interaction effect since it had a t-statistic of -2.071 and a p-value of 0.045<0.005. Model 2 had a t-statistic of 2.330 with a p-value of 0.025< 0.05 which is significant at 5% significance level. Model 2 account for more variance change in the interaction between work environment and the relationship between employee commitment and retention. Results imply that work environment has a predictive value on the relationship between employee commitment and retention and when combined with employee commitment it improves retention rate. The results concur with two factor theory and Theory X and Y in that job context, including such things as pay and working conditions relate to hygiene factors. This relates to the work environment in terms of supervisor's support and organization support which encourages managers to have a good relationship with the employees to motivate them to work. These results concur with Raziq and Maulababakh (2015) and Bushiri (2014) findings on work environment having a moderating effect on the relationship between independent variable and dependent variable.

Table 40: Model summary

Model Model 1	Coefficients	Std error	t-statistic	p-value
(Constant)	-2.148	1.037	-2.071	.045
Employee Commitment	-.298	.176	-1.698	.097
Work Environment	1.875	.234	8.018	.000
Model 2				
(Constant)	27.279	12.666	2.154	.037
Employee Commitment	-8.237	3.410	-2.154	.020
Work Environment	-5.529	3.185	-1.736	.090
Employee Commitment* Work Environment	1.996	.856	2.330	.025

R^2 for model 1=0.104. R^2 for model 2=0.206

Table 41: Anova Summary

Model	R	R^2	Adjusted R^2	F change	Sig F change
1	0.778	.606	.587	32.258	.000
2	0.807	.652	.626	5.431	.025

The results in Table 5 indicate that work environment alters the relationship between employee commitment and retention. The regression equation for the model is:

Y=27.279-8.237X-5.529M+1.996 X.M

There is an increase in adjusted R squared with a p-value of 0.025 < 0.005 indicating that there is potentially significant moderation between work environment and the relationship between employee commitment and retention as shown in Table 5. This shows the effect of employee commitment on retention depends on the interaction with the moderating variable whereas, the effect of work environment on retention is dependent on employee commitment. These findings

are similar to a study by Mwangi (2017) on the effects of compensation on retention in jubilee insurance company limited Kenya which concluded that wages, salaries, and employee benefits influence employee retention.

DISCUSSION

The objective of the study was to investigate the effect of employee commitment on retention in private security firms in Nairobi County. The finding of the study established that employee commitment had a positive effect on retention. This implies that private security firms should invest in ensuring employees are committed to their work since it increases retention of the employees.

CONCLUSION

The study concludes that there is a need for private security firms to develop human resource practices aimed at ensuring that their employees are committed to the organization to encourage them to remain longer in the organization.

RECOMMENDATIONS

Firms should come up with strategies to encourage employee commitment whereby employees will be dedicated, reliable and aligned to organizational goals and objectives which could aid in improving retention

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PRODUCTION PLANNING AND CONTROL MODULE AND PERFORMANCE OF MANUFACTURING FIRMS IN NAIROBI COUNTY, KENYA

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ABSTRACT
The performance of the manufacturing companies over the past few years has been declining and in order to address this trend, firms have focused on using information and communication technology in manufacturing process to innovate, increase productivity and improve resource efficiency. Enterprise Resource Planning system integrates business activities that allow for a smooth flow of information and interaction across all divisions. Previous studies have linked Enterprise Resource Planning system to firm performance and found diverse results. The objective of this study was to establish the effect of production planning and control module on performance of manufacturing firms in Nairobi County. Descriptive research design was used. The population of the study consisted of 533 manufacturing companies in Nairobi County that were members of the Kenya Association of Manufacturers. Krejcie and Morgan's formula was used to obtain a sample size of 223 firms and stratified random sampling was adopted. Data was analyzed using simple and multiple regression analysis with the help of SPSS version 25.0. Multiple regression analysis and correlation analysis were performed to examine the association between variables and hypothesis was tested using t-statistic at 5% significance level. With a regression coefficient of 0.709 and a p-value of 0.000, the study found that the production planning and control module had a favorable and significant impact on firm performance. This inferred that the usage of production planning and control module improved the performance of the firm. The study recommends that firms should endeavor to acquire and use enterprise resource planning systems, to promote organizational survival, efficiency, and overall performance.
Keywords: Production Planning and Control Module, Firm Performance and Manufacturing Firms**.**

INTRODUCTION
In the modern-day business world, firms are attempting to increase their competitiveness in global market that is becoming increasingly challenging. As more firms continue to grow globally, competition and customer demands increases and therefore, firms may need to employ information systems such as Enterprise Resource Planning (ERP) systems to enable visibility, cooperation, and communication throughout corporate supply chains (Vermeulen *et al*., 2016). ERP system combines many business departments, including human resource, production, and finance into one tightly linked system with a mutual podium for information exchange across the whole organization (Beheshti, 2006). ERP modules that are widely used in manufacturing firms are production planning and control module, procurement module, financial accounting module, material management and human resource management (Hasan *et al*., 2011; Katerattanakul *et al*., 2014; Madapusi & D'Souza, 2012; Momanyi, 2014).

Production planning and control module is a system module that plays an important role in assisting the firm production strategies, giving the organization the opportunity to have a competitive edge (Parto *et al*., 2016). This subsystem evaluates production demands in connection to the company's present inventory and suggests operating orders for the proper timing and volume to satisfy production demands. In a study by Dhuongó (2017) revealed that different aspects of manufacturing planning control were adopted and used by the study organizations and that material requirement planning, production resource planning and capacity planning and control were widely used. The study concluded the existence of a robust positive association between both operational performance and production control and planning.

According to Pycraft et al. (2010), manufacturing firms are businesses that are engaged in converting inputs into outputs in the most practical and efficient manner possible to satisfy customers and meet organizational objectives. Majority of manufacturing companies in Kenya are members of Kenya Association of Manufacturers (KAM). KAM represents value-added manufacturing firms in Kenya. The association of was established in 1959 as a private sector organization. By communicating the opinions and concerns of its members to the appropriate authorities, KAM creates connections for collaboration, communication, and government participation. Additionally, it encourages the development, adoption, and execution of solid procedures that support a challenging business environment and lower the transactional costs. It also supports trade, investment, and standards.

Kenya Association of Manufacturers (KAM) members are divided into twelve different sectors, including mining and construction, food and beverage, furniture, wood products and timber, chemical and related, paper and board, energy and electronics, rubber and plastics, textiles and clothing, footwear and leather, metal and related, automobile assembly and accessories, and medical equipment and pharmaceuticals. Were (2016) found that the strongest subsectors in formal manufacturing were food and beverages, textiles in Export Processing Zones (EPZs), pharmaceuticals, construction-related industries like cement, and metals, while the strongest subsectors in informal manufacturing were furniture-making and metal works. On the other hand, complex manufacturing industries including automobile assembly, electronics, and other technology-related manufacturing were the weakest sectors in formal manufacturing.

Nyekpunwo *et al*. (2019) in studying three beverage production companies in Nigeria, found that manufacturing control as well as the planning system was frequently adopted and applied by the companies and there was a connection between operational cost management and production planning and control system. Data from a sample of 97 staff members were gathered using a questionnaire and the study used descriptive research design. Production planning was measured by percentage of material planning applied for the production, part of resource planning used for the production, proportion of growth plan for production and percentage of JIT planning applied for the production and reduced unit operational expenses. The study found that effective use of production planning and control accelerated beverage firms' overall growth through higher returns.

As per a report by the Kenya Institute for Public Policy Research and Analysis (2020), manufacturing industry is second-largest contributor to GDP after agriculture. However, the manufacturing sector's proportion to GDP has been decreasing, from 10% in 2014 to 7.9 % in 2019 (KNBS, 2020). The contribution to GDP further decreased in 2020 to 7.6 percent (KNBS, 2021).

According to the Big Four Agenda, the manufacturing sector's GDP share aim was to rise from 9.2% in 2016 to 15.0% in 2022. The sector's average GDP contribution in 2018, 2019, and 2020 was 8.0 percent, which is below the anticipated goal of 9.2 percent (KIPPRA, 2021). The sector's continuous decline in GDP contribution portrays a concerning scenario of attaining the policy goal of 15 percent GDP contribution by 2022, as suggested by the Big Four Agenda (KAM, 2021). Growth in the manufacturing sector dropped from 3.6% in 2018 to 2.5% in 2019 and declined further to -0.1 percent in 2020 (KNBS, 2021). The COVID-19 pandemic had a substantial impact on the manufacturing sector and had a negative impact on its expansion. 93% of manufacturing companies reported a decline in sales, and 23% of those companies had losses of between 65 and 100 percent (KAM and KPMG, 2020).

Similarly, Dhuongó (2017) examined the 28 registered pharmaceutical firms in her study. The study dealt with how manufacturing control and planning affected the operational success of firms within the Nairobi region in Kenya. She discovered a significant positive association between production planning and control and operational performance. Data collection instrument was a questionnaire and the study adopted descriptive research methodology. The components of manufacturing planning and control systems were materials requirement and resource planning. Just in time and enterprise resource planning. The present study focused on manufacturing firms while Dhuongo's (2017) was on another industry, specifically focusing on pharmaceutical firms. This study placed more emphasis on operational performance than the current study did, which placed more emphasis on firm performance.

In addition, Adegbuyi and Asapo (2010) deliberated how the organizational productivity of a food and beverage company in Nigeria is affected by production planning and control system. The study found out that effective production planning and budgeting for improved organizational productivity. The study used experimental research design and a case study method and data was gathered using a questionnaire from 150 respondents who were randomly chosen for the sample using a table of random numbers. Moreover, research by Umoh et al. (2013) on the relation between corporate productivity performance and production planning in the Nigerian manufacturing sector revealed that production planning had a considerable impact on corporate productivity firms. The researchers picked a cross-sectional survey design and to facilitate this, a sample of eighty (80) firms was obtained using stratified random sampling method. They then utilized both secondary and primary data to facilitate the inquiry. Secondary data was obtained from the company's financial statements as disclosed in the 2009 Nigerian Stock Exchange Factbook while the primary data were obtained by administering a questionnaire. The sample size for the current study was 223 firms, whereas for this study was 80 firms. In addition, this study utilized an exploratory research design while the current used descriptive research approach.

METHODOLOGY

The study adopted descriptive research design. The study covered 223 manufacturing firms out of 553 firms in Nairobi County. Stratified random sampling was adopted. Data was collected using a questionnaire. Descriptive and Inferential statistics were used to analyze data. Simple and Multiple linear regression analyses were then conducted using SPSS software version 25.0 in order to address study objective. Assumption of linear regression model of normality, multicollinearity and heteroskedasticity were tested before analyzing data.

RESULTS AND DISCUSSIONS

Diagnostic Tests

Test for Normality

The normality of the study's variables was examined using the Shapiro-Wilk test because it is the most powerful test for normality (Saculinggan & Balase, 2013; Yap & Sim, 2011). The normality test statistics for the Shapiro-Wilk test for production planning and control module was 0.962, which was greater than 0.05 suggesting that the variable fitted a normal distribution.

Multicollinearity Test

Incidence and degree of multicollinearity if any was tested using Variance Inflation Factor (VIF) and tolerance values. The VIF value was 1.745 less than 10 and tolerance value was 0.573 above the indicative value of 0.1, therefore, multicollinearity was absent.

Heteroskedasticity Test

This study used P-P plot to determine if the residuals had constant variance because they are best in the presentation of spread of residuals. The results indicated no specific pattern and the widths were neither increasing nor decreasing as the variables rise. Therefore, heteroskedasticity is absent.

Pair Wise Correlation between the Study Variables

Correlation determines the direction of a relationship between any two variables (Table 1).

Table 1: Pearson correlation between study variables

Variables	FP	PPC
FP	1	0.513
PPC	0.513	1

KEY: PPC- Production Planning and Control module
FP-Firm Performance

The results show that the correlation coefficient between firm performance and production planning and control module was 0.513 and a p-value of 0.000 less than 0.05 showing the presence of a statistically significant moderate positive correlation between firm performance and production planning and control module. This suggests that an increase in production planning and control module would lead to statistically significant increase in performance of manufacturing firms.

Multiple Linear Regression

A multiple linear regression was used to examine the relationship between production planning and control module and firm performance. A multiple linear regression analysis is represented in Table 2.

Table *2*: Coefficients estimates of Production Planning and Control Module and Firm Performance

Model 1	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	1.007	0.180		5.591	0.000
Production planning and control module	0.709	0.096	0.513	7.414	0.000

R^2=0.263

a. Dependent Variable: Firm Performance
b. Predictors: (Constant), Production Planning and Control Module

Results in Table 2 depicted that production planning and control module and firm performance had a positive moderate correlation (R=0.531). The R-squared 0.263 infers that 26.3% of the variations in firm performance can be explained by the production planning and control module while 73.7% of variations can be accounted for by random error or other aspects left out in the model. F-value was 54.961 and a p-value of 0.000. Since the p-value is less than the significance level (0.05), the model examining the impact of the production planning and control module on firm performance was statistically significant.

The coefficient of production planning and control module was 0.709 implying that a unit change in production planning and control module increases performance of manufacturing firms by 0.709 units. The constant of the model was 1.007 depicting the percentage of firm performance that is independent of production planning and control module. The t-statistic was 7.414 at a p-value of 0.000. The null hypothesis was therefore, rejected since the p-value of 0.00 was less than the significance value of 0.05, and it was inferred that the production planning and control module has a statistically significant positive effect on the performance of manufacturing firms. These findings were in line with Nyekpunwo *et al*. (2019) and Dhuongó (2017) who found that production planning and control module had a statistically significant positive effect on firm performance.

The findings implied that the use of production planning and control module aided in proper budgeting, use and control of resources in production process and automation of production processes hence efficiency in manufacturing processes. The simple regression model for effect of production planning and control module on firm performance was presented by the equation.

$Y = 1.007 + 0.709X_1$

CONCLUSION

The study concluded that the performance of manufacturing firms was positively and statistically significantly impacted by the production planning and control module. This sub system is important since it aids in proper budgeting and allocation of resources to production processes and hence efficiency in manufacturing processes.

RECOMMENDATIONS

Manufacturing companies, as well as businesses in other sectors, should endeavor to acquire and use enterprise resource planning systems in particular production planning and control module, not just to keep up with competitors, but also because of their importance in promoting organizational survival, efficiency, and overall performance. In establish the best systems, they should make sure that the appropriate modules are adopted to cover key company functions.

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INFLUENCE OF NEED ASSESSMENT ON PROCUREMENT PERFORMANCE IN PUBLIC UNIVERSITIES IN EASTERN REGION KENYA.

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ABSTRACT
There has been effort by the public institutions in Kenya to improve performance of the procurement function. However, poor procurement performance in terms of delays and poor quality goods received is still a challenge. The objective of the study was to investigate need assessment on procurement performance in public universities. The study adopted a descriptive research design. The population of the study was 324 participants, the sample size was 102 and stratified sampling was adopted. Data which was collected by means of questionnaires. Multiple linear regression models aided in analysis to bring out the influence of independent variables on the dependent variable with the help of Statistical Packages for Social Sciences (SPSS Version 28.0). The significance of the independent variable was tested using t-test. The t statistics and significance level established a statistically significant positive effect of needs assessment on procurement performance of public universities in Eastern region at a 5% significance level with coefficient of 0.059, and p-values 0.405. The study concluded that public universities should encourage effective use of need assessments to impact positively on the effectiveness of the procurement process of public universities in Eastern region. The findings of this study are expected to be useful to; public universities, as it would provide complementary knowledge useful in formulation of policy and a regulatory framework on procurement planning in the Public Universities. The study will be a key ingredient in the; planning, designing and implementation of a sound public procurement planning that will align itself to the overall economic strategy.
Keywords: Procurement need assessment, Procurement performance, Universities, Compliance, Policy, Risk

INTRODUCTION
Background of Information
Need assessment involves processes in analysing the market, analysing procurement organisation needs and involvement of the end users. These plans ensure that procuring user needs are met at the best possible cost, quality, time and other relevant factors that support organization performance (Shabani & Yaghin (2021). Gambo, and Musonda (2021) posit that needs assessment is a critical step in procurement planning since procurement is done only to satisfy the needs of the customer, enhance competitiveness of the product in terms of the price, quality and reduce any restrictions. It also ensures clarity in communication of the firm's needs. Previous studies have failed to adequately address the link between need assessment and procurement performance. Procurement planning is the process of deciding what to buy, when and from what source (Basheka, 2019). During the procurement planning process, the procurement method is assigned and the expectations for fulfilment of procurement requirements determined.

According to Public procurement and Asset Disposal Act (2015) section (VI) procurement planning in the public sector is compulsory in order to ensure efficient procurement of goods, works and services. Those charged with public procurement responsibility must therefore ensure that procurement plans are prepared in line with those of their annual budgets and implemented. The implementation of procurement plans must be monitored on a quarterly basis and adjustments made as necessary. Procurement planning is the responsibility of those charged with procurement responsibility of the organization. Procurement is a complex function and requires participation of all actors. It is also important for all actors to cooperate and perform their roles for the success of the procurement function. Each procurement activity for acquisition of goods, works and services should be assigned to the responsible officers and within which it should be completed as per the guidelines (Public procurement and Asset Disposal Act (2015).

Previous studies done in procurement planning and procurement performance have failed to access the moderating effect of level of compliance to government regulations on the relationship between procurement planning on procurement performance. For instance, Mutangili (2021) studies effect of procurement law of procurement performance. Mutangili (2021) studied moderating effect of regulatory framework on the relationship between international procurement and procurement performance. Both studies recommended a study to be done to determine moderating effect of PPADA (2015) on the relationship between procurement planning and procurement performance. Procurement performance of PPEs in the thought of the stakeholders has a lot of grey areas ranging from tendering process which takes too long thus causing delays in procurement of goods and services. The professional competence of some of the officers involved in tendering has also been cast into doubt with some reports that some do not undergo

continued training and development to upgrade their skills. Since time immemorial, public service has been having serious capacity constraints and procurement function has not been spared either. This to a great extent affects service delivery by few officers involved in procurement planning hence negating the performance of PPEs (Uyarra, 2019).

Kenya has 31 chartered public universities, 18 private charted universities,5 private university constituent colleges and 13 institutions with letter of interim authorities (CUE,2021). These universities are established through institutional Acts of Parliament under the Universities Act, 2012 which provides for the development of university education, the establishment, accreditation and governance of universities. Public Universities are the universities that get their funding from the Government. Procurement department in public universities is one of the fastest growing departments and they are headed by the Procurement managers whose main responsibility is to coordinate procurement and disposal activities as well as offer professional advice to the University. The focus of the study will be the five chartered public universities in the eastern region of Kenya. CUE report (2021) notes that the eastern region has the highest concentration of public chartered universities that existed as university constituent colleges before the Universities Act No. 42 of 2012. These universities are better able to link procurement planning to procurement performance since they existed just immediately the PPADA (2015) and after and are less likely to be influenced by institutional procurement cultures caused by inadequate procurement regulation prior to 2015.

The departments face several challenges arising from the implementation of the Public Procurement and Asset Disposal act (2015) which requires strict adherence to the long bureaucratic procedures. However by and large, Universities have met the requirements of the Public Procurement and Asset Disposal Act, 2015. As the Universities moves forward procurement function will continue to become more important in the management of public affairs. Furthermore, efficiency in procurement policies of the public universities is enhanced by government bodies such as the Public Procurement Regulatory Authority (PPRA) and Kenya Institute of Supply Management (KISM) which assist in assuring customers, employees and stakeholders' confidence as the University institution proves that they not only procure for maximum profits but also for utmost service (Republic of Kenya, 2015). In 2003, the Government of Kenya (GoK) began to implement reforms to address inefficiency in the use of public resources and weak institutions of governance. Reforms included the development of anti-corruption strategies to facilitate the fight against corruption and the enactment of the Public Officer Ethics Act 2003, the Anti-Corruption and Economic Crimes Act 2003, the Financial Management Act 2004 and the PPDA 2005. The latter was meant to make public procurement process more transparent, ensure accountability and reduce wastage of public resource (Republic of Kenya, 2015)

Statement of the Problem

Regardless of the effort by the public institutions in Kenya to improve performance of the procurement function, poor performance still poses as a key challenge. These institutions are burdened with delays and occasional inability to deliver the goods of the right quality to the designated organizations within the required time. The goods are of poor quality that does not meet the user's requirements. Successive reports by the auditor general for the financial years 2018, 2019, 2020 and 2021 have shown irregularities in procurement planning in 90% of public Universities in Kenya. Similarly, successive audit reports by the Public Procurement and Oversight Authority for the financial years 2019, 2020 and 2021 have revealed that public universities procurement performance has been low in terms of customer satisfaction, timely delivery and quality of goods. Despite the problem of procurement performance and with legal mandates and standards set forth for procurement planning need assessment, there is scanty and inconclusive research on the effect of procurement planning need assessment on procurement performance.

Objective of the Study

The objective of the study was to investigate the influence of need assessment on procurement performance in public universities in Eastern Region Kenya.

Hypothesis

$H0_1$ Need assessment has no statistically significant influence on procurement performance in public universities in Eastern Region Kenya.

LITERATURE REVIEW

Need Assessment Concept in Procurement Planning

A needs assessment is a process used by organizations to determine priorities, make organizational improvements, or allocate resources. It involves determining the needs, or gaps, between where the organization envisions itself in the future and the organization's current state. You then develop a plan of action to address the needs (or closing the gaps)

to bring the organization closer to its desired future state (Kim *et al*, 2021). Conducting a needs assessment protects the assets of an organization and assures that resources set aside to address need issues are conserved and used only for that purpose. A needs assessment can help determine whether the procurement is necessary to improve performance. For example, if increasing an employee's knowledge and skills will not help resolve a deficiency, then training is not appropriate. Procuring an item without assuring there is a need is a waste of time and resources (Kembro and Naslund, 2019).

Procurement Planning entails the identification of what needs to be procured (which is the result of a Needs Assessment), how the organizations need can best be met, the scope of the goods, works or services required, what procurement strategies or methods to be deployed, setting the time frames, and the accountability for the full procurement process. Kariuki and Wabala (2021) studied the influence of procurement planning on the procurement performance of selected county governments in Kenya. The study identified needs assessment as critical to procurement performance. The study however focused on once aspect of needs assessment (market analysis) while the current study focuses on the three aspects of needs assessment as posited by the section 130 of the procurement regulations (2015) market analysis, need analysis and user involvement. The study also used frequencies and and percentages which did not allow for inferential relationships between variables to be tested.

According to Ezeh (2019) Needs Assessment is "a systematic process for determining and addressing the needs, or gaps between current conditions and desired conditions or wants. This is important in procurement; because it is an effective tool to identify appropriate interventions or solutions by clearly identifying the problem to ensure that finite resources (Prior Budget appropriations) are directed towards developing and implementing a feasible and applicable solution for identified projects. According to the PPOA (2009), the beginning of the procurement process is need realization and identification of the requirements. This is informed by the inventory status, projects plan, production schedules, work plans, capital or operational requirements budgets and the procurement plan. Establishment of the requirements is the foundation for conducting market survey to ascertain aspects such as prices, new products or alternative or substitute products, new sources of supply, nature of competition and environmental aspects that may affect the supply market.

In a report, Karin *et al* (2017) singled out non-adherence to procurement methods as a major impediment to public procurement development in Kenya. They however did not specify the stage of procurement where this happened. In as much as the above studies highlight the core role of proper need assessment as a foundation for an effective procurement, they fail in bringing to the fore the link between need assessment and institutional performance. Recent theorists also point to the importance of public administration as a moral and ethical concern and recognize that administrative action is permeated by moral choices and are therefore models of not only technical and professional competencies but also of moral behavior (Schlosser, 2015).

Procurement Planning is an extraneous process that does not only involve the needs of the organization that guarantees what to be procured by an organization, how best to meet these organizational needs, the services needed by the organization, the scope of the procurement and therefore, procurement of the goods, the strategies to be employed, the time frame to accomplish the procurement, but also the accountability criterion, (Ezeh, 2019). It should be noted that needs assessment, is not only a rigorous but also systemic process for identifying and addressing the needs, which are therefore the ultimate gaps between current situations and desired situations. This is therefore the most important issue in the procurement processes because it acts as conveyor belt to an effective mechanism to identify the most appropriate measures by evidently pinpointing the challenge to make certain that fixed assets (preceding Budget appropriations), are thus not only channelled towards developing but also executing a practicable and relevant resolution for known programs.

It is important to note that when we realize and identify our needs then all this will enable us to initiate the procurement process, (PPOA, 2009). All these processes are informed by the intervention status, the plan of the project, the schedules of the production, the working plans, and the budget required for all these operations, and lastly, the procurement plan. This will guarantee the market survey to ascertain the prices of the products that are of course supposed to be procured, and to the extension, to establish the new products in the market, and ultimately, latest supply sources, rivalry nature and surroundings facets that can dictate the market supply.

The main hindrance to the public procurement development in Kenya is the tendencies of singling-out no-compliance (Karin et al.2017). The challenge however is that they did not successfully ascertain the stage in procurement where

non-compliance happened. Even though Karin et al, highlights the essential function of an appropriate need consideration is a basis to resourceful procurement, its fall short of clearly bringing out the forefront connection between need assessment and institutional performance. In need analysis Loeb (2019) assert that every procurement process should be preceded by a preparatory study, where business needs and user needs are identified and analysed. The needs are then transformed into requirements and award criteria, to be included in the Call for Tenders. To ensure that good tenders can be obtained, a market analysis should be carried out. Loeb (2019) by "user" is here meant a person who interacts with a product or a service. A user could be a person employed by the contracting authority or a citizen utilizing an ICT-based service provided by the contracting authority. User needs should be identified in order to establish a basis for the user requirements to be stated in the technical specification and for the award (sub) criteria.

An approach similar to the one described in ISO 9241-210:2010 Human-centred design for interactive systems could be applied. A brief overview of how a user-centred approach to a preparatory process can look like is presented below. First, you need to understand and specify the context of use. You need to identify the user and stakeholder groups and their relationship with the intended subject-matter of the procurement; the relevant characteristics of the users or groups of users. These can include knowledge, skill, experience, education, training, physical attributes, habits, preferences and capabilities. If necessary, the characteristics of different types of users should be defined, e.g. with different levels of experience or physical capability. In order to achieve accessibility, the procured products, systems and services should be designed to be used by people with the widest range of capabilities in the intended user populations. This is a legal requirement in many countries the goals of the users and the overall goals of the system. The characteristics of tasks that can influence usability and accessibility shall be described (Wiliamson, 2019).

User Involvement is key when preparing a procurement plan. From a social-exchange perspective, government organizations need things such as cooperation and compliance from service recipients to meet not only people's material but also their symbolic and normative needs (Alford, 2020). Even though the cooperation with users and the surrounding community has been recognized essential for public procurement's success, the resources given to user's involvement in public procurement processes are often slim (Wiliamson, 2019). The early detection of user requirements and needs guides the procurement project towards better end results, efficiency and innovative solutions straight from the beginning (Satish & Shah, 2019; Majamaa,2018).

In addition to creative mind, users can also bring other resources to the process for instance by positively influencing other users and lowering the public opposition (Karin et al.2017). Some existing studies indicate that the end-user of public procurement can be seen rather similar as a competent customer on a private market setting (Majamaa, 2018). Majamaa (2018) and (Ng, Wong & Wong, 2021) approach the end-user perspective with the concept of public-private-people partnership. The definition of "people" includes all the individuals impacted by or interested about the procurement from the core users of the public infrastructure and services to the whole taxpayer community (Ng, Wong & Wong, 2021). End-users appreciate the chance to do independent choices and are able understand the value for money-principle behind the procurement process. For the supplier, the competent customer is also a strategic partner that actively takes part in the development and commercialization of products by transferring information about the market characteristics and specific customer demands (Johansson, 2020).

Procurement Performance

There has been increasing demand by the public and other government services consumers' world over for timeliness in materials, goods and services availing by the public procurement entities to enhance efficiency, effectiveness, transparency and accountability by various user departments; all these are captured in the World Bank Procurement guidelines (World Bank, 2021).Objective of maximization of economy and efficiency, promotion of competition and for fair treatment of competitors, integrity promotion and fairness of procedures, increasing transparency and accountability of procedures, increasing public confidence of the said procedures and facilitation of promotion of local industry and economic development. It is critical to note that most government procurement policies, reforms guidelines and regulations (world over) have been customized from World Bank procurement guidelines 2005, likewise the Government of Kenya own Public Procurement and Asset Disposal Act 2015. The World Bank approximates that of the world's total expenditure, 75 percent goes towards procurement related activities according to its report of 2020(World Bank, 2021). The report goes further to mention that this amount spent translates to close to five trillion United States dollars. Kenya suffered a ban from the World Bank in the year 2020 where the bank noted that a staggering figure of Kenya shillings 500 billion had been lost due to corruption in procurement related scandals (World Bank, 2021).

It is essential to note that these limiting factors to effective performance of PPEs are not unique to Kenya. In Bangladesh, the World Bank decided to deploy an independent oversight institution to monitor utilization of its funds and check corruption in projects funded by it in the 2020/2021 fiscal year. While the bank is committed in doubling its assistance to Bangladesh in four years, it says the country continues to face pervasive corruption problems especially in roads, local government engineering and energy sector. A Washington based oversight institution (Department of institutional Integrity) assigned to monitor WB funded projects will independently investigate corruption charges when it receives complaints. On the basis of the probe reports, the WB will take measures to stop corruption. If the problem persists, it will discontinue funding the project concerned (World Bank, 2021).

A research by Caroline (2015) on procurement planning strategy and service delivery on public institution performance, a case study of medecins sans frontieres, kenya supply unit found out that procurement planning has made it possible to offer customer service to clients by anticipating clients' needs, formulating a method to meet their needs with client participation while monitoring the system to ensure consistency of service and reliability of the same. The enlightened public of the twenty first century has continually demanded good governance, proper monitoring and evaluation of public funds as well as total compliance to the law by officers given the responsibility to manage public funds through procurement as contained in the recent report by National Tax Payers Association (NTPA, 2016). Customer satisfaction indicates the fulfilment that customers derive from doing business with a firm. In other words, it's how happy the customers are with their transaction and overall experience with the company. Lead time is the amount of time between the commencement and finishing of a process. In procurement, lead time includes the first effort to initiate acquisition of goods or services, up to the time of their arrival. Procurement lead time includes identifying a need, selecting a good or service and sourcing vendors, in addition to time spent negotiating, ordering and paying (Uyarra, 2019).

Lead time in procurement also includes purchasing and its lead time. The procurement process is more variable than purchasing lead time, depending on sizes and scopes of what is being procured. Usually lead time in procurement is measured in months. Purchasing lead time starts when the goods or services are ordered and ends when they are received. This lead time includes availability confirmation, ordering, order acknowledgement, shipping notice, receipt of goods or service, invoice recording and payment. Purchase processes are less customized than procurement processes and tend to have similar practices across various types of businesses (Uyarra, 2019).

Quality includes ensuring that products are free of defects and working exactly as expected and claimed to do. Nothing is worse for a business than allowing a poor-quality product to go to the market. A company is only as strong as the quality of the goods and services it produces, as consumers are less likely to invest in a business if the product did not meet expectations. Advertisement for what a product or service provides should be accurate, and if a consumer does not feel it does, the company suffers. Everyone makes mistakes, but prevention is necessary to keeping consumers happy (Uyarra, 2019).

METHODOLOGY

Location of the Study

The research was undertaken on all Public Universities in Eastern region, Kenya which comprises of Meru, Tharaka-Nithi, Embu, Kitui and Machakos Counties. Eastern region was chosen for the purpose of this study because of the proximity of the region. Further the area has the highest concentration of the public universities that were existing as university colleges before being newly chartered as per the university act of December, 2012.

Research Design

The study used descriptive research design.

Study Population

The entity under investigation was 73 employees in procurement department in all the six University, 270 Heads of Departments and 45 Technicians. Therefore, the target population of this research was 324 respondents.

Sample Size and Sampling Procedure

Since the target population is not large the researcher used 30% of the total population of participants to get a sample size of 112. Kothari (2018) says that a representative sample is one which is at least 10% to 30% of the population thus the choice of 30% was considered as representative of the population. In this study the total sample size of the respondents was 102 respondents. The sample size is shown in the Table 2 below;

Table 1: Target Population

	Participants	Target Population Procurement Employees	Heads of Departments	Technicians	Total
1	Chuka University	13	49	9	71
2	University of Embu	12	42	6	60
3	Meru University	13	47	8	68
4	South Eastern Kenya University	13	43	6	62
5	Machakos University	12	44	7	63
	Total	63	225	36	324

University Profiles (2022).

Table 2: Sample Size

	Participants	Target Population Procurement Employees	Heads of Departments	Technicians	Total
1	Chuka University	4	16	4	24
2	University of Embu	4	13	2	19
3	Meru University	4	14	3	21
4	South Eastern Kenya University	4	13	2	19
5	Machakos University	4	13	2	19
	Total	20	69	13	102

Data collection and Analysis

Data was collected using structured questionnaires. The study generated quantitative data owing to the nature of the instrument that was adopted which included closed ended questions. Descriptive statistics of frequencies, percentages, mean and standard deviation were used to describe the characteristics of the respondents and variables with the aid of statistical package for social sciences (SPSS) version 28.0 since was the latest version. Data was analyzed using ordinary least squares and multiple regression was done for the overall model. Data was presented inform of tables and charts and using t-test and F-test. Estimated linear regression models was adopted to examine the information where hypotheses was tested using t-test while the overall significance of the model was tested using F-test at 5% level of significance.

A regression model for hypothesis H_{01} which stated that need assessment has no statistically significant influence on procurement performance in public universities in Eastern Region, Kenya took the form of: $Y_1= a_0+ \beta_1 X_1+e_1$

Ethical Consideration

The study obtained the introduction letter from the Chuka University, after that, the research permit was obtained from the National Council for Science and Technology to go to the field for data collection. Confidentiality was assured, and data collection instrument did not bear their names and those that were not willing to participate in the study were not forced to do so

RESEARCH FINDINGS AND DISCUSSION

Descriptive Statistics of Need Assessment Indicators and Parameters

Need assessment is an essential part of pre-procurement that helps the organization understands user needs in order to have clear metrics for forecasts. It enables the organization budget for user needs and associated risks in such a way that it ensures procurement performance. To be effective in needs assessment the organization needs to do a proper market Analysis, Need assessment and involve the users in the entire of this process. This study aimed to find out how universities carry out their needs assessment procedures and link this to procurement performance (Tables 3 and 4).

Tble 3: Are Needs assessment undertaken by respective heads of department for goods and services required

Needs assessment undertaken by respective heads of department for goods and services	Frequency	Percent
Yes	62	63.3
No	36	36.7
Total	98	100.0

Source: Primary Data, (2022)

The study established that 62% of the universities undertook needs assessment through respective heads of department, while 36 percent of the respondents indicated that their institutions never conducted needs assessment. This finding is similar to previous study by Nuwagaba et al., (2021) who found that more than average of all public institutions had included needs assessment into their everyday procedures. The study however was based in public firms in Uganda while the current study was based in universities in Kenya. Therefore, the current study findings add to existing literature in procurement. The implication of this finding as noted by Karin et al., (2017) is that organisations need to embrace and develop a policy on needs assessment approach in their procurement methods. Thogori and Gathenya (2014) posit that to ensure procurement meets all the needs of the user departments, there is need for institutions to conduct a proactive needs assessment. The study further aimed to establish how universities carried out their procurement needs assessment. Respondents were required to respond to a Likert rating scale on the extent needs assessment has been adopted by the university. The results obtained are shown in Table 4. The results obtained are shown in table 15. Where 1-Very Low Extent, 2-low extent, 3-moderate extent, 4-large extent, 5-very large extent

Table 4: Needs Assessment Practices

Descriptive Statistics	N	Mean	Std. Deviation
My organisation conducts market analysis in procurement planning to ensure procurement performance	98	4.2653	.89155
My organisation conducts need analysis in procurement planning to influence performance of Procurement process	98	4.4286	.87343
My organisation ensures user involvement in procurement planning to influence performance of procurement process	98	4.0816	.63690
Valid N (listwise)	98		
Aggregate	98	4.2585	0.8006

The aggregate score obtained by the study showed that public universities in Eastern Region, Kenya adopted need assessment practices to a large extent (4.2585) with deviations as shown by the standard deviation (0.8006). The universities conducted market analysis before commencement of procurement activities to a large extent (4.2653) with deviations as shown by the standard deviation (0.89155). The results showed that the universities conducted need analysis in procurement planning to a large extent (4.4286) with deviations as shown by the standard deviation (0.87343). Further the universities ensured user involvement in procurement planning to a large extent with a mean of 4.0816 and standard deviation of 0.63690. The aggregate standard deviation is relatively low compared to those of other items, which shows that average scores of indicators of needs assessment practices were close to each other.

The implication of this finding is that universities are expected to have superior procurement performance in terms of customer satisfaction, timely delivery and enhanced quality of goods and services. These results are similar to those of a study Kariuki and Wabala (2021) who found that needs assessment through market analysis was highly adopted in Kenyan public firms. The current study finding adds to existing literature by showing that universities have adopted the three needs assessment indicators as posited by the section 130 of the procurement regulations (2015) market analysis, need analysis and user involvement.

Need Assessment and Procurement Performance

The study objective aimed at determining the influence of need assessment on procurement performance in public universities in Eastern Region Kenya. Simple regression analysis was done to test the null hypothesis H_{01} which hypothesized that need assessment has no statistically significant influence on procurement performance in public universities in Eastern Region Kenya. Simple regression analysis was carried out and presented in Table 5.

Table 5: Regression analysis for Objective

(a). The Goodness of Fit of Model

					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.373[a]	.139	.130	.38055	.139	15.550	1	96	.000

a. Predictors: (Constant), Need assessment

b. Dependent Variable: Procurement Performance

Source: Primary Data, (2022)

As indicated in Table 24(a) the study shows the value of R-squared obtained by the study was 0.139 at a probability value 0.000, which is less than significance value of 0.05. The R-squared 0.139% obtained in this study implies that 13.9 % of the variations in procurement performance can be explained by the independent variable need assessment while 86.1% of variations in procurement performance are explained by random error or other factors.

To further test for the influence of need assessment on the procurement performance, Analysis of Variance (ANOVA) was carried out to ascertain the significance of the estimation model. Results presented in Table 4 (b).

(b): The Overall Significance of the Model

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.252	1	2.252	15.550	.000[b]
	Residual	13.902	96	.145		
	Total	16.154	97			

a. Dependent Variable: Procurement Performance
b. Predictors: (Constant), Need assessment

Source: Primary Data, (2022)

As presented in Table 24 (b) the study shows the analysis of variance (ANOVA) of the regression analysis. F-value was found to be 15.550 and a p-value of 0.000. The p-value is less than the significance level (0.000<0.05) hence indicating that the overall model testing the effect of need assessment on the procurement performance was statistically significant. The findings of this study show that need assessment is a good predictor of the procurement performance.

Regression Coefficients for the model on need assessment and procurement performance are in Table 4 (c).

(c): The Individual Significance of the Model

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	2.246	.440		5.106	.000
	Specification	.417	.106	.384	3.928	.000

a. Predictors: (Constant), Need assessment
b. Dependent Variable: Procurement performance

Source: Primary Data, (2022)

Table 4 (c) shows that constant of regression was 2.246. The slope of regression model obtained was 0.417. The t-statistic obtained for this model was 3.928 at a P-value of 0.000 which is less than the significance value of 0.05. This implies that need assessment has a statistically significant influence on the procurement performance.

This study therefore rejects the null hypothesis H_{01}: Need assessment has no statistically significant influence on the procurement performance among Public Universities in Eastern Region, Kenya. The P value obtained (P< 0.05) does not support the hypothesis that need assessment has no statistically significant influence on the procurement performance among Public Universities in Eastern Region, Kenya. Therefore the hypothesis was rejected implying that need assessment is a good predictor of the procurement performance.

The findings of this study bring out the importance need assessment on the procurement performance. From the theoretical literature, the postulates of the systems theory which was proposed by Ludwig (1972). The theory emphasizes on the significance of systems to the performance of organisations processes. This has been supported by the results of this study which implies that having proper needs assessment in terms of market analysis, need analysis and user involvement boosts the procurement performance in terms of enhanced quality, better lead times, cost reduction and enhanced customer satisfaction. Further the findings of this study are consistent with study findings by Davis (2022) who found that proper need assessment in terms of market analysis had a significant effect on procurement performance. This means that, proper specification will lead to procurement performance by creating an

environment where user departments are satisfied due to reduced costs and receiving of quality goods, works and service within the specified timelines.

The simple regression model for influence of need assessment on the procurement performance can therefore be presented by the equation below.

$$Y = 2.246 + 0.417X_1 + \varepsilon$$

where; Y = Procurement performance , 2.246 = constant, 0.417 = slope of regression model , X_1 = specification writing, ε = error term

CONCLUSIONS

The conclusion of this study is that organisations should emphasize of effective use of cost estimation strategies such as market analysis, needs analysis and lucrative user involvement to ensure procurement performance. Therefore, lack of proper cost estimations may lead to decreased customer satisfaction, extended deliveries and lead times and receiving of poor quality products

RECOMMENDATIONS

The study recommends that universities should sustain and continually improve on their need assessment programmes in order to boost procurement performance among Public Universities in Eastern Region, Kenya. This can be done by investing in proper research and involvement of user departments. Universities should be able to prepare their specifications based on the information generated from research and participation of user departments as this will increase customer satisfaction by providing quality goods, works and services at reduced costs.

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IMPACT OF MICROFINANCE ON THE POOR IN KENYA: A SYSTEMATIC REVIEW OF EVIDENCE FROM KENYA

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ABSTRACT
This study aims to review qualitative & quantitative research on the impact of microfinance (especially micro-credit) on the poor people in Kenya to enable policy-makers, donors, and practitioners to understand the nature of the evidence available. Despite some existing studies reviewing the evidence of the impact of microfinance in Sub-Saharan Africa, a systematic study of the effects of microfinance services in Kenya does not exist. The Kenyan microfinance industry is considered the most vibrant in Africa, with approximately Kshs two hundred fifty billion total industry assets as of 2021. Therefore, this study seeks to find whether or not the microfinance innovation has been a success. To identify relevant literature, a systematic search for evaluations of micro-credit or microfinance in Kenya was conducted on four online databases, JSTOR, ScienceDirect, Google Scholar and EBSCOhost, which was then systematically studied and classified. Keywords were identified, and the inclusion/exclusion criteria were defined for identifying papers. The findings of these studies were then synthesized by identifying whether micro-credit had positive, negative, varied or no effects on poverty, along with a narrative synthesis of qualitative findings. The study concluded that rather than making rich, some poor were made poorer by microfinance. Some studies established a positive impact of poverty on the poor; however, the effect is not constant and universal across the country. With the commercialization of microfinance, the objective of reaching the poorest of the poor may be flawed. Cash transfers with no strings attached might be an impactful intervention against poverty.
Keywords: Microfinance, micro-credit, Kenya, micro-loans, financial services, poverty

INTRODUCTION
Microfinance provides financial services to underprivileged and low-income earners who largely lack access to formal banking and financial services. These services include credit, savings, insurance and other primary financial products (Ki-moon, 2008). The concept of microfinance, especially microcredit, is considered to have been pioneered by the Bangladeshi entrepreneur and economist Muhammad Yunus in 1976, which entails the advancement of loans to the poor, often without collateral. His innovative experiments culminated in the foundation of the Grameen Bank. Since then, several models of microfinance have been replicated in different countries.

Grameen aims for poverty reduction, focusing mainly on women's incomes and empowerment (Adams & Raymond, 2008). Alongside women empowerment, microfinance also targets higher income levels, wealth, fertility, education, & social welfare. Microfinance has been long assumed as a panacea for poverty eradication, encouraging growth and development within the rural sector. However, several studies have criticized microfinance and deemed it to do more harm than good to the economy such as (HULME & MAITROT, 2014); (Seenivasan, 2015); (Ghosh, 2013), (Warnecke, 2014); and (Onyuma & Shem, 2005).

Other studies indicate that the commercialization of microfinance has resulted in a mission drift from its original target groups of the poorest of the poor toward profitable and less deprived clients (Brown et al., 2012); (Hulme & Arun, 2011); (Nair, 2010); and, (Osterloh & Barrett, 2007).

With such concerns amongst academics pertaining to microfinance, several studies have been conducted studying the impact of microfinance on the socio-economic status of the poor (e.g., (Kandie & Islam, 2022); (Lorenzetti et al., 2017); (G et al., 2015); (Duvendack et al., 2011).

With its origin in Asia in the 1970s, microfinance services became known in Sub-Saharan Africa (SSA) in the 1980s. The SSA is considered one of the world's poorest regions, with every second person living below the poverty line. The Kenyan microfinance industry is considered the most vibrant in the SSA, with approximately Kshs two hundred fifty billion total industry assets as of 2021. Therefore, this study seeks to find whether or not the microfinance innovation has been a success. Despite some existing studies reviewing the evidence of the impact of microfinance in Kenya, to our knowledge, a systematic study of the effects of microfinance services in Kenya does not exist, which brings together all these studies, assessing the nature of the impact of microfinance services on the poor in Kenya,

enabling policy-makers, donors, providers, and interested academic understand the nature of the evidence available. Therefore, this systematic review of the empirical evidence on the impact of microfinance on poverty in Kenya is essential to ensure whether the objective of poverty alleviation is being met.

METHODS

Criteria for inclusion and exclusion of studies in the review

Studies have been included and excluded under the following criteria:

Region: Microcredit impact assessments conducted in Kenya were included. Studies that included Kenya and other African or developing countries were not included in the review.

Study design: Only impact evaluations which sought to measure the outcomes, results, or effects of receiving microcredit were included. Both qualitative and quantitative data were included. Diverse methodological approaches for impact assessments were included, such as quasi-experimental, econometric and other approaches.

Randomized designs, quasi-experimental designs, regression-based approaches and other studies that met the following requirements were considered for inclusion:

- Relevant financial or non-financial outcome variables were measured for a sample of microcredit clients.
- Included a qualitative or quantitative analysis on the extent to which changes in those outcome variables could be attributed to microcredit.

Purely qualitative studies were excluded. Grey literature was excluded.

Intervention: Studies explicitly discussing the effects, results, outcomes, or impacts of microcredit were included. Other microfinance services such as microinsurance, microsavings, or money transfers were not considered for the purposes of this review. Studies focusing on the impact of microfinance along with other microfinance services, such as savings, were not taken into account.

Population: Studies focusing on the impacts of microfinance on the poor were included.

Outcomes: Various financial and non-financial outcomes of microcredit measured in microcredit impact studies were included. Studies that analyzed individuals, enterprises and households were included in the review.

Language: Relevant literature only in the English language was considered.

Search Protocol

To explore the effects of microcredit on poverty in Kenya, a multi-phased process to review the literature was devised. Publications from five online bibliographical databases were extracted- ScienceDirect, EBSCOhost, and Google Scholar.

Keywords: The keywords used for the search process for this review have been developed by analyzing the keywords found in other similar systematic reviews on the impact of microfinance.

The data were obtained from Google Scholar on August 25th 2022. The search terms were "microfinance" OR "micro-finance" OR "microcredit" OR "micro-credit" OR "microloan" OR "micro-loan" OR "microlending" OR micro-lending" AND "Kenya", which explored the titles of every published document on this database.

The exact search keywords were used to identify relevant literature on other mentioned online databases.

Screening studies: The overall search strategy comprised two phases. All search results were screened during the first phase on title and abstract. Next, full-text downloads of all likely studies for inclusion were made for the second round of screening. The inclusion/exclusion criteria on study design, outcomes, and intervention were applied in this round.

All relevant papers were coded using a detailed coding framework which helped characterize the intervention, outcomes, the setting (i.e., urban or rural), gender, study design, microfinance provider, and data collection method. Next, a subset of these studies was selected based on the quality criteria for an in-depth review.

METHODS FOR SYNTHESIS

Due to the inconsistency of the measurements within outcomes and the diverse nature of the included studies concerning the study design and reporting, a thematic narrative synthesis was conducted using the coding framework designed for this review. Findings within this framework were then reported qualitatively.

RESULTS

Three online bibliographical databases-Google Scholar, ScienceDirect, and EBSCO, were systematically searched for microcredit evaluations in Kenya. The search provided over 1500 results. These were reduced to 85 relevant studies based on their titles and abstracts. The full texts of these 85 studies were downloaded and screened for the second time, applying the quality criteria defined for this review. With this second round of screening using the coding framework developed, 39 studies were identified that evaluate the impact of microcredit in Kenya on the poor. Grey literature on the impact of microfinance in Kenya was excluded from this review since it did not meet the inclusion criteria; however, it should be noted that with the exclusion of grey literature, the results might not entirely reflect the existing evidential base on the impact of microfinance services in Kenya. A summary of the search and screening results is illustrated in Figure 1.

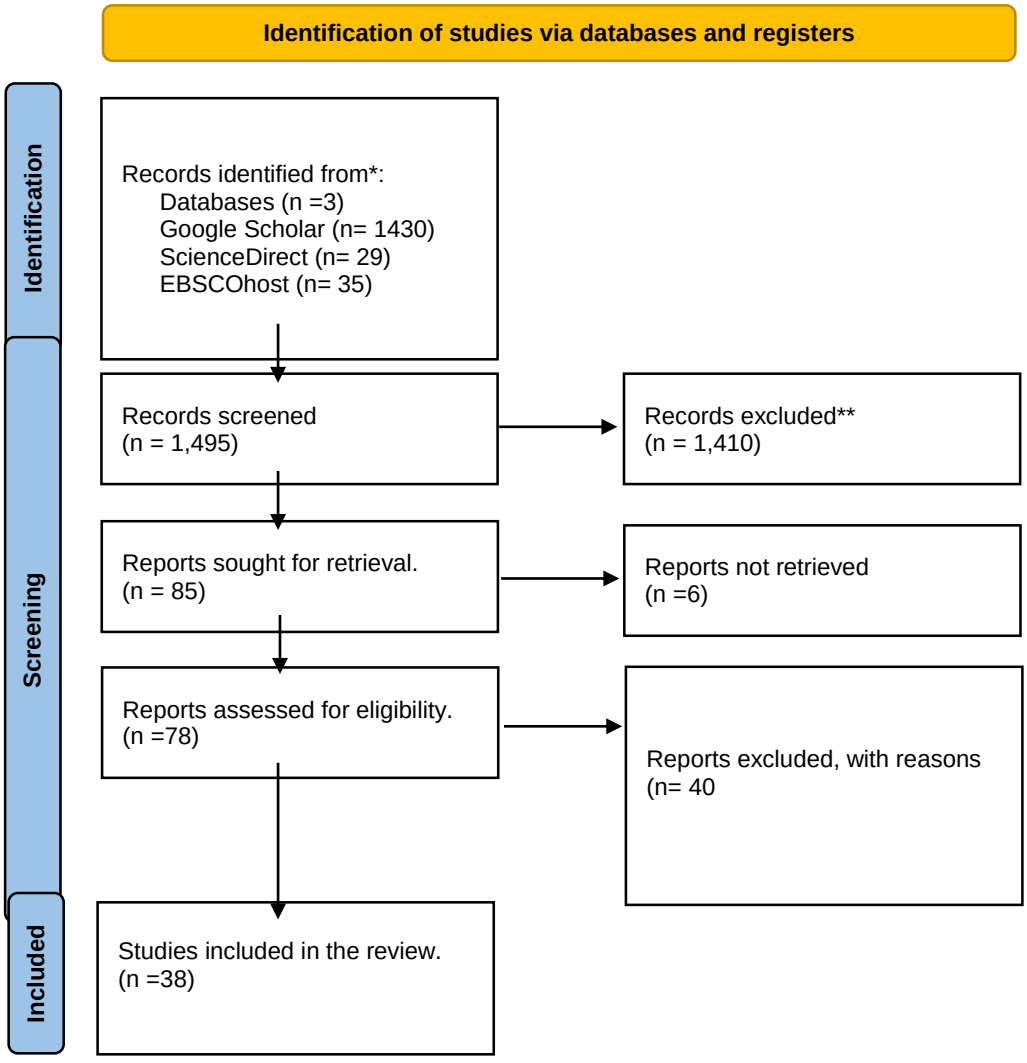


Fig. 1. Flow chart of the study selection process

Thirty-eight studies were identified that evaluated the impact of microcredit on the poor in Kenya. Of these 38 studies, 22 assessed the impact of microcredit on financial outcomes, 7 evaluated the impact on non-financial outcomes, and nine on both.

Of these 38 studies, 30 evaluated the impact of microcredit alone, whereas eight studies assessed credit interventions along with savings or insurance or both. Some studies also assessed the impact of microfinance institutions' financial training and credit interventions.

The units of assessment within these studies varied, with 14 studies assessing the impact of microfinance at the enterprise level, ten at the household level, two at the individual level, one at the community level, and the rest at 8 evaluating microfinance impact at a combination of these three levels.

Synthesis Results

Units of Assessment

For microfinance impact studies, the most common assessment units are 'the household, the enterprise or the institutional environment within which agents operate' (Hulme, 1997, p. 5). Most of the studies included in this review focus on the impact of microcredit at the enterprise level; however, some studies have also attempted to present the impacts at several levels such as (Electrin et al., 2013); (Makunyi, 2017); (Mutua & Mbuva, 2022); and (Kithuka & Otuya, 2016). Studies focusing on multiple units of assessments provide a clearer picture of the overall impact. Studies focusing on 'the individual or the enterprise' have drawbacks that could be discredited (Hulme, 1997).

Outcomes

Traditionally, microfinance impact assessments have centred around economic indicators, with changes in income at the heart of the assessments. Other commonly assessed variables for microfinance impact assessments have been assets, expenditure and consumption levels. Popular social change and empowerment variables have been education, healthcare access, and nutrition levels. A summary of studies included in this review by units of assessment and outcome is presented in Table 1. For each study, the first author and the leading paper's publication date are given. Full citations are listed in the reference section.

Table 1. Summary of studies included in this review by units of assessment and outcome		
	Financial	Non-Financial
Households	(Siringi, 2011) (Gitau, 2019) (Kiptoo Chepsat et al., 2015) (Osterloh & Barrett, 2007) (Hospes et al., 2002) (Electrin et al., 2013) (Kiiru et al., 2008) (Owuor, 2009)	(Siringi, 2011) (C. O. et al., 2017) (Kandie & Islam, 2022) (Deyoe et al., 2021) (Thuita et al., 2013) (Okibo & Makanga, 2014) (Electrin et al., 2013) (Ouma & Ogaga, 2015) (Makunyi, 201 (Mutua & Mbu (Kithuka & Otu (Mboya, 2020)
Microenterprises	(Mutai & Osborn, 2014) (Kandie & Islam, 2022) (Nyabende & Atambo, 2016) (Rono, 2018) (Kiiru, 2007) (Hospes et al., 2002) (Siringi, 2011) (Irene et al., 2015) (Wanambisi & Bwisa, 2013) (Osa Ouma & Rambo, 2013) (Omondi & Jagongo, 2018) (Okibo & Makanga, 2014) (Amsi et al., 2017) (Electrin et al., 2013) (Kisaka & Mwewa, 2014) (Muiruri, 2014) (Njoora & Kyalo, 2014) (Abayo & Oloko, 2017) (Ocholah et al., 2013) (Munuve et al., 2020) (Makunyi, 2017) (Mutua & Mbuva, 2022) (Kithuka & Otuya, 2016) (Kanake & Mahesh, 2018)	
Individuals	(Mutai & Osborn, 2014) (Kithuka & Otuya, 2016)	(Mutai & Osborn, 2014) (Omena & Ondoro, 2012) (Electrin et al., 2013) (Karuga & Jagongo, 2020)
Community	(Kiiru, 2007) (Electrin et al., 2013) (Muiruri, 2014) (Martin & Peter, 2022)	(Siringi, 2011) (Martin & Peter, 2022)

Effectiveness

Below is a summary of the directions of effect (i.e., the positive or negative impacts of microfinance), particularly in relation to the outcomes within the units of assessments mentioned earlier. This is followed by a narrative synthesis of the impact of microcredit on the individual, household, enterprise, and community levels.

Table 1 Overview of directions of the effect of microcredit on the individual level.

Study	Outcome	Direction of Impact
(Mutai & Osborn, 2014)	Living standards	Positive
(Kithuka & Otuya, 2016)	Self-esteem	Positive
(Omena & Ondoro, 2012)	Financial Empowerment	No impact of microcredit (but a positive impact of microfinance training on financial management)
(Electrin et al., 2013)	Role in decision making	Positive
(Karuga & Jagongo, 2020)	Women Empowerment	Positive

Comparative outcome evaluations measured impact of microcredit on the poor in Kenya at individual level

Five studies altogether assessed the impact of microcredit at an individual level. One of these studies reported that microcredit often granted individuals greater leverage in household decisions, especially women. Microcredit significantly expanded the economic role of the receiver, regardless of gender, resulting in a change in their overall status and bargaining position within the household. Other studies also reported that access to loans positively impacted women's economic empowerment. (Omena & Ondoro, 2012), However, one study reported that microcredit had no impact on its beneficiaries; instead, the financial training interventions offered by microfinance institutions positively impacted the clients' financial management skills.

Table 2 Overview of directions of the effect of microcredit on the household level.

Study	Outcome	Direction of Impact
(Siringi, 2011)	Income savings	Positive
(Gitau, 2019)	Debt repayment and household assets	Negative
(Kiptoo Chepsat et al., 2015)	Household income	Positive
(Osterloh & Barrett, 2007)	Household income	Negative
(Hospes et al., 2002)	Household income and consumption	Positive
(Electrin et al., 2013)	Household savings, Healthcare, and Education	Positive
(Kiiru et al., 2008)	Debt management	Both
(Owuor, 2009)	Household income	Positive
(C. O. et al., 2017)	Consumption	Positive
(Deyoe et al., 2021)	Health	Positive
(Thuita et al., 2013)	Consumption	Positive
(Okibo & Makanga, 2014)	Education	Positive
(Ouma & Ogaga, 2015)	Education, health, and consumption	Positive
(Makunyi, 2017)	Health	Positive
(Mboya, 2020)	Education	Positive
(Mutua & Mbuva, 2022)	Education	Positive
(Kithuka & Otuya, 2016)	Education	Positive

Comparative outcome evaluations measured the impact of microcredit on the poor in Kenya at the household level

Fourteen studies linked microcredit with positive outcomes at the household level. Two studies ascertained microcredit's adverse outcomes, and one found varied impacts on the poor. Broadly speaking, microfinance increased household income, which often resulted in increased expenditures on consumption and an overall reduction in the indebtedness of the house, enabling the household to increase its savings over time. The increased available income was often used to purchase household assets which might generate income. Microcredit also enabled loanees to purchase property and invest in human capital, such as education and skills training.

Comparative outcome evaluations measured the impact of microcredit on the poor in Kenya at the enterprise level

Twenty-four studies explored the influence of microcredit at the enterprise level. Of these, 24, 19 reported positive impacts of microcredit on businesses in various domains, such as asset creation, sales, turnover, profitability, productivity, and business income. 2 studies identified adverse impacts of microcredit. In contrast, three studies highlighted varied impacts of microcredit on businesses. Of these studies, many provided the causal relationship between microcredit and increases in business incomes. However, a few studies also identified the negative impacts

of loans advanced by microfinance institutions since many borrowers often fail to repay their loans and end up in a poverty trap, eventually worsening their financial situation.

Table 3. Overview of directions of the effect of microcredit on the enterprise level

Study	Outcome	Direction of Impact
(Mutai & Osborn, 2014)	Income and assets ownership	Positive
(Kandie & Islam, 2022)	Business income and profitability	Negative
(Nyabende & Atambo, 2016)	Profitability	Positive
(Siringi, 2011)	Asset creation	Positive
(Rono, 2018)	Sales	Positive
(Kiiru, 2007)	Profitability	Negative
(Hospes et al., 2002)	Employment creation and business growth	Positive
(Irene et al., 2015)	Financial growth	Positive
(Wanambisi & Bwisa, 2013)	Income and sales	Positive
(Osa Ouma & Rambo, 2013)	Sales	Positive
(Omondi & Jagongo, 2018)	Financial performance	Both
(Okibo & Makanga, 2014)	Business growth	Positive
(Amsi et al., 2017)	Financial performance	Both
(Electrin et al., 2013)	Employment Opportunities	Positive
(Kisaka & Mwewa, 2014)	Financial performance, business expansion, and liquidity	Positive
(Muiruri, 2014)	Sales, revenue, and employment	Positive
(Njoora & Kyalo, 2014)	Business expansion and sales	Positive
(Abayo & Oloko, 2017)	Business turnover	Positive
(Ocholah et al., 2013)	Profitability and productivity	Positive
(Munuve et al., 2020)	Business performance and sales	Positive
(Makunyi, 2017)	Business expansion	Positive
(Mutua & Mbuva, 2022)	Business income	Positive
(Kithuka & Otuya, 2016)	Business income	Positive
(Kanake & Mahesh, 2018)	Business Savings	Both

Table 4. Overview of directions of the effect of microcredit on the community level.

Study	Outcome	Direction of Impact
(Kiiru, 2007)	Rural Development	No impact
(Electrin et al., 2013)	Employment opportunities	Positive
(Martin & Peter, 2022)	Human development	Positive
(Siringi, 2011)	Social welfare	Positive

Comparative outcome evaluations measured impact of microcredit on the poor in Kenya at community level

'Beyond the individual, enterprise, and household, microenterprise interventions have an impact at the community level, if only through the aggregate effects at another level' (Sebstad et al., 1995, p. 29). Four studies focused on the impact of microfinance at the community level. Three studies found positive impacts of microcredit at the community level, with net increases in employment and income at the community level. In contrast, one study found no significant impact of microcredit on rural development. The study shed light on potential risk factors associated with microcredit services, such as a 'stressful debt management schedule that could lead to undercapitalization of enterprises as well as threaten the existing social networks' (Kiiru, 2007, p. 20).

Summary of the evidence of effectiveness

The current evidence from the available literature suggests that microcredit in Kenya has mixed impacts on the poor. Although, generally, it is observed that microcredit interventions have had a positive impact on the poor, however, the effects are not consistent. (Osterloh & Barrett, 2007) argued that microfinance institutions in Kenya primarily served high-income individuals, and microfinance initiates in Kenya do not appear to be 'pro-poor'. This calls for a careful analysis of the profiles of the borrowers from such institutions.

DISCUSSION

The diverse nature of the studies included in this systematic review does not allow to give a conclusive statement on the impact of microcredit interventions on the poor. The studies showed no consistency in their design, outcome

variables, units of assessments, gender, and setting (i.e., urban or rural). More importantly, only six of these studies reported the impacts of receiving microcredit on not receiving microcredit. The rest were non-comparative outcome evaluations of microcredit which again calls for further analysis. Moreover, most studies did not consider the confounding factors at the sampling or analysis stage.

Despite including evidence from various sources, this review does not include grey literature. Including grey literature could provide a more balanced picture of the available evidence. The findings point out that microfinance services, especially microcredit, might cause more harm than good. It is also evident that microfinance services are often not pro-poor. The commercialization of microfinance, which results in mission drift, is a significant concern in microfinance. Much attention to serving the poorest of the poor, along with a consistent methodological framework for impact assessments, is needed to arrive at a more informed conclusion on the impact of microcredit interventions.

CONCLUSION

In general, this study finds that microcredit positively impacts the poor; however, the results are not uniform. The proposition of microfinance as the panacea for poverty and women empowerment might be flawed (Onyuma & Shem, 2005). On the other hand, microcredit might potentially cause more harm than good if the amount is spent on consumptive activities rather than investing in the future or the businesses fail to generate enough profit.

RECOMMENDATIONS

The study recommends consideration of both the potential good and the potential harm whilst making policy decisions pertaining to microfinance in Kenya. Microfinance impact assessment studies should develop a standardized methodological framework to produce consistent results across the board. Similarly, microfinance should not be considered the only way of rescuing the poor from the chains of poverty; in fact, other structural solutions should be sought for solving structural problems such as poverty.

Recommendations for Policy

Consider both the potential harm and the good whilst extending microfinance services within the country.

Consider poverty a structural problem and devise structural changes within the country to take a more inclusive measure against poverty.

Recommendations for Research

Given the contradictory research evidence, standardization of outcomes measured and measures used is the need of the hour.

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FRUGALITY: THE MISSING PIECE IN INNOVATION AT THE BOTTOM OF THE PYRAMID JIGSAW PUZZLE?

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ABSTRACT
Given, the changing business landscape globally, innovation is increasingly getting focus as a panacea for economic downturn. However, innovation cannot be a one size fits all solution across the globe since different economies operate at different levels. To achieve economic development, innovation must take into account the constraints within which this strategy is pursued. The bottom of the pyramid consists of people who live on less than $2/day who are cross cutting in terms of cultures, literacy, capabilities and needs and to profit from these markets, focus must be placed on total value delivery. This creates an innovation opportunity that requires reframing the 'normal' rules of the game and challenging core assumptions. Innovation at the bottom of the pyramid requires commitment to awareness, access, affordability and availability as fundamental constraints for creating business models. Specifically, business models in these markets capture total value through high volumes and low margins unlike those higher up the pyramid. This article presents a conceptual discussion on how firms at the bottom of the pyramid economies can exploit frugal innovation to overcome constraints within these economies. Through analysis of literature, the article argues that the scarcity of resources at the bottom of the pyramid can confer frugality advantages. To capture value from frugal innovation, firms must take into account the specific constraints facing the firm and the market. This requires recognizing that bottom of the pyramid markets are dissimilar with different challenges and so frugal innovation must be tailored to the challenges they intend to solve in order to be sustainable. This article is informative to managers and policy makers pursuing innovation in these markets. It also provides a foundation to strategy and entrepreneurship scholars in reviewing the conditions within which innovation captures value especially in the bottom of the pyramid markets.
Keywords: Bottom of the pyramid, frugal innovation, frugal advantages, innovation, economic constraints, emerging economies

INTRODUCTION

The global business environment is changing fast with concerns such as climate change, shifting economic power and technological advancements. Marr (2021) contends that the business landscape is increasingly being shaped by need for sustainable and resilient operations, mix of human and artificial intelligence, shifting talent pool, flatter and more agile organizational structures, authenticity, purposeful businesses, co-opetition and integration and new forms of funding. Additionally, businesses are operating in the midst of increased digitization such that the lines between business and technology are becoming fuzzy. It is against this background that innovation is gaining center space as businesses seek ways of coping and surviving the changing business landscape. Indeed, innovation is also a driver to many of the changes observable in the business landscape.

Innovation seeks to come up with new products or services and derive value out of them. Innovation seeks to commercialize inventions which could be in terms of products, processes, markets or organizations. Brem (2011) observes that innovation is central to successfully enter markets or drive competition. He further points to innovation and entrepreneurship being the main triggers for the long term success of companies. Baumol (2002) attributed all the economic growth since the 18th century to innovation. It is against such a backdrop that innovation is seen to be the solution to most of the problems being experienced in the world. Bessant and Tidd (2015) concurred that innovation jumps out from thousands of mission statements and strategy documents and is indeed on the lips of every politician cognizant that innovation is pivotal to shaping and reshaping lifestyles. They attribute this trend to the recognition that if organizations do not change their offerings and how they create and deliver them, they face extinction.

While innovation is associated with positive benefits, innovation has a dark side to it. Coad, Nightingale, Stilgoe and Vezzani (2021) opined that innovation should not be simply viewed as either good or bad but rather its nature should be well understood. They argued for a more nuanced discussion that took into account both the direction and rate of change. Further they noted that the effects of innovation, both positive or negative could be distributed unevenly and thus the need to select an environment that weeds out the negative innovations. De Marchi, Pineda-Escobar, Howell, Verheij and Knorringa (2022) contended that innovation can potentially lead to harmful impacts on society and the environment. They further noted that innovation could interfere with existing practices thereby resulting in new or deeper inequalities. Coad et al, observed that policymakers tended to ignore the negative side and assumed that

innovation was always good and therefore more of it was better. This they attributed to ignoring that innovation effects are reflected in the selection environment for innovation.

In an attempt to reconcile the positive and negative effects of innovation, there is increasing focus on sustainable development. This creates a focus on balancing between innovative activities and their sustainability (De Marchi et al, 2022). This view seeks to evaluate the long term and overall effects of innovation. Coad et al (2021) isolate overall harms associated with innovation as public health risks, environmental degradation, harm to society and harm to the economy. This they observed were important since they were more instrumental to policy makers as they could provide the basis for policy frameworks that reconcile the pros and cons of innovation. Prahalad (2011) argued for going beyond the technological and product perspectives of innovations to the total delivery of value. This, he contended, requires a rethinking of the source, focus and process of innovation. Thus, to appraise innovation and its accompanying value and cost, it is important to consider the innovation context. Thus innovation cannot be approached in a one-size-fits-all approach. The contexts of the different beneficiaries of the innovation must be weighed to determine its potential benefits and costs and its attendant sustainability over time. For instance, the development of electric vehicles may be a suitable innovation for communities with access to electricity but meaningless to communities without. Such an innovation may need to take into account the context of application to be beneficial.

Bottom of the Pyramid

The bottom of the pyramid refers to the group of people who constitute the largest (two thirds) but poorest of the socio-economic status. It is the lowest of the income group. Prahalad (2004) describes the bottom of the pyramid as encompassing the world's four billion poor that is people who on less than two dollars a day. Prahalad argued that wealth distribution and income generation capacity can be depicted by an economic pyramid. The wealthy with a variety of opportunities form the tip of the pyramid while the poor form the base of the pyramid. Many of these people live in developing countries of Africa, Asia and Latin America. Solutions to achieve poverty eradication at the base, he further argued, had eluded aid agencies, donor, public and private entities alike as underscored by the Millennium Development Goals. Therefore, poverty and its accompanying disenfranchisement constituted one of the world's most formidable problems.

Prahalad (2004) identified various characteristics associated with the bottom of the pyramid with the dominant assumption being that the poor have no purchasing power and are not a viable market. Consequently, customers in this market spend on basics and are not concerned with technology and advanced products that are consumed by their counterparts in the developed markets. Prahalad and Hart (1999) observed that the vast majority of people at the bottom of the pyramid live in rural villages, urban slums and shanty towns coupled with low education levels. Further, they noted that due to the unorganized nature and limited quality and quantity of products and services, the bottom of the pyramid remains largely unnoticed in corporate efforts.

The invisibility of the bottom of the pyramid to corporate efforts has been elaborated into the innovation discussion. Indeed, Karnani (2006) observed that intellectual discourse at the bottom of the pyramid focused on public policy and development economics and it is only recently that management experts have delved into this discourse. Prahalad (2004), paved the inroads to this discussion by arguing against corporate social responsibility as the basis for initiatives at the bottom of the pyramid. To counter that, he argued that there were profits to be made by selling to the poor due to untapped purchasing power. This he argued should be led by large companies thereby helping to eradicate poverty. In short, there is fortune and glory at the bottom of the pyramid.

Attempts to resolve the problems at the bottom of the pyramid have largely taken a one-size-fits-all approach. Simanis (2012) argued that most companies adopted the low price, low margin, high volume model which was flawed. This he associated with the difficulty in penetration of such markets and the cost structures and called for a different approach that recognized the need for high margins even at the bottom of the pyramid and sticking to basic business tenets. This approach is premised on the notion that it is only a profitable business that can be scaled to meet the objective of poverty eradication to a wider market base. Simanis and Duke (2014) elaborated on this by proposing that organizations could only profit in low-income markets by understanding their challenges which are changing consumers' behavior and changing the way products are made and delivered.

Simanis and Duke (2014) observed that bottom of the pyramid markets present in a variety of shapes and sizes and they specifically classified them into mature, growth and frontier markets. This they demonstrated required a multifaceted approach in order to operate in them profitably. Prahalad (2012) observed that the composition of the bottom of the pyramid was not a monolith but rather it was composed of varied needs, capabilities, literacy, ethnicity and cultures. This he noted presented a segmentation opportunity alongside the distinct differences in these markets and any undifferentiated approach was bound to fail. Efforts at the bottom of the pyramid need to take into account

the specific conditions in each of these markets and this may even require further segmentation even within countries and regions.

In addition to the differences amongst the bottom of the pyramid markets, Prahalad and Hart (1999) observed that managers have widely held assumptions about them. To begin with they assume that the poor are not the target markets of multinationals since they cannot compete in such markets due to their cost structures. Secondly they assume that the poor cannot afford and do not have use for their products and services and thus they focus on the tip of the pyramid. Additionally, they assume that the bottom of the pyramid has no bearing on their long term viability and so leave them to nonprofit organizations and governments and as a result never consider such markets leading them to innovate around sustainable development. Finally, managers only have intellectual excitement in the developed markets and are not interested in business challenges with a humanitarian aspect. It is due to these assumptions that businesses ignore bottom of the pyramid markets. These assumptions are also applied collectively to the bottom of the pyramid which is misleading. While some may hold in some segments at the bottom, they do not apply to all and they all may not apply to one segment in totality. This suggests that it is absolutely important to understand variety that is the bottom of the pyramid.

Simanis (2012) contended that for profits to be possible at the base, two conditions are vital that is the firm can leverage on existing infrastructure that is applied in serving the richer clientele to serve the poor and the consumers know how to buy and apply the product. These conditions are rarely, if ever, applicable across the base of the pyramid. Indeed, Prahalad (2012) observed that the poor are found both in urban and rural settings with different levels of awareness and access to infrastructure. Karnani (2006) observed that the poor at the bottom of the pyramid are geographically dispersed and are culturally heterogeneous which tends to reduce the economies of scale in serving these customers. Further, there are discrepancies in terms of transportation, communication, media and legal infrastructure which exaggerates the costs of doing business. Simanis and Duke (2014) argued that to profit at the base, firms needed to surpass two common but often underestimated challenges. These they noted were the changing consumer behavior and changing the way products are made and delivered to customers. These challenges often necessitate extra costs and changes in value chains which require firms to have a realistic assessment of the opportunities at the bottom and match them with their resources, skills and capabilities.

In recognition of the challenges at the bottom of the pyramid, Prahalad and Hart (1999) advocated for a model that creates a convergence between low cost, good quality, sustainability and profitability. This requires a paradigm shift from the assumption that serving the bottom of the pyramid takes cheap and low quality products to understanding that it requires firms to bring the best technology and global resources to address local opportunities. This means that innovation becomes a key imperative in this endeavor. However, this kind of innovation requires clarity in the boundaries that shape the opportunity in terms of cost, quality, sustainable development, local knowledge, needs and volumes. To innovate within these boundaries requires firms to take cognizance of the variations that exist at the bottom of the pyramid and customize their business models to suit the constraints. Prahalad (2012) concurs that there is no universal bottom of the pyramid solution but rather solutions must be customized to the target within the bottom of the pyramid. This, he elaborates, requires a deep immersion into consumers' circumstances to obtain insights that help to define the boundaries for innovation as well as recognizing that such innovation is not just about a product but rather about developing an appropriate ecosystem for the business model to function.

Prahalad (2012) proposed the 4As as opposed to the 4Ps of marketing in order to customize a market approach at the bottom of the pyramid. The 4As namely awareness, access, affordable and availability must be a central commitment to innovation at the bottom of the pyramid. Awareness requires that the consumers and producers of products and services at the bottom of the pyramid must know what is available and how they can apply it. Access involves ensuring that consumers including those in remote locations can access the product or service which in essence requires focus on the infrastructure available to all the consumers. Affordability involves providing world class quality at lower prices and not poor quality products. This, Prahalad noted presented the most difficult conundrum for firms from developed economies since the bottom of the pyramid requires quality products at lower prices and not luxury. Finally, availability implies that there must be an uninterrupted supply of the products or services.

Karnani (2006) contended that the profits at the bottom of the pyramid proposition was simply a mirage since the market was relatively small and diverse and so the proposition could end up being harmful to the very people it was meant to protect. He therefore termed the bottom of the pyramid proposition a dangerous delusion especially when it ended up with firms exploiting the poor or disadvantaged with low capacities to choose lives they valued. Prahalad (2012) noted that firms could make breakthrough innovations addressing the 4As and the resultant challenges and thus called for working within these constraints to innovate and create sustainable development. These contentions align in the need to weigh in the constraints at the bottom of the pyramid in order to provide sustainable innovations.

Innovation at this point should seek to avail quality products or services at affordable prices driven by a clear definition of value as seen by the target consumers.

Frugal Innovation

Frugal innovation is an emerging field in the wider innovation discussion which is seen as a novel innovation approach that seeks to design or redesign business models to provide reduced complexity, essential functionality and affordable solutions for the underserved poor. It is a form of innovation that seeks to provide basic functionalities of products and services commonly for the poor. However, with higher levels of economic declines globally, the frugal innovation debate is finding its way into more developed economies. Frugal innovation is ideally intended towards developing products and services that fit the special needs and requirements of non-affluent customers. It can be conceptualized as an attempt to maximize the ratio of value to resources that is doing better with less and for more people (Prabhu, 2017).

Weyrauch and Herstatt (2016) isolated three characteristics that define frugal innovation that is substantial cost reduction, focus on core functionality and optimized performance level. Frugal innovation must be able to attain lower prices for the customer compared to other solutions available for the customer. The focus on the core functionality on the other hand entails making products that are user friendly and easy to use compared to what is available to customers that is it directly targets user requirements. Frugal innovation also requires a critical examination of the performance and quality levels required. Optimized performance implies that the innovation must provide value for the customer taking into account the variety of customer contexts. Thus it must meet the de facto purpose and local conditions better than available solutions. Weyrauch and Herstatt further added that frugal innovation could possess additional characteristics like being scalable and sustainable.

Vadakkepat, Garg, Loh and Tham (2015) argued that frugal innovations have the capacity to convert the poor from passive recipients of aid to active consumers of products and empowering them through affordable products and services. They noted that consumers at the base of the pyramid operate in geographically remote environments which are resource constrained, institutionally void and less than sufficient technological know-how. These environments tend to be "media dark" and so are denied or unaware of products and how to use them. Frugal innovations can therefore deliver more inclusive growth at the bottom of the pyramid. Citing, the cases of the Jaipur foot and the Aravind eye clinics, Vadakkepat et al, argued that frugal innovations make available important products to the poor by cutting off the frills to make them affordable.

The three attributes by Weyrauch and Herstatt (2016) provide the essence of frugal innovation and this is definitely not just providing cheap products for the poor but rather it is focusing attributes necessary to offer value to the customer at a lower cost. Ideally frugal innovation takes different shapes and sizes based on the varied needs and local conditions and can therefore differ significantly depending on the target market. Vadakkepat et al (2015) argued for making products affordable not by just stripping them off features but by understanding contextual constraints associated with cultural norms, society, technical backgrounds and environmental constraints to provide users with focused value. This they noted provided avenues for applying frugal innovation beyond the products to business models thereby scaling and ensuring sustainability of the business models.

Frugal innovation takes various forms depending on the context. Hossain (2018) noted that frugal innovation overlaps with multiple concepts specific to certain countries like Gandhian and Jugaad in India, Gambiarra and Jeitinho in Brazil, Jua Kali in Kenya, Jiejian Chuangxin in China and Kanju in Africa. On the other hand, in developing economies, there are concepts like cost innovation, catalytic innovation, good-enough innovation, resource-constrained innovation, indigenous innovation and bottom of the pyramid innovation. The concept also overlaps with grassroots innovation, blowback innovation, reverse innovation, trickle-up innovation and disruptive innovation in developed economies. Prabhu (2017) concurs that frugal innovation is disruptive in nature since it seeks to take over the market through offering affordable versions of products. Hossain argues that bottom of the pyramid innovation comes close to frugal innovation but falls short by focusing on poorer customers only. Frugal innovation is aimed at both low-income customers and emerging middle-income segments.

Basu, Banerjee and Sweeny (2013) observed that the benefit of frugal innovation is based on its ability to be economically efficient within conditions of severe scarcity. They differentiated frugal innovation and conventional innovation based on the drivers, process, core capabilities and location. Frugal innovation is driven by what customers need not what would be nice to have using a bottom-up process as opposed to top-down. Further frugal innovation relies on the core capabilities of functionality not desirability and design and it is located in developing and emerging markets unlike conventional innovation which is located in developed markets. Frugal innovation requires that the innovator addresses the essence of a problem and thereby provides a real solution to the customers' problems.

Frugal Innovation and Sustainability

Given the declining economic conditions globally, consumers are becoming more value conscious. Levanen, Hossain and Wierenga (2022) contend that business models are increasingly under societal and operational pressures. The societal pressures emanate from social, environmental and economic aspects that surround the business. On the other hand, operational pressures arise from the resource, institutional and affordability constraints. Businesses are therefore under pressure to design sustainable business models which must be clearly articulated in terms of value proposition, creation and capture.

In addressing the strategies for success at the bottom of the pyramid, Prahalad and Hart (1999) argued that an entrepreneurial orientation is required which creates instead of serving markets. Zeschky, Widenmayer and Gassmann (2011) argued that firms must rethink their business models for long term success. This is due to the increasing middle class who are keen on frugal innovations and affluent customers who over time choose products that are less expensive but still deliver. Firms must also establish organizational structures and capabilities necessary to build frugal products. This requires firms to understand the unique characteristics of frugal products. This is crucial for the sustainability of the businesses. Sustainability aims for meeting present needs without compromising future generations ability to meet their own (Albert, 2019). The emerging middle class and the affluent customers choosing frugal products are providing avenues to broaden the market for frugal innovators. Given that frugal products have low margins, a broader market is crucial for long term sustainability by ensuring the long term profitability of the business.

There is an inherent connection between sustainability and frugal innovation. By cutting out the frills on products and services, frugal innovation reduces wastage and provides for better deployment of resources. Albert (2019) observed that it is inherently socially and economically sustainable. De Marchi et al (2022) confirming that social and environmental outcomes should not be assumed in frugal innovation, noted that it can have negative outcomes. They argued that the potential of the frugal innovation to contribute to sustainable development is influenced by the actors developing the innovation. The innovation must also be relevant to be embedded in the local context. The sustainability of the frugal innovation also depends on whether the developer is foreign or local. This implies that frugal innovations need to be specific to the target market and should involve the consumers in developing them giving rise to prosumers.

Basu et al (2013) argued that by applying the core competences windows of opportunity can be opened in resource-constrained areas. This they argued required everyone to understand the needs of the developing world in order to advance to sustainability. This is because frugal innovation can lead to sustainable solutions by identifying the real needs of the target markets and tailoring solutions to those needs. This also allows users to contribute and even develop solutions to their problems and within their conditions or constraints. This contributes to economic, social and environmental sustainability of the venture by being relevant. This is especially important considering that frugal innovations can have adverse effects e.g. the Tata Nano that has been failing to pass crash tests and sachet packaging that contributes to environmental degradation through waste disposal when they end up in drainages and filling landfills.

Frugality-Based Advantage at the Bottom of the Pyramid

The bottom of the pyramid is riddled with resource constraints which may pose challenges for firms pursuing innovation in these markets. However, firms with an entrepreneurial orientation can turn the obstacles in these markets to opportunities. Indeed, clarity on the needs and the resources available can provide frugal solutions that are sustainable for their intended customers e.g. the skin-to-skin contact wrapping of preterm babies in Tanzania where there are no incubators and clay water filters in Cambodia or the Kadogo economy in Kenya.

Asakawa, Cuervo-Cazurra and Un (2019) argued that limitations in external resources could confer frugality advantages to the firm. Extending the resource based theory's propositions, they argued that resource scarcity need not be the source of competitive disadvantage but rather provided opportunity to combine elements in a way that offers both cost leadership and differentiation. This view is contrary to the perspective presented by the Porter's generic strategies. Asakawa et al delineated three types of frugal based advantages namely input, income and infrastructure frugality-based advantages. Input frugality-based advantages focus on innovations that solve constraints in inputs to the production process e.g. Sony in developing paper magnetic tape recorders due to plastics unavailability while income frugality-based advantages e.g. the Tata Nano aim at addressing constraints in customers purchasing power which is commonly associated with those living at the bottom of the pyramid. Infrastructure frugality-based advantages e.g. M-Pesa target constraints that arise from underdevelopment of a country's infrastructure including institutional infrastructure.

The conditions at the bottom of the pyramid are such that there are resource constraints that span the three types of advantages. The poor at the bottom of the pyramid live in both rural and urban setting with differing levels of

infrastructure, poor general standards, health problems, depleting natural resources, uneducated populations, limited access to electricity, poor road networks low brand protection, low income levels and poor technological know-how (Prahalad, 2012: Levanen et al, 2022). These conditions also vary from one country to another and within each country. Due to these, the conditions at the bottom of the pyramid offer opportunities for the different types of frugality based advantages.

The variety of conditions at the bottom of the pyramid also present challenges in the sense that frugal innovations have to be problem specific. This implies that some frugal products that are appropriate in one setting may not necessarily work in another setting. On the other hand, these advantages need to be transferable to other settings with similar external constraints. This does not prove to be always the case. Asakawa et al (2019) proposed that the transferability of the frugality-based advantages depended on the type of frugality based advantages with the input based being the most transferable, then income based and infrastructure based bringing up the rear. This due to the different degrees of internalization and applicability of the advantages. This transferability poses a challenge to businesses as it affects the scalability of solutions developed at the bottom of the pyramid and makes it harder to make profits in these markets. This aligns to the view by Karnani (2006) who opined that profits at the bottom of the pyramid were either a mirage or a dangerous delusion driven by the small size of the market and the consumption levels that feasible in it.

The other challenge that firms grapple with in deriving the frugality-based advantages has to do with the erosion of the advantages over time. This is related to the sustainability of the frugality based advantages. As the economies develop, the constraints decline thereby eroding the frugality-based advantages. Asakawa et al (2019) proposed that the sustainability of frugality-based advantages was also tied to the type with the infrastructural based advantages having the longest sustainability since infrastructural constraints took longer to resolve. This is followed by income based since as economies develop the income levels also rise which erodes the income based advantages. Input based advantages have the lowest sustainability due to emergence of domestic suppliers and firms vertically integrating. This erosion of sustainability suggests that the opportunities presented by external constraints require close monitoring over time. This also makes it necessary for firms to consolidate their lessons in different markets and find commonalities that allow them to transfer their innovations across markets where certain constraints exist. This requires the firm to be adaptive and be open to learning. The sustainability of frugality-based advantages also raises the need to develop innovations that are necessary for emerging markets and the affluent to increase their sustainability.

CONCLUSION

Given the pressures that are prevalent at the bottom of the pyramid, it is imperative for firms to develop innovative solutions for this market. These innovations have to take into account the constraining conditions that persist in these markets. Therefore, frugal innovation definitely provides the missing piece in the innovation jigsaw puzzle at the bottom of the pyramid. This requires a paradigm shift that perceives the constraints in these markets as opportunities to derive frugality-based advantages. Given, the common pursuit by firms to secure resources to deploy for competitive advantage, firms need to change their mental models to pursue innovations within the boundaries of the resource constrains at the bottom of the pyramid.

Frugal innovations at the bottom of the pyramid cannot be a one-size-fits-all. This is because of the variations among the people living at the bottom of the pyramid. To contribute to economic recovery and development at the bottom of the pyramid, frugal innovations need to be specific to the concerns of the targeted consumers. This requires firms to collaborate more with the consumers and deep dive into the conditions facing each consumer group so that there is clear segmentation of the consumer groups and solutions provided to each. Additionally, firms in this market need proper clustering of the customers to allow for scalability of the solutions provided. This would increase the transferability of the frugal innovations.

The conditions at the bottom of the pyramid also necessitate homegrown solutions as opposed to innovations developed elsewhere and transferred to the consumers at the bottom of the pyramid. The frugality-based advantages offer opportunities for growth of prosumers as opposed to mere consumers. This supports the view that solutions for the bottom of the pyramid may best be provided by the incumbents of the bottom of the pyramid since they have a better understanding of the constraints they face and what viable solutions would look like. This would contribute to the sustainability of frugal innovations.

On the overall, if economic recovery is to be achieved at the bottom of the pyramid, it is imperative for firms, governments and individuals to embrace frugal innovations. This is due to the ability of frugal innovations to be customized to the conditions in these markets and were best suited to provide lasting solutions to the problems faced by the people at the bottom of pyramid. In addition, due to the emerging middle-class and the affluent who are likely

to consume less expensive but performing innovations, frugal innovations can be scaled to wider markets thus overcoming the barriers of size of the markets at the bottom of the pyramid. This therefore would enable firms operating in these markets to profit within the constraints in these markets while providing collaborative solutions to the people in these markets. This would improve the livelihoods of the people at the bottom of the pyramid without subjecting them to the indignities of begging and relying on aid. Frugal innovation at the bottom of the pyramid can therefore spur economic recovery since it has the capacity to solve problems in a profitable, scalable and sustainable manner when it is developed for the people by the people.

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EFFECT OF PROCUREMENT PLANNING ON SERVICE DELIVERY AT PUBLIC UNIVERSITIES IN KENYA

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ABSTRACT
Procurement in Kenyan public universities has been recognized as essential in.service delivery since it affects how goods are procured and ensures tenders are awarded at the right time to ensure smooth running of the university. However, this has not been the case because even though most of the public procurement reforms have been achieved and procurement policies and institutions are in place, the level of quality service delivery by the universities is still low. This study therefore sought to determine the effect of procurement planning on service delivery among public universities in Kenya. This study was anchored by agency theory, resource-based theory and knowledge-based theory. Descriptive research design was used. Primary data was collected using questionnaire. The target population of the study was 31 public universities in Kenya. The study adopted census technique since the population is small in size. A total of 31 Head of procurement department were the respondents. A multiple regression model was employed to bring out the effect of each independent variable on the dependent variable with the aid of Statistical Package for Social Sciences (SPSS) version 25.0. The hypotheses of the study were tested using t-test while the overall significance of the model was tested using F-test at 5% level of significance. The study established a positive significant effect of procurement planning on service delivery with regression coefficient 0.591 with a p-value 0.000. The study concluded that procurement planning had a significant effect on service delivery of public universities in Kenya and recommends that firms should do timely procurements. This study contributes to procurement discipline by providing a model that captures procurement planning aspects and measuring their effect on service delivery. Based on the study findings it is recommended that companies should encourage implementation of procurement planning for the business needs at an early stage.
Keywords: Procurement Planning, Service Delivery and Public Universities

INTRODUCTION
Procurement planning is the process of identifying and consolidating requirements and determining the time frames for their procurement with the aim of having them as and when they are required (Basheka,2008). It is a crucial step that provides the groundwork for later procurement activities. Kabega (2016) asserts that the contribution of procurement planning is determined by the quality, delivery, cost and flexibility that influences a company's competitiveness to meet customer needs. According to Brown and Hyer (2010), planning entails identifying the primary goal, defining the scope, and determining the target audience. The function of procurement planning is to determine what to buy, when to buy it, and where to procure it. Proper procurement planning ensures the provision of products and services in accordance with stated and budgeted costs, depending on customer needs thus enhancing efficient service delivery. The Industry Manual (2008) defines the procurement plan as a budgeting tool which should be created by user departments with the intention of preventing or reducing votes in the budgets of the businesses and ensuring that procurement does not continue until they are funded. The consequences of a planning miscalculation in procurement are extensive on the entire function of the organization and ultimately has a detrimental effect on the functioning of the institution. The decision to concentrate on public universities is inspired by the fact that they all have procurement departments which are regulated by the Public Procurement Asset and Disposal Act 2015 (PPADA) and thus carry out major procurement functions in the organization like procurement planning to ensure service delivery. Munene (2017) contends that procurement planning's significance to aiding effective and providing public sector organizations with efficient services is generally irreversible both in industrialized and developing nations. Njeru (2014) says that effective procurement planning is a critical way to identify the appropriate services to be provided to the public and to raise the degree of service provision that can be realized for the local population. Public universities have been faced by various challenges in procurement process. Poor procurement planning would make the public procurement process more time consuming, inefficient and costly thereby hampering the provision of services to the customers.

Service delivery refers to the process of satisfying customers need in the right place, at the right time and at the right price Service (Mabitsela, 2012). It is a set of recommendations for the planning, designing, developing, deploying, operating, and eventually retiring of service delivery systems (Mabitsela, 2012). According to Angelova et al. (2011), service delivery was evaluated based on the level of customer satisfaction and the quality of the provided services. In the current study, service delivery was evaluated based on the degree to which students were satisfied with the services that were provided by the university, timely delivery, and the effectiveness of the quality education that was provided by the lecturers. It is expected of the procurement department to supply their services by ensuring that they pay their

suppliers on time, that they offer tenders fairly, that they evaluate their suppliers objectively, and that they plan for every action that involves the procurement of goods.

Kiage (2013) did research for the purpose of identifying the elements that influence procurement performance using the Ministry of Energy as a case study. He discussed his findings in his article. The findings of the survey indicate that public procurement is becoming more prevalent all the time. As a consequence of this, public entities have a responsibility to prepare how they will oversee the entirety of the program. According to the findings, the design of the procurement process had a substantial impact on the performance of the purchase. The degree of diversity in procurement success can be attributed to a number of factors, including but not limited to planning, resource allocation, personnel competence, and contract administration.

Onyango (2014) examined the Mombasa Law Court's procurement planning and institutional efficiency as part of his research. The goal of this study was to evaluate the impact that strategic procurement planning has on the operation of public institutions, with a particular emphasis on specified goals, cost estimates, needs analyses, and quality standards. The PPDR, the PPOA guideline, and the procurement models served as the foundation for this investigation (2006). The resource-based theory served as the foundation for this investigation. In the study, a descriptive research design was utilized, and a technique of simple random sampling was utilized, in order to obtain a sample size representative of 60 employees. There was a considerable and powerful connection between performance and the planning of acquisitions. In the aforementioned research, a simple random sampling method was utilised, but the census method was utilized in this investigation. In a 2014 study by Apiyo and Mburu, they investigated elements that influence procurement planning in Kenyan county governments. using Nairobi City County as a case study in order to provide recommendations for effective procurement planning. The study sought to determine how budgeting practices, employee competency, Management assistance and ICT technologies have an impact on the procurement planning process. All 103 members of the procurement department's workforce received questionnaires as part of a census. Self-administered questionnaires were utilized to gather the data. Both numerical and theoretical techniques were utilized to analyze the data that had been gathered. The results of the investigation show, poor management support, lack of ICT resources, and budgeting practices have an impact on procurement planning. This study used a huge representative sample while the current research used a small representative sample to check whether the results would differ.

According to Shiundu and Rotich (2014), evaluating or assessing the effectiveness of procurement specialists has been an issue that has continually proved difficult. There are two categories of words that are defined in the procurement system. These two categories include non-procurement goals and terms of purchase. The primary purposes of purchasing rules are to protect the system's integrity and competitiveness while at the same time reducing the amount of risk that is incurred financially and operationally. Generally speaking, the economic, social, and political policies of the system are considered to be non-purchasing reasons. Ouma and Kilonzi (2014) came to the conclusion that resource planning is important and has an influence on public entity procurement. Resource planning plays a significant role in determining how a procurement process will go about its business. Ouma and Kilonzi (2014) came to the conclusion that resource planning is important and has an influence on public entity procurement.

Willy and Njeru (2014) investigated the ways in which logistics management impacted the efficiency of procurement, the influence of procurement plan adherence in state-owned companies, and the impact of the portfolio of procurement management on procurement performance. The use of simple stratified random sampling allowed for the selection of a sample size of forty respondents from the sample frame. Questionnaires were used throughout the collection process to gather primary data. In addition to this, they investigated the effects that portfolio management had on the overall performance of the procurement process. In the study, descriptive statistics were utilized, and the data were analyzed using a combination of qualitative and quantitative approaches. Diagrammatic presentation of the data was achieved through the use of pie charts and graphs as well as tables. According to the findings of the research, there is a good connection between the availability of a procurement portfolio, effective management of logistics, and following procurement plans. This connection was found to have a positive impact. This data adds credibility to the premise that there is a strong association between procurement planning and procurement performance. Specifically, this finding suggests that there is a positive correlation between the two. The fundamental objective of the strategy for the procurement process is to devise ways to make use of the resources that are already at one's disposal in order to accomplish one's desired outcomes regarding the procurement process.

According to Davis (2014) he investigated how Kenya Power's procurement methods affected the provision of services by the government with an emphasis on Kenya Power. The purpose of the study was to evaluate procurement practices influencing service delivery in the public sector with focus on the provision of electricity: A case study of Kenya Power. Methodology used in the study wass a case study with a focus on Kenya power. Stratified sampling technique was used to select a representative sample from a target population of 160employees with a sample size of

100 respondents. Socio-economic and institutional theories served as the foundation for the research. The study's goals were to determine how procurement policy affected the delivery of services, assess how procurement planning affected service delivery, and assess how maintainable procurement practices affected delivery of services. Kenya power is the focus of the study's case study technique. 71% of the respondents responded to a combination of an interview and a Likert-scale survey. Excel and SPSS software were employed for gathering and analyzing data., along with descriptive statistics. The results showed that: Procurement planning does not address enduring ownership expenses as was stated by 39.4% of respondents; Procurement rules and regulation are not flexible and impair the effectiveness of procurement operations. The results also showed that 59.1 percent of responders agreed that although the company has a green policy in place, implementation is limited by the organization's culture and financial restrictions. Many of these studies looked at how procurement planning affected performance, thus current research is needed to find out how procurement planning affected service delivery at Kenya's public institutions using census technique.

Anane et al., (2019) carried out a research on the effect of procurement practices on service delivery: a case study of VRA, Ghana. This study was conducted to determine the effect of procurement policy, procurement planning and sustainable procurement on service delivery. The study employed a quantitative research approach and explanatory design. The target population for the study was staff and management of the Volta River Authority. Structured questionnaire was used to gather primary data. The study used SPSS version 32.0 for the data analyses. The study found that 73.6% variations in service delivery were explained by Procurement Policy, Procurement Planning and Sustainable Procurement. The study found that Procurement Policy ($\beta = 0.623$ $\rho=0.000< 0.05$) are significant determinants of service delivery thus a unit change in procurement policy will result in 62.3% change in service delivery. Procurement Planning ($\beta = 0.027$, $\rho=0.080< 0.05$) are significant determinants of service delivery thus a unit change in procurement planning will result in 2.7% change in service delivery. Sustainable Procurement ($\beta = 0.39$ $\rho=0.000 < 0.05$) are a significant determinant of service delivery. This study was carried out in Ghana while the current study was carried out in Kenyan public universities

Chepkesis and Kieran (2018) looked at the example of Moi University to determine how procurement planning affected the performance of suppliers to public institutions. They came to the conclusion that planning has an effect on the value for money, improves quality, promotes the efficient use of resources, enables quick decision making, and promotes innovations as a way to solve problems and save time. As a result, the researchers came to the conclusion that procurement planning boosts the performance of suppliers in terms of service delivery. In a similar vein, Kibitz and Nero conducted research on the influence that strategic procurement planning has on the day-to-day operations of the Agricultural Development Corporation in Nairobi (2014). According to the findings of the study, there is a positive connection between institutional procurement and performance when there is a portfolio of procurement available, as well as when there is good logistical management and strict adherence to procurement strategies. According to the findings of the study, there is a significant connection between strategic institutional procurement planning and performance. The purpose of procurement planning is to use the available resources in the most effective way possible to achieve the overall procurement goals.

Kipkemoi (2017) on the influence that various procurement procedures have on the delivery of services within the public sector. The research design that was adopted was descriptive. 111 Portland Cement Company Ltd. was the target demographic for this campaign. Through the use of stratified sampling, we were able to obtain a sample size of 58. The data collected included both primary and secondary sources. The questionnaires were used in the collection of the primary data. Journal articles and yearly reports were used to compile the secondary data set. Participants in the study included individuals from the procurement officer section, stores, the operations officer section, and the payment department. According to the results of the research, procurement management methods had a favorable impact on service delivery. This previous research revealed a methodological hole, which the present investigation intended to solve by making use of the census methodology. Nyakoe (2017) an assessment of the effect of enhanced procurement practices on service delivery in public institutions in Kenya. The study used comparative study design. The target population of 214 was used. Primary data was collected using questionnaires. Data was analyzed using SPSS package. The findings of the study were that procurement management practices had a positive influence on service delivery. This study gave a conceptual gap as it used other aspects of procurement management practices such as procurement policy which are different from the current study.

An investigation by Maurice (2014) was carried out to evaluate the ways in which purchasing procedures affect service provision. In the context of this study, the approach that was utilized was a case study. The sample size was determined with the help of a process called stratified sampling. The number of employees who made up the target population was 160, and a sample size of 100 was chosen for the data collection. The primary data were collected through the use of questionnaires. The study came to the conclusion that procurement management methods had a

favorable influence on service delivery based on the findings of the study. This previous research revealed a methodological hole, which the present investigation intended to fill by employing a census survey.

Changalima et al., (2020) investigated procurement planning as a strategic instrument for improving the efficiency of public procurement, gathering their data from the experiences of several public procuring organizations in the city of Dodoma in Tanzania. The primary objective of the study was to investigate the impact that strategic procurement planning has on the efficiency of public procurement, drawing on the experiences of a selection of public procuring organizations in the city of Dodoma in Tanzania. Using a survey-based questionnaire, data were collected from 146 respondents who were purposefully chosen from several public procuring entities located in Dodoma city in the United Republic of Tanzania. These respondents were then analyzed using a binary logistic regression model. A cross-sectional design was chosen as the research method. According to the findings, the strategic function of procurement planning has a considerable influence on the efficiency of public procurement. The implementation of prepared procurement plans ($p = 0.039$), the involvement of users as stakeholders and important institutional actors in public procurement ($p = 0.033$), compliance to procurement laws and regulations when planning ($p = 0.016$), and adequacy of budget ($p = 0.042$) were tested to be significantly related to the efficiency of public procurement using the binary logistic regression model. We came to the conclusion that public procuring bodies can attain efficacy in public procurement through the use of procurement planning. The above study was carried out in Tanzania and focused on public procuring organizations with a sample size of 146 respondents while the current study was carried out in all public universities in Kenya comprising a representative sample of 31 respondents.

Basheka (2008) carried out a study on procurement planning and accountability of local Government procurement systems in developing countries: Evidence from Uganda. The purpose of this study was to investigate the connection between strategic procurement planning and the accountability of procurement systems used by local governments in Uganda. The findings are the result of an investigation that was carried out utilizing a correlation research design and which involved the participation of 99 local government stakeholders chosen from 11 Districts in Uganda. The information was evaluated using a technique called principal component factor analysis, the purpose of which was to determine the essential aspects of procurement planning and responsible local government systems in Uganda. As a consequence of this, a correlation study was carried out in order to determine the nature and degree to which the two variables were associated. The findings of this analysis are shown below. The research showed that there is a meaningfully beneficial connection between strategic procurement planning and responsible local government procurement systems in Uganda. This study showed that there was a positive relationship between procurement planning and procurement systems therefore there is need to investigate the effect of procurement planning on service delivery to check whether different results will be obtained.

Matasio (2017) conducted research on the impact of the Public Procurement and Asset Disposal Act of 2015 on the connection between procurement planning procedures and service performance in the road sector of state-owned businesses in Kenya. The purpose of this study was to determine whether or not the regulations imposed by the public procurement and asset disposal act had an effect on the connection that exists between procurement planning procedures and service delivery in Kenya State-Owned Corporations operating in the road sector. The research design utilized in this study was descriptive. The census method was used for the research, and all personnel who worked in the procurement departments of the three state corporations that operated in the public road transport sector were included in the study. We used structured questionnaires that contained both open-ended and closed-ended items. Both quantitative and qualitative approaches were utilized in the data analysis process. The qualitative data were examined using a method called content analysis, while the quantitative data were studied using a method called regression analysis. Both of these methods offered the chance to test the statistical link between the variables of the study. At the 5% significance level and the 95% confidence level, the study found that there was a statistical relationship between procurement planning practices (procurement plans, supplier integration, e-procurement, demand forecasting, and process evaluation) and service delivery among State-owned Corporations in the Public road transport sector in Kenya. The above study was carried out among state corporations in the road sector while the current study was carried out in public universities in Kenya to determine whether different results would be obtained.

A research project titled "Procurement Planning and Service Delivery in Local Government: A Case Study of Lira District and Municipality" was done out by Awanyo (2019). The primary objective of the research was to evaluate the connection between strategic procurement planning and efficient service delivery carried out by the procurement system used by local governments in Uganda, using a case study of the municipal and local governments located in the Lira District. The study was directed by the following three goals: The goals of this study are to determine whether or not the procurement planning process contributes to the efficient delivery of services, to investigate the procurement planning practices that contribute to the efficient delivery of services, and to investigate the connection between the value of procurement planning and efficient delivery of services. Both qualitative and quantitative approaches to research design were utilized throughout the course of the investigation. Employees from the district

made up the target population, which totaled 170 people, and a sample of 130 of them was used (90.77% of them responded). The approach of cluster sampling was used, and then, within each cluster, both random and purposive sampling strategies were utilized in order to choose samples for this investigation. The use of structured questionnaires allowed for the collection of the necessary data. SPSS was used to perform analysis on the quantitative data that was gathered. The results of the study indicate that there is a relationship that can be described as positive, strong, and significantly significant between service delivery and procurement planning. It is also possible to draw the conclusion that, of the three different constructs that fall under the umbrella of procurement planning (procurement planning process, practices, and value), the one that has the most influence on the enhancement of service delivery is procurement planning value, which will result in an enhancement of service delivery by 30.9%; this will be followed by the procurement planning process, which will result in an enhancement of service delivery by 20.9%; and finally, the procurement planning practice, which will result in an enhancement of service delivery by 17%. The aforementioned study established a positive relationship between procurement planning and service delivery thus creating a need for carrying out the current study to check whether different results will be found in examining effect of procurement planning on service delivery of public universities.

A study conducted by Makafu (2018) investigated the impact that strategic procurement planning had on the level of service that was provided by the Ntungamo District Local Government. The relationship between strategic procurement planning and improved service delivery in Ntungamo District Local Government was investigated in this study. The following specific goals served as the foundation for the research project: to evaluate the connection between identifying the needs of users and providing services; to determine the extent to which the methods of procurement chosen have an impact on providing services; and to determine the nature of the connection between procurement work planning and providing services at the Ntungamo District Local Government. The research strategy for this study was an across-sectional survey research design, and both qualitative and quantitative research methods were used in its execution. The number of respondents who would be included in the study was determined to be 149 by employing both probability and nonprobability methods. The use of questionnaires and interviews allowed for the collection of data. The findings of the study showed that the methods and processes of procurement planning have an effect on the delivery of services in the Ntungamo DLG. As a result, these methods and processes require an in-depth analysis before they can be implemented in order to achieve correct and efficient service delivery. As a result, it was reached the conclusion that procurement planning is an important activity in the local government that contributes to the delivery of services. As a result, top management must provide their full support, and a well-laid-out procurement plan must be in place to ensure that the procurement process is carried out without any hiccups. This is the only way that value for money can be achieved through the provision of effective services. The above study established a positive relationship between procurement planning and service delivery thus creating a need for carrying out the current study to check whether different results will be found in examining effect of procurement planning on service delivery of public universities

Objective of the Study

The objective of the study was to determine the effect of procurement planning on service delivery among public universities in Kenya.

$H0_1$: There is no statistically significant relationship between procurement planning and service delivery among public universities in Kenya.

METHODOLOGY

The study adopted descriptive research design since it facilitated in choosing and grouping of the components and features of object. The study covered all the 31public universities in Kenya. Census technique was used since the population was small. A questionnaire was used to obtain the primary data for this study. Inferential and descriptive statistics were utilized in the process of data analysis. In order to achieve the purpose of the study, further analyses involving simple and multiple linear regression were carried out with the help of the SPSS software version 28.0. Before beginning the analysis of the data, the assumptions of the linear regression model about multicollinearity, homoscedasticity, normality, and autocorrelation were put to the test.

RESULTS AND DISCUSSIONS

Procurement Planning and Service Delivery

Procurement planning was measured in terms of head of procurement views which were based on a five point Likert scale ranging from 1-strongly disagree to 5- strongly agree. Selected statements captured indicators of procurement planning according to the literature reviewed. The respondents were requested to indicate the extent at which they agreed or disagreed with the listed statements under procurement planning. Table 1 shows the results of descriptive statistics of procurement planning.

Table1: Descriptive Statistics for Procurement Planning

Statement	N	Min	Max	Mean	Std.deviation
The business need is clearly defined by the responsible personnel in the unit /department	50	3.00	5.00	4.0800	.7783
Thorough needs assessment is undertaken by respective heads for goods and services needed	50	3.00	5.00	4.2000	.7825
Budget allocation is done to plan for procurement activities	50	3.00	5.00	4.1600	.7656
Procurement staff do timely procurements	50	3.00	5.00	4.1000	.7354
Procurement staff have access to procurement planning	50	3.00	5.00	4.1000	.7354
Procurement staff are familiar with procurement planning procedures	50	3.00	5.00	4.1600	.7656
Procurement staff prepare annual budget sufficient for their department	50	3.00	5.00	4.1400	.7562
Aggregate	50			4.1343	.7599

Source: Primary Data (2022)

The finding presented in Table 1 show that on average head of procurements agreed with an aggregate mean of 5.00 on the various statements on the procurement planning mentioned as existed in public universities. According to extensive needs assessments conducted by the appropriate heads for the required goods and services, which notably differed from the mean for public universities, there was a standard deviation of 0.7825.The overall mean was 4.1343 and a standard deviation of 0.7599 implying that on average the respondents agreed that public universities in Kenya incorporated procurement planning.

Pearson Correlation between the Study Variables

Correlation determines the direction of a relationship between any two variables. Correlation was presented in Table 2.

Table 42**:** Pearson Correlation between Study Variables

Variables	Service Delivery	Procurement Planning
Service Delivery	1	0.594
Procurement Planning	0.594	1

Procurement planning and Service delivery had a correlation coefficient of 0.594 with a p-value of 0.000< 0.05 thus indicating a statistically significant positive relationship between procurement planning and service delivery. This implies that an increase in a unit of procurement planning would result to a statistically significant increase in service delivery. This suggests that a small increase in purchase planning would have a big impact on service delivery.

Multiple Linear Regression

This study determined the significance of procurement planning on service delivery. A multiple linear regression was used to examine the relationship between between procurement planning and service delivery. A multiple linear regression was represented in Table 3.

Table 43: Coefficients Estimates of Procurement Planning on Service Delivery

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	1.603	0.470		3.411	0.001
Procurement Planning	0.591	0.116	0.594	5.111	0.000

R^2=0.352

Results in Table 3 above shows the regression coefficients of procurement planning was 0.591 with a p-value of 0.000<0.05 hence procurement planning had a positive and statistically significant effect on service delivery. The R-squared obtained was 0.352. The R-squared indicates that 35.2% of service delivery fluctuations may be attributed to the independent variable procurement planning, whereas 64.8% of service delivery variations can be attributed to random error term or other factors not included in the model. This means that a unit increase in procurement planning would result to 0.591 units increase in service delivery holding other factors constant. Therefore, the null hypothesis was rejected and this implied that there is a statistically significant relationship between procurement planning and service delivery. This is an indication that the head of procurements and their counterparts agreed that the demands of procurement were determined and completed in a timely manner. These results are in line with those found by Kiage (2013) as well as Willy and Njeru (2014).

These findings are consistent with the resource-based theory, given that enterprise resource planning systems (ERP) are required for procurement planning in order to facilitate the process of procurement planning. ERP can also be considered as a valuable resource that is difficult to replicate due to the high cost of installation and the skill that is necessary in order to run the system. As a result of this, those in charge of the procurement process have the right to make plans on behalf of the government. According to these findings, public universities carried out requirements analysis and prioritizing, generated budgets, and made timely procurements, all of which contributed to a reduction in the costs incurred in the provision of services.

DISCUSSION

Procurement planning was noted to exert positive and statistically significant influence on service delivery of public universities in Kenya where it had a coefficient of 0.591 and a p-value of 0.000 at 5% significance level. This is consistent with the resource-based approach, given that enterprise resource planning systems (ERP) are required for procurement planning in order to facilitate the process of procurement planning. The Enterprise Resource Planning system can also be viewed as a valuable resource that is difficult to replicate due to the high cost of installation and the level of skill necessary in order to run the system.

CONCLUSION

Procurement planning had a positive and statistically significant effect on service delivery hence the null hypothesis that procurement planning has no statistically significant effect on service delivery of public universities in Kenya was rejected at 95% degree of confidence. This might be attributed to the fact that procurement planning is a function of procurement that has the capacity to improve service delivery and the success of the operations of any organization. Planning for procurement begins the entire process of purchasing services and items according to the requirements, which helps to ensure that procurements are completed in a timely manner to ensure timely service provision. Proper procurement planning was poorly done ensures procurements are being executed and conducted within the procurement plan, thus providing efficient service delivery in institutions.

RECOMMENDATIONS

In order to avoid unnecessary delays, it is important that public universities encourage the early implementation of procurement planning for the operational needs of the university. The requirements of all user departments in a company should be consolidated into any and all procurement strategies. In order to ensure that services are provided on time and to avoid delays, the procurement strategies should be examined and planned in accordance with the budget that is now available.

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INFLUENCE OF WELLNESS PROGRAMS ON PERFORMANCE OF THE BANKING INDUSTRY IN KENYA

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ABSTRACT
As employees increasingly find themselves in the midst of work-family conflict due to the emerging work demands, the effect of these conflicts may affect employee commitment decisions which in turn may affect organizational performance depending on the manager's role in supporting the employee to attain a balance. Due to simultaneously long or unprecedented working hours and upward trend of nonstandard work schedules such as working in the evenings at night or weekend as a spread of a more globalized 24/7 economy, this has also put considerable strain on workers. Notably satisfaction and customer service being the prime work in the banking sector has evoked changes which consequently have brought changes in work setups. The study objective was to establish the influence of wellness programs on performance of the banking industry in Kenya. This study adopted survey research design using both quantitative and qualitative approaches. The target population was 36,212 employees from all 43 commercial banks in Kenya focusing on branches in Nairobi. Primary data was collected using questionnaire that had both structured and unstructured questions. The researcher also used descriptive statistics including frequency distribution tables, percentages and measures of central tendency such as mean. In addition to this, advance statistical techniques were also considered particularly measures of variations such as standard deviation and others like regression analysis to establish relationships among variable. The study found that wellness programs were strongly related to performance of the banking industry. This was through preventive care, education and training on importance of wellness on employees as well as through supportive manager. The study recommends that organizations should focus on the use of wellness programs practices as they are necessary to ensure that employees support their objectives.
Keywords: Influence, Wellness Programs, Organizational Performance, Banking Industry

INTRODUCTION
The ultimate performance of organizations depends on the performance of its employees which in turn depends on numerous factors. Wellness programs are programs intended to promote or improve the health or fitness of any person which may include health screenings, fitness programs and preventative care. Wellness programs which enhances efficiency and thus productivity of an employee increases satisfaction or dissatisfaction of workers which in the long run affects the performance of an organization. In this case therefore corporate organizations need to ensure wellness programs practices are incorporated in the policies of the organization to realize increased organizational performance. Bardoel & De Cieri (2006) notes there is been little serious analysis of work life needs and approaches to policies, practices in the context of multinational enterprises and a global workforce.

Workplace wellness emerged during the 1990's as a major concern for employers, especially in the U.S., marking an evolution away from the traditional occupational health and safety focus on injury and disease prevention. Programs designed to promote employee health and well-being is now found in an estimated 80 to 90 percent of medium and large size U.S. workplaces (Aldana, 2001). The motivation for most employers is to bring down or contain the rising cost of health benefits, with the alternative being cut backs in benefits coverage. Some firms also view these programs as contributing to a culture that is supportive of employees. Less often, the main objective is to boost productivity (Powell 1999; Leonard 2001).

Taylor and Don, (2010) see wellness programs as a way of promoting maintenance of good health rather than correction of poor health. They include fitness programs, recreational opportunities, social activities and intellectual and spiritual development programs which in turn impacts on company bottom line where the employees' wellbeing is seen to greatly affect overall productivity (Naydeck & Pearson, 2009).

Himmel, Thorne, Warren & Wool handler (2009) argues that by developing new and integrated concept of well-being at workplace can be particularly important since many of the concepts have fields e.g. occupational health services, occupational safety and organizational consultancy and since they have been brought from outside of the companies, they have mostly remained fragmented and isolated actions which have no real link to daily activities of various work places (Mar Collin & Abraham 2012). Miller and Harlem, (2009) indicates that worksite fitness programs are important for the organization as it lowers employees' absenteeism and job turnovers, Findings by

Kamau, Tuwai & Kuria (2015) on corporate wellness in commercial banks in Kenya shows strong relationship between physical wellness and employee's performance.

In many African, Asian, Latin America countries incidences of informal employment is growing and the current crisis is accentualating. Simultaneously long or unprecedented working hours and upward trend of nonstandard work schedules e.g. in the evenings at night or weekend as a spread of a more globalized 24/7 economy has also put considerable strain on workers and their families. In some instances, parents are working 24 hours shifts one on a child duty while the other works. While this may permit families to make ends meet, it has a negative effect on workers wellbeing. In middle and low income countries, family responsibilities appear to constitute a barrier to women's employment and to good quality jobs.

Employees in these Kenyan banks need to play a great role of delivering quality services and creating a pool of satisfied customers. Despite their key role, there persist work life policies and challenges in the implementation of existing policies (Aycan & Eskin, 2004; Hyman & Summers, 2004). Long hours working culture is common among many institutions and in such circumstances employees are more likely to experience work-family conflict hence this affects organizational performance. There is tremendous increase in the provisions of banking services to low income households and micro and small enterprises (MSE's) in the country but despite these developments, the banking sector has encountered numerous challenges associated with the human resource practices in Kenya.

Statement of the Problem

The fast pace of economic development in the 20th century across the globe has created new endeavors for the organizations. Globalization has changed the world into a global village where this change has pushed the organizations like the banking sector to strive hard to gain and sustain their competitive advantage. Customer satisfaction and customer service being the prime work in the banking sector has evoked changes which consequently have brought changes in work setups (Korir, 2015).For example employees in the banking sector in Kenya are more involved in their jobs, working longer hours more than 48 hours (IL0, 2010) hence making it difficult for employees to keep a balance between job, family and other personal issues (Muhammadi et al., 2009). Hence this has resulted in work life conflicts which has been found to be associated with mental health issues like stress and depression (Beck & Davis, 2004) which in the long run affects performance of the organization

International labour organizations global report on wellness programs of 2010 rates Kenya among those with the highest prevalence of long working hours more than 48 hours per week (ILO, 2010). Moreover, the banking sector in Kenya is said to be the most affected by work life imbalances ranking 3 in a list of 24 industries (ILO, 2010) raising concerns from key stakeholders in the country because of work life conflict and life work conflicts. Research has shown that WLB is associated with reduced levels of stress and somatic complains, increased job satisfaction and reduced labor turnover as well as organizational performance (Rathi & Barath, 2013).There is need for more Research on wellness programs as a way of improving performance among commercial banks in Kenya (Kamau, Tuwai, & Kuria, 2015).

Research Objective

To establish the influence of wellness programs on performance of the banking industry in Kenya.

Hypothesis

H_{01} There is no significance influence of wellness programs on performance of the banking industry in Kenya

Scope of the Study

The study covered all the 43 banks registered by Central Bank of Kenya focusing on branches in Nairobi. Specifically, the study sought to determine the influence of wellness programs on performance of the banking industry in Kenya.

LITERATURE REVIEW

Work/Family Border Theory

This study was guided by work family border theory according to Clark's (2000). The theory aims at explaining how individuals manage and negotiate the work and family spheres and the borders between them in order to attain balance. The concept of "work" and family constituting different domain or spheres which influence each other is central to the model. Clark defines balance as satisfaction and good functioning at work and at home with a minimum role conflict, stating that although many aspects of work and home are difficult, to alter, individuals can shape to some degree the nature of the work and home domains and the borders and bridges between them in order to create a desired balance''.

The theory aims at explaining how individuals manage and negotiate the work and family spheres and the borders between them in order to attain balance. The concept of "work" and family constituting different domain or spheres which influence each other is central to the model. The theory states that each person's role takes place within a specific domain of life, and these domains are separated by borders that may be physical, temporal, or psychological. The theory addresses the issue of "crossing borders" between domains of life, especially the domains of home and work. Hence, this theory shows that there should be a proper balance between work and non-work activities like social life, family life, health and so on.

Whilst this theory allows for individuals to attach different values to the domain of work and family, it appears to be largely focused on the needs of parents, care givers. Failing to take account of importance attached to other domains such as leisure, sport for wellness and socializing of which again this study sought to find their influence on performance.

Empirical Review

Wellness Programs

A study by Kamau, Tuwai, & Kuria (2015) assessed the effects of corporate wellbeing practices on employee's performance in commercial banks in Kenya. The aspects covered were financial wellness, environmental wellness, physical wellness and social wellness. The target population was 43 commercial banks in Kenya where heads of human resource were targeted. For inclusion purposes, census sampling method was used to collect data as sampling method omitted important population. The researcher mainly used qualitative analysis techniques and descriptive methods to analyze data collected from the organization of study. The study found that financial, intellectual, environmental, social and physical wellness programs improved employee's performance. The study concluded that flexible work arrangements relieves employee's stress that comes with job and that physical health brings the benefits of looking good on employees which in turn improves their performance.The study recommended that banks should come up with long term investment advice to employees which will be beneficial in their retirement age. Intellectual wellness programs should enable employees be more creative by coming up with ways of solving problems encountered by the organization. Employees should be allowed to suggest the best environment which would make them work better. Social wellness programs should aim at improving the relationship between employees and how they should work together as a team. Physical wellness programs should aim at improving overall health of employee where a healthy employee should perform better in the organization.

Performance

Organizations that offered more extensive bundles of wellness programs practices had higher ratings on a measure of organizational performance obtained from senior Hr Directors or such dimensions as being able to attract essential employees 'quality of relations between management and employee and product quality (Ioan 2010). These effects are often associated with employee attitudes such as increased job satisfaction and enhanced control over their work schedule. The results are reduced absenteeism, intend to turnover, job stress levels and work life conflict and increased productivity. A lower turnover intention means lower recruitment and training costs, increased retention of valuable employee's and increased organizational commitment and loyalty. All of these aspects are associated in turn with cost savings, higher customer satisfaction and implicitly higher levels of organizational performance (Ioan, 2010).

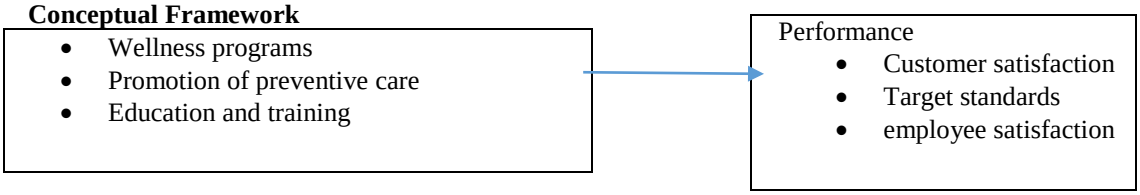
Employers who improve wellness programs for workers are likely to have a competitive advantage in the market. Other benefits of wellness programs include increased employee control over time, meeting set targets and standards, employee satisfaction, reduced family conflicts hence higher performance for the organization.

RESEARCH METHODOLOGY

This study adopted a descriptive survey research design using both qualitative and quantitative approaches. Quantitative approach because it places emphasis on methodology, procedure and statistical measures to test hypothesis and make predictions. (Mugenda, 2003, Saunders, 2009). Qualitative approach was also used because it provides greater depth to response and understanding which forms a link with respondents (Berg, 2001). This research design has been used in previous studies by Baughman, DiNardi & Holtz (2003); Mukanzi, Gachunga, Karanja & Kihoro (2014).

The target population consisted of 43 registered banks by the central bank of Kenya (CBK, 2015). These consisted of banks located in Nairobi because major banks have their busiest and main branches in Nairobi and most of their headquarters are in Nairobi with a target population of 36,212 employees (Bank Supervision Annual Report, 2015).

Conceptual Framework



INDEPENDENT VARIABLE **DEPENDENT VARIABLE**

The sample size was determined by use of the following formula;

$$n = \frac{Z^2 pq}{e^2}$$

n adjusted = N n

N+ n

$$n_{adjusted} = \frac{Nn}{N+n}$$

Where

n = number of samples, N=Total population and e= precision level 0.05.

z=Standard normal distribution set at 1.96 corresponding to a confidence level of 95%

p=probability of success (0.5)

q=probability of failure

In this case the target population being 36,212 at 0.05 level of significance, the sample size was:

$$\frac{0.96 \times 36{,}212}{0.05^2(36{,}211)+0.96}$$

= ~380 Respondents

$$\frac{34{,}7632.52}{91.4875}$$

The multiple regression model for this study was:

379.9

Y = β0 + β1X1+ e

Y	Performance
X1	Wellness Programs
BO	Constant

RESEARCH FINDINGS AND DISCUSSION

A high percentage of respondents 50.5% disagreed that employees get subsidized gym membership fees at a place of their choice with 63.5% of respondents also disagreeing that staff are allowed time off for exercise or gym training paid by the organization. However, 68.9% of respondents agreed that employees are given training and education on importance of good health with 55.5% of respondents disagreeing that managers support employees by providing them with subsidized balanced meal in the company. Also majority of respondents 69.6% agreed that the organization often organizes regular employee health counselling programs with 54.9% of respondents agreeing that through manager support, they find it easier to take care of their health. Again 54% of respondents disagreed that employees are not given training and education on importance of health to their bodies. However overwhelmingly 70.5% of

respondents agreed that the manager minds about their personal health and conditions of work hence provides comfortable tools of work with 44.8% agreeing that employees are allowed rest periods in between work against 37.3% who disagreed with that statement.

Table 1:Wellness Programs

	S A %	A %	N %	D %	S D %	Mean	Standard deviation
a. Employees get subsidized gym membership fees at a place of their choice	8.2	22.8	18.4	27.1	23.5	3.35	12.85
b. Staff are allowed time off for exercise or gym training paid by the organization	3.9	17.6	15.0	32.6	30.9	3.69	1.192
c.Employees are given training and education on importance of good health	23.7	45.2	17.4	11.5	2.2	2.23	0.980
d. Manager supports employees by providing them with subsidized balanced meal in the company	6.8	22.5	15.3	28.6	26.9	3.46	1.008
e. The organization often organizes regular employee health/counselling programs.	24.8	44.8	19.2	7.1	4.1	2.21	1.283
f. Through manager support, employees find it easier to take care of their health and their bodies	15.9	39.0	23.9	18.3	2.9	2.53	1.026
. Employees are not given training and education on importance of health to their bodies							
h. My manager minds about our personal health and conditions of work hence provides comfortable tools of work.	10.5	21.9	13.6	29.9	24.1	3.35	1.334
i.Employees are allowed rest periods in between work	23.0	37.1	20.6	6.5	2.4	2.18	0.941
	12.8	43.0	17.9	22.8	14.5	2.94	1.282

n=416, KEY: SA=Strongly Agree, A=Agree, N= Neutral, D=Disagree, SD=Strongly Disagree.
Croch bach Alpha=0.715 with 8 items when item c is dropped.

Regression Analysis Output of Wellness Programs and Performance

Further test to determine the amount of variation on performance explained by wellness programs was carried out. Results in tables 2a, 2b, 2c below shows the amount of variation on the dependent variable explained by the independent variable. Regression analysis yield coefficient R value of .178 and R^2= 0.032 which means that 3.2% of corresponding variations in performance can be explained by wellness program. The remaining 96.8% is explained by other variables not included in the model

The model is: Performance= 2.072+0.111(wellness program index).

The model was found to be significant F (1,408) = 13.330, p< .000) which was large enough to support the goodness of fit model explaining the variations in the dependent variables. This validates that wellness program is a useful predictor of performance implying that employees who are accorded wellness programs tend to have higher performance. The following account highlights how respondents (40.5%) responded when asked how wellness programs played a role in their work:

The results of regression analysis revealed that there was a significant positive relationship (β = 0.178), p <0.000) between wellness programs and performance.

Therefore, H01 of the study is supported which states that there is no significance influence of wellness programs on performance in the banking industry in Kenya, hence we reject the null hypothesis. This shows that the regression model has less than 0.001 likelihood (probability) of giving a wrong prediction. Hence the regression model has a confidence level of 95%.

Discussion of Findings for Wellness Programs on Performance of the Banking Industry in Kenya.

The objective for this study was to establish the influence of wellness programs on performance of the banking industry in Kenya. Findings of this study indicated the coefficient for wellness programs was -0.004. Regression analysis yielded R value of .178 and R^2= 0.032. This means that a unit change in wellness programs will result to a change in performance by a factor of 0.004 at 5% significant level. The empirical results of this study indicate that regression analysis revealed there was a significant positive relationship (β = 0.178), p <0.000) between wellness programs and performance.

This finding agrees with findings by other scholars Eisingerich, and Bell (2006) who support that the underlying purpose of wellness programs is to unlock the value of the relationship assets in organizations to enable acceleration in revenue and profit. Utilizing wellness programs in meeting the bank's immediate and long-term needs enables companies to build customer loyalty and long-term relationships to the benefit of both parties. Miller and Harlem indicates that worksite fitness programs are important for the organization as it lowers employees' absenteeism and job turnovers, Findings by Kamau, Tuwai & Kuria (2015) on corporate wellness in commercial banks in Kenya shows strong relationship between physical wellness and employee's performance. Wellness promotion does not just benefit the employees because an organization filled with healthy and fulfilled employees is a productive workplace that retains its employees. Offering on –site seminars and workshops on topics such as stress, healthy leaving, communication styles among others is also key in enhancing wellness and health living of employees (Duxbury & Higgins, 1992).

Findings from the descriptive statistics indicate majority of informants agreed that training and education was one of the mostly used ways by the banks to promote wellness as well as organizing regular employee health counselling programs. The informants also indicated manager support on personal health and conditions of work as well as provisions of rest periods in between work as opposed to gym facilities in the places of work and outside of work at subsidized rates was provided apart from gym facilities which respondents disagreed on being offered. It is therefore evident from the foregoing discussions that there was evidence of wellness programs from the banking industry in Kenya though not satisfactorily which is very important in ensuring that employees are health and motivated to enhance performance. Organization should therefore encourage fitness and health living in addition to offering workshops.

Table 2a Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.178[a]	.032	.029	.42389

Table 2b ANOVA[b]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	2.395	1	2.395	13.330	.000[a]
	Residual	73.309	408	.180		
	Total	75.704	409			

Table 2c Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients		Sig
		B	Std. Error	Beta	T	.
1	(Constant)	2.072	.093		22.373	.000
	Wellness programs	.111	.030	.178	3.651	.000

a. Dependent variable: Performance

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The study established that wellness programs influenced performance. This was through preventive care, education and training on importance of wellness on employees as well as through supportive manager. The research attempted to establish whether preventive care, training and education on health issues to employees was provided as well as if managers were supportive on the same to enhance performance of the banking industry

Based on the results of this research as evidenced in the regression models, there shows an interaction between wellness programs and performance. The findings of this study indicated that performance of the banking industry was increased when wellness programs were provided to employees and there was a significant change in performance. The value of R square was significant (R^2=0.032) and as revealed by results of F tests ($p< 0.001$). This led to rejection of the null hypothesis that wellness programs had no significance influence on performance in the banking industry in Kenya. It was evident that majority of the banks in Kenya encouraged wellness programs and embraced preventive care, education and training opportunities and managers were supportive of the programs for higher performance though not satisfactorily.

CONCLUSION

The results of this research indicating an interaction between wellness programs and performance is a reflection that wellness program practices such as promotion of preventive care, education and training opportunities on wellness matters and having supportive manager are good practices that influence performance if employees are accorded them.

Based on the findings of this study it can therefore be concluded that majority of the banks in Kenya which were sampled in this study lay emphasis on wellness programs for increased performance. Hence wellness programs remained significant in influencing firm performance. Wellness programs provisions which includes promotion of

preventive care, education and training opportunities on wellness, and having supportive managers on wellness issues had a linear relationship with customer satisfaction, target standards, employee satisfaction and in the banking industry in Kenya. This could imply that they played a major role in influencing overall performance. It is widely accepted that wellness promotion does not just benefit the employees because an organization filled with healthy and fulfilled employees is a productive workplace that retains its employees which obviously translates to increased performance.

RECOMMENDATIONS

Aspects of wellness and policies that pertains to wellness of employees such as promotion of preventive care, education and training opportunities on wellness of employees alongside supportive managers on aspects of wellness plays major role in increasing performance. The results of this study has helped to determine the crucial role of wellness programs practices and therefore recommends organizations to focus on the use of wellness programs practices as they are necessary to ensure that organizations support their objectives. In addition, this study recommends that organizations should increasingly recognize the influence of wellness programs practices as critical in achieving their objectives.

These findings therefore recommend that organizations should carefully consider the alignment of wellness programs aspects they adopt so that they support and supplement one another in ensuring the objective of both the organization and employees is met. In addition, it is proposed that in light of these findings, policy makers in organizations evaluate the wellness programs practices and activities by the degree to which they contribute directly to the accomplishment of an organizations goals and also the benefit they have to employees so that they ensure the policies are in place and implemented in organizations as mandatory.

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HOW DOES EMPLOYEE REPRESENTATION CONTRIBUTE TO STAFF TURNOVER INTENTIONS IN A UNIVERSITY SETTING?

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ABSTRACT
The study aimed to establish the effect of employee representation on academic staff turnover intentions in chartered universities in Kenya. The study hypotheses were derived from the stated objectives. $H0_1$: There is no statistically significant relationship between employee representations and academic staff turnover intentions in universities in Kenya; The study was anchored on the Universalistic Theory, the Harvard HRM and Unfolding Model of Voluntary Turnover model. The study was guided by a positivist research philosophy, and a descriptive cross-sectional survey design was used. The study population was 17210 academic staff in chartered universities in Kenya from whom a sample of 364 academic staff was drawn. A multistage sampling technique was used. Data was collected using a structured questionnaire and were analyzed using both descriptive and inferential statistics. The study findings were presented using tables, charts, and graphs. Reliability was established through the use of Cronbach's Alpha coefficient. The results revealed that employee representation had a significant negative influence on academic staff turnover intentions in universities in Kenya. The findings of the study offer insight into the situational positioning of employee representations in Kenyan universities, as well as managerial and epistemological insights for scholars in HRM. The findings further contribute to theory and policy development
Keywords: employee representation**,** academic staff**,** turnover intentions, Universities

Introduction

The most valuable asset available to an organisation is its people. Thus retention of employees in their jobs is essential for organisational success. Globally, organisations are keen on evaluating the attraction, hiring, development, motivation, retention, and separation of employees. Various reasons have been advanced on why employees quit their jobs in an organisation. They include workplace-related factors, a mismatch between work and the employee, lack of coaching and feedback, lack of growth and advancement opportunities, remunerations, lack of recognition, overwork related-stress, and lack of trust from the management (Marchington, 2015; McCloskey & McDonnell, 2018; Wilkinson, Gomez, & Kaufman, 2018). To resolve these issues related to turnover intention, adopting employee voice mechanisms is crucial (Puni *et al*., 2016). Human resource management (HRM) literature on employee voice has grown enormously in recent decades. Given the broad scope of the concept and its importance in contemporary workplaces, researchers have focused attention on a wide range of aspects in the employee voice mechanisms phenomenon. They have paid particular attention to the meaning of employee voice mechanisms, evolution trends, consequences, relationship with individual and organisational outcomes in shaping employee voice mechanisms systems and influencing their effects in different countries (Wilkinson *et al*.,2016).

Adopting relevant HRM strategies in organisations may be constrained by the employee representations system at the unit, functional level, and first-line management. An essential component of employee voice mechanisms is the employee representation that may influence the adoption of employee-centered HRM practices is employee representation at various levels in the organizational hierarchy. The standard and popular representation method used by employees is trade unions, where employees form unions to safeguard their interests. Wilkinson, Dundon, Donaghey, and Freeman, (2014) provided evidence linking union voice to higher productivity, job satisfaction, and lower labour turnover rates. They further indicate that employee trade unions offer workers a collective voice to make their desires well-known to the management. Labour trade unions' representation reduces the probability that employee will quit their jobs and leave the organisation for two fundamental reasons. First, unions offer employee voice mechanisms to gain greater compensation than they could net in comparable non-union employment. Second, unions give employees a voice in shaping a range of rules and working conditions, including policies that decrease pay inequality, complaint and arbitration and mediation processes for appealing administrative decisions, “just cause” for discipline and discharge, and seniority clauses preferred by employees. Cherry's (2018) study believes that the number one reason people quit their job and leave the organisation is poor employee representation.

The HRM theoretical literature on the relationship between employee representations and turnover intentions considers employee representations a critical factor in employee success in the modern workplace. Employee representations result in better employee and organisational outcomes in the form of higher performance that it is

supposed to generate. Empirically, the most recent development of this stream of research focuses on the declining role and power of unions in western economies (Wilkinson *et al.*, 2016); Kim *et al*., 2010; Bryson, 2004), the emergence and success of the high-performance work system practice (Harley, 2014; Wood & Wall, 2007; Combs *et al*.,2006) and the adoption of different mixes of employee voice mechanisms in the same workplaces and on their potential outcomes (McCloskey & McDonnell,2018; Wilkinson *et al*., Marchington, 2015; Holland *et al*., 2012; Benson & Brown, 2010).

The loyalty-exit theory asserts that employees have two ways to respond to dissatisfaction; either information management of their dissatisfaction or leaving the organization (Hirschman, 1970). Those who are reluctant to voice their dissatisfaction may exit silently (CIPD, 2019). Employee turnover intention is an employee's inclination to quit the job (Taylor, 2017). Employee turnover intentions are the last steps before quitting and leaving the organization or actual turnover Khan, (2015). Employees who are not given opportunities to express themselves do not feel valued by the organisation. Therefore, they are likely to develop an increased desire to quit their jobs and leave the organisation. Afifah and Aryana (2019) assert that employee representation can respond to felt employee dissatisfaction. Organizations may reduce employee turnover intentions by adopting a system of robust employee representation. In that case, Employees will look for alternative employment and not indicate that anything is wrong until they leave the organization. Effective employee representation in an organisation can help reduce turnover intentions (CIPD, 2019).

Literature Review

Theoretical Review

The current study was anchored on universalistic theory, the Harvard model of HRM, and the unfolding model of voluntary turnover.

The Universalistic Theory

Dewar and Werbel (1979) postulated the universalistic theory, which sought to identify the best practices on Human Resource Management (HRM). Several researchers such as; Delaney, Lewin, and Ichniowski (1989), Huselid (1993), Osterman (1994), and Pfeffer (1994) contributed to the Universalistic theory. These scholars contend that some HRM practices are superior to others, and therefore all organisations should undertake these superior practices. Pfeffer (1994) referred to the universalistic model as the "best" practice model founded on the postulation that there is a set of superior or best human resource management practices. Adopting them will lead to outstanding organisational performance and a reduction in turnover. These "best" human resource management practices are seen through enhanced employee attitudes and behaviours, reduced absenteeism and turnover intentions, higher skills levels, enhanced quality and efficiency, and increased profitability (Marchington & Wilkinson, 2008). Therefore all organisations will benefit and experience improved organisational output if they can identify, get dedicated to and implement a set of superior human resource management practices.

Those who adopt this viewpoint, which knows the unavoidability of workplace conflict, tend to regard conflict as necessary for the well-being of an organisation since it helps to convey employees' complaints and grievances to the management. In such a situation, workers may unite in employee trade unions to safeguard their interests. As a result, employee trade unions become the legitimate agents of workers in the organisation. Thus, the Industrial Relations (IR) structure gets chastised on concessions and cooperation between administration and employee trade unions. Workers are not as powerful in the negotiation as the management. Hence, workers join employee trade unions to negotiate with management on equal standings to guard their interests.

The universal theory has been utilised previously to illuminate the link between human resource management best practices and firm outcomes (Delery & Dorty, 1996; Youndt *et al*., 1996). The orientation recognises the value of human resource management practices in realizing sustainable competitive advantage (Pfeffer, 1994). The theory further, appreciates the value of human resource management practices such as employee voice mechanisms to attain organizational objectives. The universal perspective implies a direct relationship between a particular HRM approach referred to as 'Best practices' and the outcome of employee turnover intentions. The universal perspective prescribes HRM practices that provide superior performance in the industry or sector. Pfeffer (1994) identified seven superior practices for enhancing organisational performance.

The first practice is internal career advancement, which refers to the hiring and progression of employees from within. The second practice is the training and development of workers. Some entities desire to get completely trained workers, but others hire workers to train them. Third, an assessment is behaviour or result-based. Behaviour-based

assessments pay attention to the conduct of persons necessary to accomplish the job, while results-oriented assessments emphasize the results of that behaviour. Fourth, profit-sharing strategies link pay to organisation performance. Fifth is the extent to which employees jobs are protected, being permanent, pensionable, temporary, and contractual employment; sixth, employee voice mechanisms for official complaint structures and participation. In decision-making Finally, the extent to which jobs are fitted or demarcated in the organisation.

The "best practice" belief has been criticized by several researchers. Cappelli and Crocker-Hefter (1996) suggest that a single set of universal superior practices has been exaggerated. Every industry has its management and human resource practices that shape workers' fundamental competencies and determine how each operates. In one firm, what works well will not automatically work well in another because it may not fit its plan, technology, or operational practices. The superior practice or Universalisty view was also criticized by Prucell (1999), who pointed out the contradiction between a belief in universal superior practice and the resource-based theory that pay attention to intangible resources, including human resources, which permits the organisation to have a competitive advantage. The universalism of superior practice can be utilised with the understanding that only some resources and routines are vital and valuable by being scarce and non-imitable. This theory was the foundation of the relationship among employee voice mechanisms, leadership style, job satisfaction and turnover intentions. It was also the lead theory of the current research since every organization has a set of employee voice mechanisms that it deems "best" practice for adoption in HRM.

The Harvard Model of HRM

The Harvard model of HRM (Beer *et al*., 1984) created what is well-known as the Harvard framework. They suggested that human resource management involves all management decisions and actions that affect the relationship between the organisation and the worker. They argued that many challenges necessitated a broader, more complete, and strategic view of organizational human resources. They also underlined the need to employ a long-term strategy for human resource management and viewed employees as potential assets rather than fluctuating costs. They advocated that HRM's job be to provide regulations that regulate how HR strategies are conceived and implemented in a more mutually reinforcing manner (Armstrong & Taylor, 2017).

The Harvard model of HRM, which emphasizes current humanistic orientation and soft HRM orientation, serves as a strategic road map for all managers in their relationships with employees. Its goal is to get employees' commitment instead of control. It is based on the idea that personnel should be consistent, competent, and cost-effective. HRM is depicted in the model as a set of broad strategic 'choices' made in response to the demands of organizational characteristics such as stakeholders, business strategy and conditions, management philosophy, and technology in the context of the external labour market and social, economic, and political conditions (Nankervis *et al*., 2011).

The Harvard model suggests that Human resource management strategies, policies, and processes, fall into four categories. First, employee influence and involvement are contingent on management delegating responsibility, authority, and power voluntarily. Employees are also encouraged to offer their thoughts and participate in organizational consultation and decision-making (Wilson, 2009). On the other hand, human resource flow is concerned with the flow of people into, through, and out of an organization. Recruitment and selection (hiring), socialization, training, motivation, maintenance, separation, related job security issues, career growth, advancement, and fair treatment are all decisions made by the employer. Third, incentive systems govern how people are compensated for their performance, both extrinsically and intuitively, while considering internal and external equity. Finally, organizational structure and work systems refer to how people, information, activities, and technology are organized at all levels of an organization to function efficiently and effectively (Wilson, 2009). according to the Harvard model of human resource management strategies, policies, and processes fall into four major categories of human resources. First, employee influence and participation refer to the amount of responsibility, authority, and power that management willingly delegated to them. Workers are encouraged to contribute ideas and participate in organizational consultation and decision-making (Wilson, 2009). Second, human resource flow involves managing people into, through, and out of an organization. Richard (1985) opined that policies in these four areas must be formulated and implemented consistently.

Beer *et al*., (1984) asserted that disconnected human resource management strategies, made up of unusual combinations of past practices and ad hoc responses to outside forces, are significantly less likely to be effective. Shareholders, employees, consumers, suppliers, labour trade unions, trade organizations, communities, society, and government are among the stakeholders who must be satisfied by the four policy areas. Employees are important

stakeholders in the organization. Managers must build procedures that promote employee influence Beer et al. (1984) suggested that employee influence is one of the four issues highlighted in the human resource system. Regardless of whether the organization is unionized or not, what leadership style is adopted, or if the organization is growing or declining, these are general problems that all managers must address. According to the model, a strategic approach to human resource management strategy, policy, and processes reflects how employees are treated, managed, and employment contracts, including the 'psychological contract' between employees and their employers.

The Harvard human resource management model takes a soft human resource management orientation to grow employees and organizations instantaneously (Hendry, 1986). The Harvard human resource management model has been criticized for ignoring the hard human resource management orientation, resulting in increased social loafing and place of work conflicts. It leads to organisation failure and diminished productivity. The Harvard model of human resource management has been virtually applied in organizations that need to grow their business by focusing on their workers. This model is critical to the current study because it supports the link between employee voice mechanisms, leadership style, and job satisfaction. Employee voice Mechanisms must be embraced by the organization as HR strategy, activities, and decisions that influence academic staff turnover intentions. It indicates that managers can use a leadership style that encourages employees to share their ideas and participate using voice mechanisms to build relationships and exert employee influence and involvement. Employee voice mechanisms, leadership style, and job satisfaction may help reduce academic staff turnover intentions in Kenyan universities.

Unfolding Model of Voluntary Turnover

This method of voluntary turnover was developed by Lee and Mitchell (1994). It was founded on the principles of Image Theory (Beach, 1990). The Lee and Mitchell model highlight the psychological processes involved in quitting a job and leaving an organization. An employee's decision to quit an organization can take a variety of forms. People use psychological and behavioral tactics when it comes to quitting and leaving an organization.

According to Lee *et al*., (1996), who tested the Lee and Mitchel model, employees choose one of four distinct decision paths when deciding to leave their jobs. Reality "shock" is a factor in deciding which path to take. They categorized shocks as expected or unexpected, positive or negative, personal or organizational, and personal, job, and organizationally connected. Marriage, motherhood, and becoming debt-free are examples of individual shocks. Position and organizational-related shocks include corporate reorganization, new management, and changes in work assignments.

Maertz and Campion (2004) advanced the theory and provided four quitters based on the circumstances surrounding their decision to leave their job and the organization. The first group quits on the spur of the moment, usually due to a bad experience. Management finds it impossible to predict or even avoid the behaviour repercussions of this type of quitter due to their unpredictability. The second type of quitter is persuaded away from their current job by tempting alternatives but negatively influences their current employer. The third type of quitter intends to leave after the birth of a child, the retirement of a partner, or even if they want to pursue their formal education. The last sort of quitter is the conditional quitter. When an unexpected occurrence or shock occurs, this person decides to come to a halt. This type of incident or shock can include the possibility of a better job offer, a transfer, being passed over for a promotion, working conditions, and how a supervisor treats them. Almost invariably, they are detrimental to the company (Maertz & Campion, 2004).

Even though the unfolding model of voluntary turnover includes more turnover categories than traditional turnover models, systematic classification failure calls into question claims that it provides a complete picture of turnover. Employee turnover intentions are triggered in one of four ways by leadership style and job dissatisfaction. This model examined the relationship between HRM practices such as employee voice mechanisms, leadership style, job happiness, and turnover intentions in the current study.

Conceptual and Empirical Review

Employee Representations and Turnover Intentions

Employee representations are divided into two categories: non-union and labour trade unions. Labor trade unions have arguably claimed the lion's share of interest in employee voice in the literature on industrial relations (Beis, 2017). Medoff (1984) linked labour union membership and increased output and lower turnover intentions. (Dundon *et al*., 2017) argued that labour trade union representation reduces the likelihood of employees quitting their jobs and leaving the company for two main reasons. First, employee voice methods allow employees to earn more money than a

comparable non-labour trade union job. Second, labour unions provide employees with employee voice mechanisms and the power to set a variety of other workplace norms and conditions. Pay equity policies, grievance and arbitration procedures for challenging managerial decisions, "just cause" for discipline and discharge, and seniority clauses are included. Empirical evidence supports the idea that union wage and employee voice mechanisms reduce turnover intentions in active labour unions. Employee representatives are appointed to non-union organizations' various decision-making organs and committees to represent them (Beis, 2017).

Islam and Rahman (2016) undertook a study on the relationship between job satisfaction, organisational commitment, and turnover intentions among unionized bank employees in selected Banks in Bangladesh. The study employed a descriptive research design. A purposive sampling method was used, which yielded no probability sample, and hence the data may have been biased. Data were analyzed using multivariate analysis techniques, specifically factor analysis. Descriptive statistics were used to explain the demographic characteristics of the respondents. The study found that representations, an excellent promotional system, a fair rewarding system, support in a personal emergency from the organisation, and workplace flexibility in performing tasks were the most influential factors on job satisfaction and organisational commitment. This study suggests that if workers are paid satisfactorily and there is support in proactive representation, these variables will lead bank employees to a higher level of commitment in the team and a reduced turnover rate. This study was done in a different operating environment and organisational setup. It failed to indicate the representation programme put in place to protect employees. The study also lacks well-defined objectives inhibiting the study from incorporating the actual effect of employee representations on turnover intentions. The study used factor analysis that only ranked the factors without establishing the relationship among the variables.

Park *et al*., (2014) investigated employee turnover intentions in union and non-union enterprises in the United States. The study looked at workers' attitudes toward union and non-union construction companies regarding organizational commitment (OC) and turnover intentions. The research was conducted over a long time, and information was gathered via questionnaires. Employees in unionized firms are more loyal to their employers than those in non-unionized firms. Even though the regression coefficients of unionized components in commitment and turnover intentions were not statistically significant at the standard significance threshold, they had a higher turnover intention. The study was based in the USA, a developed country, relating organisational commitment and turnover intentions. Data were analyzed using frequencies and percentages and therefore incapable of testing relationships which the current study intends to address.

Mwathe *et al*., (2017) investigated how employee productivity in Kenyan Technical and Vocational Education Training (TVET) institutions is affected by representations and participation. This study used a cross-sectional survey research design. The 5718 employees targeted included principals, vice-principals, heads of departments, teaching staff, non-teaching professionals of TVET Institutions, ministry of science and technology education officials, and TUC Secretary Generals. The decision was made to use stratified sampling. A standardized questionnaire and an interview schedule were used to obtain the primary data. The study's findings revealed that representation and participation significantly influenced employee productivity and job satisfaction. The study suggested that each TVET organization should have an employee representative. The study addressed only one construct of employee voice mechanisms against employee productivity with no guiding theory. The study was also contextualized in TVET institutions. The current research established the effect of employee voice mechanisms on turnover intentions of teaching staff in Kenyan universities and the moderating effect of job satisfaction and leadership style on their relationship.

The above perspectives on employee representation highlight the opportunities for organization management to use labour trade unions to elicit employees' views. Upward communication means employees can communicate their issues through their representatives and established channels or informally, which is critical to success. Park *et al*., (2014) found that employees in unionised organizations are more committed to the organisation than non-unionised organizations; however, they have higher turnover intentions. Mwathe *et al*., (2017) revealed that representation and participation significantly influence employee productivity and job satisfaction. However, none of these studies is contextualized in the university setting, and none has applied all combined constructs of employee voice mechanisms on turnover intentions.

Turnover Intention

Employee turnover is one of the most important concerns that firms are tackling these days because of its impact on the organization's economic success (Samuel & Chipunza, 2013). This is because the loss of people has significant

tangible and intangible consequences for the performance of an organization (Frank, Finnegan, & Taylor, 2004; Tanova & Holtom, 2008). The administrative expenditures of recruiting, selecting, training, and developing new staff are visible consequences, whereas intangible consequences include a loss of employee morale, social capital, and corporate memory (Morrell, Load-Clarke, & Wilkinson, 2004). Companies' intangible loss of skills, expertise, and know-how is more substantial than the tangible costs of replacing individuals since it can result in lower productivity and performance, leading to lower profits. As a result, firms must understand the adverse effects of employee turnover and adopt methods to keep their current personnel (Frank et al., 2004; Tanova et al., 2008). Unstable organizations have high turnover intentions, according to Ongori (2007), and workers are more eager to stay in a predictable work environment and vice versa. Employees are more likely to leave insecure companies favoring more secure ones as they plan their future progress. A high incidence of staff turnover, he says, could suggest a lack of HRM procedures. According to Gaiduk and Gaiduk (2009), three major groups of variables influence employee intentions to leave/remain with an organization: employee demographic characteristics such as gender, age, position, and level; the nature of an employee's current job; and adequate working arrangements, which include aspects such as current supervision quality, opportunities for advancement, available training, and communication quality. Employee attitude surveys are seen as the organization's efforts to encourage and enhance employee participation and voice from the employee's perspective. As a result, Employee attitude surveys reflect the company's concern for the well-being of its employees. According to Guest (1997), employees are happier, and their psychological contract improves as they experience more Employee attitude surveys in their jobs.

METHOD

Positivist research relies on taking a large sample. The study adopted a descriptive cross-sectional survey research design using quantitative approaches that is the measurement of weights of the responses given by the respondents (Bryman & Bell, 2018). A descriptive cross-sectional survey research studies large populations by selecting and studying samples from the population to discover the relative incidence, distribution and interrelations of sociological and psychological variables (Kerlinger & Lee, 2000). A descriptive cross-sectional research design enabled the study to establish the relationship between employee voice mechanisms and turnover intentions. The relationship is moderated by leadership style and job satisfaction in Kenyan chartered universities. The descriptive cross-sectional survey design was used because the parameters of a phenomenon were picked at a specific time to accurately capture the characteristics of the population relating to what, where, how, and when of the research topic (Cooper & Schindler, 2003). The design was adopted because the parameters of the phenomenon and the existing data among universities were collected at a specific single point in time. The results were generalized to represent the entire population of the study. The descriptive cross-sectional design allowed for the description of relationships between variables under study, which enabled the study to collect and compare several variables in the study simultaneously. The research design has been used in previous studies by Abigail (2018), Nkari (2015), Kombo (2015) and Mucheke (2013).

Sample Size

The primary data for the research was obtained from a sample of chartered university academic staff in the rank of professor, senior lecturer, lecturer, assistant lecturer and teaching assistants. The multistage sampling technique was used to identify sampling units at different stages according to the structure of the population. This sampling approach involved the use of several probability sampling techniques at several stages. Kilika, K'obonyo, Ogutu and Munyoki (2012), Mitalo (2018) also used a similar approach in their studies. Four multistage sampling techniques were adopted in this study. The first stage involved selecting fifteen (15) chartered universities from which the sample of academic staff was drawn. As of January 2020, there were 49 chartered universities in Kenya consisting of 31 pubic chartered universities and 18 private chartered universitiesBryman and Bell (2018) indicated that for a study that includes target populations with five or more subgroups to be studied, the survey should only target 30 percent of the population to enable a detailed examination of the population.

To get the required sample of academic staff in the public and private chartered universities, the study took 30% of 49 chartered universities, which produced more than 30% of the population. A simple random proportionate sampling method was then used to get public and private chartered universities. A total of 15 chartered universities out of 49 public and private chartered universities which were 30% of all chartered universities, was selected, comprising nine public chartered universities and six (6) private chartered universities on a prorated basis. The second stage involved selecting public and private chartered universities from which academic staff was sampled per region. The eight regions of Kenya are Coast Region, North Eastern Region, Eastern Region, Central Region, Rift Valley Region, Nyanza Region, Western Region and Nairobi Region. The study used a simple random proportionate sampling technique to get the required universities per region from which a sample of academic staff was drawn. The distribution

of public and private chartered universities from which the sample of academic staff is drawn per region is shown by the sampling matrix in Table 1.

The distribution of public and private chartered universities from which the sample of academic staff is drawn per region is shown by the sampling matrix in Table 1.

Table 44: Sampling Matrix
Source: Researcher, (2020)

Region	Public chartered universities	Private chartered universities	Number to be sampled in Public chartered universities	Number to be sampled in Private chartered universities	The total number to be Sampled in both Public and Private chartered universities
Nairobi	6	10	2	3	5
Coast	3	-	1	-	1
Rift Valley	6	2	2	1	3
Central	4	2	1	1	2
Eastern	5	2	2	1	3
Nyanza	4	2	1		1
Western	2	-	1	-	1
North Eastern	1	-	-	-	-
Total	31	18	9	6	15

The third stage involved selecting the sample from the study population of academic staff in fifteen (15) chartered universities. The total academic staff from the fifteen 15 chartered universities in Kenya is 6893, comprising 4993 academic staff in 9 public chartered universities and 1900 in 6 private chartered universities. The sample size was obtained using an easy sample size calculator by Krejcie and Morgan (1970). Using a population size of 7,000, a sample size of 364 respondents was appropriate to achieve a confidence level of 95 percent and 5% margin of error. The study then used a proportionate sampling technique to apportion the sample size of 364 respondents to every university. The summary of the distribution of the sample in the selected universities is shown in Table 2.

Table 45: Distribution of the Sample in the Universities

University	Population	Sample
Dedan Kimathi University of Technology	482	25
Kenyatta University	1,702	89
Egerton University	570	30
Masinde Muliro University of Science and Technology	453	24
Chuka University	270	14
Pwani University	171	9
Technical University of Kenya	616	33
University of Eldoret	313	17
Kisii University	416	22
United States International University	287	15
Africa Nazarene University	166	9
KCA University	238	13
Kabarak University	315	16
Mount Kenya University	694	37
Kenya Methodist University	200	11
Grand Total	6893	364

Source: Researcher, (2020)

The fourth stage involved selecting the academic staff from academic ranks of professor, senior lecturer, lecturer, assistant lecturer/tutorial fellow, and teaching assistants. The study allocated the sample of 364 respondents proportionately to each of the 15 selected universities, as tabulated in Table 4. Then stratified random sampling

technique was used to select desired respondents from each academic rank. The serial number of each participant in an academic rank will be written on a piece of paper and placed in a basket. The basket was shaken, one paper picked at a time and the number on the paper record. The process was repeated until the desired number in every academic rank was achieved. If a paper already been picked was picked again, the paper was folded and returned in the basket.

RESULTS AND DISCUSSION

Descriptive Statistics of Employee Representations

Employee representation was conceived in terms of labour trade union representations and non-labour trade union representations. The existence of trade unions and non-trade union representatives, recognition of labour trade unions, regular meetings, sitting in university committees, providing avenues for representation and management resolving issues raised by representatives were investigated. Selected statements captured indicators of employee representation according to the literature reviewed. The findings are presented in Table 3.

Table3: Descriptive Statistics on Employee Representations

Statements	N	Mean	S.D
Employee representations supported through labour trade unions	353	3.23	1.34
Management provided Other avenues for representations	353	2.94	1.25
Management holds regular meetings with unions officials	353	2.88	1.20
Representatives sit in several university committees	353	2.86	1.25
Representatives Participate in decision making	353	2.78	1.25
Management addresses issues raised by unions	353	2.90	1.24
Management addresses issues raised non-unions	353	2.75	1.18
Aggregate Score	353	2.90	1.04

Note. N: Frequency; SD: Standard deviation
Source: Primary Data, (2021)

The results in Table 3 show the level and existence of employee representations aggregate($mean = 2.90\ and\ SD = 1.04$). The average scores of items ranged between 2.75 and 3.32 (Range = 0.57). The perception that employee representations were supported through labour trade unions had the highest (mean score=3.23and SD=1.34), followed by Management provided other avenues for representations (mean score=2.94 and SD=1.25). The lowest rated was employee attitude surveys report shared (mean score=2.75 and 1.18). The aggregate standard deviation is relatively low compared toother items in the questionnaire, which can be attributed to the reliability of the selected indicators.

As a result, the average scores of each item were close to each other, lowering the aggregate standard deviation. The implication is that, on average, academic staff was neutral that employee representations have been adopted and utilized effectively in Universities. The existence of labour trade unions in public universities and the non-existence of recognized unions in private universities can explain the phenomenon. The Absence of Employee representations is expected to result in employee turnover intentions. Employee representations are not implemented adequately, affecting employee voice and the resulting motivation as alluded by Maslow's need hierarchy theory.

Correlation Analysis of the Relationship between Employee Representation and Turnover Intentions

The study's objective sought to establish the influence of employee representations on academic staff turnover intentions in chartered universities in Kenya. Academic staff turnover intentions had three indicators: serious thought of leaving, intention to leave, and actively searching for jobs elsewhere. Correlation analysis was conducted for employee representations and academic staff turnover intentions. Pearson's Product Moment technique was used. Its purpose was to determine the direction and strength of the relationship between employee voice mechanisms indicators (independent variables) and academic staff turnover intentions (dependent variables).

The correlation coefficient can range between -1 and +1. In a linear sense, a correlation coefficient of +1 shows that the two variables are perfectly positively correlated, -1, on the other hand, indicates that the two variables are perfectly correlated in a negative linear manner. According to Hair et al. (2006), correlation coefficients (r) ranging from 0.81 to 1.0 are very strong, 0.61 to 0.80 are strong, 0.41 to 0.60 are moderate, 0.21 to 0.40 are weak, and 0.00 to 0.20 are very weak. The result of the correlation analysis is presented in Table 4:

Table 46: Correlations Between Employee Representation and Turnover Intentions

Employee Representation	Pearson Correlation	-.289**
	Sig. (2-tailed)	.000
	N	352

.**. Correlation is significant at the 0.01 level (2-tailed).
Source: Primary Data, (2021)

The correlation results presented in Table 4 show the correlation between employee representations and academic staff turnover intentions is weak negative and significant values ($r = -0.289, p = 0.000 < 0.01$). The implication is that an increase (improvement) of employee representations weakly reduces academic staff turnover intentions.This imply that employee representations play a critical role in influencing academic staff turnover intentions. Further, this suggests that university management needs to improve employee representations to avert academic staff turnover intentions.

Regression of Employee representations and Academic Staff Turnover Intentions

The objective of the study sought to investigate the relationship between Employee representations on academic staff turnover intentions in universities in Kenya. The following null hypothesis *H0₁* was formulated to determine the relationship between employee representations and turnover intentions,

$H0_1$: There is no statistically significant relationship between employee representations and academic staff turnover intentions in universities in Kenya.

To test the Null Hypothesis $H0_1$, a simple regression analysis was carried out between employee representations and academic staff turnover intentions. The results are presented in Table 5.

Table 5: Regression Analysis of Employee Representations and Academic Staff Turnover Intentions

a). The Goodness-of-Fit of model

R	R Square	Adjusted R Square	Std. Error of the Estimate
.289	.084	.081	1.072

b).The Overall Significance of the Model

	Sum of Squares	df	Mean Square	F	Sig.
Regression	36.748	1	36.748	31.949	.000
Residual	402.583	350	1.150		
Total	439.331	351			

c).The Individual Significance of the Model

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	3.463	.170		20.373	.000
Employee Representation	-.312	.055	-.289	-5.652	.000

a). Dependent Variable: turnover intentions

The regression results presented in Table 5(a) indicate that the coefficient of determination for employee representations (Adjusted R^2) was 0.081. The results imply that 8.1% of the variation in the academic staff turnover intentions is explained by employee representations in chartered Universities in Kenya. The remaining variation is explained by other variables not included in this study like personal factors, demographical factors, level of employment in the country and labour mobility. Further, the regression results in Table5 (b) indicate that fitted regression models linking the relationship between Employee Representations and academic staff turnover intentions is statistically significant ($F - Statistic = 31.949, p = .000 < 0.05$) at 5% level. This implies that the suggested model is suitable for prediction purposes.

Results presented in Table 5(c) indicate a statistically significant negative linear relationship between employee representations and academic staff turnover intentions (regression coefficient $= -0.312, p = 000 < 0.05$) at a 5% level. Implying that one unit increase (improvement) in employee representations leads to a significant decrease in academic staff turnover intentions by a factor of 0.312. The null hypothesis that there is no statistically significant relationship between employee representation and academic staff turnover intentions in universities in Kenya is not supported in the current study and therefore, the hypothesis is rejected, which means that employee representation had a significant negative influence on academic staff turnover intentions in universities in Kenya. Further, it implies that employee representation negatively influences academic staff turnover intentions in universities in Kenya. Based on results, the regression model for the prediction of academic staff turnover intentions in public universities can be as follows:

$$Y = 3.463 - 0.312X_{1b} \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots (2)$$

Where;
$Y =$ The independent variable (academic staff turnover intentions)
X_{1b}= Employee representations
3.463=Y- Intercept(constant). Estimate of the expected value of academic staff turnover intention when employee representations are Zero. (Constant)
-0.312 =An estimate of the expected decrease in academic staff turnover intentions in response to a unit increase (improvements) in employee representations(X_{1b}).

The findings on the hypothesis suggest that employee representations reduce academic staff turnover intentions in universities in Kenya. The relationship between employee representation and academic staff turnover intentions was negative and statistically significant. It is important to observe that this phenomenon is as a result of labour relations in Kenya. Freeman and Medoff (1984) found a relationship between union membership, increased production, and decreased employee turnover. For two main reasons, unions minimize the likelihood of people quitting their jobs. The unions gave workers a voice and improved in which they are earning more money than they would in a similar non-union position. Second, unions give workers a say in various important workplace policies, including pay equity policies, grievance and arbitration procedures for challenging managerial decisions, "just cause" for discipline and firing, and seniority clauses.

The conclusion reached in this hypothesis can be attributed to a number of factors. First, the findings of this study highlight the relevance of employee representations in reducing turnover intentions, which is a major concern in this study. The result indicated that there is an inverse relationship between employee representations and academic staff turnover intentions. The descriptive statistics supported by showing that, on average academic staff were neutral on the existence of labour trade union and non-union representations with an aggregate$(mean = 2.90,\ SD\ = 1.11)$. This phenomenon can result from employee participation in decision-making which is not yet realized in universities in Kenya.

Second, the findings of this study can be explained from the theoretical literature, especially by the Harvard model of HRM (Beer et al., 1984). This model explained that human resource management is all managerial decisions and activities affecting employees' relationships. Many demands, they argued, necessitate a broader, more complete, and strategic view of organizational human resources. They also emphasized the importance of taking a long-term approach to human resource management and viewing human resources as potential assets rather than fluctuating costs. They proposed that HRM's goal should be to establish policies that regulate how HR strategies are developed and implemented in a more mutually reinforcing manner (Armstrong & Taylor, 2017). The Harvard model of HRM focuses on the modern humanistic orientation and soft HRM orientation and serves as a strategic map for all managers in their relationships with employees. It aims to elicit commitment from employees rather than control. It is based on the idea that employees should be consistent, competent, and cost-effective. HRM is depicted in the model as a set of broad strategic 'choices' made in response to the demands of organizational characteristics (such as stakeholders, business strategy and conditions, management philosophy, and technology) in the context of the external labour market and social, economic, and political conditions (Nankervis et al., 2011). According to the Harvard model, HRM strategies, rules, and processes should include employees in determining how much responsibility is entrusted to them and the authority and power that management has freely delegated. Employees are also encouraged to offer their thoughts and engage in organizational discussion and decision-making (Wilson, 2009). Finally, the findings of this study correspond with those of Mwathe et al. (2017), who discovered that employee representations and involvement have a significant impact on employee productivity and job satisfaction, implying that increased employee

representations will result in high satisfaction. Individuals that are content with their jobs are more likely to stay with the same organization, resulting in reduced turnover intentions. Park et al. (2014) revealed employees at unionized organizations are more loyal to the organization than employees at non-unionized organizations, but they also have higher turnover intentions. Islam et al. (2016) found that trade union representation influenced job satisfaction and organizational commitment, resulting in lower turnover. Nurun et al. (2017) asserted that human resource management practices are linked to work satisfaction, absenteeism, and turnover.

CONCLUSION

The study sought to examine the effect of employee representation on academic staff turnover intentions. The hypothesis was meant to answer this objective by testing the relationship between employee representation and academic staff turnover intentions in universities in Kenya. The study explained the conclusions arrived at using the descriptive statistics obtained on the indicators for employee representation. From the descriptive results on employee representation, the study noted that academic staff was neutral and neither agreed nor disagreed that employee representations have been adopted and utilized effectively in Universities. The existence of labour trade unions in public universities and the non-existence of recognized unions in private universities can explain the phenomenon. The Absence of Employee representations is expected to result in employee turnover intentions. Employee representations are not implemented adequately, affecting employee voice and the resulting motivation as alluded by the Harvard model of HRM. The correlation between employee representations and academic staff turnover intentions was weak negative and significant. Based on the findings of this study, this research concluded that employee representation **negatively and** statistically influenced academic staff turnover intentions in universities in Kenya. The Government, universities Council and Management should pay more attention to the university sector's employee representation, which predicts academic staff turnover intentions. They need to make an effort to have improved employee representation, to reduce employee turnover intentions.

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Ideas contained in the papers reflect opinions of authors and not of Chuka University, Journal Editors, or the Advisory Board. As an editorial policy, original unpublished full papers (2000 to 6000 words) in all disciplines related to environmental sustainability advancement through agricultural, biological, business, educational, health, social and physical, scientific, technological and innovative, basic and applied research works that generate new knowledge to advance University teaching and research, as well as stimulate intellectual, economic, cultural, scientific and technological advancement, will be considered for publication in this Journal.

Language of Publication

The Journal publishes papers in UK English only. Use of complex jargon must be avoided.

Format of Manuscripts

Manuscripts should be typewritten on one side of plain white A-4 paper, double-spaced, with 2.5 cm margins, left and right justification, one space between paragraphs, and no tab at the beginning of each paragraph. The abstract should appear in one column, whereas the rest of the text should be set in two columns per page. The font type should be Times New Roman and font size should be 12 for the main body text throughout the manuscript. Font size may be slightly reduced in Figures, Illustrations and Tables. Complex mathematical equations must be hand-written for clarity in typesetting.

Parts of a Research Manuscript

Research manuscripts should preferably range from 2,000 to 6,000 words. Pages should be centrally numbered at the bottom. Each manuscript should contain the following parts:

Title Page

The title page should bear the title of the manuscript, followed by authors' names and addresses. The title should be succinct, descriptive of the research reported and not exceed fifteen (15) words. The corresponding author should be indicated with a note.

Abstract

Each research article must have an abstract that is a non-critical informative digest of the contents, conclusions and recommendations. Each manuscript should have an abstract written in a single paragraph of 300 words maximum. Below the abstract, indicate keywords of up to eight for indexing purposes.

Introduction

The introduction should indicate the importance, define the problem, state the hypotheses and objectives, and give a brief survey of the relevant literature. It should follow the abstract after skipping only one space.

Materials and Methods

This section describes the methodology employed to conduct the research and hence it should clearly describe in prose format, not list, the individuals/items/materials used, their sources, conditions, research design, steps or procedures followed in experimentation to enable others adopt or double-check findings.

Results and Discussion

Results support or reject the hypotheses set out for the research, or answer the questions stated in the introduction. The discussion section interprets the data and draws conclusions, inferences and recommendations for adoption and/or further research.

Tables

Tables should be used to present material not elaborately included in the text or Figures. Tables should be inserted in the text near where they are first mentioned. Tables should be numbered using Arabic numerals (e.g. Table 1) and given specific titles at the top. Tables should not be enclosed in grid lines, but should be given the top, bottom and subheading borders only. Example: Table 1

Table 1: Treatments used for testing performance of grain amaranth

Treatment	Inter-row spacing (cm)	Fertilizer applied (units ha^{-1})	Number of plants ha^{-1}
S1F1	90	0	37,037
S2F1	75	0	44,444
S1F2	90	5 tons FYM	37,037
S2F2	75	5 tons FYM	44,444
S1F3	90	10 tons FYM	37,037
S2F3	75	10 tons FYM	44,444
S1F4	90	20 kg P_2O_5	37,037
S2F4	75	20 kg P_2O_5	44,444

Figures

Figures must be cited in the text in numerical order and present material that is not included in the text or tables. Figures should be inserted in the text near where they are first mentioned. Figures should be numbered in Arabic numerals e.g. (Figure 1) and carry specific titles at the bottom. Lettering on the Figures must be sharp, large and dark enough to withstand reduction down to by 50%. Legends to Figures should be included in the Figure, giving sufficient data to make the Figure comprehendible without reference to the text. Example: Figure 1

8.4.8. Illustrations

Illustrations should be in black and white. If colour is necessary, the cost of re-production will be charged to the author(s). Pictures intended to grace the Journal cover must be in colour and submitted as a soft jpeg copy and a sharp print. An appropriate scale bar on the Illustration should be used to indicate magnification. Example: Plate 1

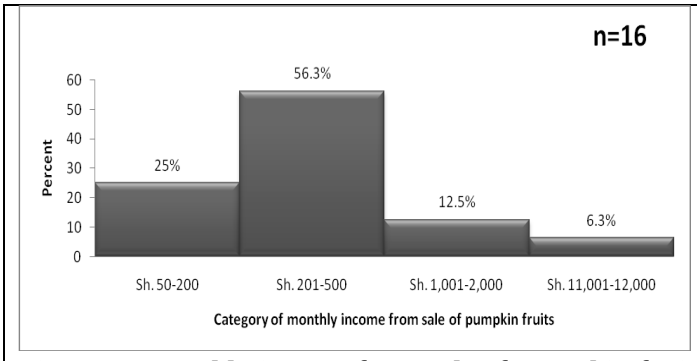


Figure 5: Monthly income from sale of pumpkin fruits by farmers



Plate 1: Pumpkin fruits and leaves

Units

Units of measure should be metric Standard International (SI) and clearly indicated in the main text, Tables and Figures. Example: kilogramme (kg), metre (m), litre (L), tonne (t), hectare (ha).

Abbreviations

Only standard abbreviations should be used; unusual ones should be given initially in full spelling out followed by the abbreviation in parentheses; thereafter abbreviated.

References

- Only articles or books that have been published or are accepted for publication may be listed in references. Papers presented at conferences or symposia may be listed only if proceedings are published. Unpublished and personal communication material should not be used.

- References must be cited in the text by author and date; e.g. Mukami (1983), Kirumba and Mbogo (2000), or Onyonka*et al*. (2005) [in case of more than two authors].

- In alphabetised references, journal names should be spelt out and references listed as follows:

Journal articles: -Ekesa, B.N. 2009. Agricultural biodiversity for food and nutrient security: The Kenyan perspective. International Journal of Biodiversity and Conservation, 1(7):208-214.
-Siddiqui, Z.A. and Akhtar, M.S. 2007. Biocontrol of chickpea root-rot disease complex with phosphate-solubilising microorganisms. Journal of Plant Pathology, 89(1): 67-77.
-Oswell, F.N., Rufaro, M.M., Susan, K. and Arnold, B.M. 2007. Indigenous knowledge of the traditional vegetable pumpkin (*Cucurbita maxima/moschata*) from Zimbabwe.African Journal of Agricultural Research, 2(12):649-655.

Book: Ochapa, C. O. 1984. *Introduction to Tropical Soil Science*. Macmillan Intermediate Agriculture Series. Macmillan Education Ltd, London, UK.

Chapter in a book: Kauffman, C.S. and L.E. Weber. 1990. Grain amaranth. p. 127-139. *In*: J. Janick and J.E. Simon (Eds.). *Advances in New Crops*. Timber Press, Portland, Oregon, USA.

Proceedings: Chweya, A.J. 1997. Genetic enhancement of indigenous vegetables in Kenya, p. 90-99.*In*: L. Guarino (Ed.). Proceedings of IPGRI International Workshop on Genetic Resources of Traditional Vegetables in Africa: Conservation and Use. 29th-31st August, 1995, ICRAF Headquarters, Nairobi, Kenya.

Thesis/dissertation: Wekesa, F.S. 2010. Socio-economic analysis of production and response of grain amaranth *(Amaranthus caudatus*L.) to fertilizer application and intercropping with maize or beans in Kisumu West district, Kenya.Master of Science Thesis, University of Nairobi, Kenya.

Footnotes

Footnotes must be avoided in the main body of the manuscript. They may be used sparing in the footer of a manuscript, if the discipline of study so demands that they be used.

Parts of a Review Manuscript

Review manuscripts should range from 3,000 to 4,000 words and contain extensive literature analysis and citation. The review should include title page, abstract, key words, introduction, extensive literature search and review, discussion, application, conclusions and references. It should not duplicate already existing similar reviews.

Other Manuscripts

- Letters and viewpoints: Debates on policy issues relating to JESAR disciplines; personal views and experiences relevant to important policy issues will be considered.
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- New technologies and products: Evaluation of new products and technologies developed for or relevant to global markets will be considered.

- Announcements: Information on scientific conferences, training programmes, industrial exhibitions, awards of interest to the global scholarly community will be considered.

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Page proofs will normally be sent to the corresponding author through email for correction within a specified timeframe. Failure to comply with the deadline will result in exclusion of the manuscript from publication schedule.

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