Edible Insects in Sustainable Food Systems

Afton Halloran • Roberto Flore
Paul Vantomme • Nanna Roos
Editors

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Editors
Afton Halloran
Department of Nutrition,
Exercise and Sports
University of Copenhagen
Frederiksberg C, Denmark

Roberto Flore
Nordic Food Lab
Department of Food Science
University of Copenhagen
Frederiksberg C, Denmark

Paul Vantomme
FAO
United Nations Food and Agriculture
Organization
Rome, Italy

Nanna Roos
Department of Nutrition,
Exercise and Sports
University of Copenhagen
Frederiksberg C, Denmark

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Caption: Bee larvae taco by Roberto Flore

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This book is dedicated to Dr. Alan Yen, who sadly passed away on March 20, 2017. His dedication and passion for edible insects and conservation was an inspiration for many.

Preface

Crickets, locusts, grasshoppers, mealworms, black soldier flies and termites – these are just a handful of the protagonists that you will meet in this book, selected because of their environmental, social, economic and cultural importance.

Wild insects have been a part of the diets in human cultures around the world, and to date, more than 2100 species have been recorded as 'edible'. However, over the past few years, edible insects have moved from belonging to a large and diverse group of traditional foods with little attention from the stakeholders in the formal food system, to being claimed as the 'future of food'.

The vast diversity in the use of insects for food and feed is reflected in this book by the wide range of inputs from authors from all over the world, documenting the fascinating variation in uses of insects across cultures. The emergence of insect farming has also sparked a new form of production which has shifted many of these countries to move from wild harvesting to farming insects.

As can be seen from the contributions from the chapter authors, there are varying opinions of the role of edible insects in sustainable foods systems. Thus, the aim of this book is to present and clarify a wide spectrum of cases, opinions and research on the topic of edible insects and their relationship to sustainable food systems. Inputs were provided by a wide range of authors from the public, academic, governmental and private sectors, with the belief that all those views may help clarifying more comprehensively the role in insects in more sustainable food systems.

The internationality of this textbook is shown by chapters from authors of over 20 nations and four continents are represented. Moreover, many disciplines are covered by this book, such as entomology, agricultural economics, human nutrition, environmental science, fisheries and animal science, sociology and anthropology, reflecting the interdisciplinary efforts that have been made by the editors to describe sustainable food systems globally.

We believe that this book will be useful for students, researchers, farmers, food and feed processors, decision- and policy makers, investors, NGOs/international organizations and entrepreneurs in the food sector.

Copenhagen, Denmark — Dr. Afton Halloran
Copenhagen, Denmark — Roberto Flore
Rome, Italy — Paul Vantomme
Copenhagen, Denmark — Dr. Nanna Roos

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Introduction

The release of the Food and Agriculture Organization of the United Nation's publication *Edible Insects: Future Prospects for Food and Feed Security* in May 2013 accelerated attention to the past, present and future uses of insects in human diets and as animal feed ingredients. Researchers, entrepreneurs and practitioners around the world were roused to action by this traditional and yet novel utilization of insects. In recent years, activities to explore and exploit insects for food and feed have resulted in an explosion in the number of academic publications on the topic, accompanied by a great deal of new companies that have popped up in most corners of the world. From the academic world, studies on the role of insects in food systems cross disciplinary boundaries and bring together scientists from natural and social science as well as the humanities to document the past and explore the future potential of this group of organisms that up until now have escaped the globalization of food systems.

The words 'sustainable' and 'sustainability' have often accompanied the terms 'entomophagy' – the consumption of insects – and 'edible insects'. While a global concern about the sustainable utilization of resources was born at the Rio Earth Summit over 25 years ago, there have been few major renewals in food systems that could bring hope for more sustainable food production up until now. The FAO publication ignited this hope by pointing out the overlooked potentials of insects. Consequentially, many academics and entrepreneurs have been inspired to explore how this potential can be unfolded, begging the question: *Why, how and for whom can farming or gathering insects as food and animal feed be a sustainable part of food systems, locally and in a globalized world?*

What is a sustainable food system? A food system is considered sustainable when it delivers food security and nutrition for all in a way that economic, social and environmental sustainability is not compromised for future generations.[1] The sustainability of food systems can be interpreted in a variety of ways, depending heavily on context, culture, economic scale and geographical location. To explore the state of turning hope into reality, we have gathered cross-cutting cases and studies

[1] As defined by the High Level Panel of Experts on Food Security and Nutrition (HLPE).

from across the world related to the environment, people, production, infrastructures and institutions involved in shaping the role of insects in food systems as well as the current and intended impacts of these activities on livelihoods and environment.

The sustainability of our food systems is already challenged and will be further challenged in the future as the demand to feed the growing world population continues. At the same time, increased consumption of foods of animal origin, urbanization, climate change and degradation of land, water and ecological systems and loss of biodiversity challenge natural resources and place further constraints on food production. Insects are not a silver bullet to solving all global challenges. Nonetheless, our growing understanding of the potential of insects can be a part of the solution to transforming our food systems to become more sustainable overall.

While global dietary transition raises the average consumption of meat, fish, milk and other animal-source foods (ASF) (IFPRI 2015), malnutrition persists as a significant public health concern causing millions of deaths in children in low- and middle-income countries, particularly in Asia and Africa. Poor quality of the everyday diet is a key problem in the populations burdened by undernutrition, and improving the access to a nutritious diet, in particular, access to ASF in poor households, is critical to secure good nutrition for all (IFPRI 2015). ASF have been shown to improve dietary quality, micronutrient status, growth and cognitive function in children (Dror and Allen 2011). However, ASF are often expensive and therefore not accessible for the households in need. ASF production also has a large environmental footprint, and expanding traditional livestock production systems to meet the nutritional needs of the populations may inhibit the environmental sustainability of the food systems of the future. In this context, insect farming has emerged as a promising opportunity either through providing nutritious ASF for direct consumption (Halloran et al. 2016) or through producing high-quality protein for animal feed with less environmental impact (van Huis 2013).

A segment of modern consumers is becoming increasingly aware of the consequences associated with the production of the meat they consume, generating concerns over animal welfare and the environmental impact of livestock production. A wide range of commercial insect products have emerged over the past years, taking different shapes and forms such as energy bars, burgers, flours and snack foods. While some consumers may not wish to consume these products, willingness to consume the meat or eggs derived from an animal fed a diet consisting of insects may be higher. However, consumer preferences and willingness to pay for insect products depend on many factors such as geographical location, consumers' perceptions of the product attributes. Further, insects cannot be lumped together into one category. In fact, each insect has its own specific processing and preparation requirements (Evans et al. 2017). Edible insects have also been an important part of not only food culture in many parts of the world, but also storytelling, song, folklore and spirituality, representing the traditions that make up intangible heritage for humanity (Costa-Neto 2015; Kelemu et al. 2015). As a result, recipes have reflected this profound knowledge and relationship that human beings have developed over millennia (Evans et al. 2015). At the same time, researchers, food entrepreneurs and chefs alike are developing new ways to use insects as a food ingredient.

Legislation and regulations of insect farming and insect value chains are unfolding in many countries. The production, processing, consumption, trade and use of edible insects concern a variety of regulatory bodies, from food safety and conservation authorities to ministries of environment, health and agriculture. The traditional collection and utilization of edible insects have largely been part of informal unregulated food systems. However, the transition from harvesting insects to farming them also brings out questions concerning the regulations of the formalized food systems (Yen 2015). Edible insect species, in most cases, have simply been off the radar of decision-makers as they are often a part of informal trade or are considered as unimportant (Belluco et al. 2017). As a result, there is a lack of institutional governance surrounding the consumption and production of edible insects.

As we pave the way for a more sustainable future for our food systems, we must continue to address the long-term challenges and knowledge gaps. Thus, an enhanced understanding of the value chain, legislation and regulations, impacts on rural economy, and possible improvements in production methods and techniques is required. Moreover, the investigation of the linkages between agriculture and nutrition is essential for the creation of more socially, environmentally, economically and culturally sustainable food systems.

This book presents a state of the art of a rapidly developing field of documenting, exploring and developing insects in local and global food systems. It is made up of eight different sections which address key topics related to how insects can contribute to sustainable food systems. Part I introduces the basic principles of entomology, the science of insects. In Part II, the role of edible insects in culture is addressed. Part III touches on aspects of nutrition and health. Part IV discusses the gastronomic applications of insects and their uses in the future. In Part V, the environmental impacts associated with insect production as well as conservation and ethics are analyzed. Part VI deliberates various aspects of insects as animal feed ingredients. The multiple aspects of consumer preferences and acceptability are investigated in Part VII. The final section, Part VIII, scrutinizes the policy and legislation which affects insects for food and feed in a variety of regions around the world.

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