

Introduction: Feeding the Future Sustainably—What Role for Novel Foods and Edible Insects?



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Abstract Food systems all over the world are increasingly under pressure: according to the United Nations, in 2020, 2.37 billion people suffered hunger or were unable to eat a healthy balanced diet on a regular basis. This worrying scenario, mainly affecting developing countries in the Global South, has been exacerbated by different phenomena such as climate change, the global spread of Covid-19, and recent geopolitical tensions. In this context, innovation and technological progress have been considered important allies to promote environmental, social and economic sustainability in the food sector and provide solid answers to the urgent demand of accessible and safe food for present and future generations. So-called Novel Foods represent an interesting and relevant example of the potential role of innovation for the guaranteeing of food security. This introductory chapter aims to present the main issues affecting the food sector globally and offer some first insights on this Volume's main topics: Novel Foods in the European Union and a particular category of 'new' foods, namely insects for human consumption. The structure of the book and the reasons behind the content selection are explored, highlighting the importance of an interdisciplinary approach to such a complex topic.

Keywords Food security · Food sustainability · Novel foods · Edible insects · Innovation

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1 Food Systems Under Pressure: The Need to Find Safe and Sustainable Solutions to Multiple Challenges

Food systems all over the world are increasingly under pressure: according to the United Nations (UN), in 2020, 2.37 billion people suffered hunger or were unable to eat a healthy balanced diet on a regular basis. This disturbing scenario, mainly affecting developing countries in the Global South, has been exacerbated by the global spread of Covid-19. The Food and Agriculture Organisation of the UN (FAO) estimated that while 607 million people worldwide in 2014 were undernourished, in 2020 these numbers grew tragically to between 720 and 811 million. The devastating impact the pandemic produced on national economies also showed its effects on food systems, causing a parallel pandemic of hunger. Virus containment strategies were responsible for severe economic slowdowns, affecting the most vulnerable segments of the population and impairing their access to adequate, nutritious, safe, and sufficient food. Inflated prices, unemployment, and in some cases scarcity of food—resulting from elevated raw material costs or nationalist policies blocking exports—have revealed both the fragility of existent food systems and their major interdependence in a profoundly globalised world.

In this context characterized by serious food insecurity issues and a constantly growing population, estimated to reach 9.3 billion in 2050, the FAO underscored the need to increase global food production by 70%. Feeding the world became an ever more pressing objective but, at the same, an ever more formidable goal to achieve.

In fact, anthropogenic climate change, land degradation, extreme weather events such as droughts, wildfires, and flooding are making it extremely difficult to meet envisaged future food needs. Empirical studies—including those elaborated by the World Food Programme—have demonstrated that a global temperature rise of 2 °C from pre-industrial levels could increase the number of people struck by hunger to 189 million. Moreover, higher temperatures and decreasing precipitation levels translate into a reduction of crop productivity, also affecting livestock, and strongly impacting the guarantee of food safety: climate change affects “the occurrence and intensity of some foodborne diseases,” as affirmed by the European Food Safety Authority in the 2020 report on the repercussions of climate change on food and feed safety. The complexity and consequences of environmental issues are also linked to another relevant criticality: in the above-mentioned scenario, food systems are affected and, at the same time, contribute to this alarming situation. Despite being difficult to quantify, the greenhouse gases produced by the food system are evaluated as being responsible for between 21% and 37% of annual global emissions, thus demonstrating a significant impact on the environment. The exploitation, and in several cases the waste of exhaustible natural resources—particularly soil and water—necessary to keep food systems functioning, together with deforestation, loss of biodiversity, and the pollution produced by the entire food supply chain, are severely compromising the environmental sustainability of food production.

Climate change and pandemics, however, are not the only factors capable of putting pressure on the global food system and of negatively impacting food

security: wars, such as the one currently taking place in Ukraine, endanger agricultural markets. As the European Union Commission and the World Food Programme underlined in the Communication “Safeguarding food security and reinforcing the resilience of food systems” (COM(2022)133 final) of 23 March 2022 and in the document “Food security implications of the Ukraine conflict,” dated March 2022, global grain markets are in turmoil, with immediate and worrying repercussions on food prices and availability of wheat and maize as both food and feed. These consequences, alongside fertilizer shortages and energy insufficiencies, are at the basis of serious global food security concerns. In cereal import-dependent countries especially in the Middle East, Northern and Sub-Saharan Africa and in South Asia, food prices are destined to rise dramatically, severely challenging the ability of low-income consumers to access basic foods. Conflicts, social unrest, and political instability could accompany these phenomena, primarily affecting already vulnerable people.

In the face of these complex and multi-faceted but interrelated challenges, we note once again how food systems today are required to simultaneously increase food production and ensure food security while safeguarding the environment, guaranteeing sustainability, and protecting food safety and consumer health. Recognising these urgent necessities, what clearly emerges from the evaluations here presented is that we cannot reach this objective without a real and pervasive paradigm shift in the current food systems. The negative impact of present practices on the preservation of natural resources and the growing need to contain climate change impel a transition towards a more equitable and healthier food production and distribution system. At the same time, such a system must be more sustainable and resilient, and capable not only of meeting local specificities and needs but also of confronting the wider and strictly interconnected global challenges. Thus, the paradigm shift requires a twofold change: it must account for food security and for the sustainability of food chains. Both are, in the present scenario, urgent and of paramount importance if we are to afford food security for present and future generations. It bears repeating: food security without sustainable food chains is impossible. It is not by chance that the ambitious Agenda 2030, adopted in 2015 by the United Nations General Assembly, dedicated the second Sustainable Development Goal to “End hunger, achieve food security and improved nutrition and promote sustainable agriculture,” thus underlining the importance of guaranteeing access to safe and nutritious food and diets while also insisting upon sustainable practices that safeguard the environment, natural resources, and biodiversity.

In the complex context here described, innovation is considered a precious ally. Solutions coming from technical, technological, and scientific progress are exceedingly useful to countering the drastic challenges food systems are facing, contributing in important ways to the realisation of necessary transitions. In this sense, innovation in the food sector delivers intelligent products, processes, services, and technologies that can help shape our way of eating, both now and tomorrow.

An interesting and relevant example of the potential role of innovation in guaranteeing food security is represented by the so-called Novel Foods. In the European Union, ‘new’ foods are currently disciplined by Regulation (EU) 2015/

2283, which defines as ‘novel’ a food “that was not used for human consumption to a significant degree within the Union before 15 May 1997 [date of the entry into force of the first European Union Novel Foods legislation, Regulation (EC) 258/97], irrespective of the dates of accession of Member States to the Union” and that falls under at least one of the ten categories indicated in Art. 3, para. 2, lett. a). This long and detailed list ranges from food with a new or intentionally modified molecular structure; food consisting of, isolated from or produced from microorganisms, fungi or algae or material of mineral origin; food consisting of engineered nanomaterials; food consisting of, isolated from or produced from animals or their parts, and so on. As is apparent, these categories significantly differ from one another, including not only innovative foods produced by scientifically advanced processes or technologies, but also foods that are already part of the traditional diets of populations living in countries outside the European Union (the so-called traditional foods coming from Third Countries).

Despite their differences, all these ‘new’ foods offer solutions for health issues related to the consumption of certain foods, thus responding to the necessity of ensuring healthy and safe foods. New foods also effectively address food security challenges by delivering more sustainable products and methods of production, and by providing diets with more energy, protein, and micronutrients. Indeed, the European legislator’s awareness of the value of Novel Foods and their potentially positive role in fighting against famine, malnutrition, and unsustainable food production practices clearly emerges from Recital 29: “New technologies and innovations in food production should be encouraged as they could reduce the environmental impact of food production, enhance food security and bring benefits to consumers as long as the high level of consumer protection is ensured.”

Driven precisely by these considerations, a peculiar type of Novel Foods has recently been gaining momentum: edible insects. While insects have long been consumed in several Latin American, Asian, and African countries, the consumption of insects as food and feed in Western Countries is quite recent and brings with it benefits and challenges. In 2013, the FAO published a pioneering and much discussed study, significantly titled “Edible insects. Future prospects for food and feed security.” The examined data demonstrated how on the one hand, meat demand was predicted to have doubled by 2020, in part due to the fact that the consumption of meat in developing countries had grown three times faster than in developed states, with China and Brazil representing two major contributors of this increasing meat demand. On the other hand, the report highlighted how livestock and livestock production processes significantly contribute to global greenhouse gases emissions and deforestation, also requiring considerable amounts of water, soil, and other exhaustible natural resources. Given these data and facing the need to provide the world population with sufficient protein rich foods while limiting the environmental impact of intensive farming, the FAO reflected on the contribution that the consumption of insects could secure. The high feed conversion efficiency, the substantially fewer greenhouse gases emissions, as well as the limited use of land and water required for rearing insects, combined with the high nutritional value of insects, are all beneficial qualities that have attracted the attention of researchers and food

business operators alike. Edible insects and insect-based products have consequently been studied in recent years as possible alternative protein sources and as one of the possible solutions to food insecurity, malnutrition, hunger and unsustainable food practices and food systems. Falling under the definition of Novel Foods in the European Union context, these ‘new’ foods have been at the centre of a lively regulatory and political debate. Food security and environmental considerations have been complemented by food safety concerns and legislative uncertainties related to the applicable provisions regarding rearing and production phases, but also consumer aversion and misconceptions due to misinformation and prejudice.

Edible insects consequently represent a clear example of how, notwithstanding their significant potential, since the end of the twentieth century Novel Foods have raised concerns related to the existence of potential risks for human health deriving from the consumption of unknown food products, foods with a new molecular composition, and foods that are not part of the habitual diets of European Union populations. For these reasons, the supranational legislator introduced a precise preventive risk assessment procedure: the obtainment of a prior authorisation, based on a food safety evaluation of the ‘new’ food, has become a mandatory precondition for placing on the European Union market a food falling within the scope of application of the Novel Foods Regulation.

The regulatory choices made by the European legislator significantly impacted food business operators in the marketing and strategizing of innovative products and production processes. The need to correctly balance the safeguarding of high food safety standards with the promotion of innovation and progress that nevertheless engage resilient food systems with positive impacts on food security and sustainability, has become a complex challenge for European Union institutions and Member States.

In light of the vigorous—and still open—regulatory, scientific, and economic debate over Novel Foods and edible insects, and with careful consideration for this discussion within the broader framework of the urgent challenges currently affecting food systems all over the world, in May 2021 the Conference “Novel Foods and Edible Insects Between Food Safety and Sustainability” was organized at the University of Parma, as part of the project “Food Sustainability and Technological Innovation: From Cultured Meat to Edible Insects. The EU Law and Its Implementation at the Regional Level, between Consumers’ Perception and Clear Rules for Food Producers,” coordinated between 2020 and 2021 by Professor Lucia Scaffardi (University of Parma) and funded by the Emilia-Romagna Region. The purpose of this event, gathering scholars and experts from several different fields, was to shed light on this relatively unexplored topic, in the belief that it should, and hopefully will be further studied in the years to come.

Collecting the proceedings of that Conference, the present Volume intends to offer an in-depth study of the multiple issues connected to Novel Foods and edible insects marketing in the European Union territory, using an interdisciplinary approach that can provide a comprehensive view of this multi-faceted topic. By allowing the reader to appreciate the strong links among legislative choices, food security, food safety, innovation, market needs, and sustainable development, the

book aims to contribute not only to a more informed and aware knowledge of the impact of Novel Foods on the current urgent issues concerning global food systems, but also to a comprehensive understanding of the complex efforts regulators and legislators must face in order to promote an appropriate and efficient balance among different—and, in certain aspects, also conflicting—scientific, economic, cultural, social, and environmental factors.

2 The Structure of This Volume: An Interdisciplinary Approach to Novel Foods and Edible Insects

Reflecting the focus of the papers presented at the Conference that inspired this Volume, the first part of the book is dedicated to Novel Foods, while the second is devoted more specifically to a peculiar yet interesting category of Novel Foods: insects for human consumption. The chapters from 2 to 5, therefore, provide an in-depth investigation of the legal as well as scientific challenges related to the Novel Foods legislation in the European Union scenario, thus representing the broader framework into which the edible insects' focus must be inserted. The last three chapters, from 6 to 8, subsequently assess the specific regulatory issues concerning the marketing of edible insects, as well as the role of the European Food Safety Authority and its food safety evaluations. Insight is also offered on consumer perception and acceptance of insects as food and feed. As clearly emerges from the outlined structure, the book takes an actively interdisciplinary approach. Various contributions touch on different aspects of the same topics, thus allowing for a representation of diverse perspectives and sensibilities. This choice also reflects the importance of fostering an enriching and fruitful dialogue among jurists, economists, and scientists, especially in highly controversial and complex areas where an understanding of scientific and economic aspects is of paramount importance to the implementation of clear and effective legislative rules.

2.1 *Novel Foods*

Since 1997, the EU legislator has been confronted with the need to discipline Novel Foods. In the second chapter, Volpato investigates the European legal framework for the placing on the market of 'new' foods, starting from the definition of Novel Foods, first provided by Regulation (EC) 258/97 and then updated by the currently in force Regulation (EU) 2015/2283. The evolution of the legislative framework, also significantly impacting the authorisation procedure, elicits profound reflection on the roles of the diverse actors involved, and the collocation of Novel Food legislation in the broader context of EU Food Law and an integrated European administration. The author does not fail to highlight how regulating new technologies represents a

“daunting challenge” for policymakers and legislators. Though cognizant of the potential of innovation as an instrument to achieve prosperity and sustainability, Volpato affirms the need to define regulatory solutions that can foster progress and offer new solutions to urgent challenges, while addressing potential unintended effects on consumer health, the functioning of the internal market, and the environment. According to the author, the legislative reform finalised in the 2015 Regulation demonstrates how a new procedure can facilitate a clear distinction not only between Member State and European Union responsibilities and functions but also between scientific and non-scientific factors, by clearly distinguishing the actors devoted to the delicate risk assessment phase from those who deal with the—more politically influenced—risk management decisions.

In keeping with the legal reflections explored in the second chapter, Scaffardi proposes an examination of a peculiar category of Novel Foods, whose inclusion in the scope of application of the 1997 Regulation raised serious concerns not only in Europe but also at the international level: traditional foods coming from Third Countries. These foods, characterised by a history of safe use outside EU borders, thus part of Third Country population diets, are considered ‘new’ foods from the European perspective. Not habitually consumed in the EU before 15 May 1997, these foods were subjected to a long and expensive authorisation process established by the first Novel Foods Regulation. This procedure resulted, in the past, in a serious ‘barrier’ to the marketing of traditional foods coming from Third Countries and was considered by several Governments of developing countries as illegitimate and disproportionate. The author analyses the problematic effects produced by Regulation (EC) 258/97, paying great attention to the strong interconnection between the marketing of this peculiar category of Novel Foods in the EU and the promotion of sustainable development in Global South countries, where the trade of local products such as exotic fruits or tea leaves represents an important source of income that can boost environmentally sustainable production practices and enhance the social and economic sustainability of rural communities. The author also discusses the positive effects produced by the 2015 Regulation, while also delineating persistent issues and challenges.

In the fourth chapter, Sforza explains why Novel Foods could—and partly, already do—play a pivotal role in the concrete realisation of sustainable and resilient food systems. Focusing on dramatic food insecurity data that depict an unbearable and unsustainable situation, the author examines the need to redesign food production systems in a more circular way, namely through the minimisation of food waste, the exploitation of novel biomasses for food production, as well as the promotion of innovative technological solutions. The presentation of such an articulated context allows Sforza to show the potentialities of Novel Foods by providing useful cutting-edge examples covering novel healthy and nutritious foods from sustainable sources, new foods or ingredients deriving from sources not traditionally consumed in the EU, and also new foods or ingredients produced with new technologies, including chemical synthesis. The examination of these relevant examples contributes to demonstrating how Novel Foods can support not only circular economy models

and more sustainable food systems, but importantly new health benefits to the human diet, which are a critical driver for European industry and consumers alike.

In the final chapter of the first part, Dall'Asta examines a fundamental aspect related to the consumption of Novel Foods: food safety. After having explored the legal issues concerning the marketing of Novel Foods in the EU as well as the intertwining of innovation and sustainability as possible solutions to food insecurity, fifth chapter presents an overview of the safety assessment provided by the European Food Safety Authority according to the Novel Food Regulation, with the ultimate purpose of demonstrating why approved Novel Foods can be considered safe. The author elucidates the rigorous procedure and high standards requested for marketing in the EU territory, noting how the information required helps to identify potential knowledge gaps and any need for additional toxicological or nutritional studies. The contribution also reflects on the assessment of the allergenic potential of Novel Foods, which represents a serious constraint. Though the current European safety evaluation process is affected by limitations and bottlenecks and given the impossibility of guaranteeing in absolute and fixed terms that a food will never pose risks to consumers' health, the assessment established by the European legislation represents a structured and serious process upon which consumer trust in Novel Foods can and should be properly based.

2.2 *Edible Insects*

The second part of the Volume explores the main issues and challenges concerning insects for human consumption. Among all the diverse and relevant categories of Novel Foods, edible insects certainly represent an interesting and complex case study. While studies and research on whole insects and by-products derived or isolated from insects have multiplied in recent years, underlining the possibility of relying on this alternative protein source in the near future, the marketing of these foods in the EU still proves to be controversial; the lively political, economic, scientific, and cultural debate surrounding edible insect consumption is destined to persist, especially now that the first EU Commission insect authorisations have begun (in 2021).

The complex legal issues related to the commercialisation of insects-as-food in the EU territory are examined in the sixth chapter. Formici begins with an investigation of the confused regulatory landscape that emerged from the 1997 Novel Foods Regulation, whose scope of application in relation to edible insects was interpreted in various ways by the public authorities of Member States. This fragmented scenario mirrored contrasting national political and cultural approaches to insects and profoundly affected the correct functioning of the internal market by causing significant operative difficulties for food business operators. The author analyses these impacts and pays particular attention to the relevant intervention of the Court of Justice of the European Union in the so-called *Entoma* case (CJ Judgement 1 October 2020, Case C-526, *Entoma SAS v Ministre de l'Économie*

et des Finances, Ministre de l'Agriculture et de l'Alimentation). Even if the interpretative doubts related to the previous Regulation have been addressed by the 2015 Regulation, which explicitly includes whole insects and by-products in the Novel Foods definition, some uncertainties remain. The contribution examines open issues and possible future developments, by scrutinising the impact of the simplified notification procedure as well as the data protection provision disciplined by Art. 26 Regulation (EU) 2015/2283.

Complementing the regulatory perspective, particular relevance is attributed to food safety evaluation specifically devoted to insects-as-food. In their contribution, Precup, Ververis, Azzollini, Rivero-Pino, Zakidou and Germini provide a comprehensive picture of the principles guiding the risk assessment process conducted by the European Food Safety Authority. Close attention is paid to the main challenges that may arise during the safety evaluation of insects and products thereof concerning, specifically, the production process, the compositional and nutritional analysis of the product but also aspects related to toxicological information and allergenicity potential. Carefully examining the scientific opinions adopted up until March 2022, the authors show the multiple and complex profiles the European Food Safety Authority is called to take into proper consideration, by focusing, for example, on the intended and proposed uses indicated by the application or the nutritional profile. The chapter offers insight on the European Food Safety Authority's work and the relevance of its scientific opinions not only for risk managers' decisions but also for food business producers and consumers, by raising awareness on safety aspects that must be considered during the production process and considerations that can contribute to informed dietary choices.

This last aspect related to consumer perception and the acceptance of insects is broadly analysed by Sogari, Dagevos, Amato and Taufik in the eighth chapter. Although in recent years multiple small companies, start-ups, and entrepreneurs have demonstrated growing interest and investment in insect-product sectors, the EU market for insects as food and feed is still restricted by various factors. Among these, consumer unwillingness to eat insects and insect-based foods undoubtedly looms large. Following an examination of the main characteristics of the emerging insect farming industry in the European Union, the state of the art in terms of consumer acceptance of both animals fed with insects and insects for human consumption is then explored. What appears evident from numerous studies, carefully reported in the chapter, is that neophobia together with disgust significantly impact the probability of accepting entomophagy. Starting from this premise and considering the promising potentialities represented by the consumption of insects as food and feed, the authors discuss possible future developments. Although according to recent studies consumers appear to be more open to accepting insects as feed than consuming them directly in their diet, the possible growth of food products containing hidden insects ('entomophagy by stealth') should be properly investigated. Accurate consumer information that also highlights the merits of insect consumption, the rigorous safety assessment established by European Union legislation, and the positive impact on the creation of a circular economy and a more sustainable food system is crucial.

3 Conclusions: Prompting a Fruitful Debate on the ‘Food for the Future’

As has been foregrounded in this Introduction, food systems are now more than ever facing dramatic challenges: emergencies such as war, energy insufficiency, drought, and global pandemic are impacting an already compromised state of affairs, risking to obscure old and unsolved issues. The desperate call for a paradigm shift impels us to re-think the way we produce food. While it is of utmost importance to produce more, thus ensuring food security, at the same time we must produce better, namely in a more sustainable way. This means, *inter alia*, promoting social, economic, and environmentally sustainable development, without compromising consumer health (food safety). Ignoring the acute need to redesign today’s fragile food systems will certainly result in detrimental effects for present and future generations.

If keeping food security and sustainable food systems at the centre of the political, scientific, economic, and regulatory debate is paramount, Governments at all levels, together with private actors and the entirety of stakeholders involved, are asked to urgently develop and implement feasible solutions and strategies. The European Union has made significant efforts in this direction: the European Green Deal, the ‘From Farm to Fork Strategy,’ the Common Agricultural Policy, as well as the significant investment package ‘Next Generation EU,’ adopted recently as a resolute answer to the disruptive effects of the Covid-19 pandemic, show the commitment of the European Union institutions and Member States to designing policies aimed at ensuring a resilient and sustainable food system, that also guarantees the attainment of the United Nations’ Sustainable Development Goals, and other goals established by international agreements such as the Paris Agreement on Climate Change or the Glasgow Climate Pact adopted by the Conference of the Parties (COP) of the United Nations Framework Convention on Climate Change (UNFCCC). Notwithstanding these efforts, more still needs to be done. Concrete implementations of ambitious yet necessary projects often struggle to be included in national or subnational political agendas, while already adopted measures frequently result in timid attempts to encourage environmentally and socially sustainable food systems and agricultural strategies.

In this complex and worrying scenario, Novel Foods play an important role in combating food insecurity and unequal access to healthy, safe, and sustainably produced foods. As Sforza affirms in the fourth chapter, “every Novel Food is a small but essential step towards [the] Sustainable Development Goals.” Starting from the premise that food and food systems are essential for dignified human life, we must give full recognition to the reality that ending hunger, achieving food security, improving nutrition and promoting sustainable agriculture (Goal 2) can significantly contribute to achieving all the other Sustainable Development Goals.

The European Union legislation on Novel Foods, therefore, is a pivotal instrument that can foster innovative solutions in the agri-food sector. The promotion of new foods and their positive impact on sustainable development and practices require careful regulatory choices. Food safety and consumer protection must also

be ensured. At the same time, investment in innovation and technical progress towards sustainable products and resilient, efficient production methods must be encouraged, while not losing sight of investors' economic gain. The long and highly debated legislative reform that led to the adoption of Regulation (EU) 2015/2283 demonstrates the difficulty of finding a clear and appropriate balance among the many diverse needs and interests at stake.

By providing a wide-ranging analysis of this complex and multi-faceted topic including recent, and in some ways revolutionary developments—such as the first authorisations of insects and insect-products as Novel Foods—as well as describing possible future evolutions, the book is intended as a useful resource for students, academics, food business operators, institutional officials, and public authorities interested in better understanding the numerous challenges related to Novel Foods and edible insects. An informed and comprehensive view—to the extent possible—provides the foundation for a thorough and fruitful debate aimed at finding innovative solutions and scientific, economic, and regulatory answers to the urgent questions posed now and in the future. Inexpert readers approaching this fascinating subject for the first time could find in the chapters of this volume useful information for navigating not only the legislative regime adopted in the European Union—alongside its difficulties and criticalities—but also the main scientific and economic aspects concerning the food safety and marketing of Novel Foods. An interdisciplinary and 'integrated' approach to innovative foods could ultimately contribute to promoting transparency by dismantling fake news, misinformation, and bias.

These reflections on the purpose of this work stem from a clear premise: the scientific community is called, especially in difficult and challenging times, to foster knowledge and to ease an enriching dialogue among diverse but strictly interrelated research areas and expertise. This dialogue is key to promoting awareness and informed decision throughout civil society: from consumers to business operators, from public authorities to policymakers. Moving from this key idea, the present Volume strives to offer food for thought, able to inspire and encourage regulatory, economic, and scientific evolutions towards the guarantee of safe, adequate, sustainable, and sufficient food for present and future generations.

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