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Session VI. Insects in the future

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Insects on the menu

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Major challenges facing humanity Feeding the rapidly growing human population is a challenge with many facets: the need for producing 70% more food in 2050 compared to 2010 is challenging in itself. Yet, it is even more challenging in the context of environmental and population changes, nutrition crises, and health issues. Moreover, this challenge is closely connected to other challenges, including mitigation of climate change, avoiding waste by developing a circular economy, conserving biodiversity, and supporting human health (Fig. 1). These challenges can only be met when we fundamentally change the way we produce food because current food production methods face serious limitations in resources, water, land, and energy [1]. The most important issue in supplying food to the rapidly growing human population is the production of sufficient high-quality proteins. At present, this especially relies on the production of livestock. However, livestock production has a large ecological footprint in terms of land use and greenhouse gas production [2,3]. Most of this is the result of the inefficient conversion of feed-to-meat by conventional livestock, especially cattle [3]. At present, 80% of global agricultural land is used to produce livestock, and increasing the production of meat will have major negative consequences for land use and climate change. Hedenus et al. [2] concluded that a reduction in ruminant meat consumption is indispensable for meeting the maximum 2 °C target above the pre-industrial level. An excellent, sustainable, alternative to conventional meat is available in insects. Insects are the most abundant group of animals on Earth with one million species being described and an estimated 5 million species still to be discovered. More than 2000 insect species are known to be consumed by humans (https://www.wur.nl/en/Research-Results/Chair-groups/Plant-Sciences/Laboratory-of-Entomology/Edible-insects/Worldwide-species-list.htm) (Fig. 2). Their nutritional content varies between species, but in general the protein content is similar to that of conventional meat, while insects contain more unsaturated fatty acids [4]. Moreover, the high mineral content of insects in comparison to conventional meat is particularly interesting, considering the worldwide prevalence of iron and zinc deficiency. For instance, anaemia is a global public health problem affecting a quarter of the human population [5].

Fig. 1 The challenge of feeding the rapidly growing human population is closely connected to other challenges, including mitigation of climate change, avoiding waste by developing a circular economy, conserving biodiversity, and supporting human health.

Insects in a circular economy Insects can transform rest streams such as food waste or rest streams from food industry into high-value protein products. In doing so, they are valuable components of a circular economy. Recent reports show that insects can make important contributions to global food security [6] and that producing insects for food and feed has prospects for rapid commercial and societal uptake. Insect production has a much smaller ecological footprint, in terms of land and water use and greenhouse warming potential compared to the production of pigs and cattle [6–8]. This is especially due to the much better feed-to-meat conversion ratio of insects: ca. 2.2 kg feed required per kg of edible weight production for crickets, whereas this is more than 10 times higher (25 kg per kg edible weight produced) for beef [4,9]. Moreover, important feed sources for livestock production currently include fish meal and soybean meal, both obtained from a market competing between human food and animal feed. In addition, the use of fishmeal poses an increasing threat to the viability of marine and aquatic ecosystems [10]. In recent years, important developments have been initiated in the private sector that can contribute to the urgently needed changes in food production systems, i.e. the production of insects as food and feed [6,11,12]. Important developments are being made in the commercial production of insects as food and feed (www.ipiff.org). These new production systems provide an important contribution to addressing several of the main challenges that we face, including resource, land, and water scarcity [12].

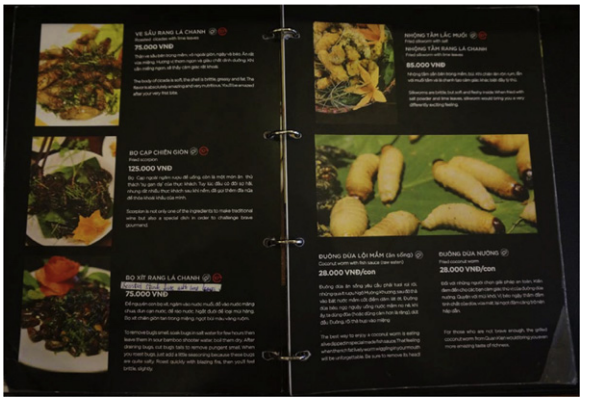

Fig. 2 Menu of a restaurant in Hanoi, Vietnam.

Future To effectively develop insects as food and feed, a first step should be to rehabilitate insects and leave the 'nasty, dirty and avoidable' image behind. This will require extensive information on the environmental and nutritional benefits as well as in assuring food safety aspects [13]. In the context of the positive change in the perception of insects as human food that we have seen in the western world in the past two decades, it is clear that a lot can be accomplished in the years ahead. Yet, much research needs to be done for this, especially in a multidisciplinary and transdisciplinary context. Topics to investigate include, e.g., production of insects on various rest stream, consequences for insect health and immunity, insects and food quality, economics, consumer behaviour, food technology, human health aspects, ethics and value chain development. Such studies will help to develop a new food sector that is likely to provide the growing human population with a novel protein source whose production is much more sustainable than current production of animal protein. Moreover, this new food sector also has excellent opportunities to contribute to achieving various of the global development goals [14,15].

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Industrial insect production as an alternative source of animal protein

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By 2050, the World Resources Institute projects a 70% human food calorie gap [1]. The race for sustainable protein alternatives is heating up and to avoid global issues, the world needs massive productivity increases in protein production. The FAO expects insect protein could help close the gap [2,3]. The European insect sector (Fig. 1) is an emerging industry, which concentrates on research and innovation efforts that are invested in the sustainable protein sector worldwide. Legislative decisions taken by EU policy makers constituted decisive factors that contributed to boost the advancement of the sector. We urgently need to address the entire food chain and make it possible to produce a better, high-quality product–with lower cost inputs. This means zeroing in on earlier stages of the food production process: namely how farmed fish and, ultimately, poultry and cattle are fed. Livestock consume roughly 20% of global proteins and compete with humans for ocean fish stocks, water, land, and soil resources (FAO, 2016). Poultry, pigs, aquaculture and some pets are fed diets that include fishmeal and fish oils, which are produced from ocean-caught fish and fish trimmings. Aquaculture plays a critical role in human nutrition, growing faster than any other protein source for human consumption. Around half of the fish we eat today comes from farmed sources. Yet fishmeal, the primary food source for farmed fish, is in crisis because it is derived from fast-depleting ocean fish stocks.

By replacing traditional animal and fish-based diets with insect protein, we can offset the growing competition for the ocean fish stock required to be able to feed 2 billion more people by 2050. This further serves to reduce fish, water, and soil depletion, as well as agriculture's 25% share of global greenhouse gas emissions. Insects are part of a natural diet for fish, birds and some mammals; they contain high levels of essential proteins and nutrients, which are optimal for animal growth. Today, the feed given to farmed animals does not include this sustainable protein.

However, due to the rising costs of traditional feed ingredients, coupled with the increased production of farmed fish, feed nutritionists and manufacturers have reduced the amount of fishmeal in aquaculture diets, replacing it with plant-based ingredients, especially soy. Mostly imported to Europe from the Americas, soy bean production carries a huge environmental cost resulting in, among other things, deforestation and soil erosion. It is pretty crazy to be feeding the animals we eat with one of the most expensive forms of protein in the world. This

Fig. 1