15. The way forward

Recent developments in research and development show edible insects to be a promising alternative for the conventional production of meat, either for direct human consumption or for indirect use as feedstock. Nevertheless, a tremendous amount of work still needs to be done by a wide range of stakeholders over many years to fully realize the potential that insects offer for food and feed security. The roadmap drawn up during the Expert Consultation Meeting on Assessing the Potential of Insects as Food and Feed in Assuring Food Security in Rome in January 2012 summarized the main tasks that lie ahead:

- Further document the nutritional values of insects in order to promote insects more efficiently as a healthy food source.
- Investigate the sustainability and quantify the environmental impacts of harvesting and farming insects compared with traditional farming and livestock-raising practices.
- Clarify and augment the socio-economic benefits that insect gathering and farming can offer, with a focus on improving the food security of the poorest of society.
- Develop a clear and comprehensive legal framework at the (inter-)national level that can pave the way for more investment, leading towards the full development (from the household scale to the industrial scale) of production and trade in insect products for food and feed internationally.

The case needs to be made to consumers that eating insects is not only good for their health, it is good for the planet. Additionally, insect rearing should be promoted and encouraged as a socially inclusive activity. Rearing insects requires minimal technical knowledge and capital investment and, since it does not require access to or ownership of land, lies within the reach of even the poorest and most vulnerable members of society. In the future, as the prices of conventional animal proteins increase, insects may well become a cheaper source of protein than conventionally produced meat and ocean-caught fish. For this to occur, there will need to be significant technological innovation, changes in consumer preferences, insect-encompassing food and feed legislation, and more sustainable food production.

Insects can contribute to food security and be a part of the solution to protein shortages, given their high nutritional value, low emissions of GHGs, low requirements for land and the high efficiency at which they can convert feed into food. The production of insect biomass as feedstock for animals and fish can be combined with the biodegradation of manure and the composting and sanitizing of waste. Insects can partly replace the increasingly expensive protein ingredients of compound feeds in the livestock, poultry and aquaculture industries. Grains now used as livestock feed, which often comprise half the cost of meat production, could then be used for human consumption (van Huis, 2013).

Considering that insects already form part of the human diet in many countries, their potential needs to be re-evaluated. The sustainable harvesting of edible insects in the wild requires nature conservation strategies. Habitat manipulation measures can increase the abundance and accessibility of insect populations. The possibility of simultaneously controlling pest insects by harvesting them as food/feed should be exploited. Simple rearing procedures for some promising insect species need to be developed. Micronutrient bio-availability (particularly of iron and zinc) in edible insects needs further investigation, given the massive occurrence of these deficiencies in the tropics.

In the Western world, consumer acceptability will be determined, in large part, by pricing, perceived environmental benefits, and the development by the catering industry of tasty insect-derived protein products. Preservation and processing techniques are

needed to increase shelf life, conserve quality and increase the acceptability of insect food products; processing procedures are also needed to transform insects into protein meal for animal/fish feedstock and for the extraction of insect proteins to be used as ingredients in the food industry.

Considering the immense quantities of insect biomass needed to replace current protein-rich ingredients such as meal and oil from fish and soybeans, automated mass-rearing facilities that produce stable, reliable and safe products need to be developed. The challenge for this new industry will be to ensure the cost-effective, reliable production of an insect biomass of high and consistent quality. Regulatory frameworks need to be developed. The close collaboration of government, industry and academia will be essential for success.