'Under-used' food sources of key nutrients

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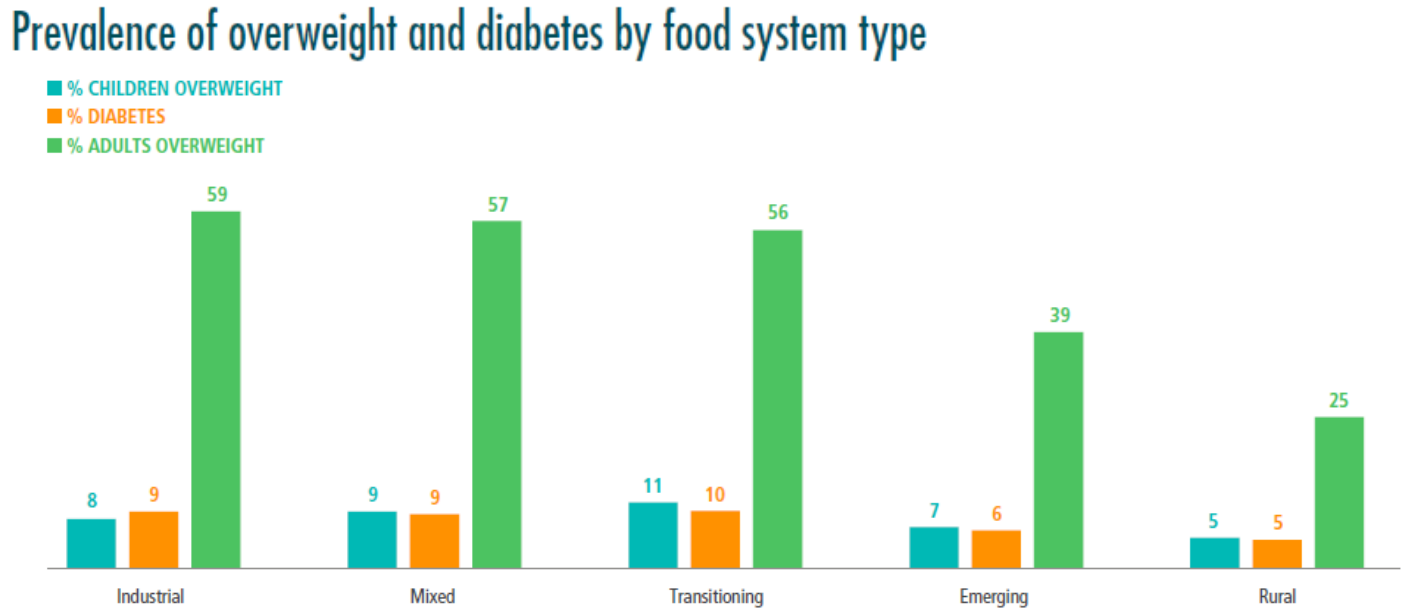
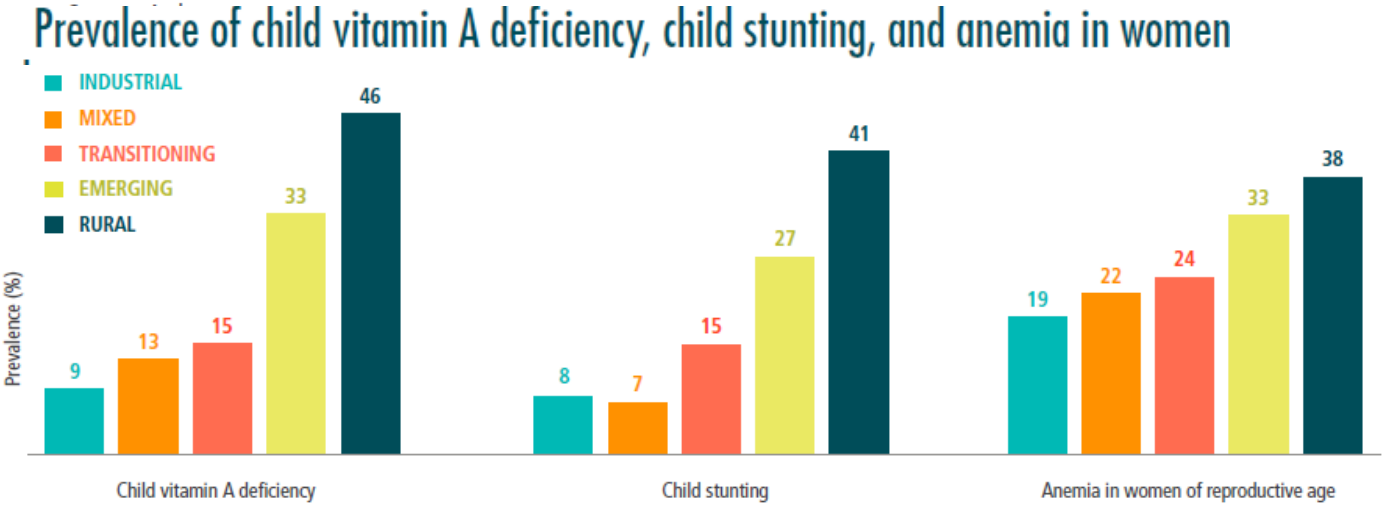
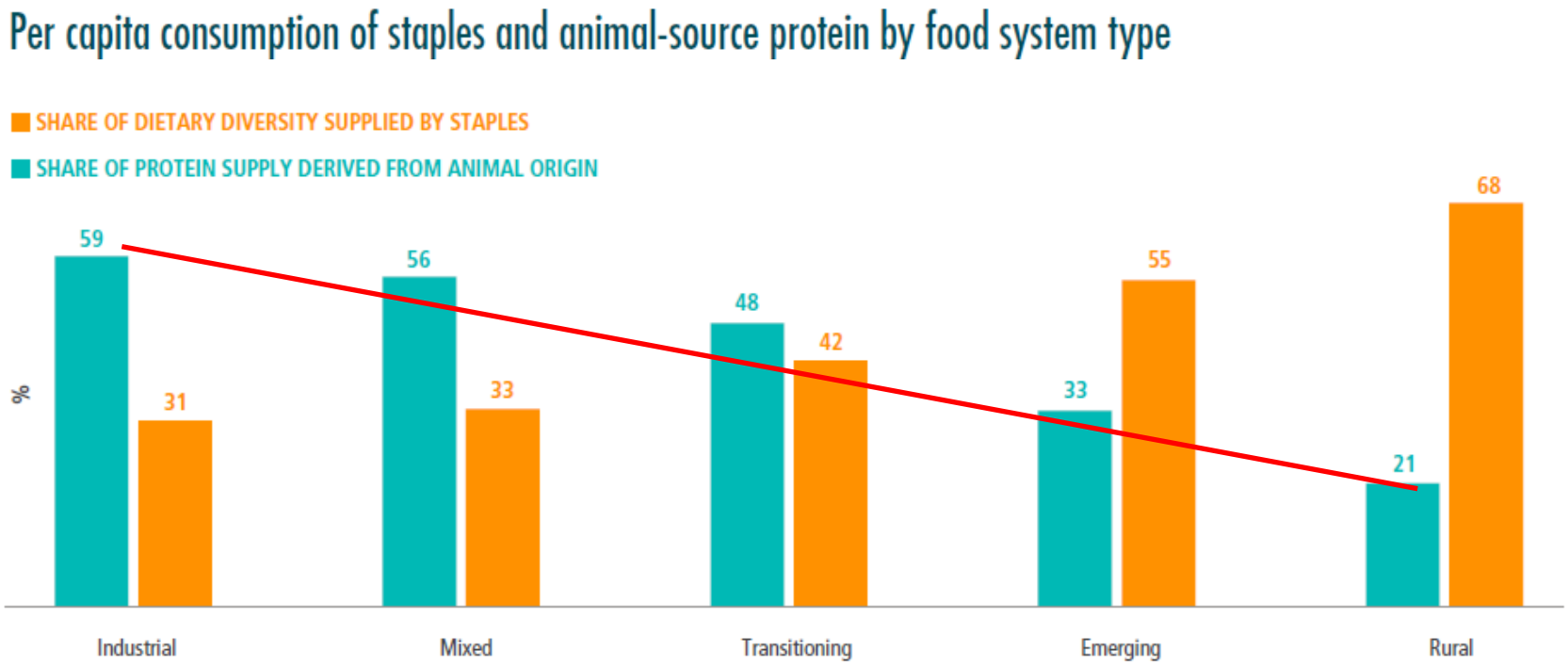
Nutritonal challenges by food systems (as categorised in Global Nutrition Report 2015, IFPRI)





Global Nutrition Report 2015, International Food Policy Institute (IFPRI)

Dietary patterns by food systems



- Supply of **animal-source foods** limited in populations vulnerable to micronutrient deficiencies and **undernutrition**

Global Nutrition Report 2015, IFPRI

'Under-used' animal-source food

- **Mammals and birds** (livestock, poultry): Little potential for new 'under-used' foods/species
- **Fish and other seafood**: New species in culture and new production systems emerging. Potential for 'under-used' species can be mass-produces and contribute significantly to key nutrients
- **Insects**: Few mass-production systems investigated and developed. Large potential for 'under-used' species can contribute significantly to diets and key nutrients

Example: identified 'under-used' indigenous fish species for key nutrients in Bangladesh

Category of fish species	Vitamin A content RE/100 g raw edible parts	Common name[2]	Scientific name
Very high content	>1500	Mola (SIS)	*Amblypharyngodon mola*
		Chanda (SIS)	*Parambassis baculis*
High content	500–1500	Dhela (SIS)	*Osteobrama cotio cotio*
		Darkina (SIS)	*Esomus danricus*
Medium content	100–500	Chanda (SIS)	*Parambassis ranga*
		Koi (SIS)	*Anabas testudineus*
		Golsha tengra (SIS)	*Mystus bleekeri*
		Chanda (SIS)	*Chanda nama*
		Taki (SIS)	*Channa punctata*
		Chela (SIS)	*Chela cachius*
Low content	<100	Baim (SIS)	*Macrognathus aculeatus*
		Baim (SIS)	*Macrognathus pancalus*
		Kachki (SIS)	*Corica soborna*
		Gutum (SIS)	*Lepidocephalus guntea*
		Chapila (SIS)	*Gudusia chapra*
		Puti (SIS)	*Puntius chola*
		Puti (SIS)	*Puntius sophore*
		Khalisha (SIS)	*Colisha fasciatus*
		Shing (SIS)	*Heteropneustes fossilis*
		Magur (SIS)	*Clarias batrachus*
		Baim (SIS)	*Mastacembelus armatus*
		Puti (SIS)	*Puntius ticto*
		Chata (SIS)	*Colisa lalia*

Cultured species:

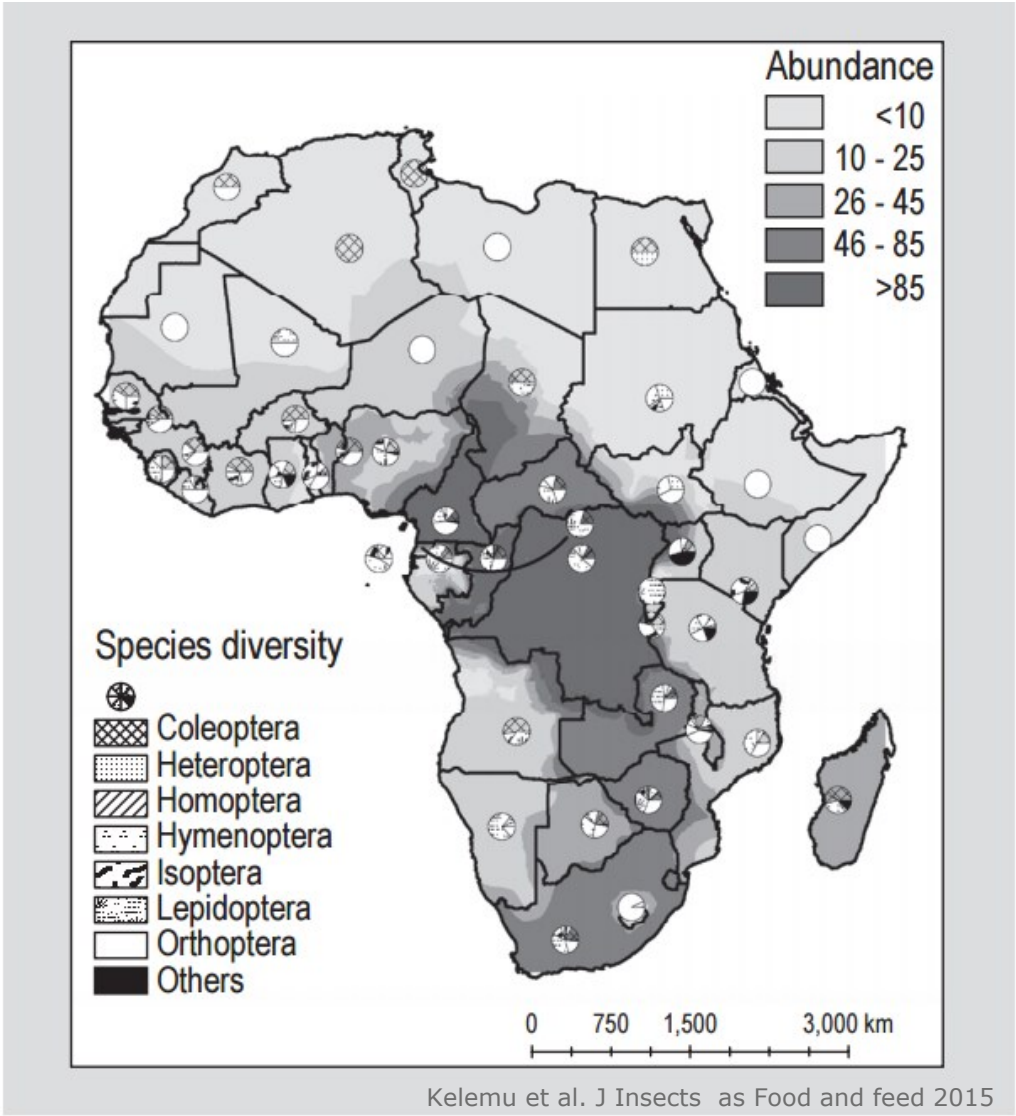
- Mola fish species **integrated** into small fish ponds with 'cash' species for **better nutritional output from aquaculture**

Roos et al. J Nutr 2003

'Under-used' animal-source food

- **Mammals and birds** (livestock and poultry, incl. milk and eggs): Little potential for new 'under-used' foods/species
- **Fish and other seafood**: New species in culture and new production systems emerging. Potential for 'under-used' species can contribute significantly to key nutrients
- **Insects**: Few mass-production systems investigated and developed. Large potential for 'under-used' species can contribute significantly to diets and key nutrients

Edible insects: under-used source of key nutrients?



Kelemu et al. J Insects as Food and feed 2015

Insects: Nutritional composition

Insect larvae/pupae

Adult stage





(based on dry matter)	Coleoptera (beetles)	Lepidoptera (butterflies, moths)		Orthoptera (crickets, grasshoppers, locusts)	
	Rhynchophorus phoenicis (larvae)[1–7]	Bombxy mori (pupae)[8–11]	Cirina forda Westwood (larvae)[1,12–15]	Acheta domesticus (adults)[16–18]	Ruspolia differens (brown; adult)[19]
Nutrient composition					
Protein [%]	10.33–41.69	48.70–58.00	20.20–74.35	64.38–70.75	44.30
Fat [%]	19.50–69.78	30.10–35.00	5.25–14.30	18.55–22.80	46.20
Fibre [%]	2.82–25.14	2.00	1.80–9.40		4.90
NFE [%]	5.49–48.60	1.00	2.36–66.60	2.60	
Ash [%]	2.54–5.70	4.00–8.60	1.50–11.51	3.57–5.10	2.60
Energy [kJ/kg]	20,038–20,060.63	23,236.74	15,030.61	19,057.89	

- Nutritional composition **varies** with species and morphological stage
- Insect are in general to be viewed as **animal-source food** which can supply protein, fat and key micronutrients of **high quality**

Rumbolt & Schlüter 2013

Are insects 'under-used' foods for key nutrients?

- Insects collected from **wild sources** already contribute animal-source food to a wide range of diets
- Nutritional contribution to traditional diets largely **unknown**
- Sustainability of **scaling up exploration** of edible insects collected from **wild sources** (+2,000 species) **limits** contribution
- Insects are '**under-used**' by having an untapped potential for supplying high quality animal-source food from **scaled-up mass-production in managed systems**

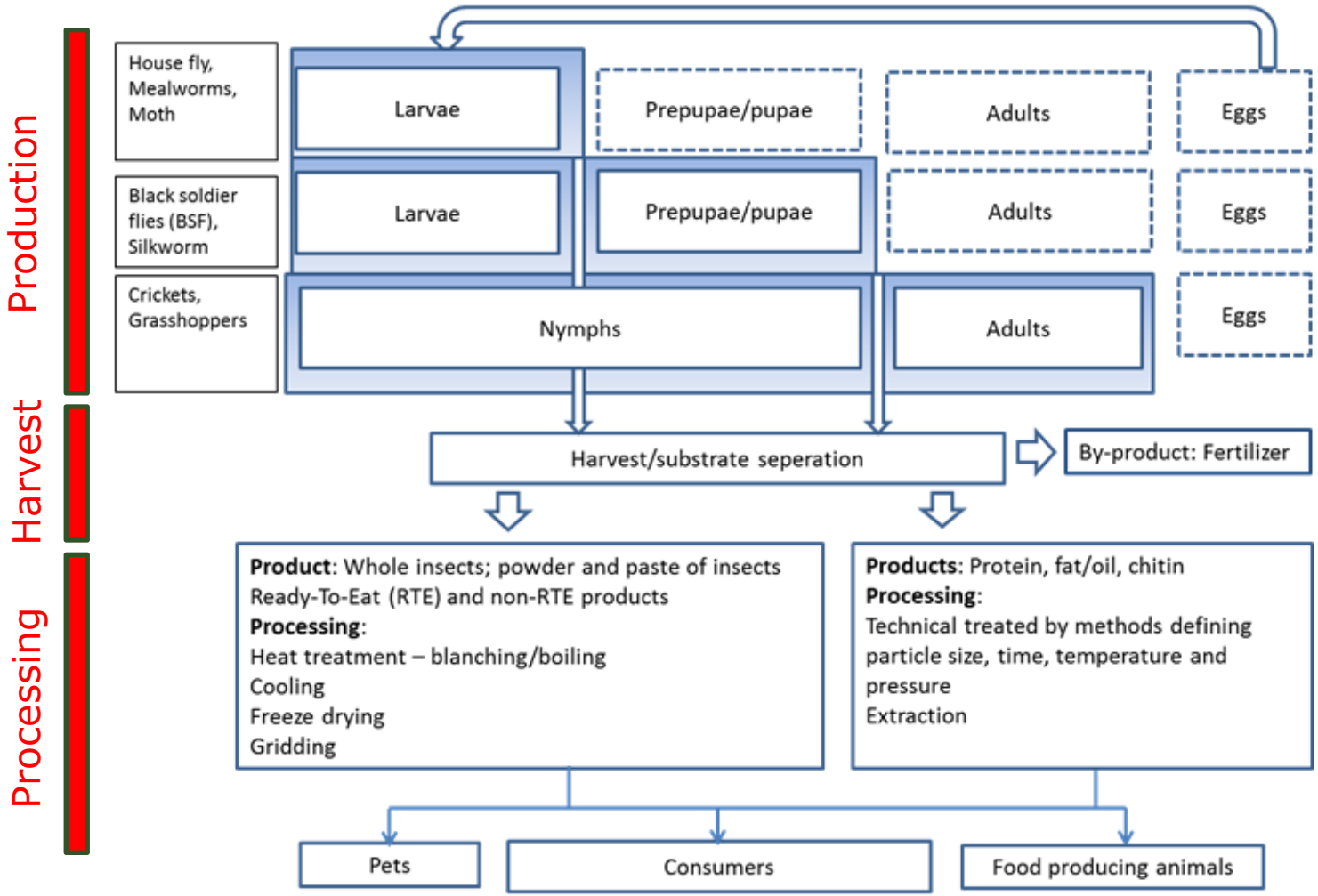
Insect species emerging for managed mass-production

- **Species farmed for food and feed (incl pet feed):**
  - Crickets (4-6 species)
  - Mealworm (3 species)
  - Locust/grasshoppers (various species)
  - Few other species
- **Species farmed for animal feed:**
  - Black soldier fly (*Hermentia illucens*)
  - Housefly (*Musca domistica*)
  - Few other fly larvae
- **By-products for food and feed from two existing insect systems:**
  - Silk larvae/pupae
  - Honey bee brood (larvae/pupae)

About 10-12 species are farmed at present

More will come – but not many

Insect production chains



Insect farming – what does it look like

- **Cricket production** in Thailand (+20,000 farmers, complete value chain incl. processed products)




- **Mealworm** production, Europe (for pet food, limited for consumption, experimental for feed):

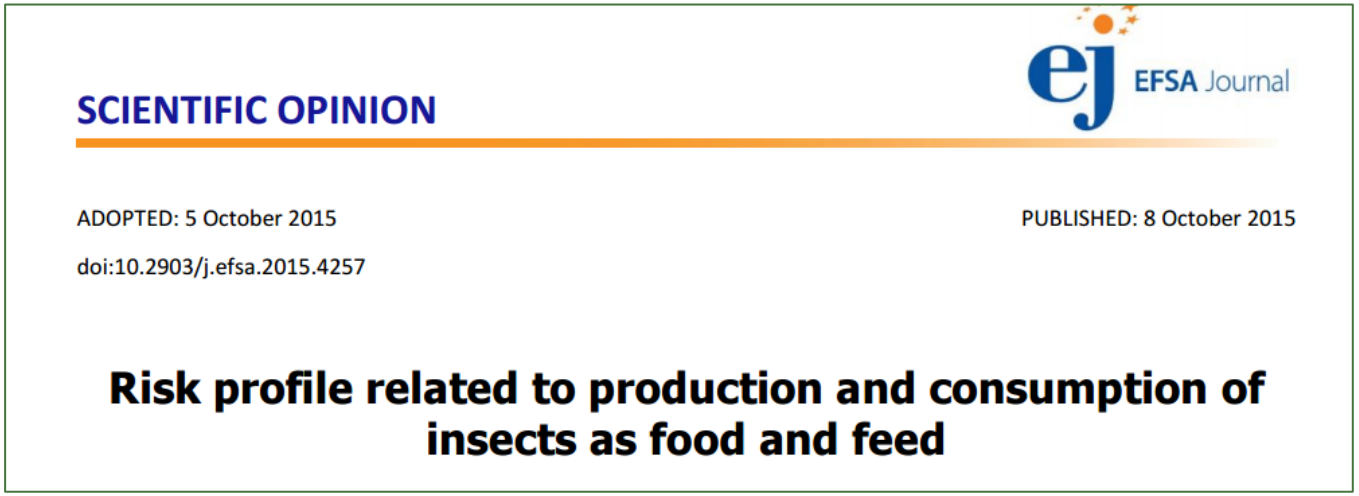




- **Black Soldier Fly** production for animal feed, US




Farming insects: A part of future food systems?



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Risk profile related to production and consumption of insects as food and feed

- Covers potential **biological** (incl. prions)**, chemical and environmental** hazards, as well as **allergenicity**
- Only **farmed** insects used as food and feed
- Taking into account the **entire chain**, from farming to the final product

Summary of hazards in farmed insects for food and feed

- Biological and chemical hazards would depend on **production methods,** in particular what the insects are fed on (**substrate**)

- When **currently allowed feed materials** are used to feed insects, the possible occurrence of microbiological hazards are equal (or lower) to other sources of protein of animal origin and should not pose any additional risk

- The use of **other (currently not allowed) substrates** to feed insects such as organic wastes (food waste and manures) must be specifically evaluated

Summary of hazards in insects **compared to other protein sources** of animal origin, depending on which **substrate insects are fed on**

	Biological hazards	**Prions**	**Chemical hazards**
Group A: Feed materials authorized as feed for food producing animals	Equal or lower	Equal or lower, if the substrate does not include material of ruminant origin Unknown, if the substrate includes material of ruminant origin	Unknown if equal, lower or higher
Group B: Food produced for human consumption, but no longer intended (expired etc)			
Group C: By-products from slaughterhouses (animals fit for human consumption)			
Group D: Food waste from restaurants, catering and household			
Group E: Animal manure and intestinal content	Unknown		
Group F: Other types of organic waste of vegetable nature	Equal or lower	No expected occurrence	
Group G: Human manure, and sewage sludge	Unknown	Unknown	

Summarized from Scientific Opinion EFSA Journal 2015;13(10):4257

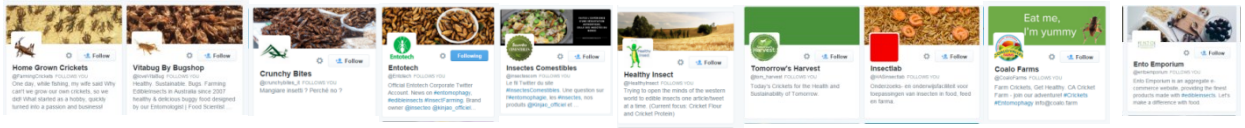
The role of insects in future diets?

- More and more people will consume **processed foods**, in urban and rural populations. What can insects contribute?

- **Global perspective**: Reduce the climate and resource burden of future diets. What can insects contribute?

Can insects improve nutritional value of **processed foods** in future diets?

- Many commercial **entrepreneurs** emerging with insect based products (bars, chips etc.). Busy on Twitter:



- Documentation of **nutritional quality** and health impact needed

- Undernutrition: Improve nutritional **quality of food aid products?**

- Most food aid products are **milk** based. Can insect substitute milk (improve quality/reduce price)?

- Experimental **school feeding product** in Kenya:
  - \+ Equal **acceptability** to milk-based product
  - \+ Cricket product has a better nutritional profile
  - \+ Crickets can be produced locally
  - \- Sensorical qualities can improve

Insects in future diets – a new gallery of tastes?

- Insects have potential for adding taste diversity to diets in Europe

Nordic Food Lab and NOMA in Copenhagen experimenting with insects for deliciousness

- Insects are in many traditional diets viewed as a delicacy

Crickets, Cambodia

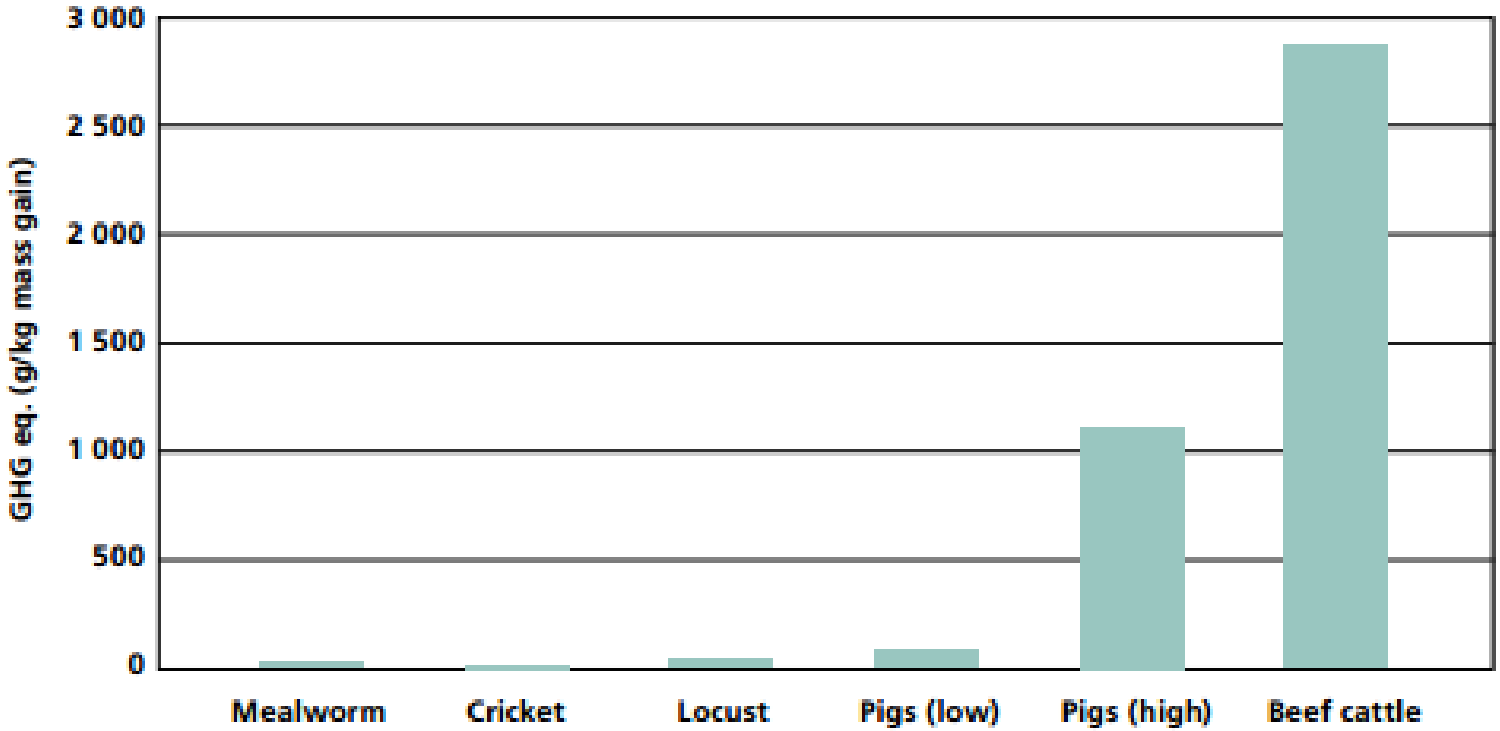
Grilled spider, Cambodia

Termites, Kenya

Palm Weevil, Thailand

Global perspective: Insects have **potential** to contribute to sustainable animal-source food production

Production of Green House Gas (GHG) per kg of mass gain, comparing experimental insect production systems with existing livestock systems



FAO 2013. Data from Oonincx et al 2010

Are insects 'under-used' foods for key nutrients?

- Sustainability of **scaling up exploration** of edible insects collected from **wild sources** (+2,000 species) limits contribution
- Insects are 'under-used' by having an untapped potential for **scaled-up mass-production in managed systems**
- A **selected number of species** (< 20) are expected to be suitable for domestication and **mass-production**
- Insects are **animal-source food** and can contribute **key nutrition** to food systems lacking sufficient supply of animal protein
- Insects can contribute to **dietary and gastronomic diversity**
- Insects have potential for contributing to more **sustainable/less climate burdening** diets

Thank you for your attention

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http://www.wageningenacademic.com/loi/jiff