The significance of edible insects as food and feed for world nutrition (Berlin, 24-05-2016)

BfR-Symposium "Insects as food and feed - food of the future?"

Prof. dr ir Arnold van Huis

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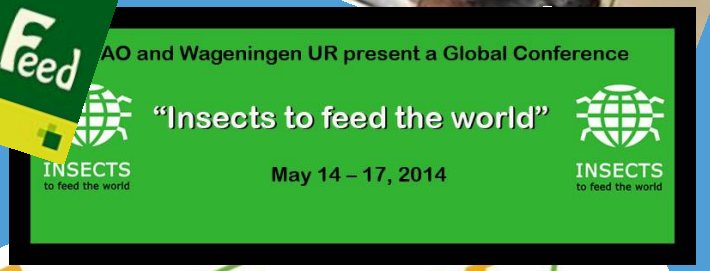
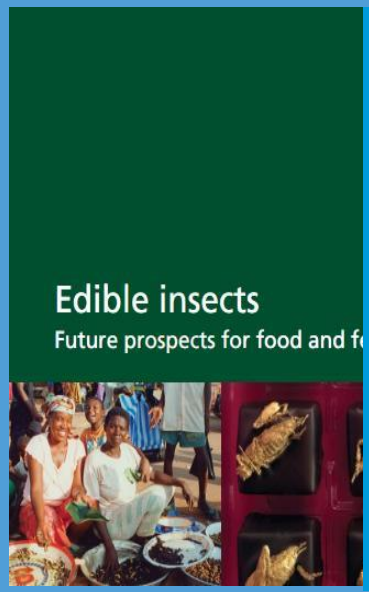
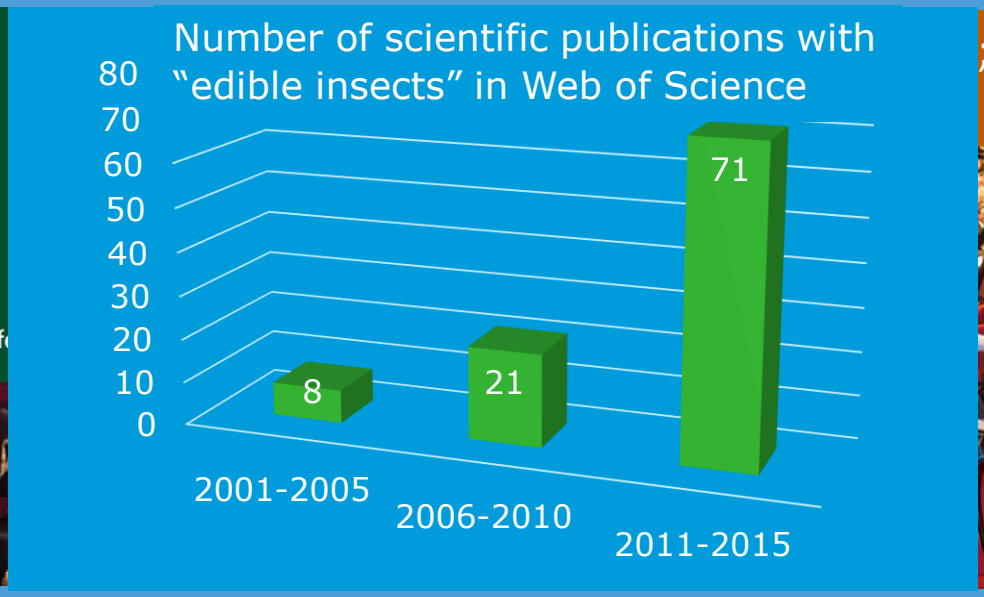
Contents

- Why insects?
- Insects in the food chain
- Private enterprise
- Crucial issues



Last five year increased interest

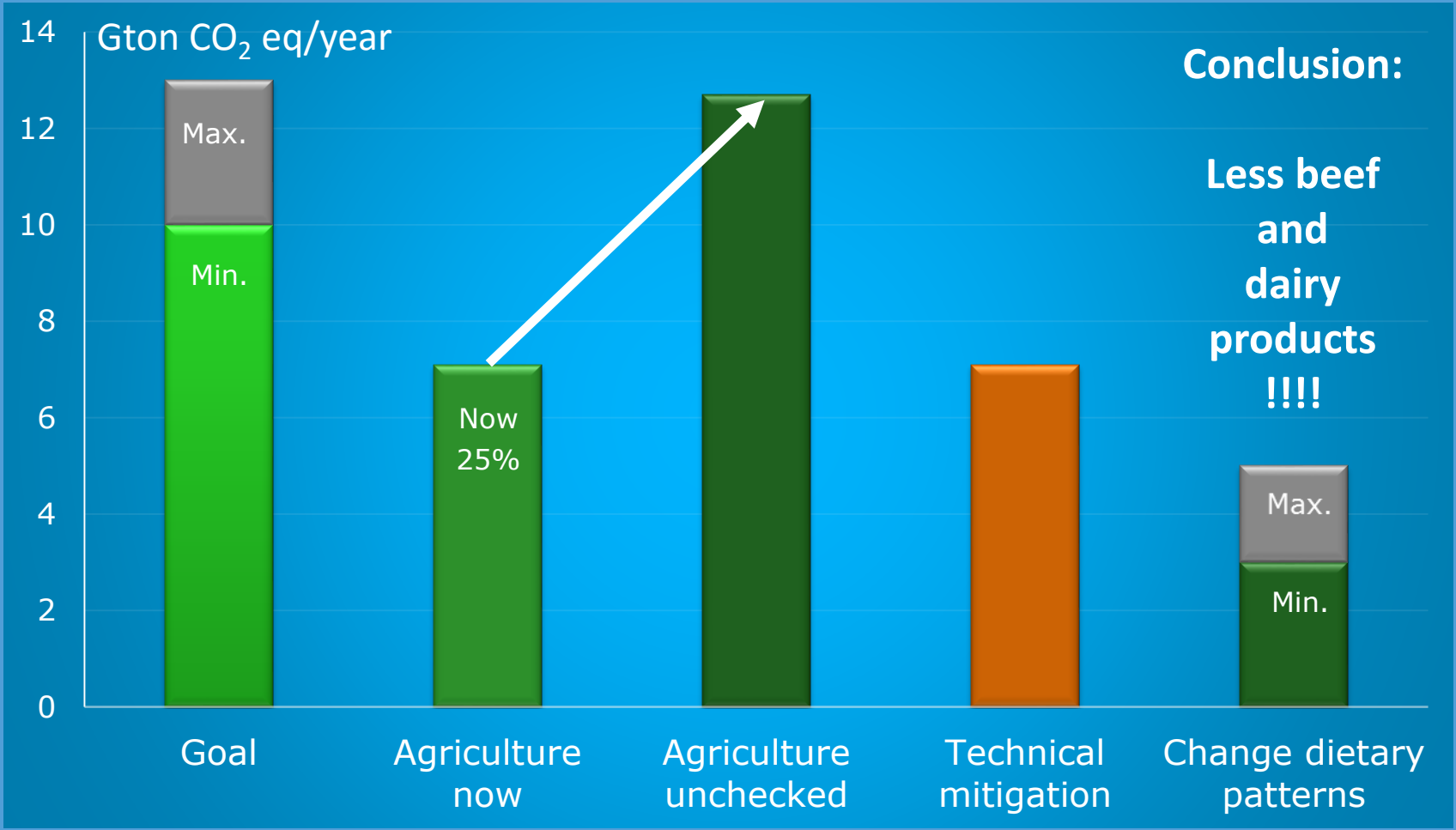




Book published (FAO, Rome)
(Van Huis et al, 2013)
7 million downloads

World Conference
FAO & Wageningen UR
14-17 May 2014

Urgent: how to remain below 2ºC rise (Paris)?



Hedenus et al (2014)

Why alternative protein sources ?

- **Land area not enough in 2050**
  - Increase demand meat: 76%
  - Area livestock **now**: 68%
- **Livestock globally emits**
  - Greenhouse gases: >14%
  - Ammonia: 59-71%
- **Water** for 1 kg beef: 20.000-40.000 liters
- **Others problems:** Deforestation, soil erosion, desertification, loss of plant biodiversity, public health, and water pollution

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Dietary solutions needed:
global challenge and opportunity

Impact on environment: edible insects versus livestock species

ENVIRONMENTAL IMPACT	Number of times insects less than livestock spp.	
	Chicken	Beef
Greenhouse gases	1.3	12.5
Ammonia production	8	1900
Land area	1.8	14.1
Water	1.5	4.9
Feed conversion ratio	2.1	11.9

Insects can convert organic side streams
Globally: 1.3 billion tonnes - US$ 750 billion

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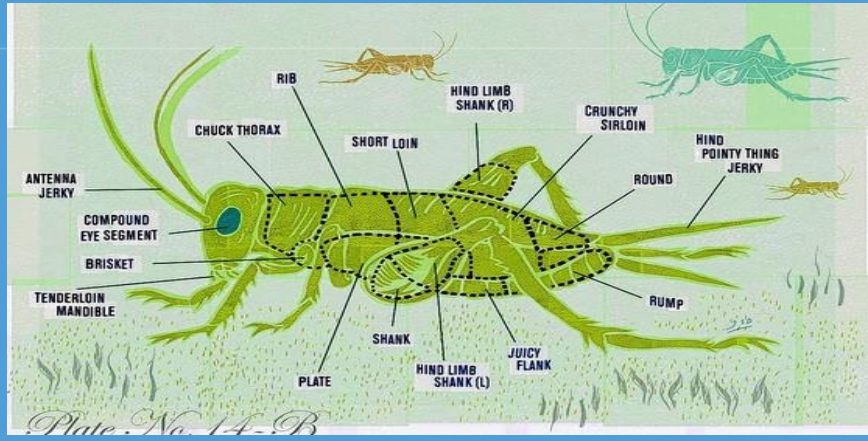
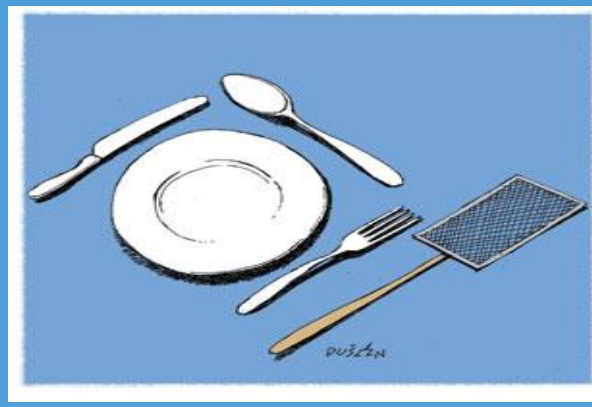
Miglietta et al, 2015; Oonincx et al, 2010; Oonincx & de Boer, 2012

Nutrition edible insects





- Large **variation**
- **Protein** (DM): 40-60%
- **Essential amino acids** (~ beef, soy)
- **Fat** content (DM): 10-30% (PUFAs)
- **Iron and Zinc** content high
- **Nutrient value score** edible insect species similar to conventional meat
- **Processing** influences nutritional value

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From harvesting

Palm weevils

Edible insects

Weaver ants

Mopane caterpillar

10 billion caterpillars
US$ 85 million / year

to rearing

Mealworms for human food

Black Soldier Fly as feed for animals

Crickets as food in Thailand

20.000 farms produce
7.500 tonnes a year

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Food chain: weaver ant pupae in Laos

Ant nest in tree

Women harvesters with bamboo sticks with basket at the end

Stabbing into nest
Pupae fall in basket

Basket with pupae

Pupae sold on ice
on local market

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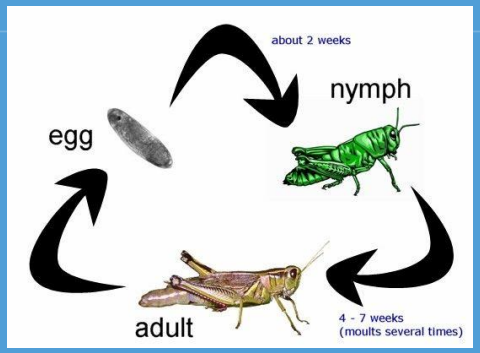
Cricket food chain

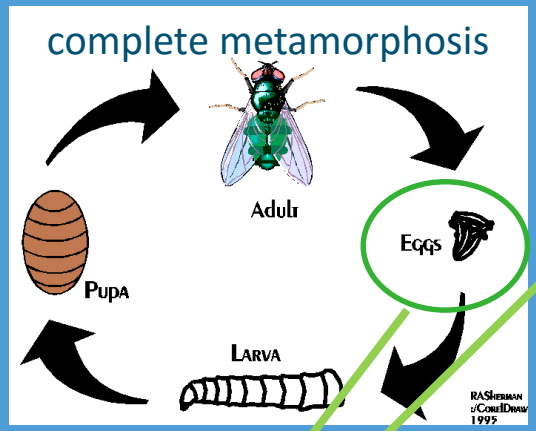


Production units

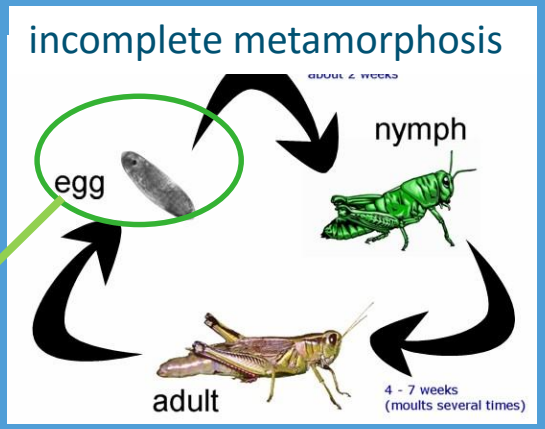
- Reproduction (continuous process to produce eggs

Production (eggs to larvae or pupae)

Flies



Crickets



Eggs harvested & sown on feeding substrate

Eggs | Larval stages | Last larval stage | Pre(pupae)

Harvested by separating insects from substrate

Production of Black Soldier Fly

Eggs

Synchronization of larval development

Reproducing (Mating)

Egg Hatchery

Rearing Insects

Separating pre-pupae and substrate

Products

Processing of prepupae

Harvesting

- Fertilizer
- Chitin
- Larvae

Protein

Fat

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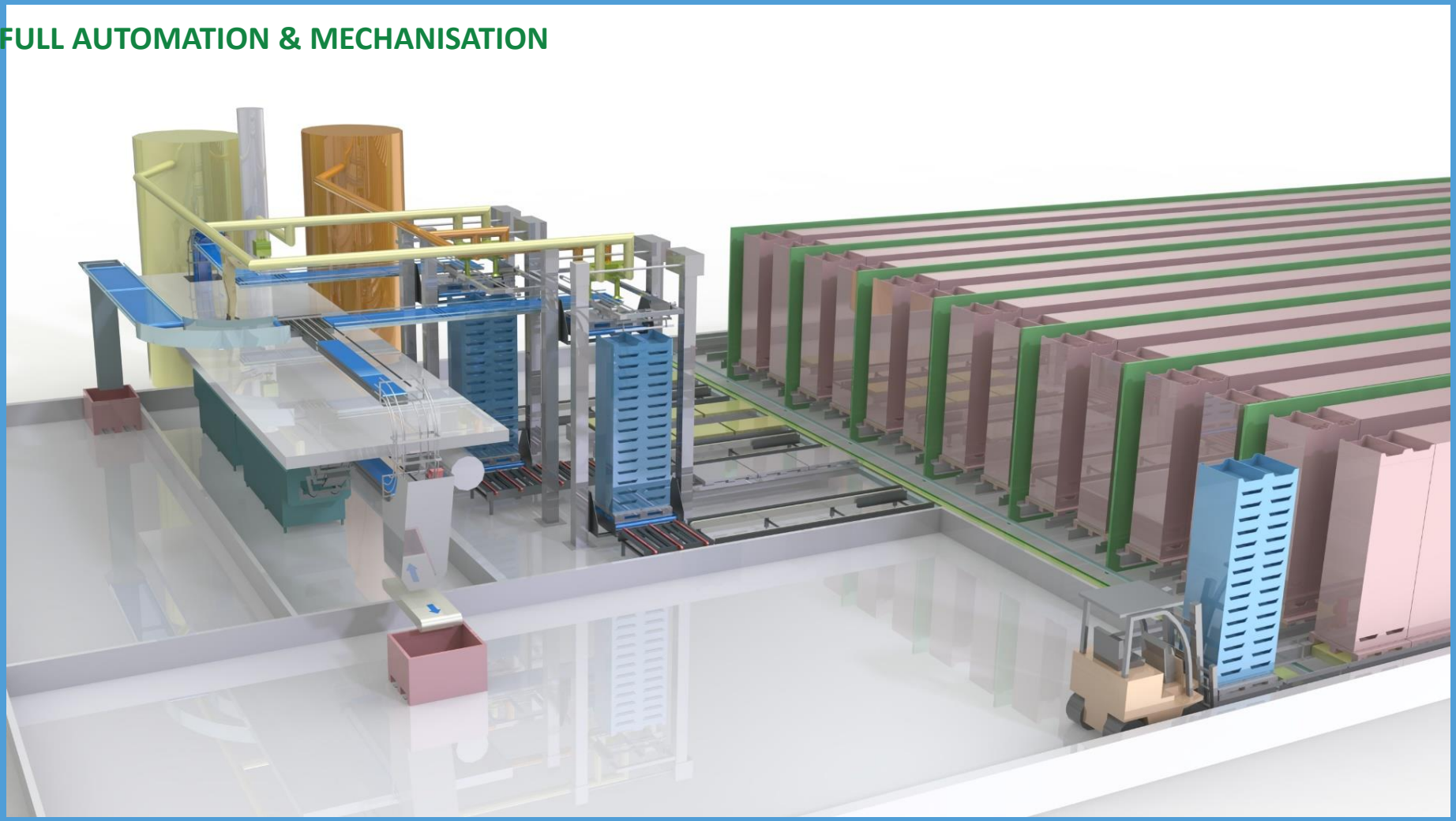
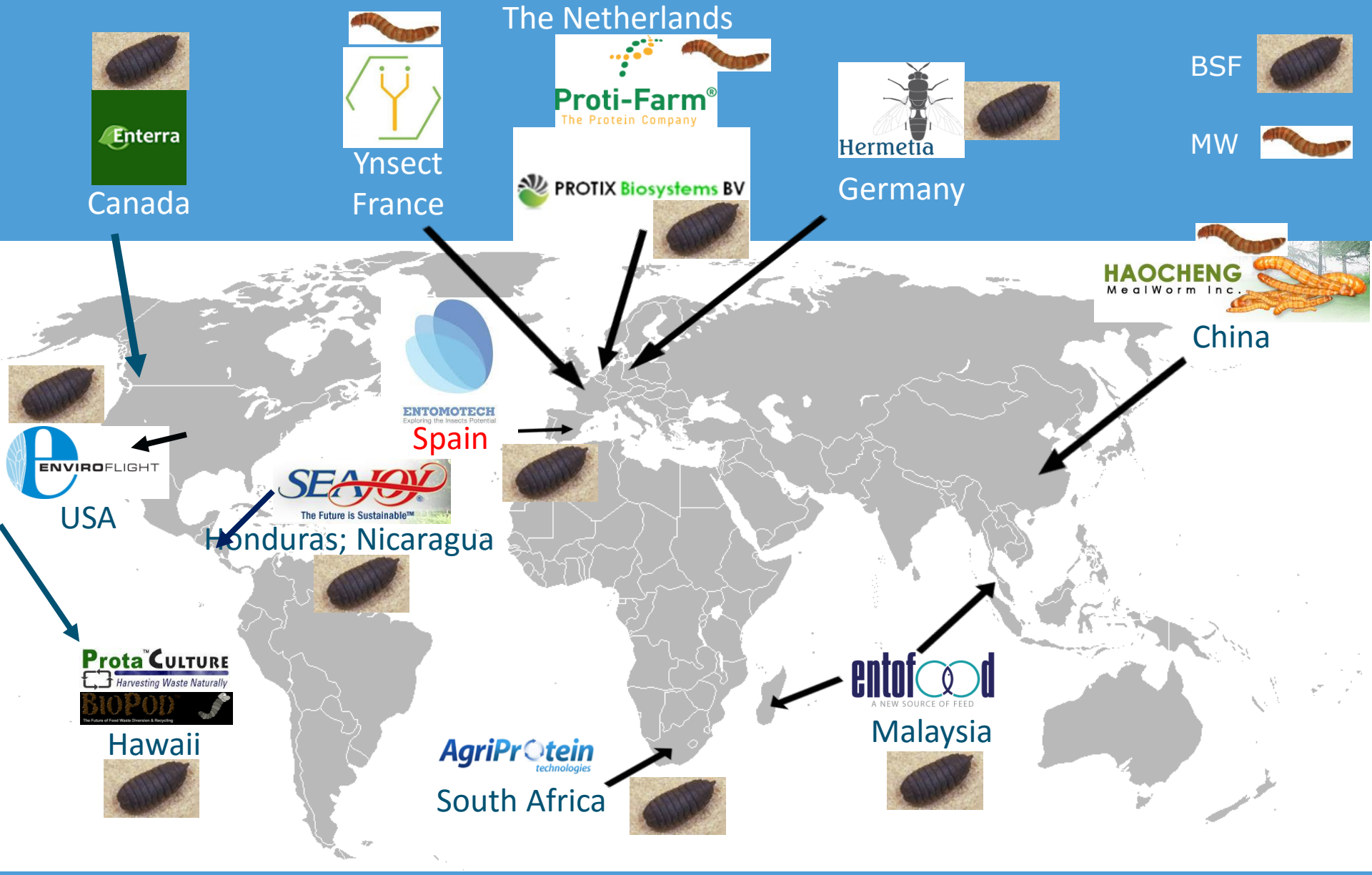
Proti-Farm (Lesser mealworm)

FULL AUTOMATION & MECHANISATION





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Europe: International Platform for insects as food and feed (launched 13 April 2015)

Some companies selling cricket products

France
Gryö—Gryö's
Kinjao

UK
Gathr Foods
Mophagy

USA
All Things Bugs
Big Cricket Farms
Bitty Foods
Next Millennium Farms
Tiny Farms

S. Korea
Edible Inc.

Thailand
Bugsolutely
Eco Insect Farming

Canada
Aspire
Entomofarms

The Netherlands
Jumping Jack Snack
Delibugs

List of insect companies in the world

Eating insects startups: list of Entopreneurs http://www.bugburger.se/foretag/the-eating-insects-startups-here-is-the-list-of-entopreneurs-around-the-world/ (168 companies)

Entomology company database: https://ilkkataponen.com/entomology-company-database/ (254 companies)

Legislation EU

- ✓ Insects for human consumption declared novel food (25 Nov. 2015) – before 1 Jan. 2018 food safety proven
- ✓ National and EU assessments
  - ✓ Belgium, The Netherlands, France (2014, 2015)
  - ✓ European Food Safety Authority (EFSA, 2015)

Belgian Federal Agency for the Safety of the Food Chain:
- Hazards can largely be controlled by good hygiene
- Contamination should be avoided
- Heating step indispensable

2015

- ✓ Biological hazards
- ✓ Chemical hazards
- ✓ Allergens

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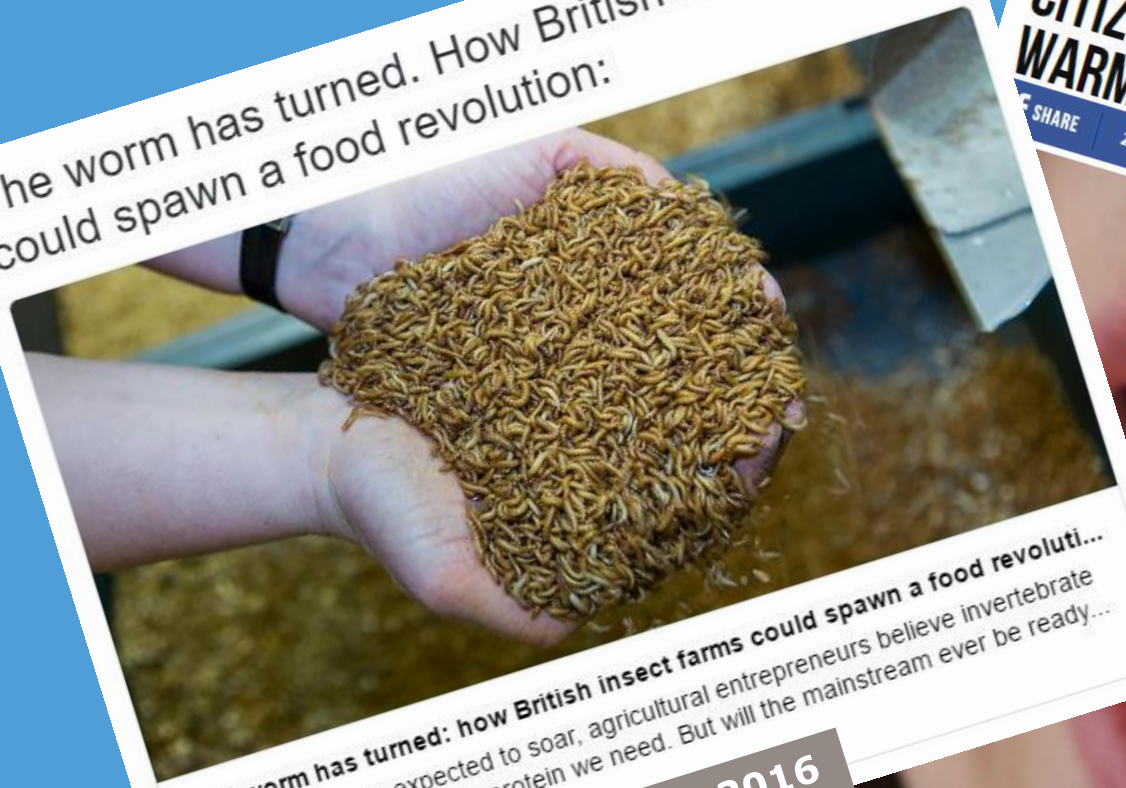
Challenges legislation insects as feed

- Insects as feed for livestock (Reg. EC 999/2001)
- Rearing insects on manure or catering waste (Reg. EC 1069/2009).
- Allowed in aquaculture (Reg. EC 56/2013), but killing only allowed in official registered slaughterhouse) (Reg. EC 999/2001 Annex IV)

- Feed market for pigs and poultry: US$ 300 billion
- Worldwide 1.3 billion tons of waste; value US$ 750 billion
- Worldwide US$ 50 billion market (growing 5-7% a year)

(EFSA's 'Risk profile related to production and consumption of insects as food and feed' published in October 2015)

The worm has turned. How British insect farms could spawn a food revolution:



The worm has turned: how British insect farms could spawn a food revoluti...

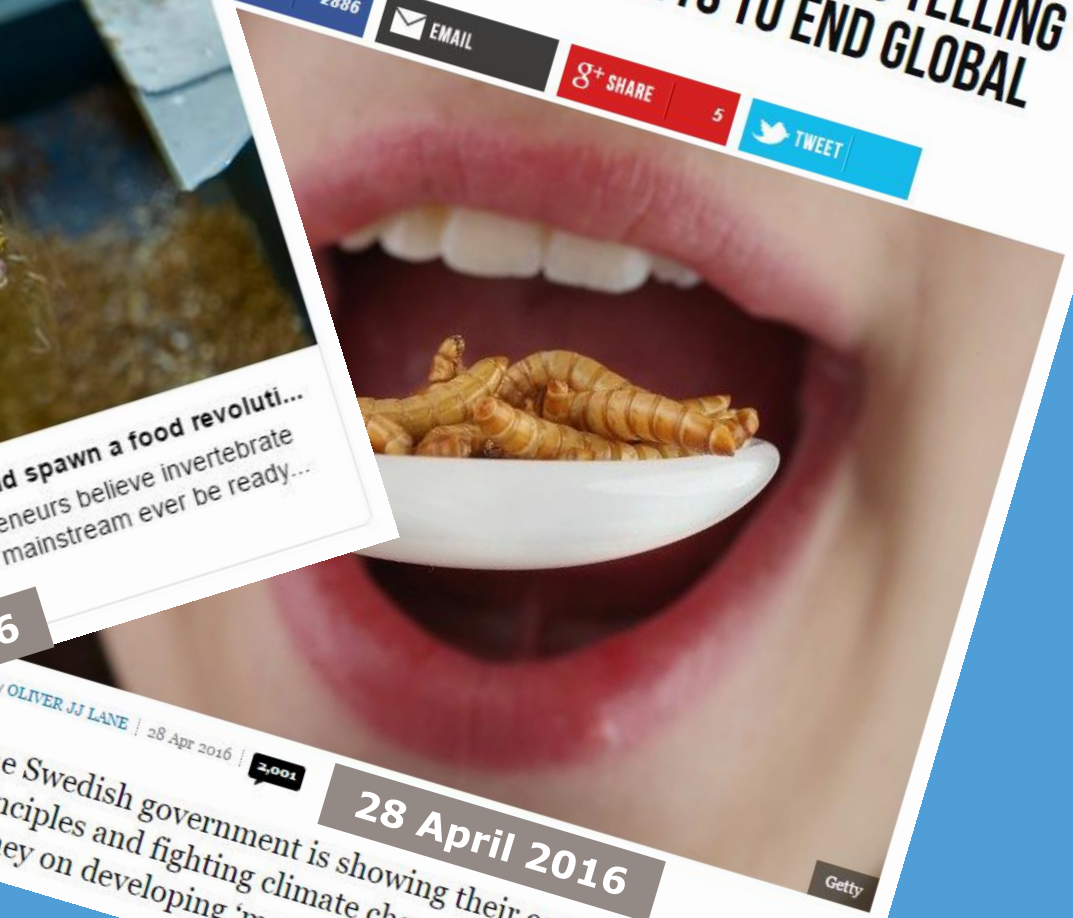
With meat prices expected to soar, agricultural entrepreneurs believe invertebrate livestock can provide the protein we need. But will the mainstream ever be ready...

theguardian.com

10 April 2016

SWEDISH GOVT SPENDS MILLIONS TELLING CITIZENS TO EAT INSECTS TO END GLOBAL WARMING

SHARE 2886 EMAIL SHARE 5 TWEET



Getty

28 April 2016

by OLIVER JJ LANE | 28 Apr 2016 | 2,001

The Swedish government is showing their commitment to green principles and fighting climate change by spending tax payer money on developing 'meat' made out of crickets and mealworms.

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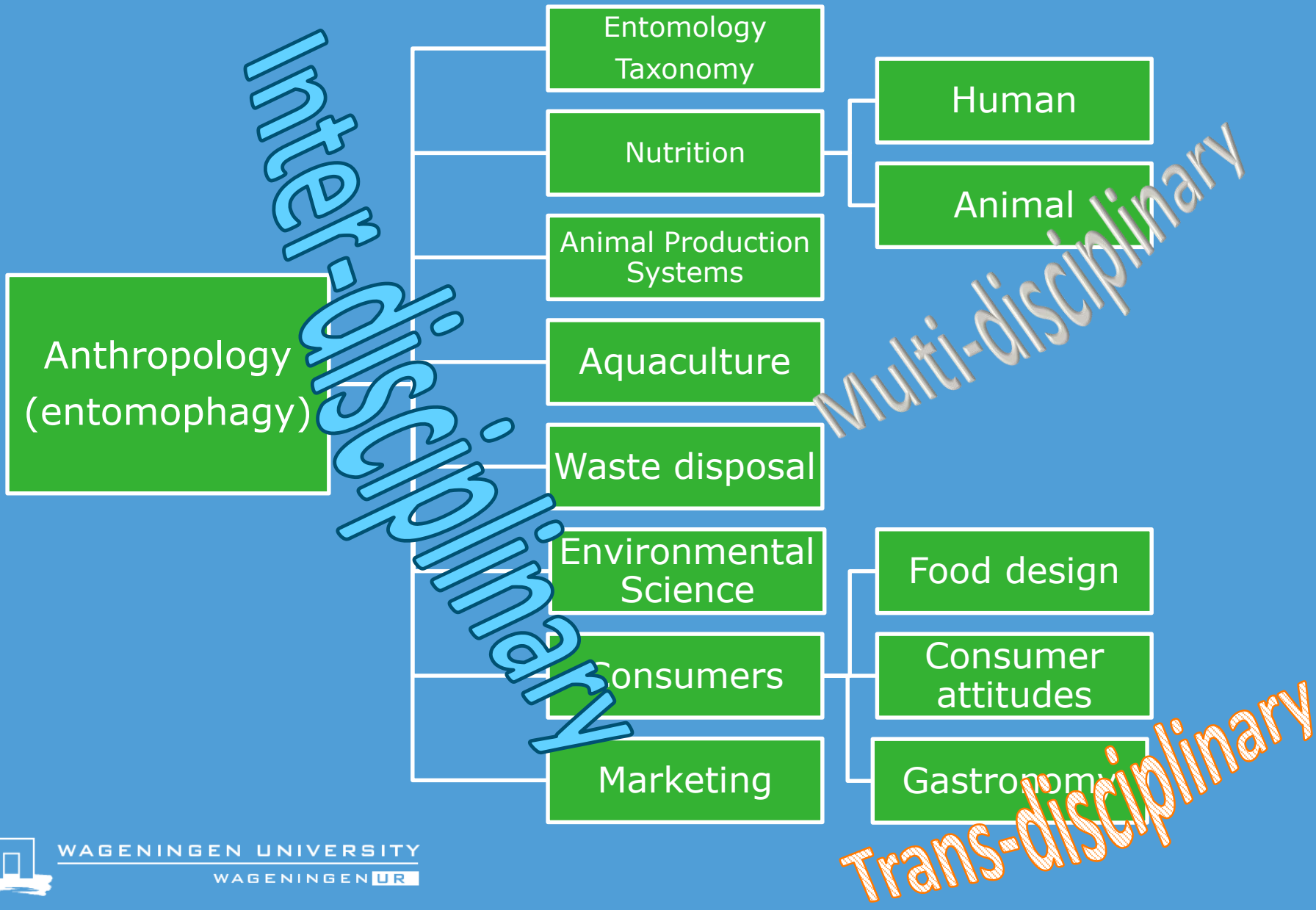
Insect burgers and meatballs

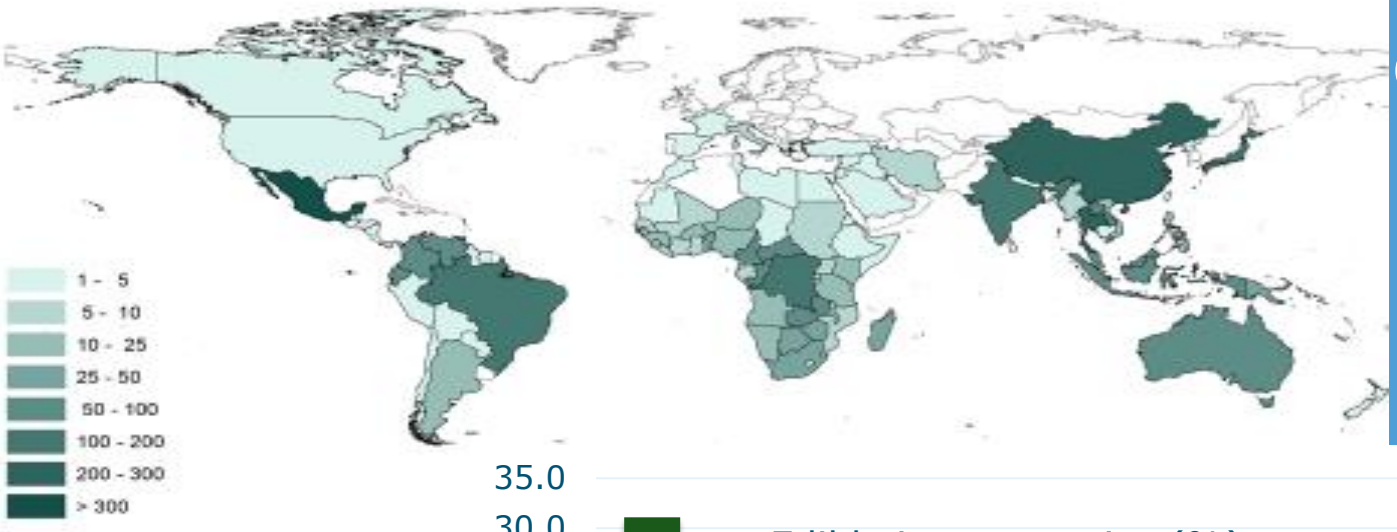
In supermarkets in Belgium and the Netherlands

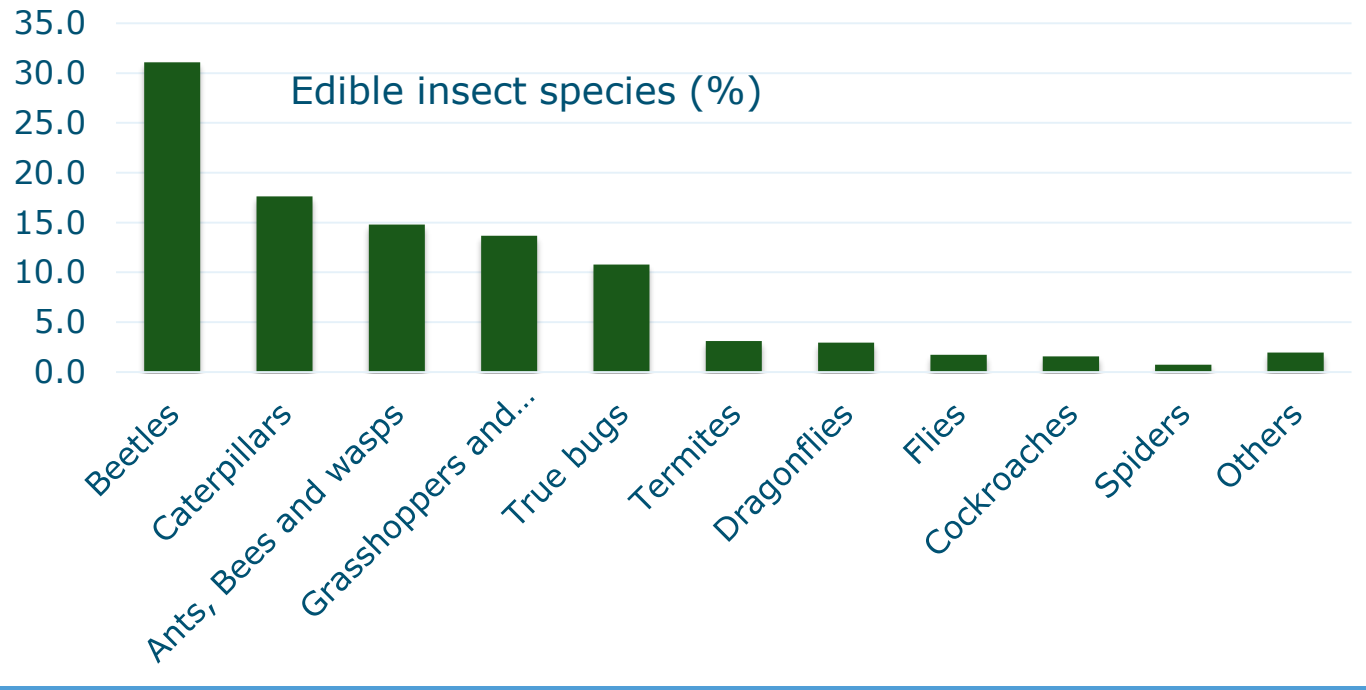
Disciplinary focus



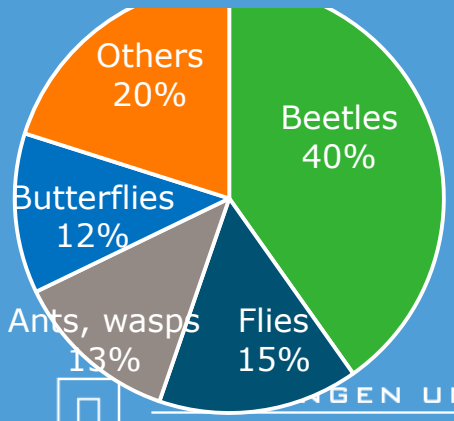
Ethno-entomology

insect species in the world: 2037





World: 1 million species



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Jongema (2015)

Statistics on edible insects

- Not considered in national or international databases
- Neglected because considered

  "a peculiar habit by primitive people"
- Hardly any knowledge on
  - Extent of practice
  - Importance of insects in diets
  - Contribution to livelihoods

INSECTS ARE FOOD™

Entomophagy is the future

Nutrition – many articles

Nutritional values similar or better than meat products

However:

- Many insect species
- No standard analytic methods used
- Value depends on issues like gender, life stage, diet, and environmental conditions (temp., hum., light, etc.)
- Bio-availability often unknown

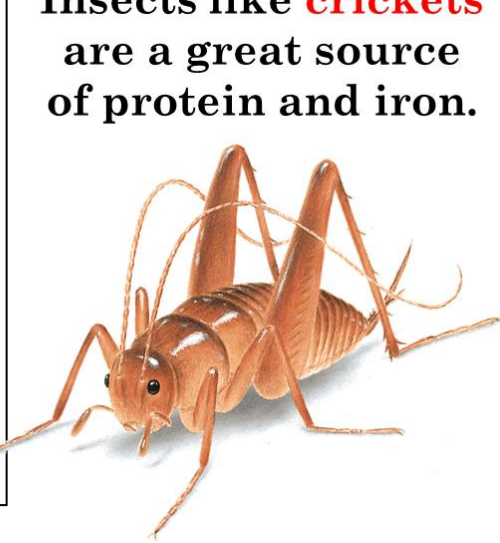
Nutrition Facts

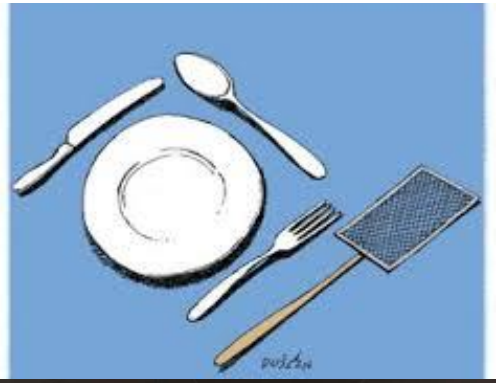
Serving Size 3.5 ounces (100g)

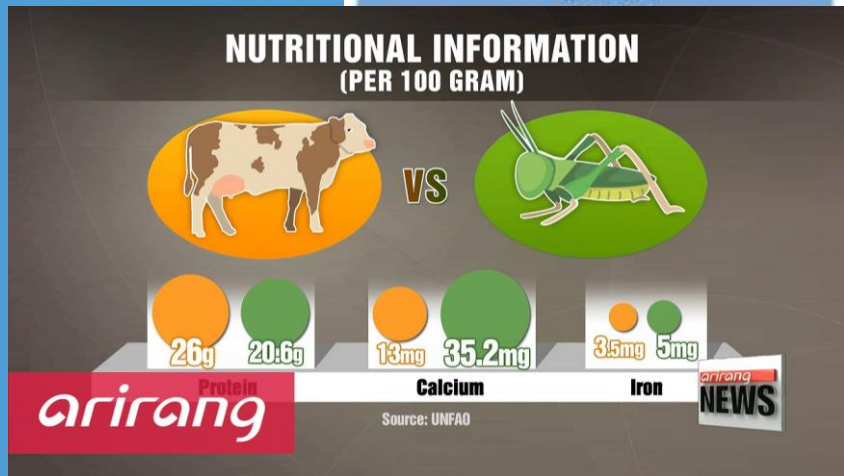
Amount Per Serving	
Calories 122	Calories from Fat 50
	% Daily Value*
Total Fat 5.5g	8%
Cholesterol 0mg	0%
Sodium 0mg	0%
Total Carbohydrate 5g	2%
Protein 13g	26%
Calcium 8% • Iron	53%

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs

http://www.ent.iastate.edu/misc/insectnutrition.html







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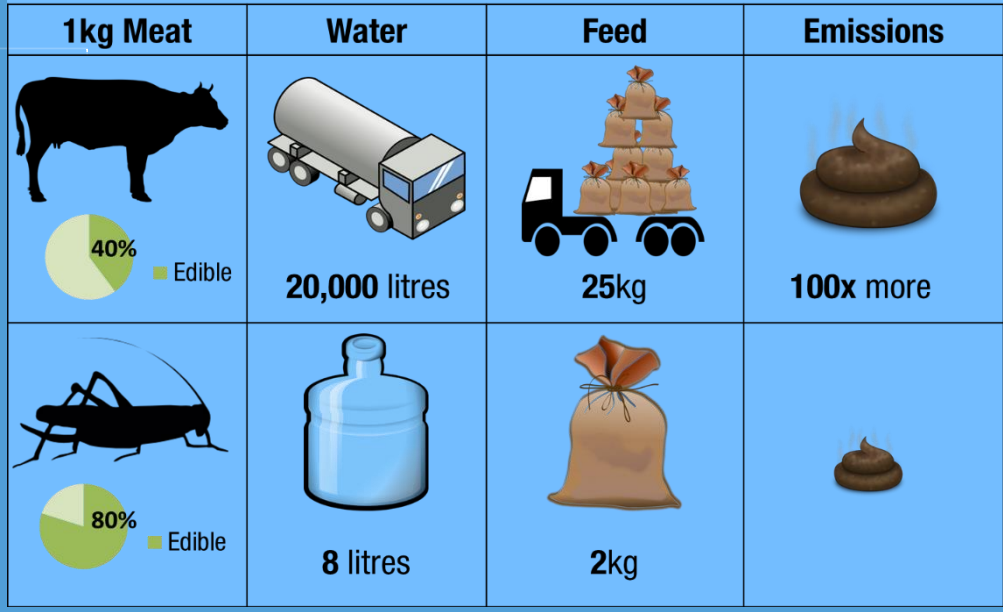
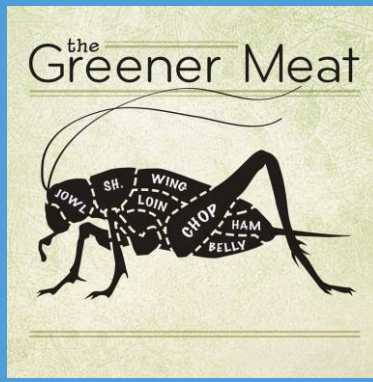
Environmental impact compared to livestock products



- Life Cycle Analysis studies:
  - Mealworms (Oonincx & De Boer, 2012)
  - Water footprint mealworm (Miglietta et al, 2015)
  - Housefly (van Zanten et al, 2015)
  - More needed !!!!!!!!!



- How do insects perform on organic waste products (development, food safety)?

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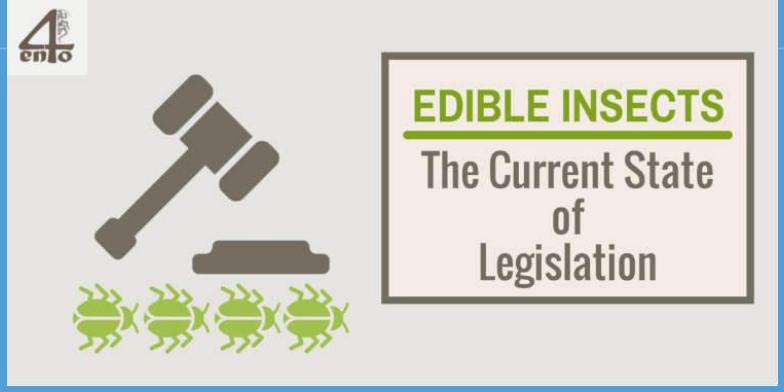
Food safety



- Most information about harvested insects from the wild
- Little information when reared under controlled conditions, but few problems expected
- However, for the sector to develop: urgently more information needed

  In particular when insects are reared on organic by-products: how do insects deal with chemical and biological contaminants ?

- Largest problem: feed (needs to be certified)
- Allergy: cross contamination occurs (seafood, HDM)

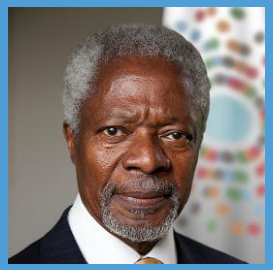
Farming

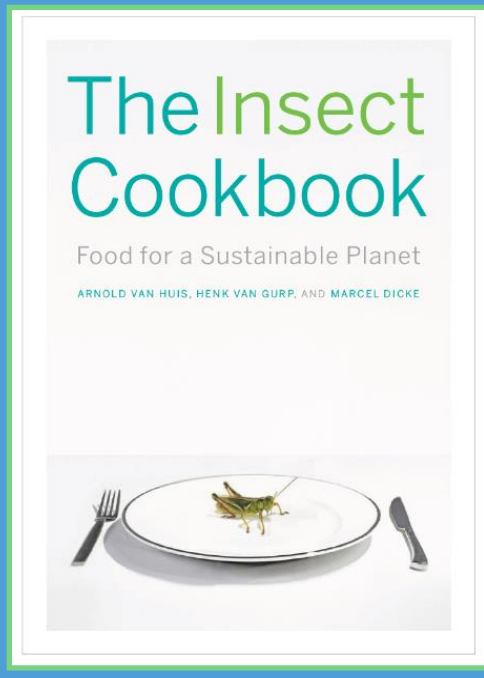
- Developing countries: from harvesting to farming
- Western world – companies are investing to produce tonnes a week (automation)
- Little known about diseases in insect rearing
- In a very preliminary phase of even not yet started:
    - Genetically improving insect species (breeding)
    - Using different strains
    - Inbreeding, outbreeding

Consumer studies

'How to market the impossible'

- How to convince the western consumer?
- Strategies proposed: experimental tasting, providing info, processing (burgers), sky shrimps, role models, cookbooks, children
- Gastronomy





Enabling environment

- National cooperation between
  - Companies (e.g. VENIK in The Netherlands)
  - Government, private enterprise, academia (projects like Riskinsect in Belgium)
  - All stakeholders (e.g. UK - WOVEN)
- International
  - European Union (ProteInsect)
  - Between companies
  - FAO

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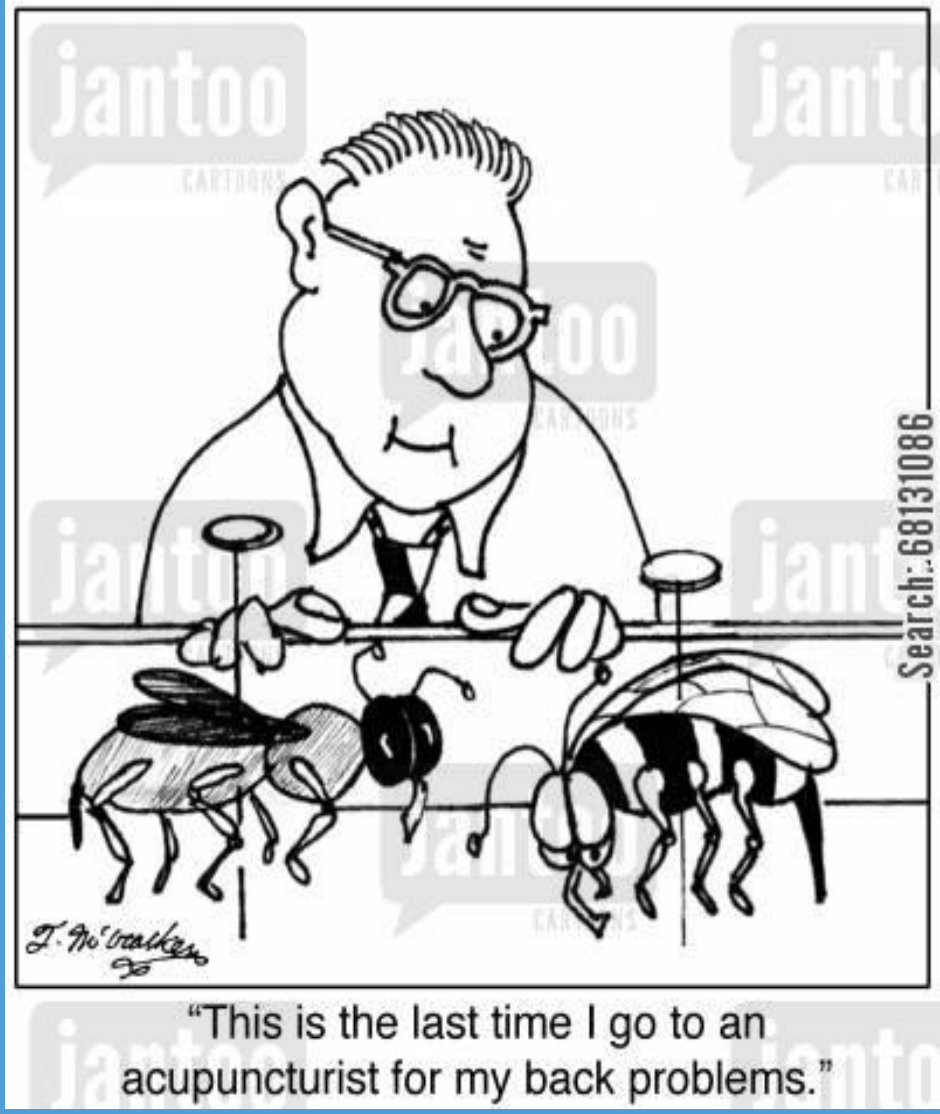
ipiff
International Platform of Insects for Food and Feed

Emerging issues: Insect welfare

- Can insects experience pain?
  - Not adaptive
  - Perception pain in brain absent
  - No pain behaviour
- Benefit of the doubt (freezing, blanching, grinding)

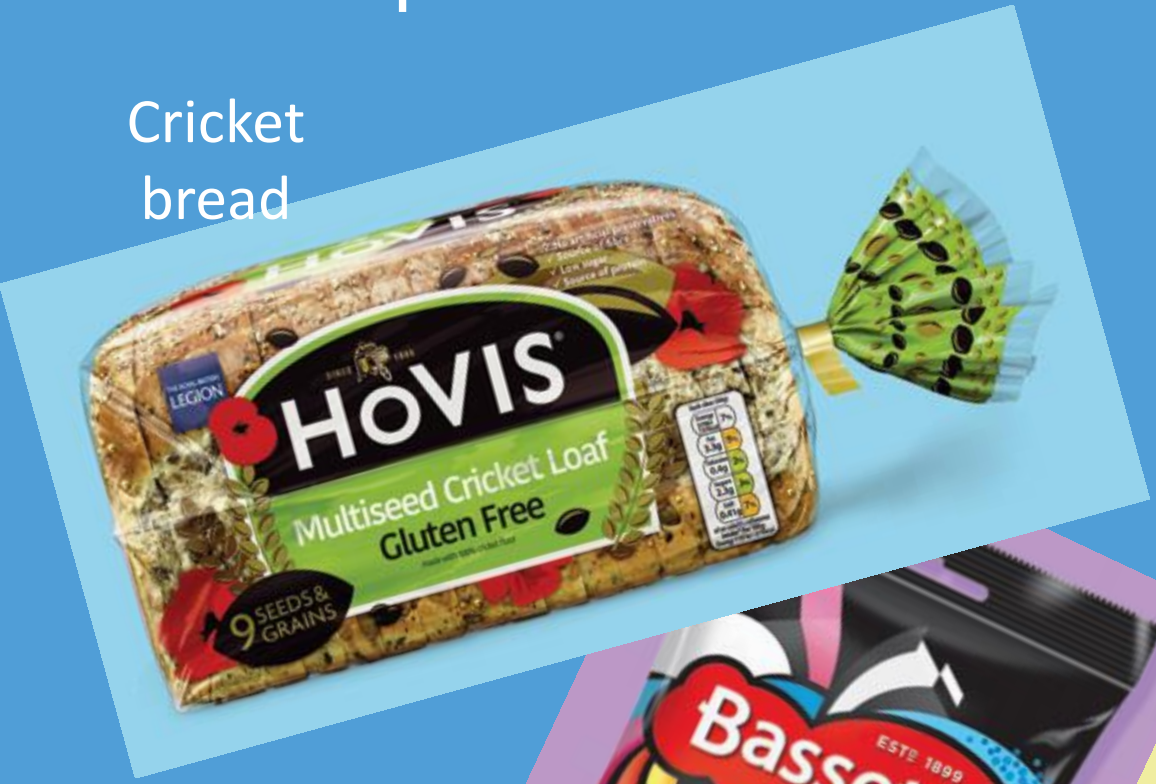


Number of neurons brain animals

-	Fruitfly	100.000
-	Cockroach	1.000.000
-	Mouse	75.000.000
-	Human	85.000.000.000

Insect products of the future

Cricket bread



Termite sauce

Liquorice waterbug

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Add Roasted Cricket Bitters to Tonight's Cocktail

News articles Oct. 2015

Insects as food and feed have a bright future

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