

Insect Farming: A circular economy solution to create value for food loss and waste

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www.icipe.org

The Crawford Fund Annual conference
Global Food Security in a Riskier Environment: Diversification for
Resilient Food and Nutrition Systems
5th September 2023



General facts - *icipe*

- ❖ A *Center of Excellence* in Africa- for research and capacity building in insect science and its application
- ❖ An *intergovernmental organization*- Charter signed by 13 countries worldwide
- ❖ >571 staff (>30 nationalities) including several contracted workers
- ❖ 150-180 graduate students annually



Organization with a *unique history: >50 years*



T.R. Odhiambo



H.R. Herren



C. Borgemeister

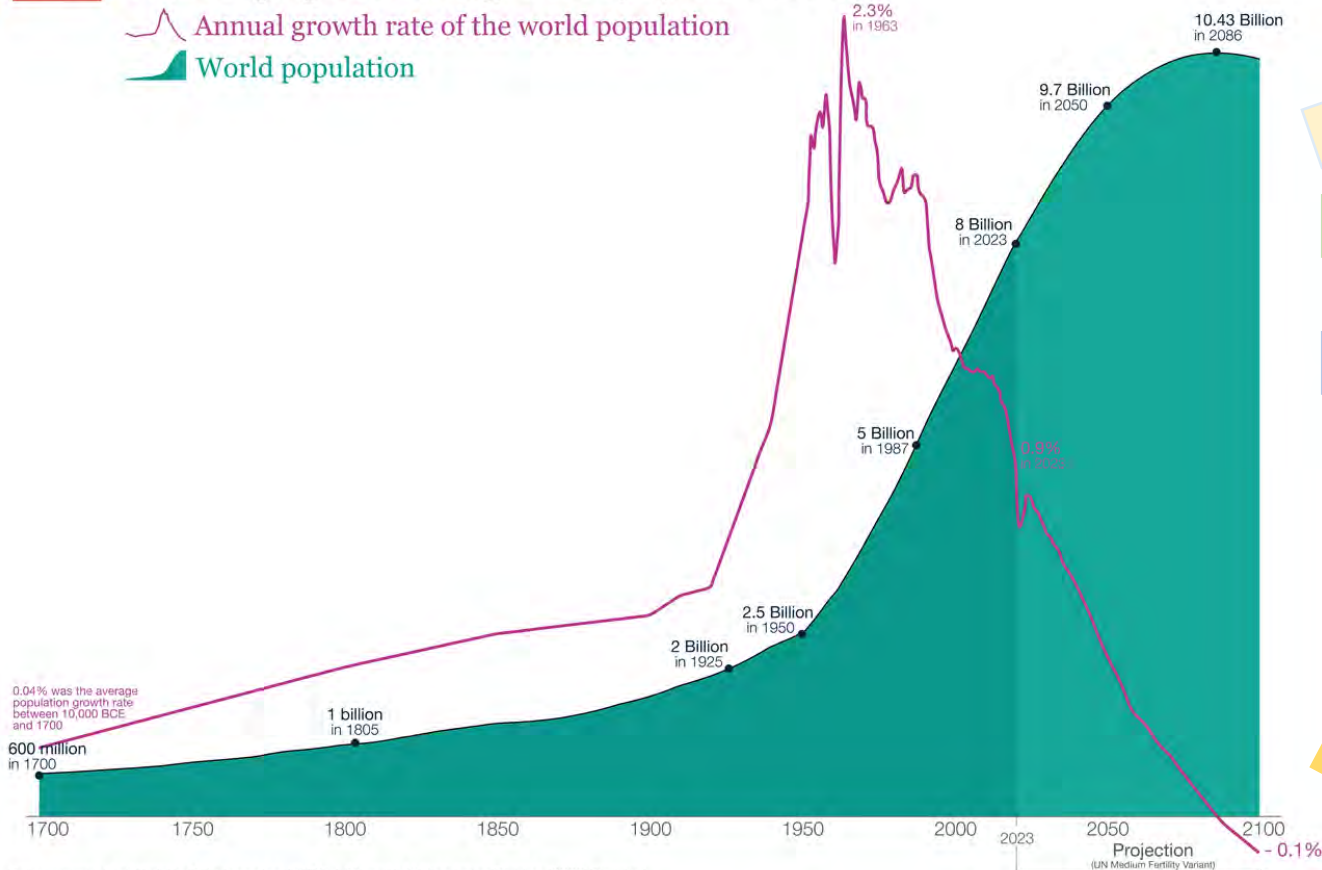


S. Kelemu

Population Growth and Food security

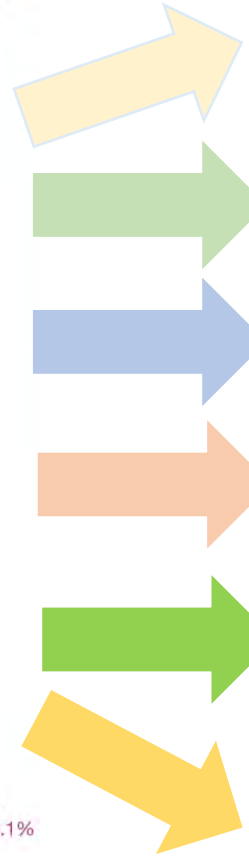
Our World in Data

World population growth, 1700-2100



Data sources: Our World in Data based on HYDE, UN, and UN Population Division [2022 Revision]
This is a visualization from OurWorldinData.org, where you find data and research on how the world is changing.

Licensed under CC-BY by the authors Max Roser and Hannah Ritchie.



Increased demand for food

Increased crop productivity

Urbanisation

Decrease land for agriculture

Solid waste accumulation

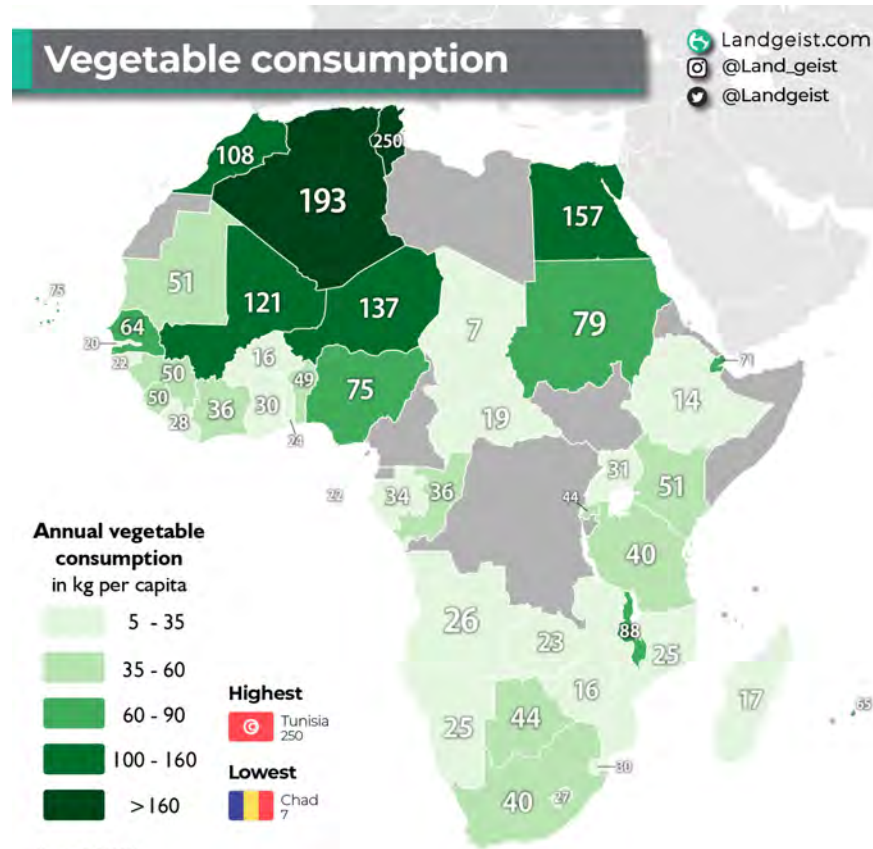
Increased demand for protein

Challenges

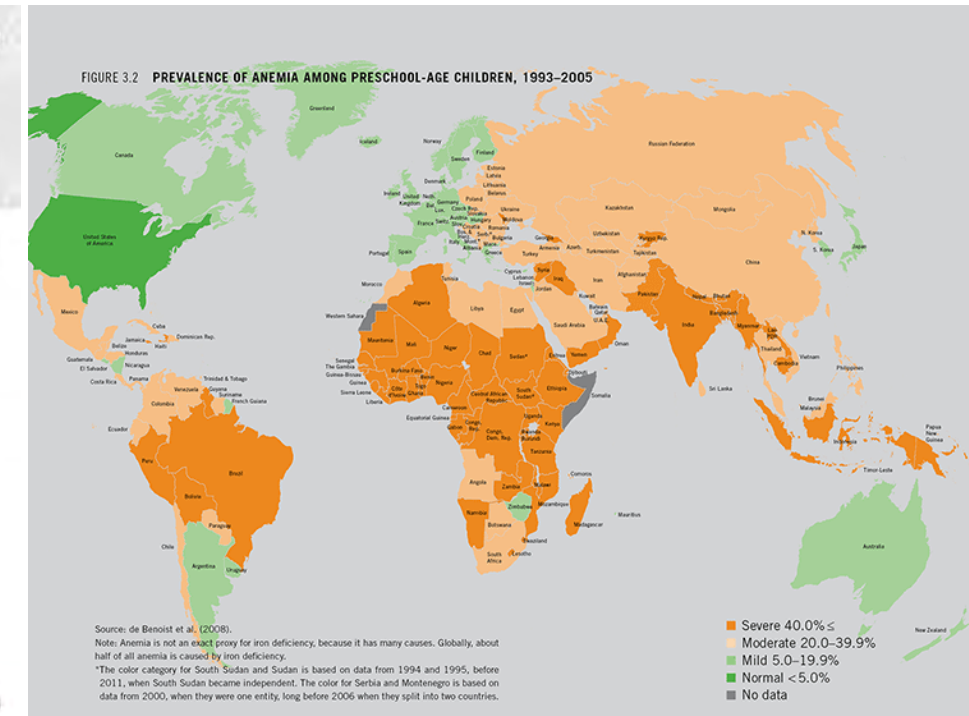
1. Food and nutritional insecurity - Consumption of nutrient rich vegetables vs Hidden hunger in Africa

❖ **About 20% of people** in Africa face chronic hunger

❖ “Africa’s annual food import bill of \$35 billion, estimated to rise to \$110 billion by 2025” - AfDB



Source: FAO, 2018

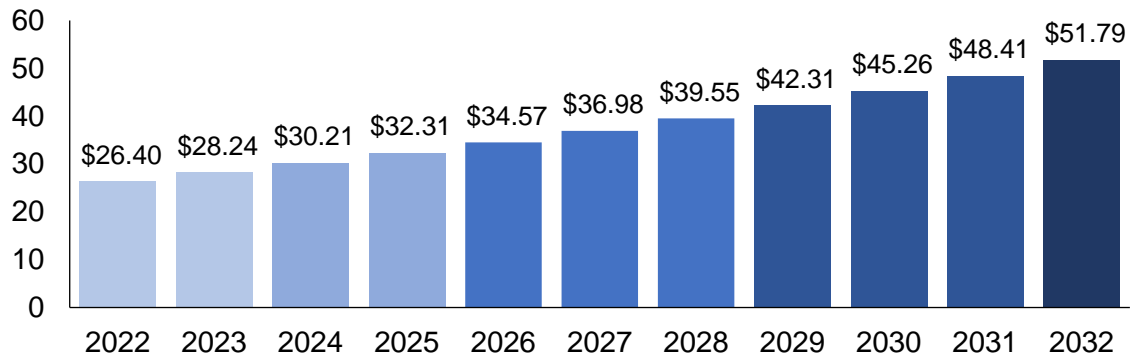


Source: IFPRI

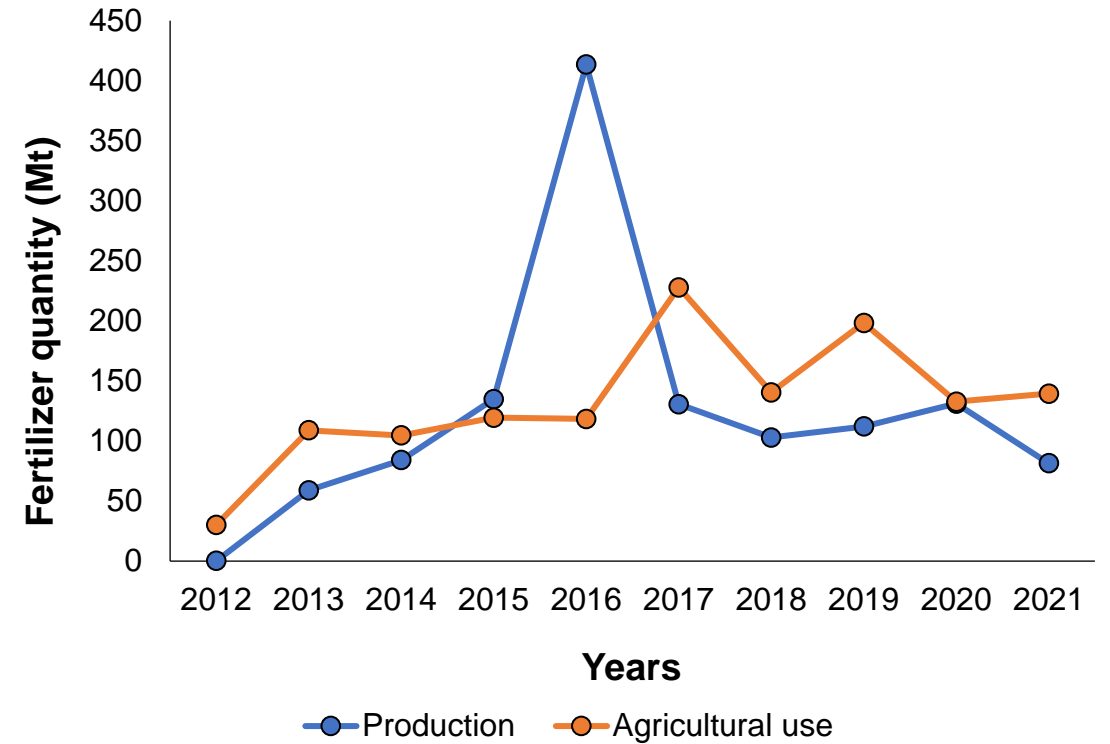
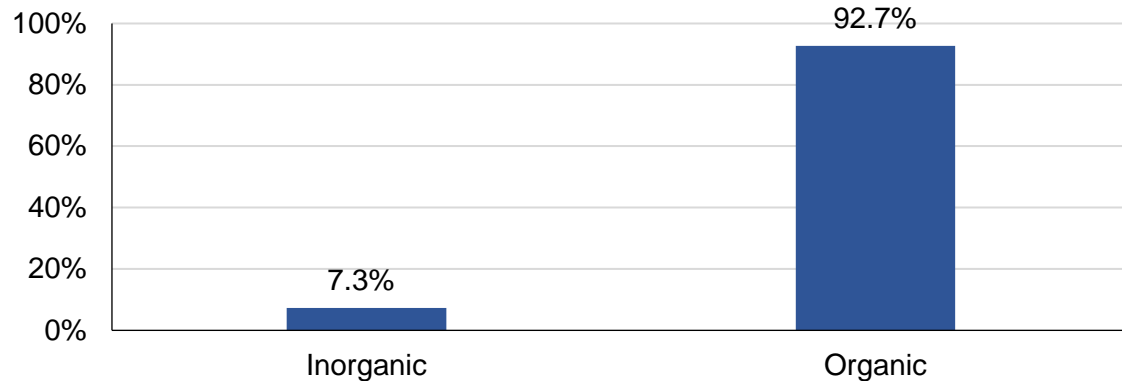
Challenges

2. Demand for fertilizer

SPECIALTY FERTILIZERS MARKET REVENUE, 2023 TO 2032 (USD BILLION)



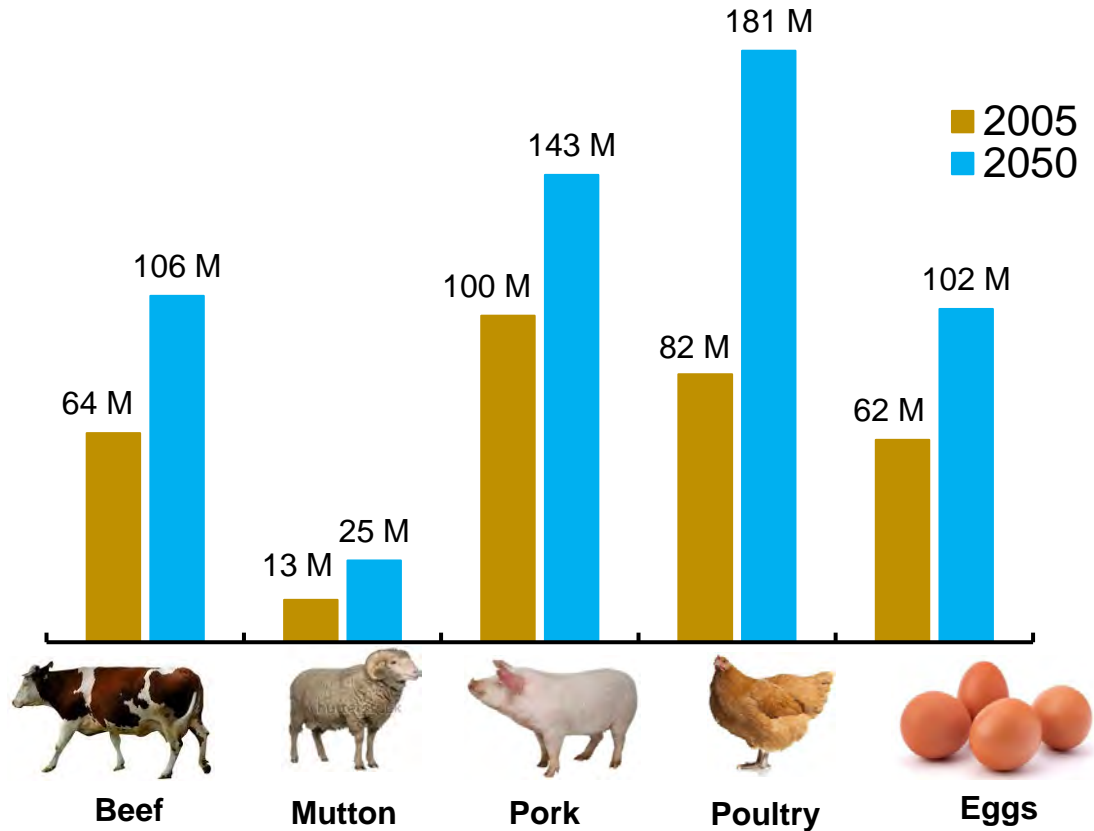
FERTILIZER MARKET SHARE, BY PRODUCT, 2021 (%)



Source: FAOSTAT 2023

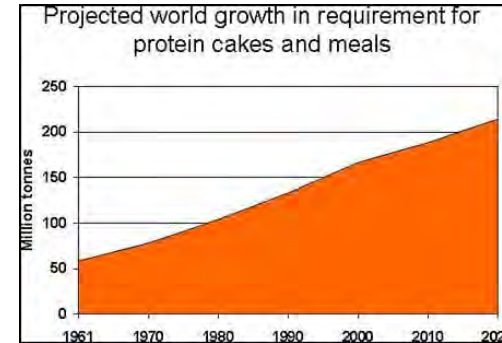
Challenges

3. Global demand for meat (tons) protein



Source: FAO, ESA Working Paper No. 12-03. Pg. 131.

4. Global demand for animal feed protein

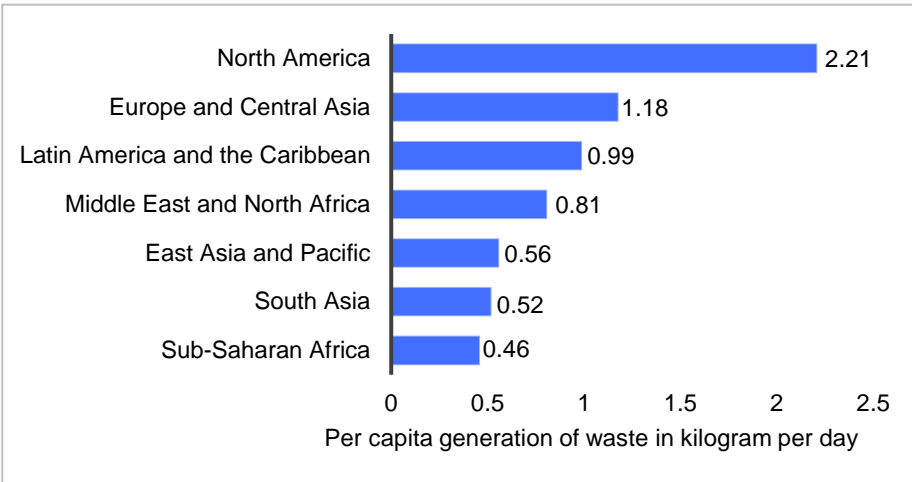


@ 15% addition of Protein, the global demand for protein additives is expected to be 220 million tonnes (FAO, 2000)



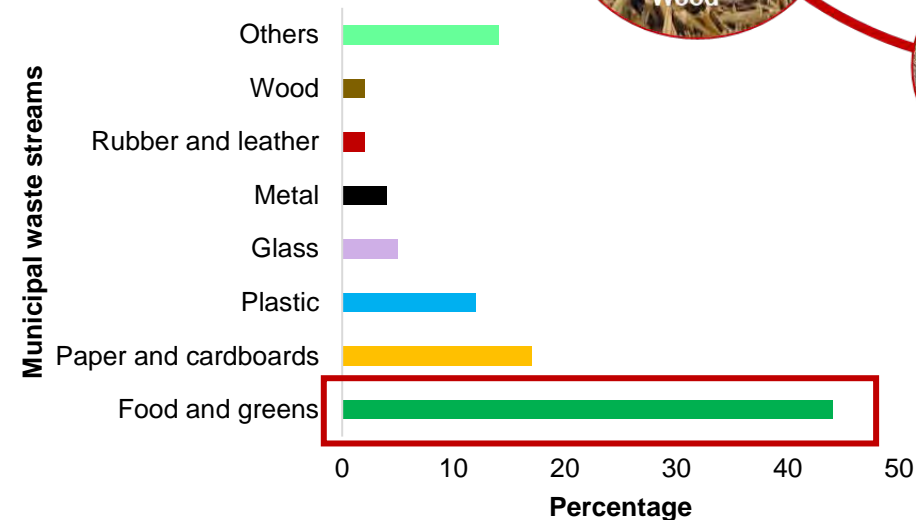
Challenge/Opportunity!

5. Municipal Solid Waste



Average per capita generation of municipal solid waste worldwide in 2016, by region (in kilograms/capita/day)

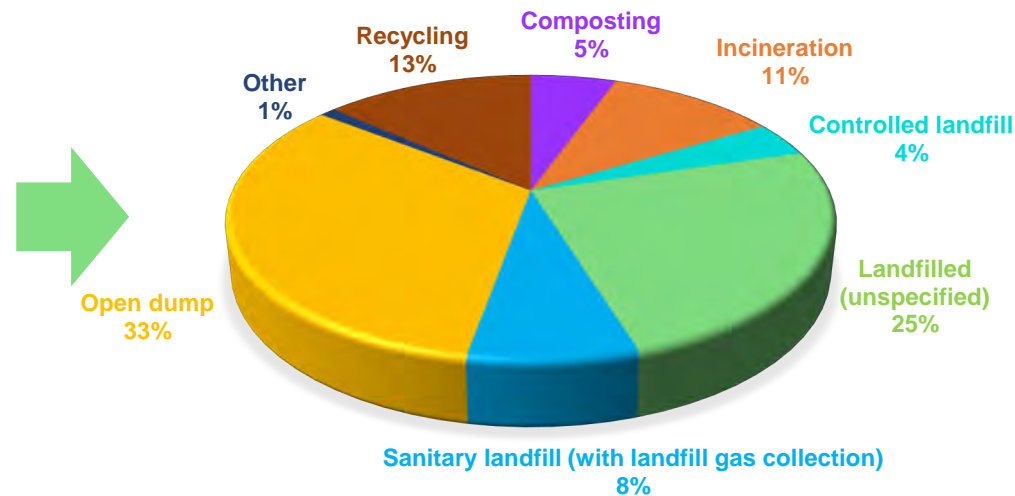
Waste types



Managing the waste in a sustainable way



GLOBAL WASTE TREATMENT AND DISPOSAL



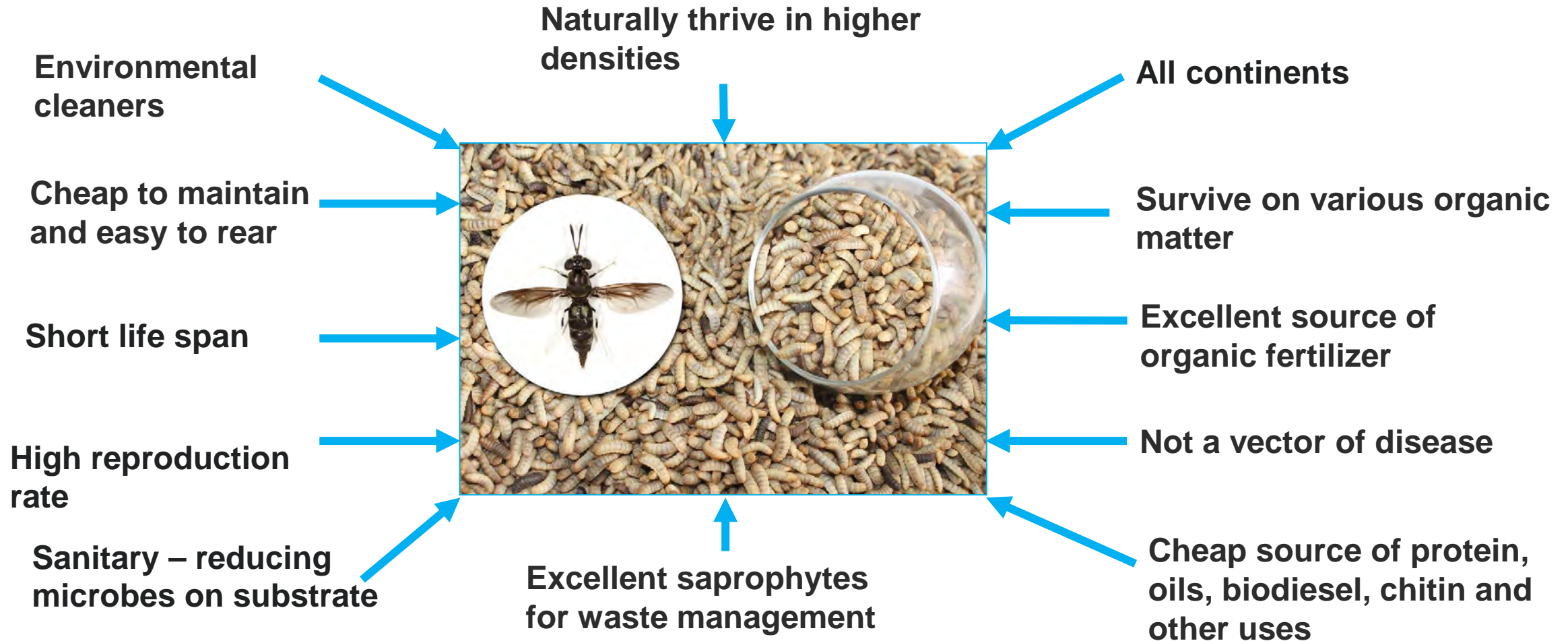
Open dump
33%

Disposal that is environmentally sustainable

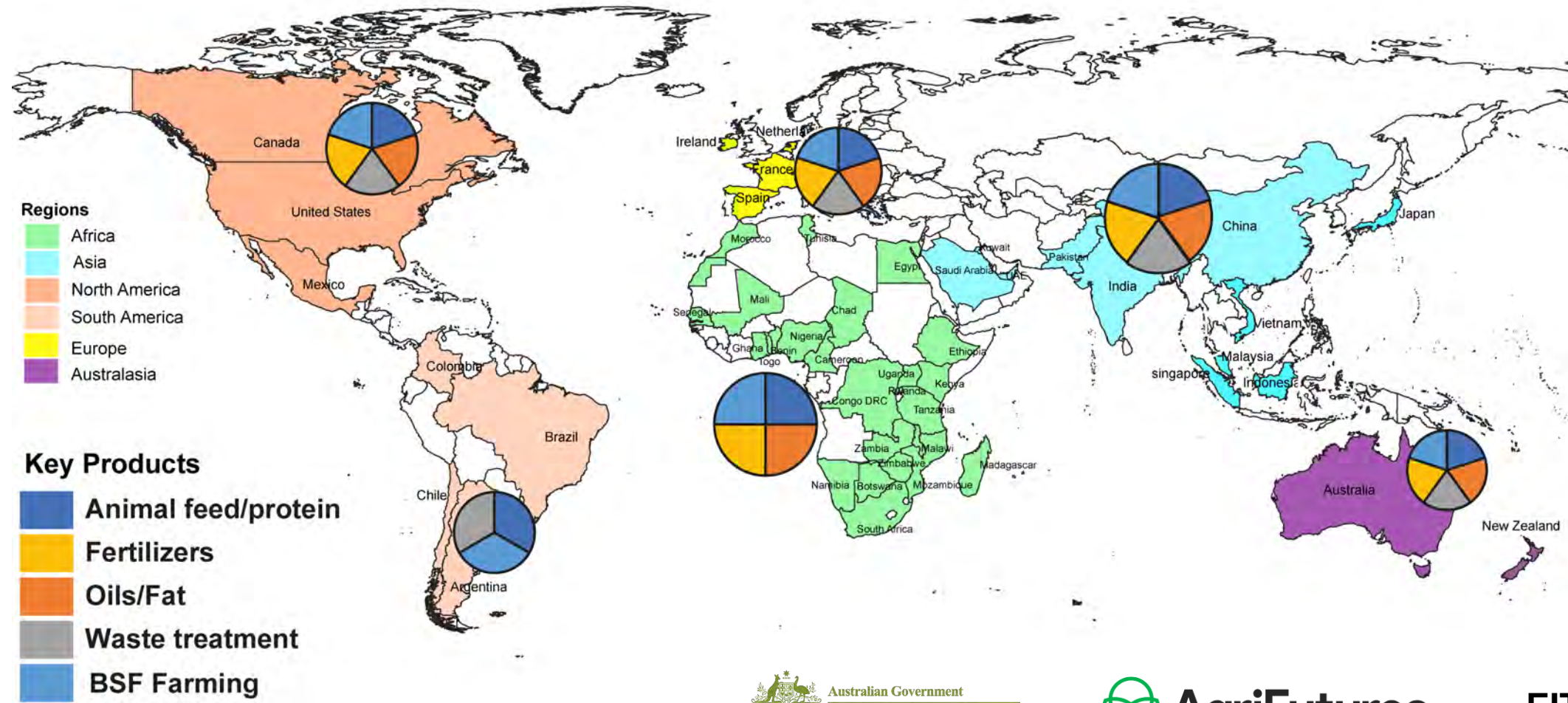
Look for alternative ways for waste management without BIG impact to the environment

- ❖ Bulky and landfills
- ❖ Increase in greenhouse gas emission
- ❖ Impact on climate change
- ❖ Human health hazards and risks

Black soldier fly (*Hermetia illucens*)



Current global distribution of black soldier fly



Global black soldier fly utilization
www.icipe.org



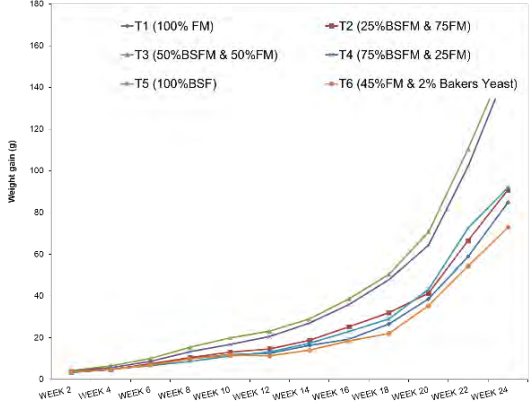
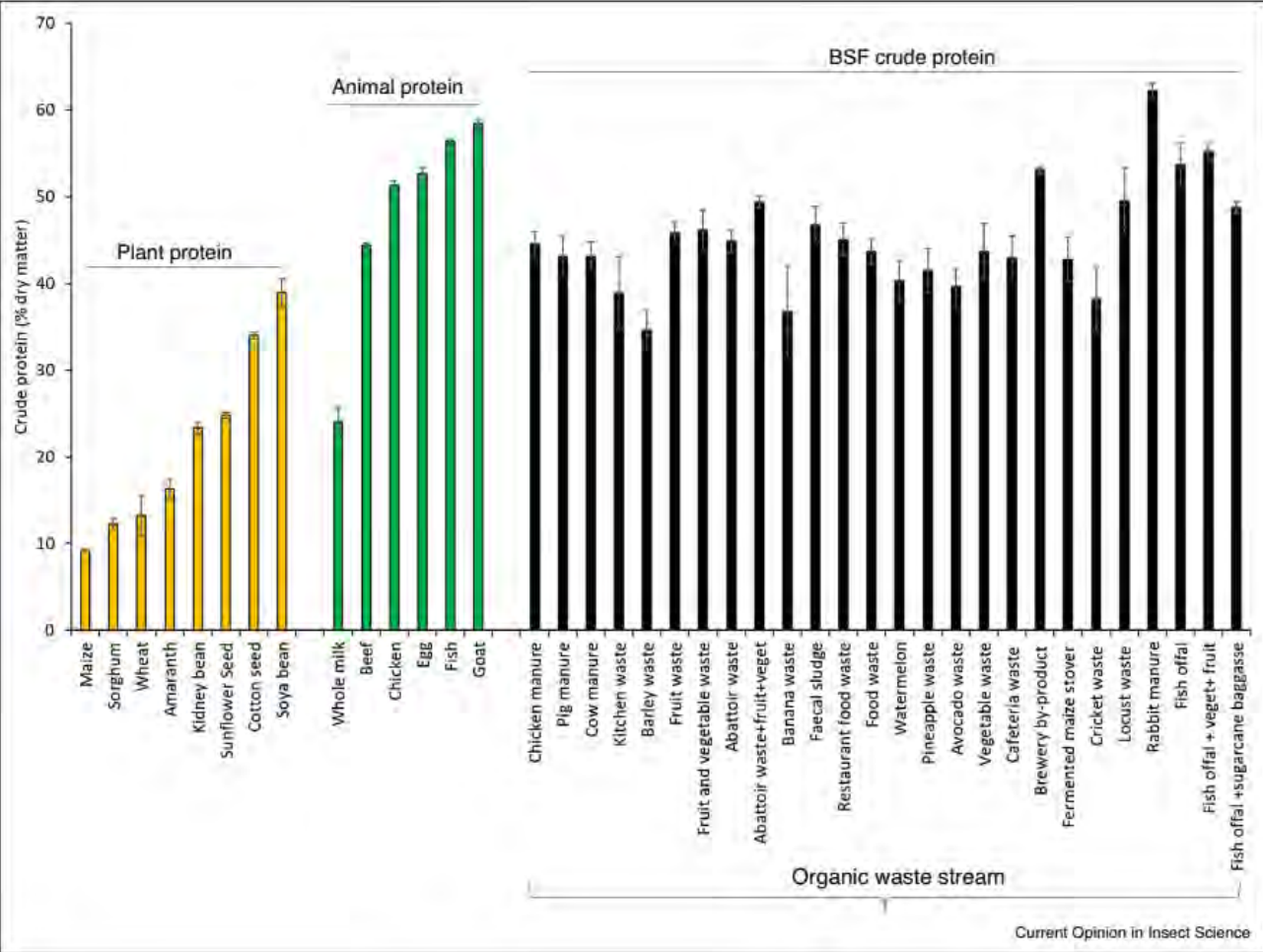
EIT-Hub



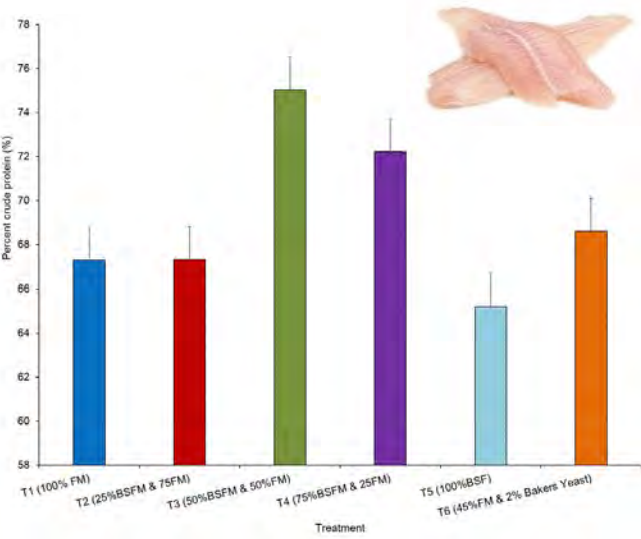
Crude Protein – Application in Aquaculture



Improved Tilapia growth rate by 23% and catfish by 37%

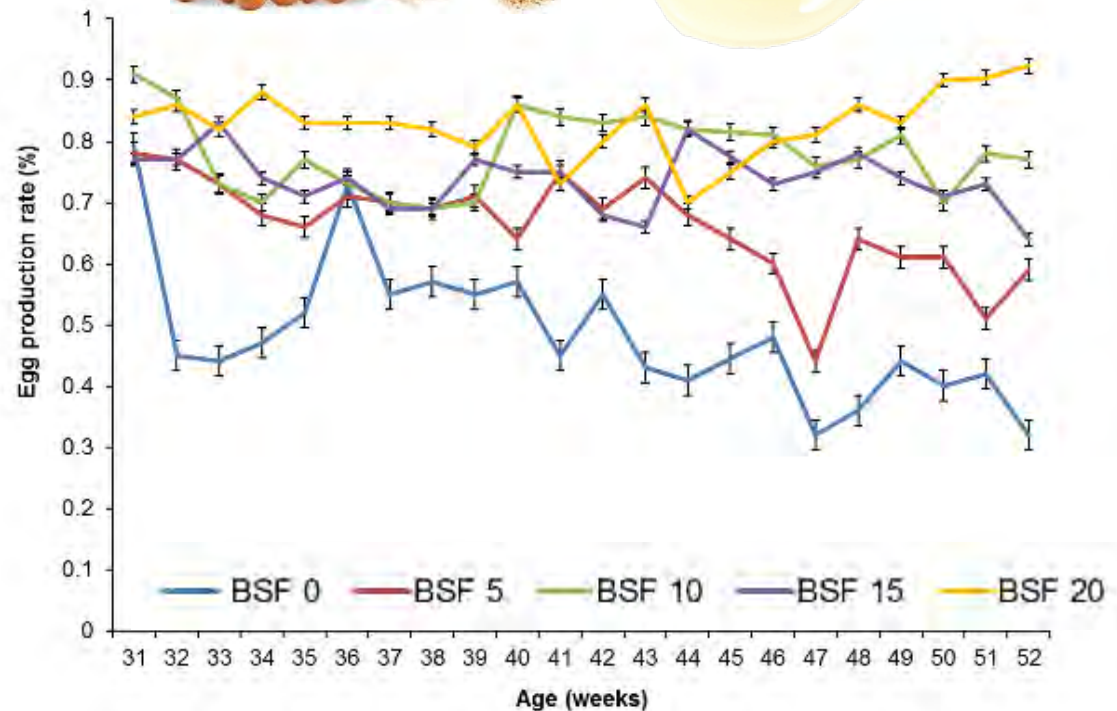
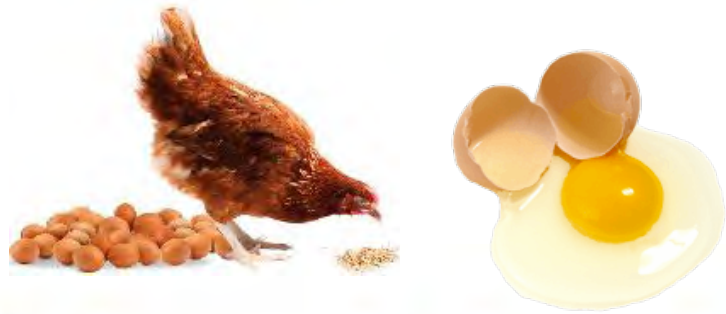


7-10% increased Crude Protein in fish carcass



❖ Protein crude content % comparable to animal protein

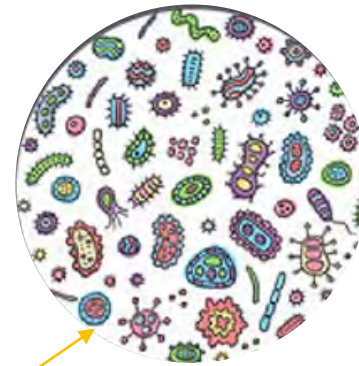
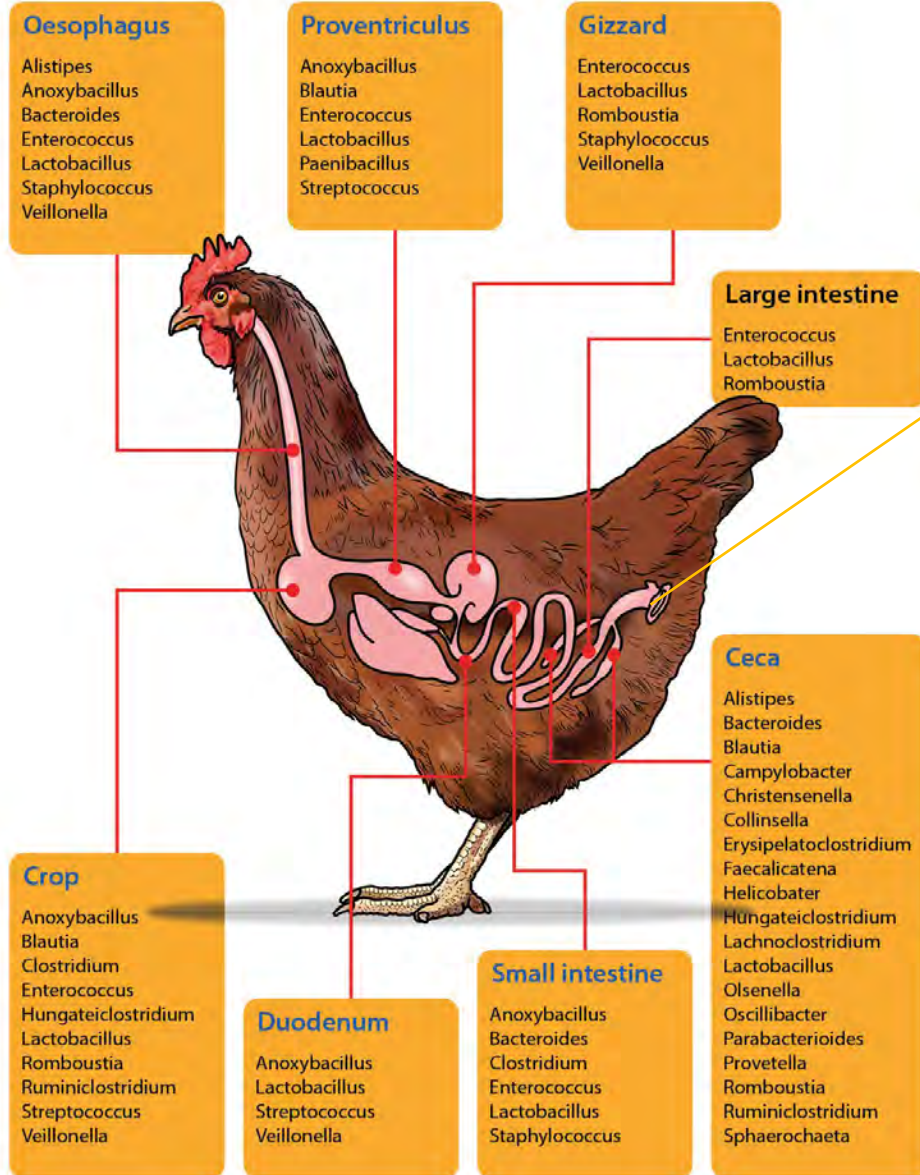
Application in Poultry farming



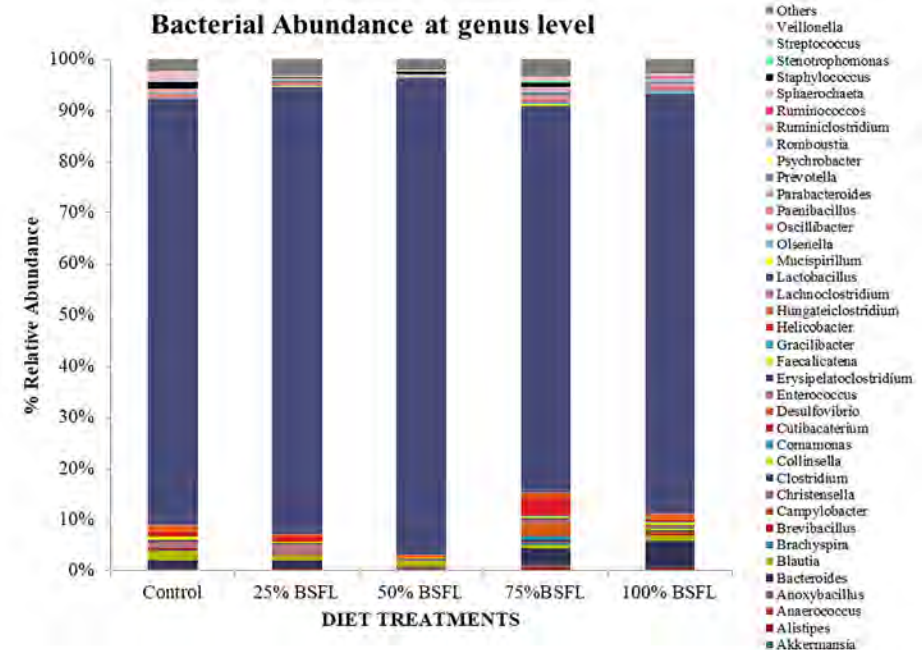
- ❖ 62% increase in egg production and crude protein content

- ❖ Broiler chicken get ready to market size 1 - 2 weeks earlier.
- ❖ **25% broiler weight gain when fed IBF**
- ❖ More intense flavour, tenderness, taste and >90% acceptability.
- ❖ High return on investment (25%) and cost-benefit ratio (16%).

IBF Improves Chicken Gut Health



Healthy Bacteria such as *Lactobacillus*, *Bacteroides* and *Enterococcus*)



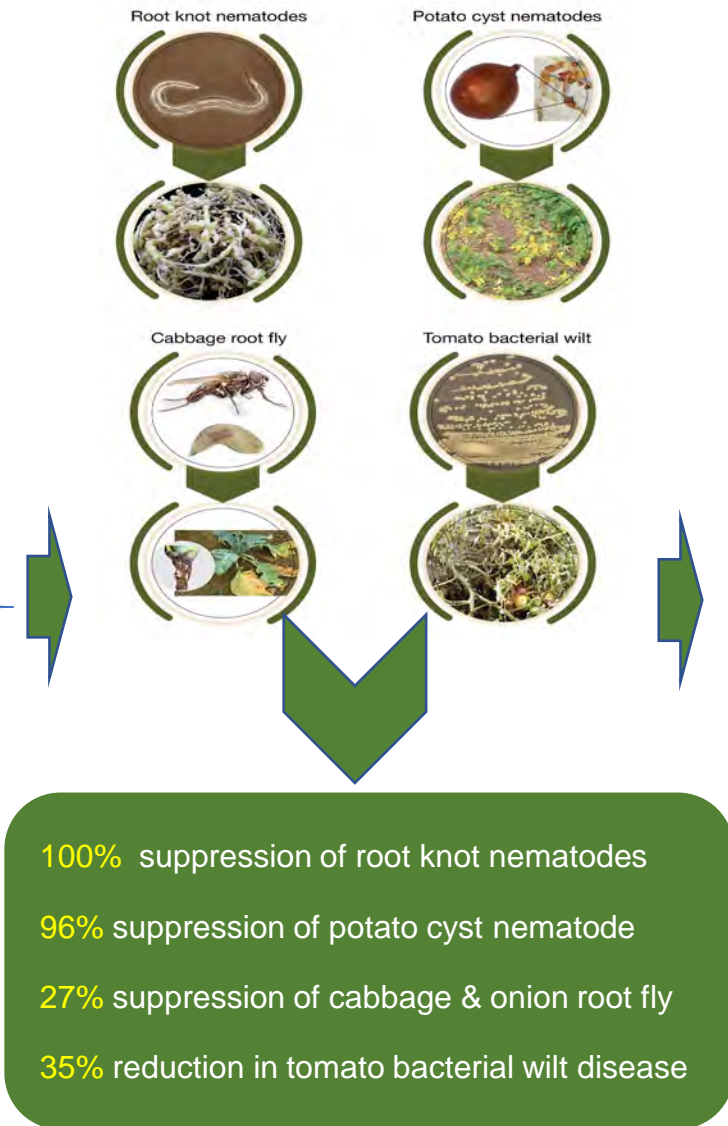
Decrease pathogens of the gut

Maintain normal intestinal microbiota

Stimulate the immune response and antioxidant indexes

Increase digestive enzymes activities

Chitin and Insect Frass Fertilizer



Tomato

- **IFF** increased yield by 63 – 71% than commercial organic fertilizer.
- **IFF + NPK** resulted in 22 – 135% higher yields than NPK alone.



French bean

- **IFF** increased yield by 52 – 65% than commercial organic fertilizer
- **Crop with IFF + NPK** produced 20 – 27% higher yields than NPK alone



Kale

- **IFF** fertilized crop produced significantly higher yield than commercial organic fertilizer
- **IFF + NPK** increased yield by 38 – 50% than NPK alone



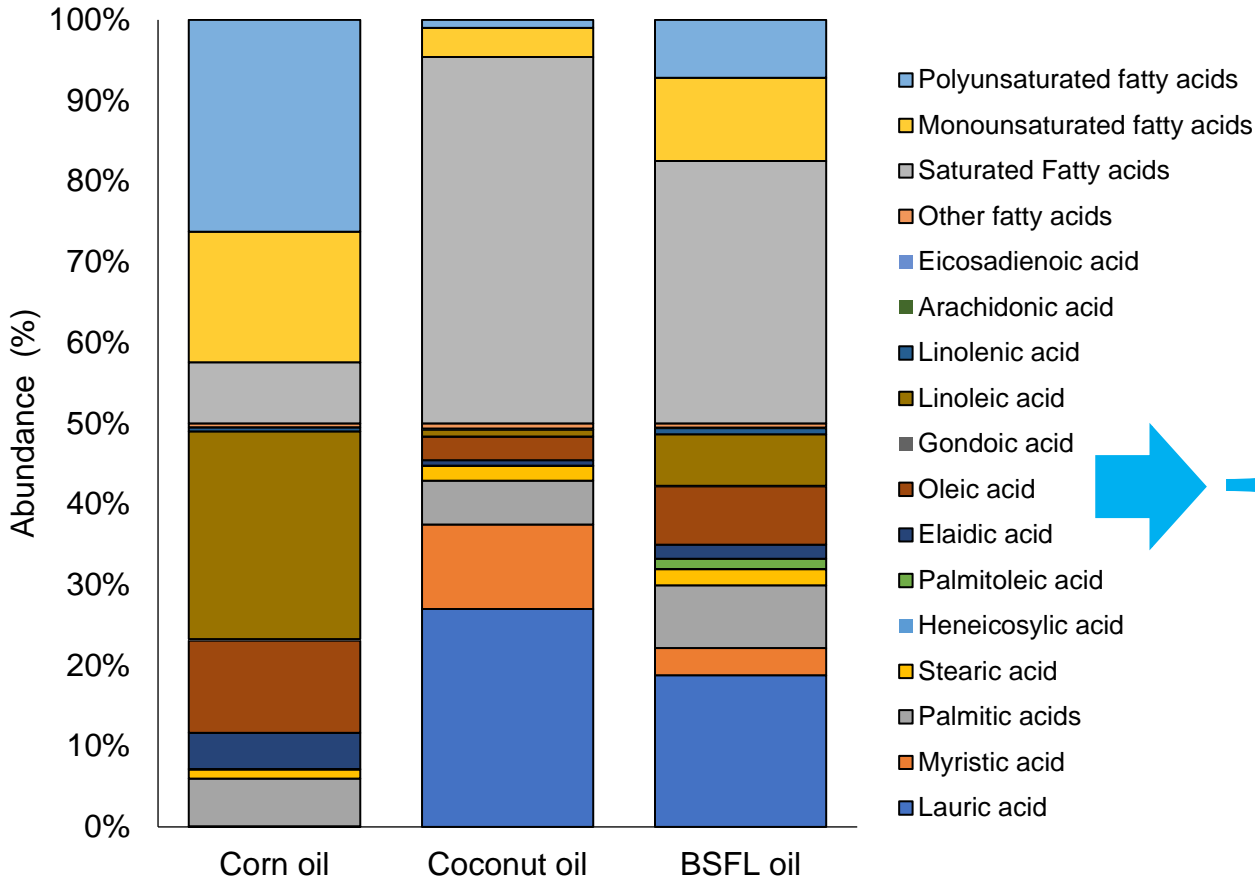
Maize

- **IFF** caused 27% and 7% increase in grain yields than commercial organic fertilizer and urea fertilizers, respectively.



Beesigamukama et al. (2021): Waste Management; Beesigamukama et al. (2020): Frontiers in Plant Sciences; Beesigamukama et al. (2022): PLoS ONE; Beesigamukama et al. (2020): Agronomy

Excellent Source of Oil and Application



Soap



Mosquito repellent



Feedstock for biodiesel



Glycerin products



Bakery products



Omega-3 fatty acid supplements

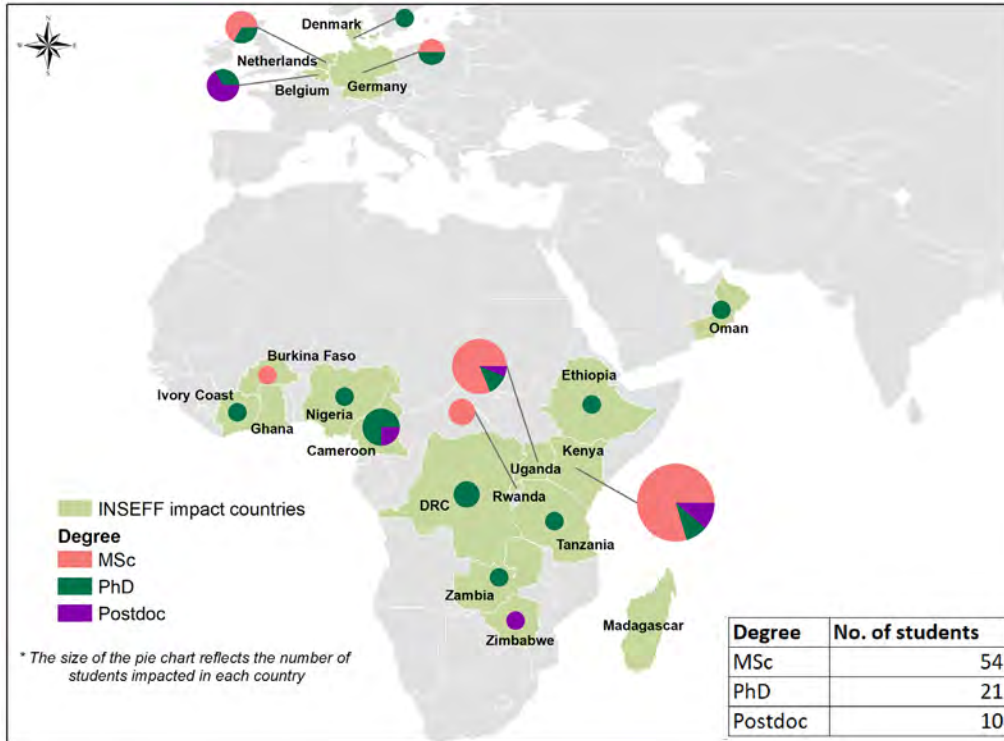


Feed products

Source data: Kim et al 2020: *Poultry Science*, (99)3133–3143.

www.icipe.org Cheseto et al. (2020): *Foods*, 9(6), 800.

Capacity Building



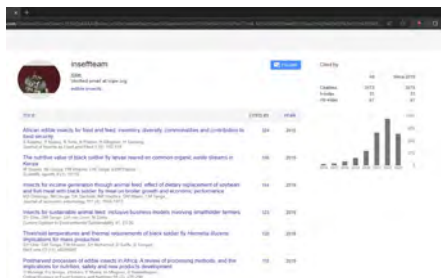
Training at postgraduate level



Training of Trainers



INSEFF mentioned in 494 articles produced in 15 major languages across 40 countries in 4 continents. The estimated reach is over 3-5 billion people.



www.icipe.org



Training materials



Providing starter kits to farmers

Scaling, Networks, Partnerships & Media engagements



Demonstration of commercial BSF farming at ICIPE

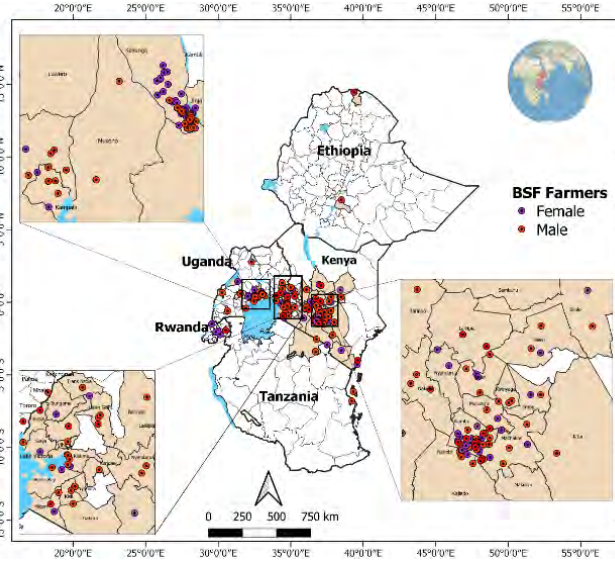


Emerging entrepreneurs in BSF farming in Kenya



Large Scale: ~ 1,320 – 3,600 MT/yr

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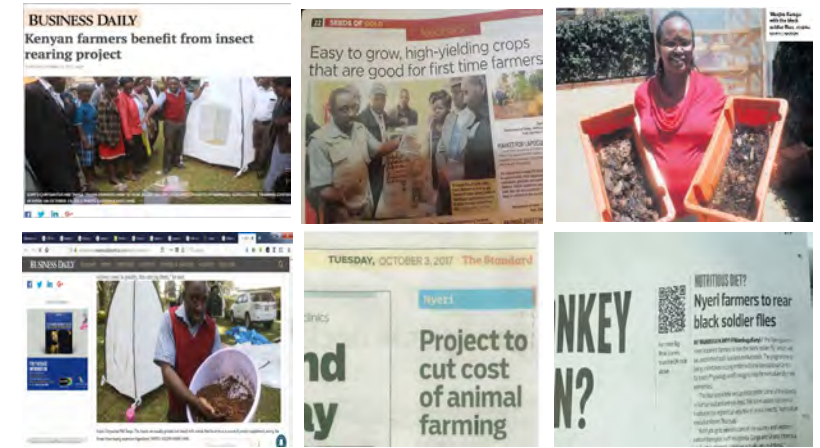
57,000 people trained, over 1000+ new SMEs in insect farming in East Africa region



> 200 partners in 61 countries across 5 continents



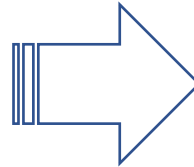
 ecodudu 600 MT per yr	 BOBO ECO FARM Innovate Commercialize ~26 MT per yr	 INSECT PRO ~1,320 MT per yr	 THE BUG PICTURE ~90 MT per yr
 BioBuu ~120 MT per yr	 Protein ~10 MT per yr	 PROTEEN ~250 MT per yr	 ENVIBUZZ CONSULE LTD ~42 MT per yr
 SANERGY ~3,600 MT per year			



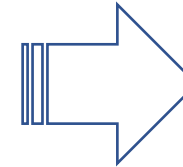
Extensive Media Coverage



Policies, Standards & Certifications



UGANDA NATIONAL BUREAU OF STANDARDS



African Organisation for Standardisation

International Conference on Legislation and Policy on the Use of Insect as Food and Feed in East Africa



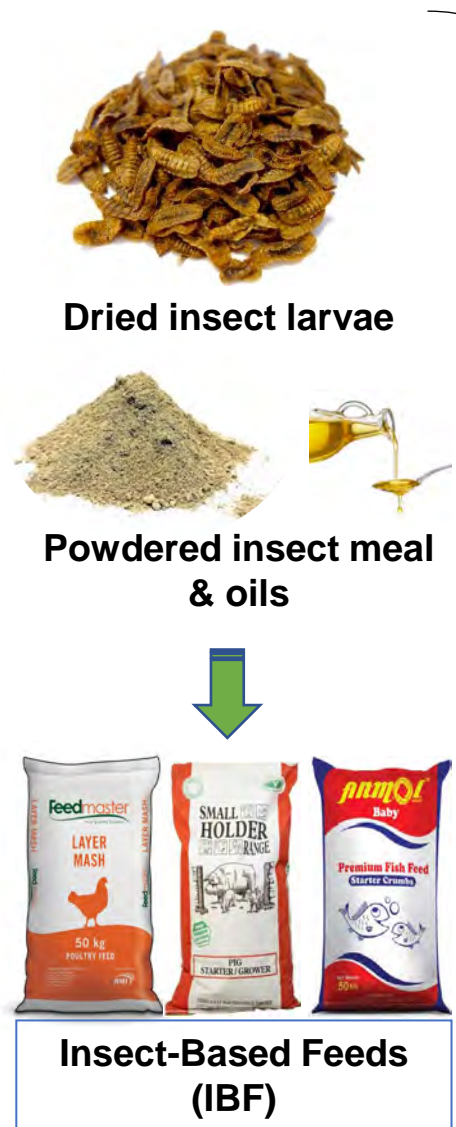
March 2 – 3, 2016
The Vic Hotel, Kisumu, Kenya



www.icipe.org



Socioeconomic and Environmental Impact of IBF in Kenya



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Willingness to adopt and use insect-based product



93% F and 90% M

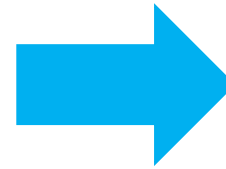


85%

90%

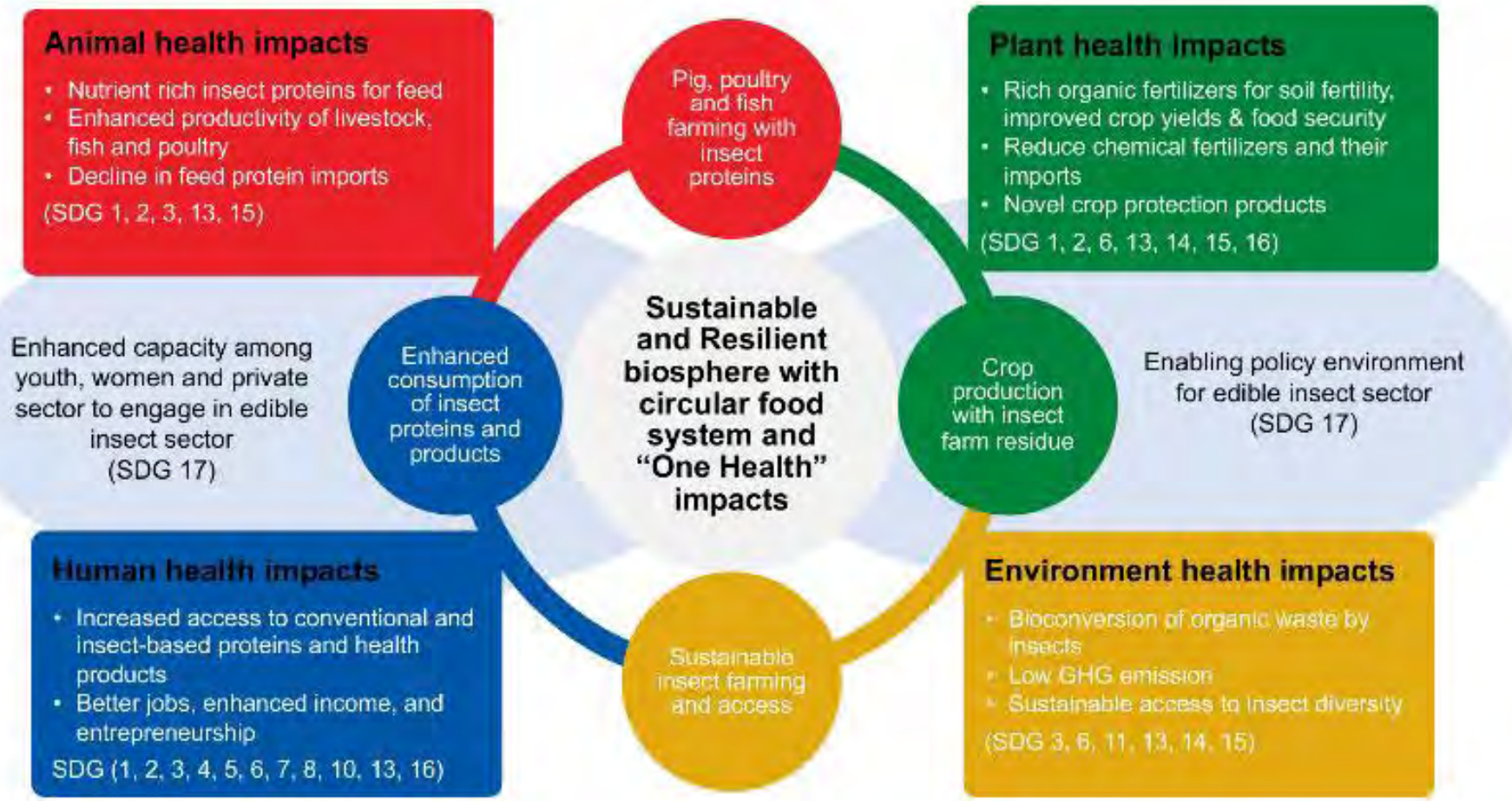


80%

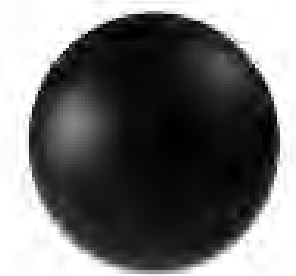


Chia et al. (2020): PLoS ONE; Sebatta et al. (2018): Int. J. Agril. Res. Innov. Tech

icipe-Insects for One Health



THE
CURT BERGFORS
**FOOD
PLANET
PRIZE**



**WINNER
2020**

Insects for food and feed team, *icipe*











Senior management team



Dr. Segenet Kelemu Dr. Sunday Ekesi Dr. Subramanian Prof. Baldwin Torto



Dr. Chrysantus Tanga (Cameroon), Senior Scientist and Head, Insects for Ecological Entomologist
(*Insect rearing, formulation, feed performance*)

Insect ecology, food and insect-frass fertilizer		Chemical ecology and Nutrition		Socioeconomics and impacts		Microbes, Microbiomes and Biosafety		Technology transfer and Gender integration	
	Dr. James Egonyu (Uganda) Insect bioecology (<i>Insect rearing and behavior research</i>)		Dr. Xavier Cheseto (Kenya) Organic chemist (<i>Processing and organic chemistry</i>)		Dr. Menale Kassie (Ethiopia) Social Scientist (<i>Market and socio-economic impacts</i>)		Dr. Fathiya Khamis (Kenya) Molecular Biologist (<i>Microbial safety of insect-protein products</i>)		Dr. Saliou Niassy (Senegal) Technology Transfer (<i>Technology-transfer and outreach</i>)
	Dr. Bessigamukama (Uganda) Soil Scientist (<i>Insect Frass fertilizer development</i>)		Dr. Cynthia Mudalungu (Kenya) Natural product chemist (<i>Antimicrobial peptides</i>)		Dr. Zewdu Abro (Ethiopia) Socio economist (<i>Impact assessment</i>)		Dr Komivi Akutse (Togo) Entomopathologist (<i>Insect microbes</i>)		Dr. Holger Kirscht (Germany) Social science (<i>Gender analysis and impacts</i>)

Insect farming promotion in Ethiopia



Dr. Tadele Tefera (Ethiopia)
Entomologist and Head, *icipe* – Ethiopia
(*BSF optimization and scaling in Ethiopia*)

Acknowledgement



Acknowledgement

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Thank you



International Centre of Insect Physiology and Ecology

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