Development and promotion of sustainable crop and animal production for smallholders in Africa

Subramanian Sevgan

On behalf of the Environmental Health theme team, *icipe*

General facts - *icipe*

- A *Center of Excellence* in Africa- for research and capacity building for insect science
- An *intergovernmental organization* - Charter signed by 13 countries worldwide
- >530 staff (>40 nationalities)
- 150-180 graduate students annually
- Collaborate with > 300 partners worldwide

100% Solar

Organization with a *unique* history: > 50 years

T.R. Odhiambo

H.R. Herren

C. Borgemeister

S. Kelemu

African smallholder production systems

Major challenges to crop production in Africa

Climate-change impacts

Low adoption of technologies

96% of cultivation in Sub-Saharan Africa is rainfed

Land degradation and soils deficient in nitrogen

Striga

Stemborers

Asian Stemborer

MLN

Mycotoxins

Fall armyworm

Current approach to pest management

Intensity of Pesticide applications in specific crops

Country	Crop	Frequency per season	Reference
Tanzania	Onion	16 sprays	Ngowi et al. 2007
	Tomato	11-15 sprays	
	Cabbage	6 – 10 sprays	
Senegal	Vegetables	Weekly sprays	Cissé et al. 2008
Malawi	Tomato	19 sprays	Orr and Ritchie 2004
	Cabbage	14 sprays	
Madagascar	Watercress	6 – 18 sprays	Dabat et al. 2008
Kenya	French bean	11 sprays	Dudutech-Kenya

Source: DeBon et al., 2014

Sustainable Fall armyworm IPM strategy for Africa

EUROPEAN UNION

icipe

FAW-IPM Africa-specific, science-led, sustainable and integrated management of the fall armyworm

KALRO Kenya Agricultural & Livestock Research Organization

LZARDI Lake Zone Agricultural Research & Development Institute

RWANDA RAB AGRICULTURE BOARD

Ethiopian Institute of Agricultural Reasearch

NARO

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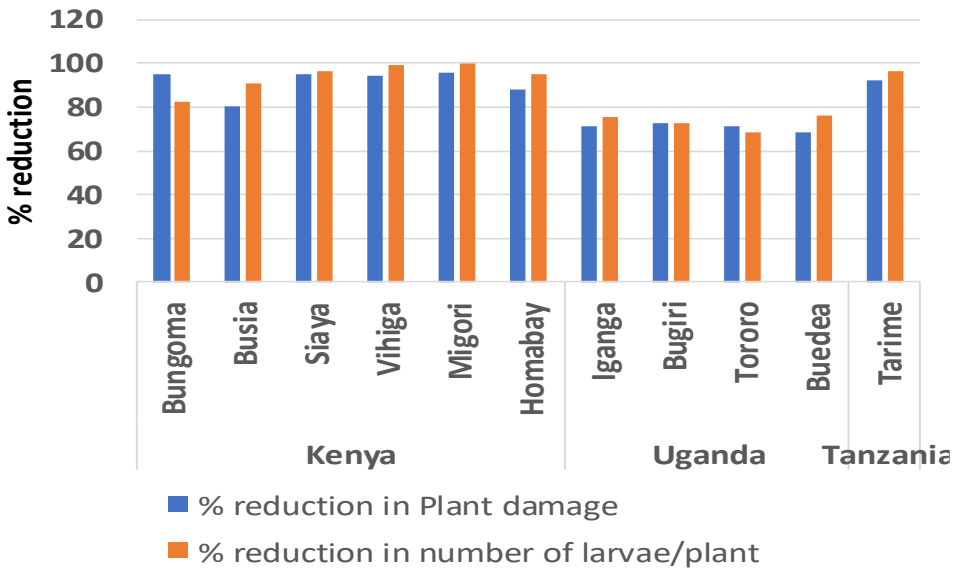
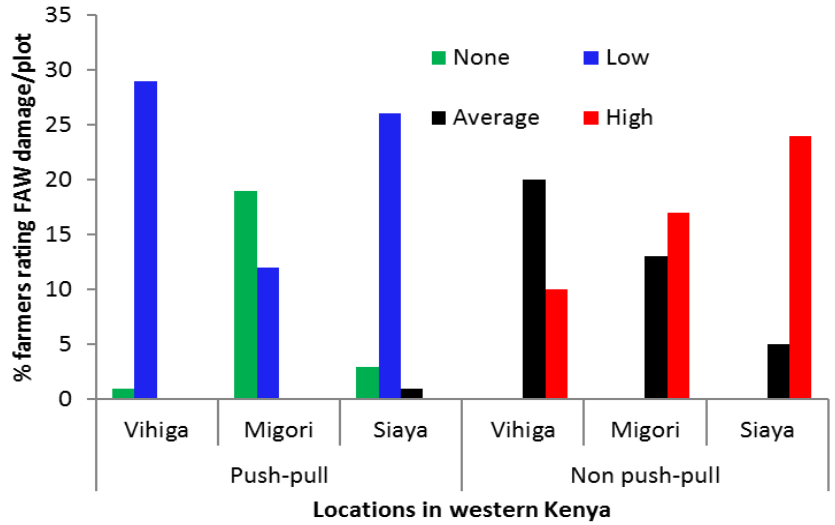
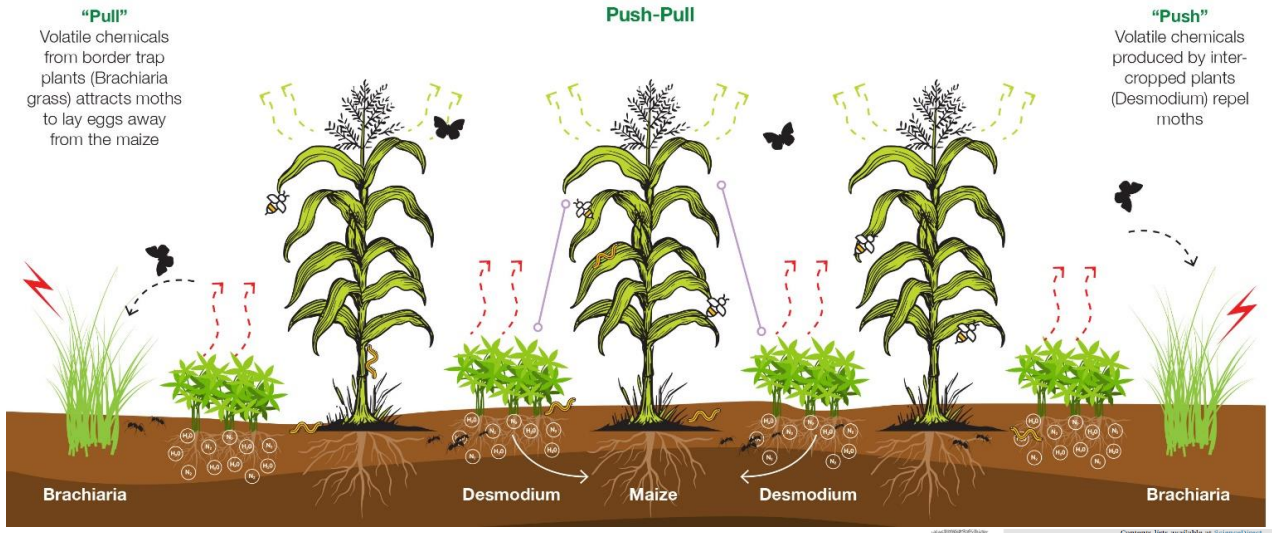
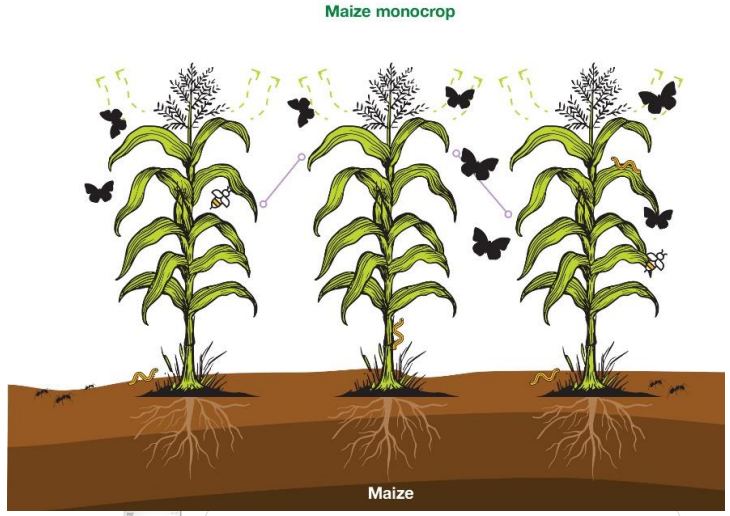
Push-pull controls FAW









Midega et al., 2018. Crop Protection 105, 10-15


Crop Protection

journal homepage: www.elsevier.com/locate/cropro

A climate-adapted push-pull system effectively controls fall armyworm, *Spodoptera frugiperda* (J E Smith), in maize in East Africa

Charles A.O. Midega, Jimmy O. Pittchar, John A. Pickett, Girma W. Hailu, Zeyaur R. Khan

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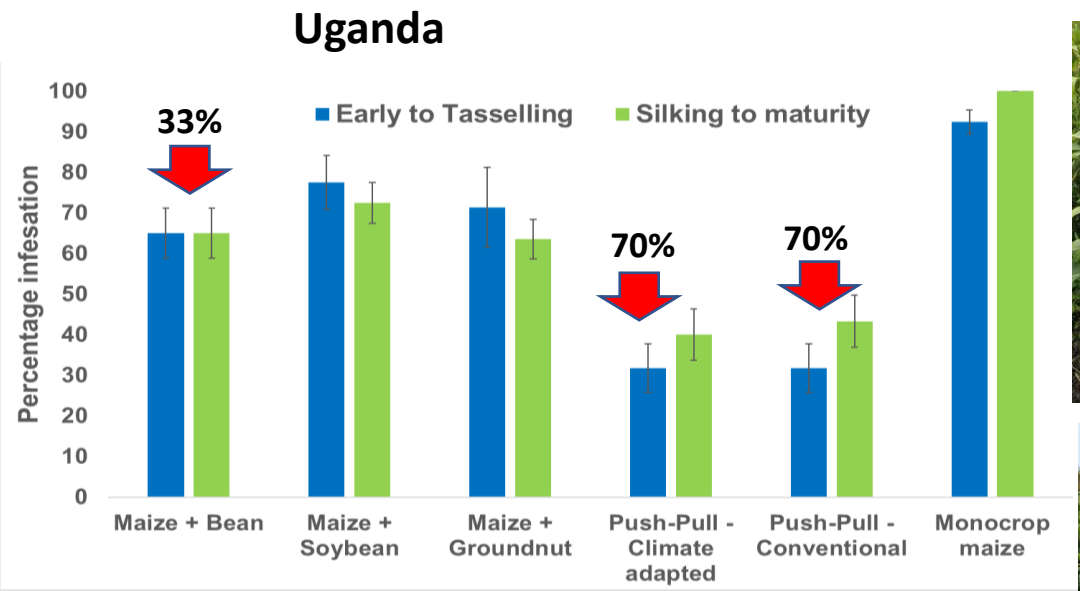
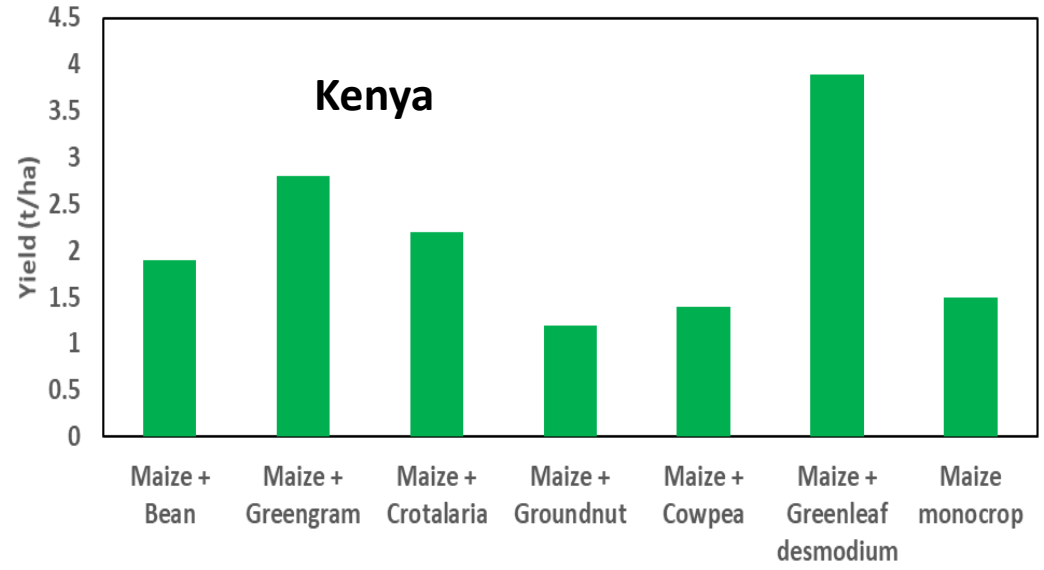
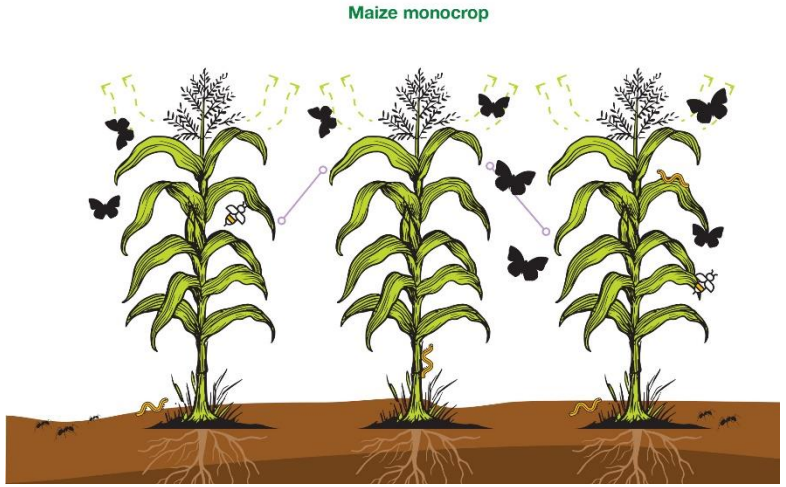
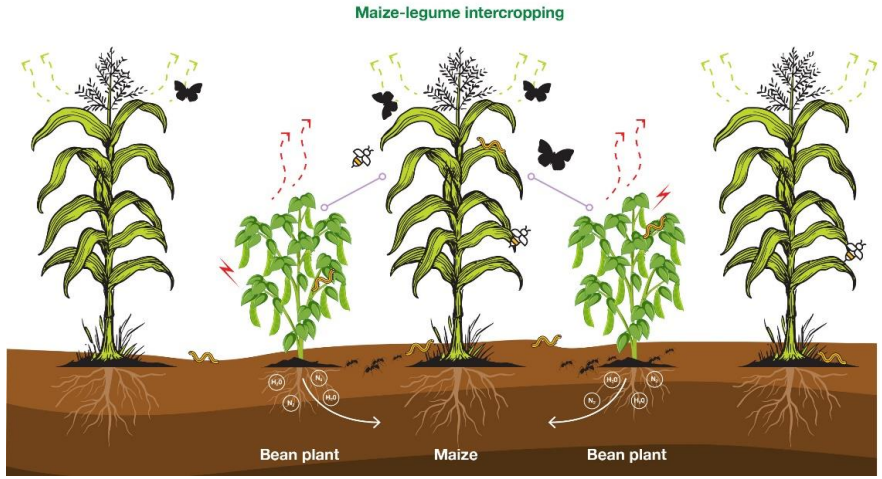
Impact of maize-legume intercropping on FAW









Published online September 27, 2018
PEST INTERACTIONS IN AGRONOMIC SYSTEMS

Maize–Legume Intercropping and Push–Pull for Management of Fall Armyworm, Stemborers, and Striga in Uganda

Girma Hailu,* Saliou Niassy, Khan R. Zeyaur, Nathan Ochatum, and Sevgan Subramanian

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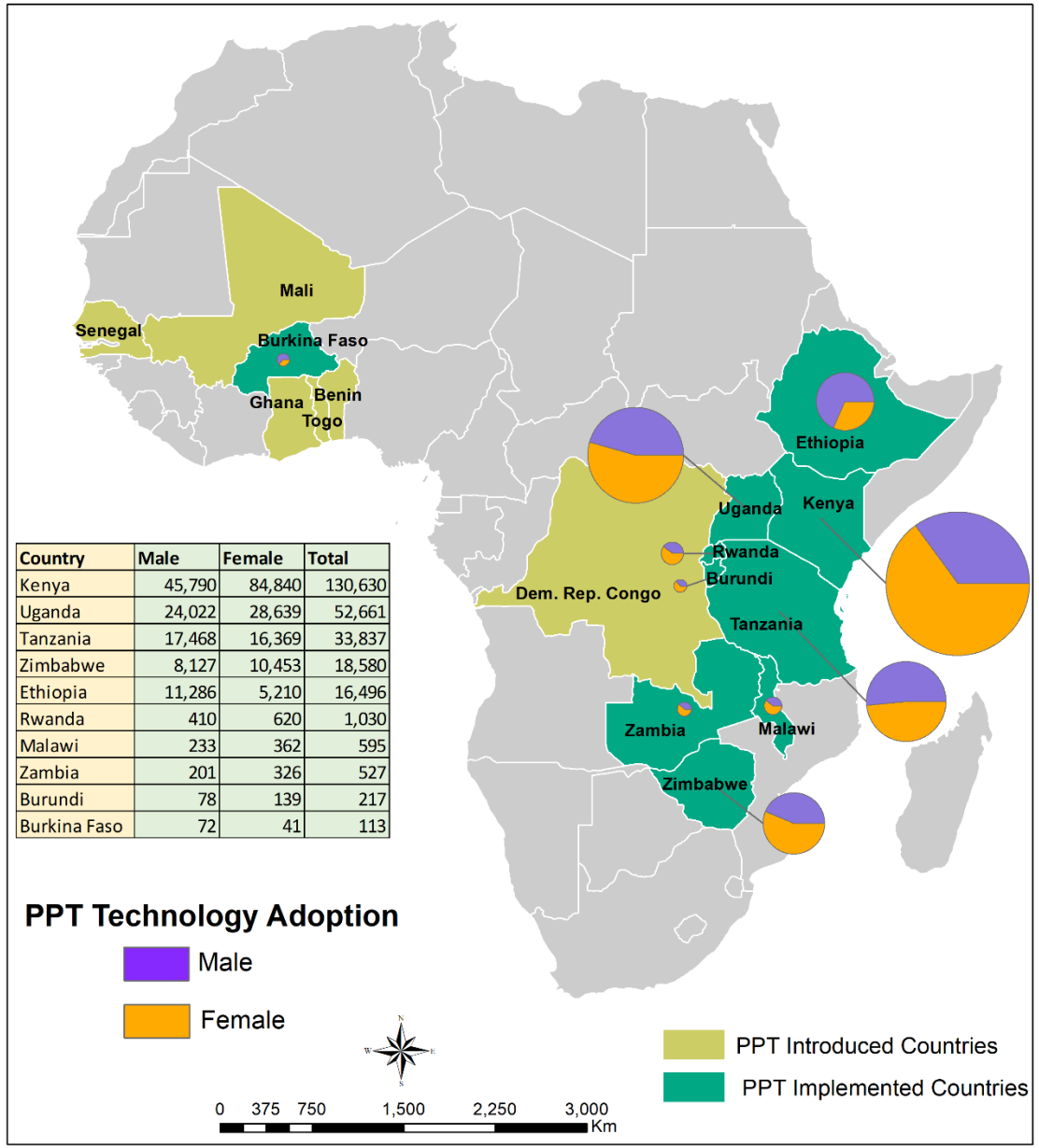
Scaling Push-Pull technology for Fall armyworm management



Country	Male	Female	Total
Kenya	45,790	84,840	130,630
Uganda	24,022	28,639	52,661
Tanzania	17,468	16,369	33,837
Zimbabwe	8,127	10,453	18,580
Ethiopia	11,286	5,210	16,496
Rwanda	410	620	1,030
Malawi	233	362	595
Zambia	201	326	527
Burundi	78	139	217
Burkina Faso	72	41	113

Scaling efforts

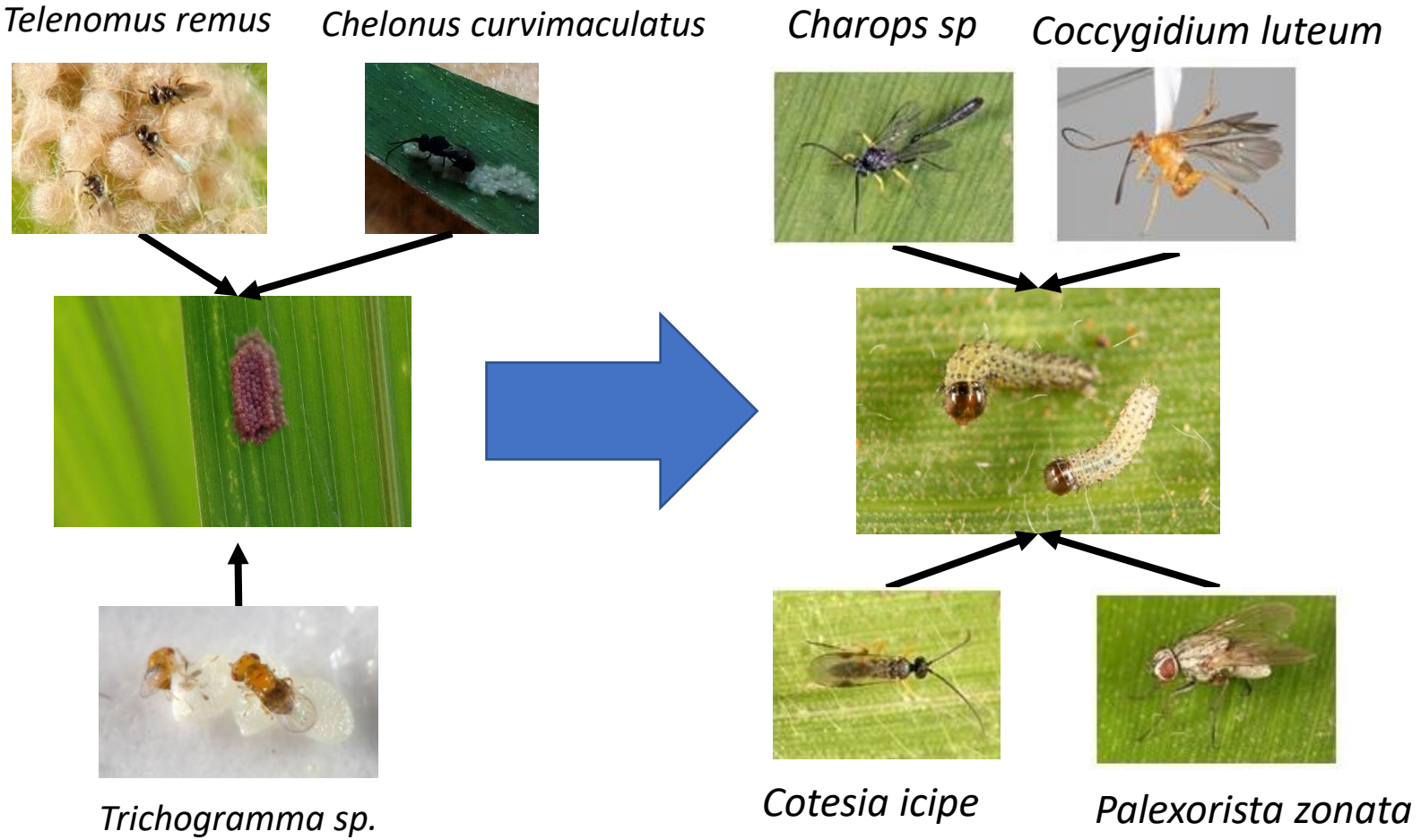
- Adoption: ~254,971 farmers
- Reach: 1,225,582 beneficiaries
- Partners: > 20
- Seed producers: <5
- Successful collaborations with NARS

Needs for further scaling

- Promotion of local production of companion crop seeds and distribution system
- Enhance awareness on the benefits of Push-Pull and intercropping
- Integration of Push-Pull and intercropping in national level agricultural development program and policy support

https://www.push-pull.net/

Potent natural enemies of FAW in Africa

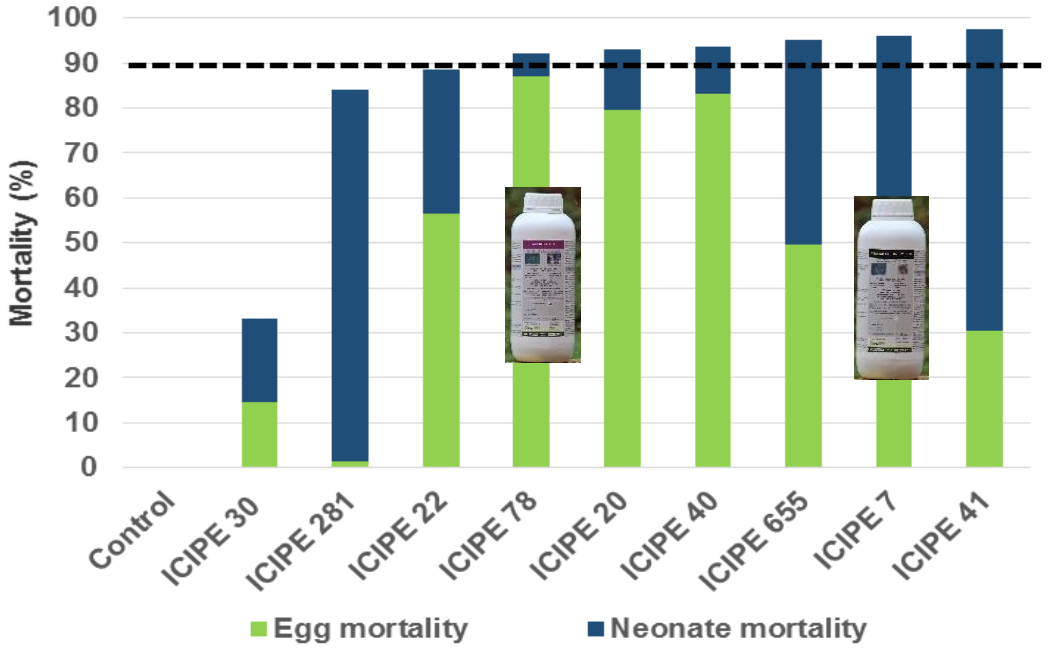


MDPI
insects
Article
Telenomus remus, a Candidate Parasitoid for the Biological Control of *Spodoptera frugiperda* in Africa, is already Present on the Continent
Marc Kenis [1,*], Hannalene du Plessis [2], Johnnie Van den Berg [2], Malick Niango Ba [3], Georg Goergen [4], Koffi Eric Kwadjo [5], Ibrahim Baoua [6], Tadele Tefera [7], Alan Buddie [8], Giovanni Cafà [8], Lisa Offord [8], Ivan Rwomushana [9] and Andrew Polaszek [10]

Up to 30% parasitism of eggs in the field

Up to 45% parasitism of larvae in the field

Efficacy of Entomopathogenic fungi against FAW



Trials undertaken in three counties in Kenya: Embu, Kakamega, Homabay

ORIGINAL CONTRIBUTION

WILEY JOURNAL OF APPLIED ENTOMOLOGY

Ovicidal effects of entomopathogenic fungal isolates on the invasive Fall armyworm *Spodoptera frugiperda* (Lepidoptera: Noctuidae)

Komivi Senyo Akutse | Jane Wanjiru Kimemia | Sunday Ekesi |
Fathiya Mbarak Khamis | Odhiambo Levi Ombura | Sevgan Subramanian

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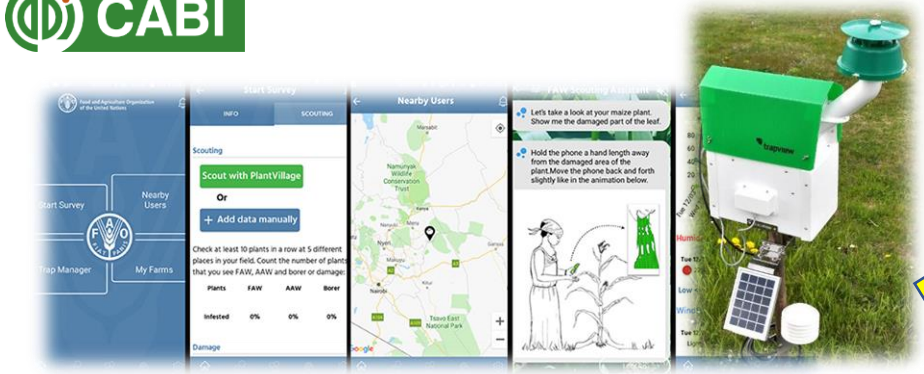
System-level integration and way forward

"Fawligen"

AgBiTech

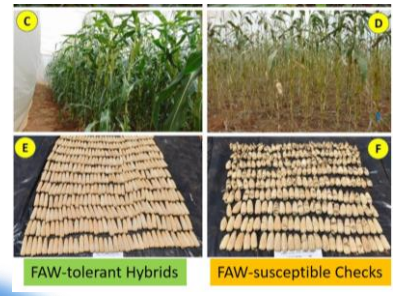
CABI

Safe biopesticides/judicious use of less toxic molecules



Robust surveillance and monitoring mechanism

Resistant cultivars/hybrids



CIMMYT
International Maize and Wheat Improvement Center

Building capacity and PPP partnerships for biological control

Creation of enabling policies at regional/continental level

www.icipe.org

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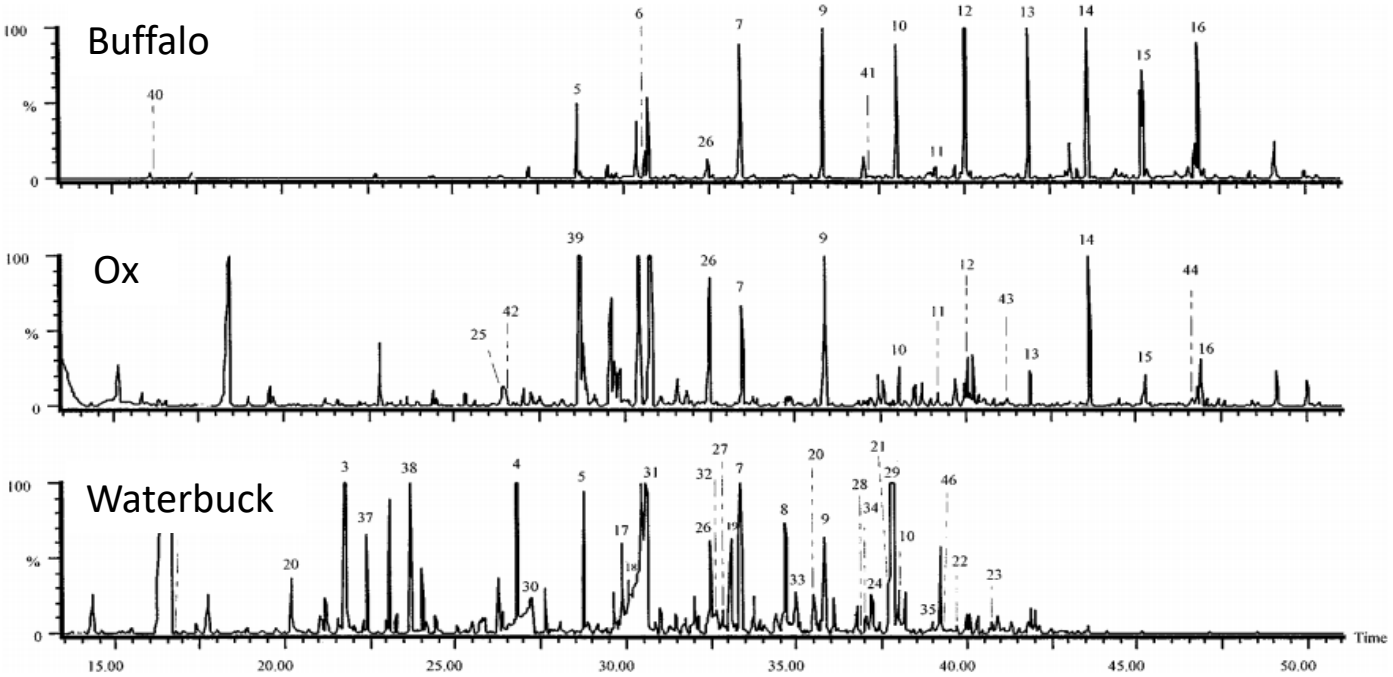
Key constraints to smallholder animals

TseTse fly

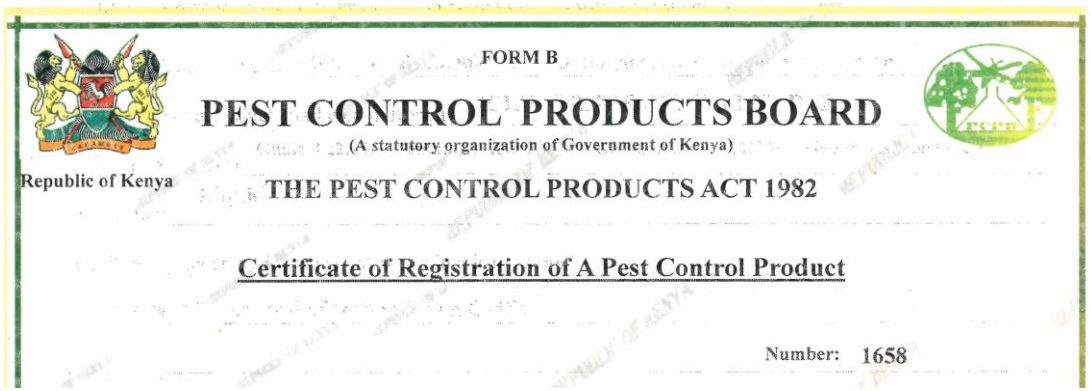
Biting fly

Ticks

The *icipe* tsetse repellent technology: in a snapshot



Tsetse repellent technology: from field to market



FORM B

PEST CONTROL PRODUCTS BOARD

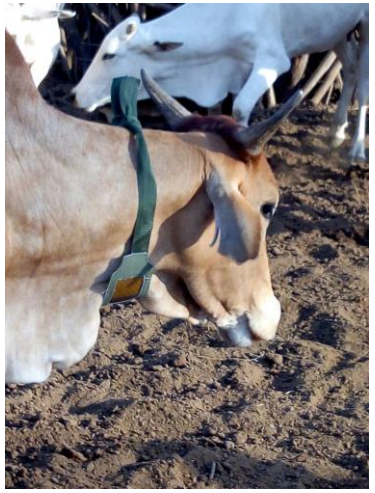
(A statutory organization of Government of Kenya)

Republic of Kenya

THE PEST CONTROL PRODUCTS ACT 1982

Certificate of Registration of A Pest Control Product

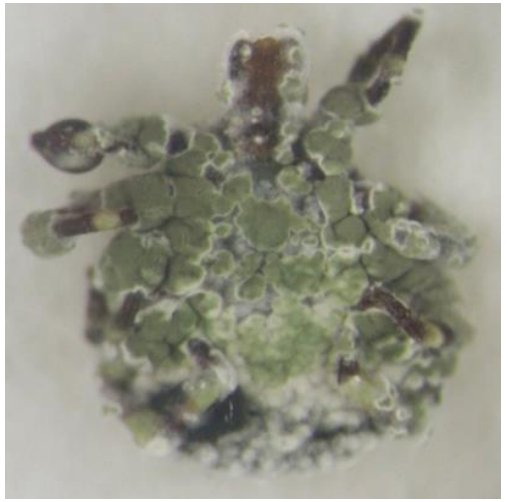
Number: 1658



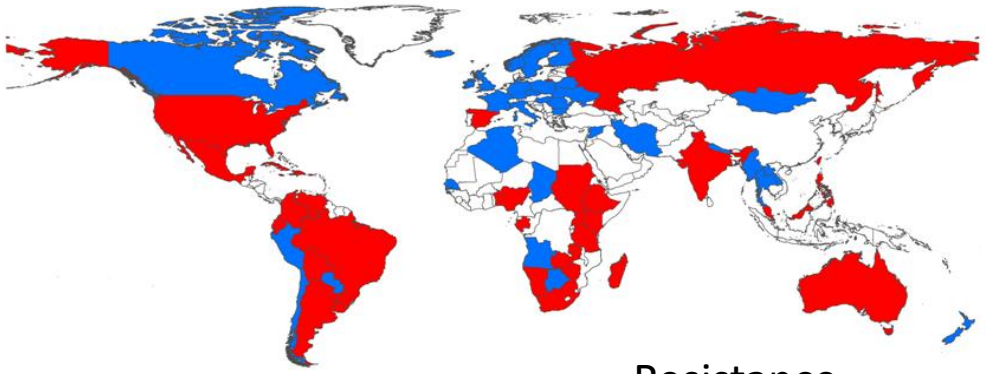
Ticks and tick borne disease

Tick borne diseases

- Anaplasmosis
- Babesiosis
- Ehrlichiosis
- Hepatozoonosis
- Lyme Borreliosis
- Rickettsiosis
- Tick-borne Encephalitis



Biopesticide kill ticks



Resistance

Proteins for Animals vs Humans

INSECTS AS VALUABLE SOURCE OF PROTEINS FOR FEED INDUSTRY

Dried insect larvae

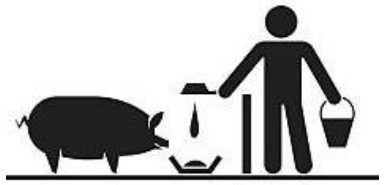
Powdered insect meal & oils

Insect-Based Feeds (IBF)

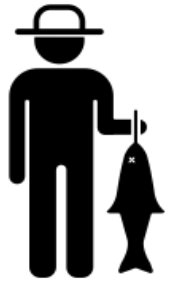
www.icipe.org

Willingness to adopt and use insect-based product

93% F and 90% M



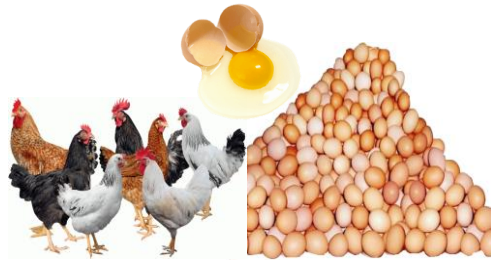
85%



90%

80%

- 25% broiler weight gain when fed IBF
- 62% egg production when fed IBF



- Pig mature 1.2 -2 months earlier & 15% heavier

- Tilapia and catfish 23% and 37% growth rate

Insect Composted Organic Fertilizer Enhances Growth and Yield of Key Crops

Organic waste

Insect larva & adult

Insect frass fertilizer (**IFF**)

Packaged IFF

www.icipe.org

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. (202): PLoS ONE; Beesigamukama et al. (2020): Agronomy

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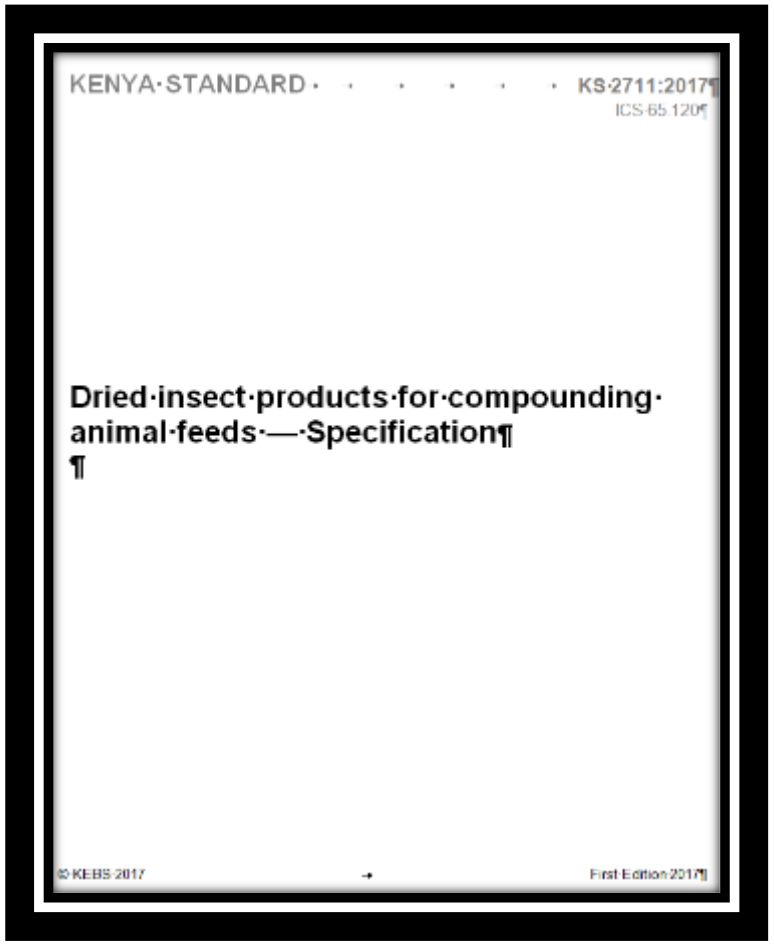
Policy Engagement, Standard Development & Certifications

www.icipe.org



KENYA·STANDARD · · · · · · KS·2711:2017¶
ICS·65.120¶

Dried·insect·products·for·compounding·animal·feeds·—·Specification¶
¶

© KEBS 2017 → First Edition 2017¶

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Socioeconomic and Environmental Impact of IBF in Kenya

$1-10 M forex exchange Saving on import/year

Improve Kenya economy by **$69-687 M** /year

Recycle **2-18 M** tonnes/year of waste to **frass fertilizer**

25000 – 252,000 new Jobs/year

Available **fish and maize** to feed **0.47 – 4.8 M** people/year

0.32-3.19 M people out of poverty/year

Zewdu et al. (2020): *Journal of Cleaner Production*

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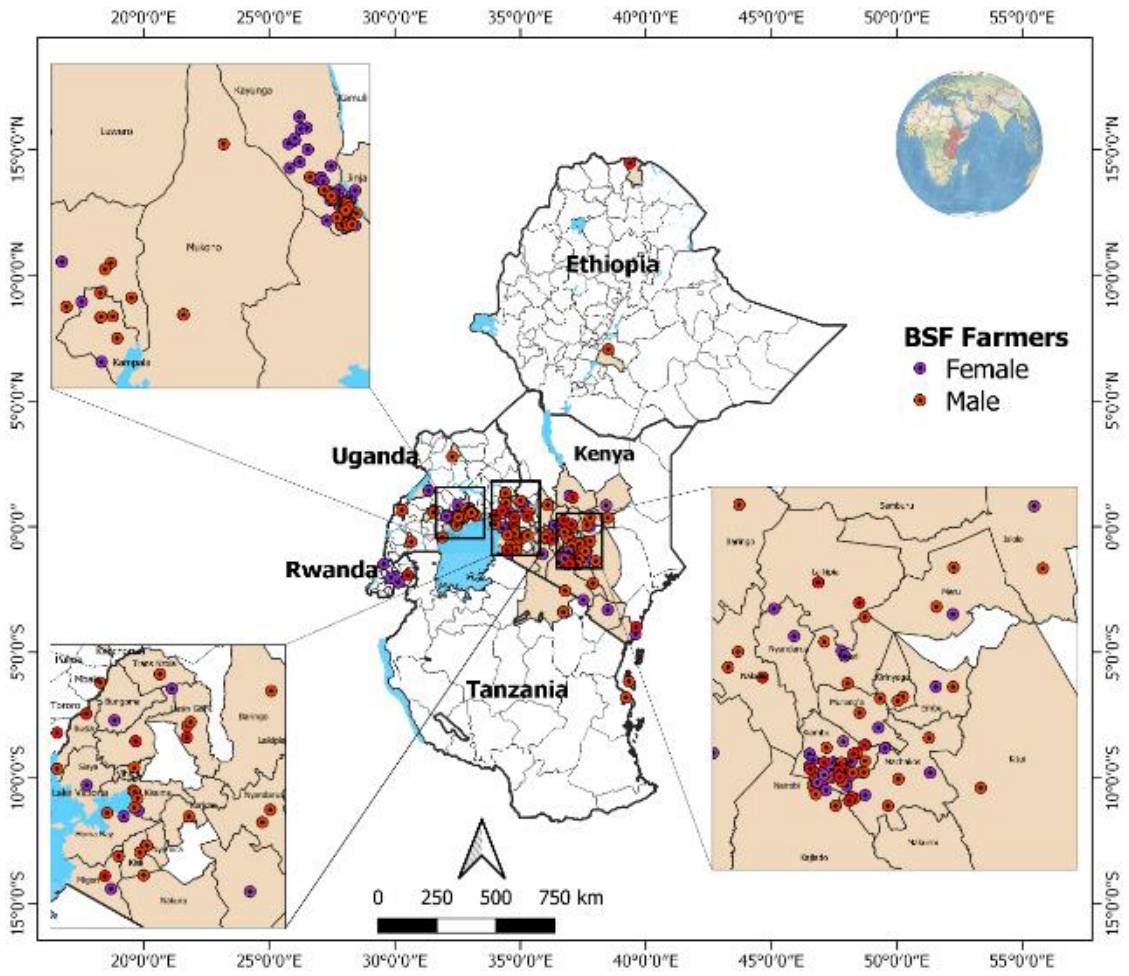
Outcome of Scaling Black Soldier Fly in East Africa

SMEs: ~26 – 600 MT/yr)

Large Scale: ~ 1,320 – 3,600 MT/yr

SANERGY

INSECTPRO



THE CURT BERGFORS FOOD PLANET PRIZE

WINNER 2020

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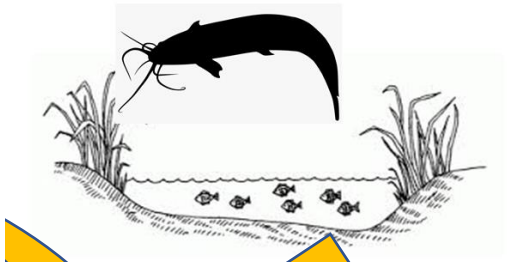
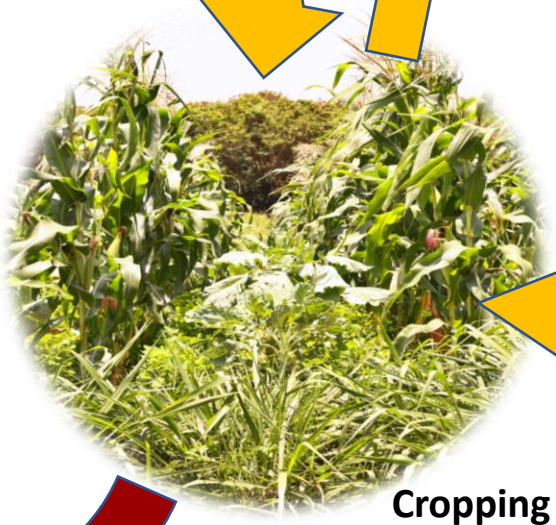
Regenerative and Circular smallholder farming in Africa

Insect proteins for poultry, pigs and fishes

Smallholder livestock, Poultry and fishes



Organic Frass Fertilizer for crops



Smallholder households

Urban populace and markets

Cropping systems innovations –Integrated Push-Pull

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Acknowledgement

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Thank you

International Centre of Insect Physiology and Ecology

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