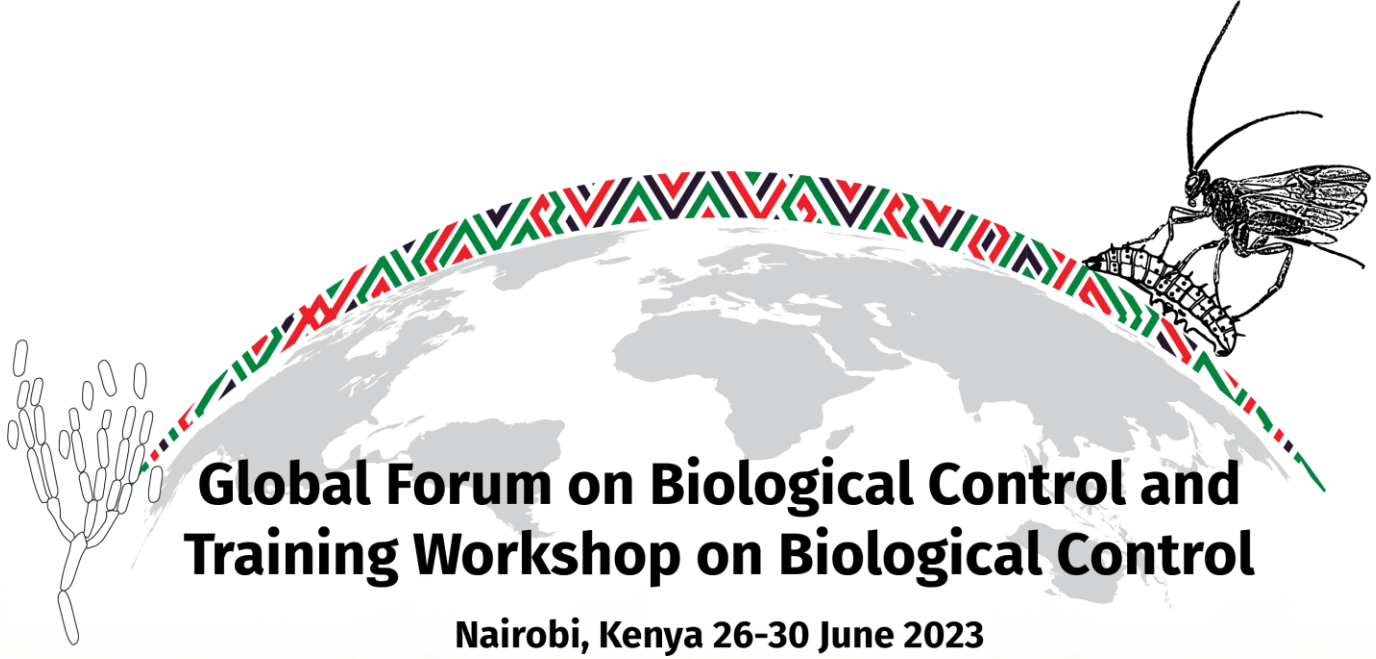

Global Forum on Biological Control and
Training Workshop on Biological Control

Nairobi, Kenya 26-30 June 2023

Socioeconomic impacts of biological control and willingness to pay among smallholders

Dr. Beatrice W. Muriithi

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Food and Agriculture Organization of the United Nations

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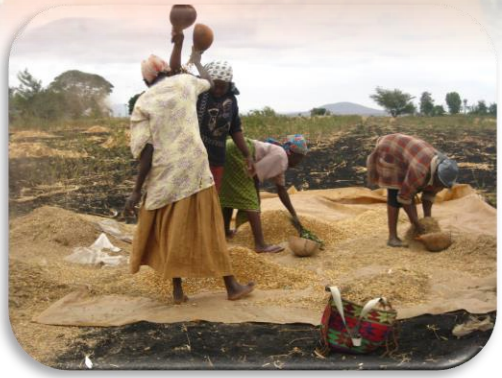
Introduction

40-50% food loss to pests in developing countries

- Advancing impact of climate change continue to **favour invasive pests** that may become even more frequent problem in the future

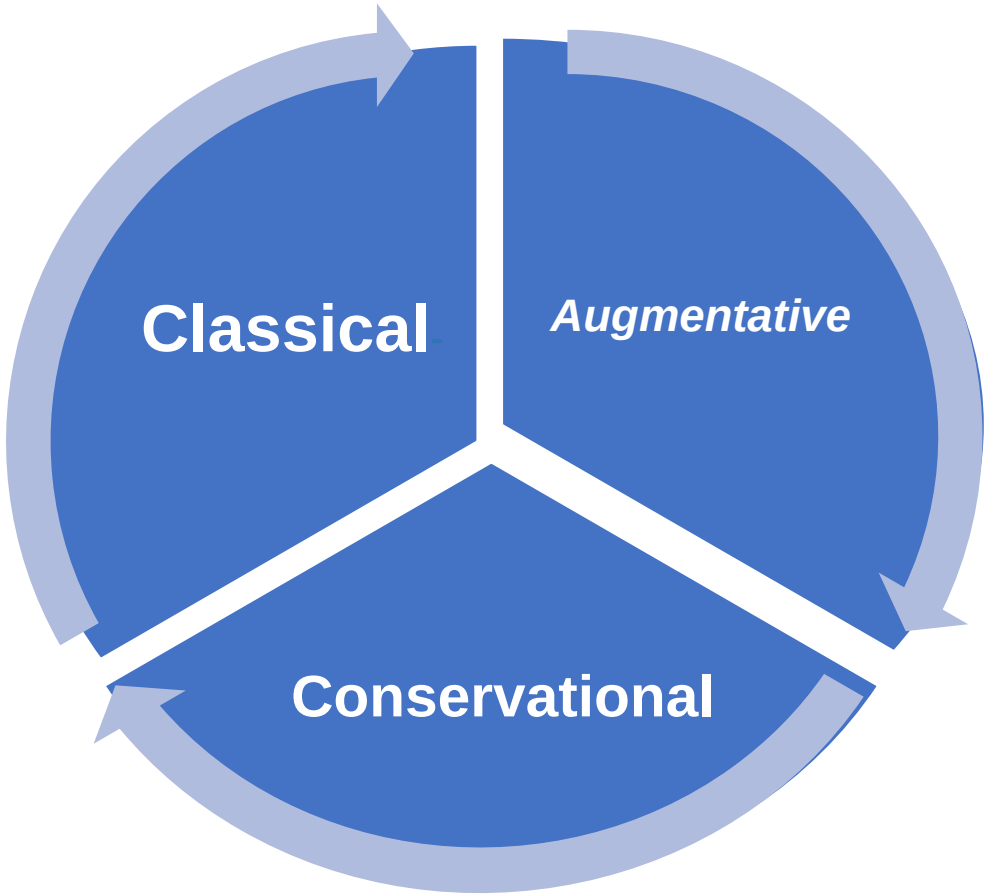
- Causing food insecurity and reduced revenues with adverse effects to vulnerable rural communities; women worst affected



Introduction cont'

- Surging population (>9 billion expected by 2050) requires significant effort to reduce these losses
- Besides, pesticides use is associated with high human health and environmental risks, pest resistance, market restrictions
    - Pesticide are also expensive and often unaffordable to majority of resource poor farmers especially women farmers
- Alternative and sustainable pest management approaches such as Integrated Pest Management (IPM) including **biological control** should be promoted

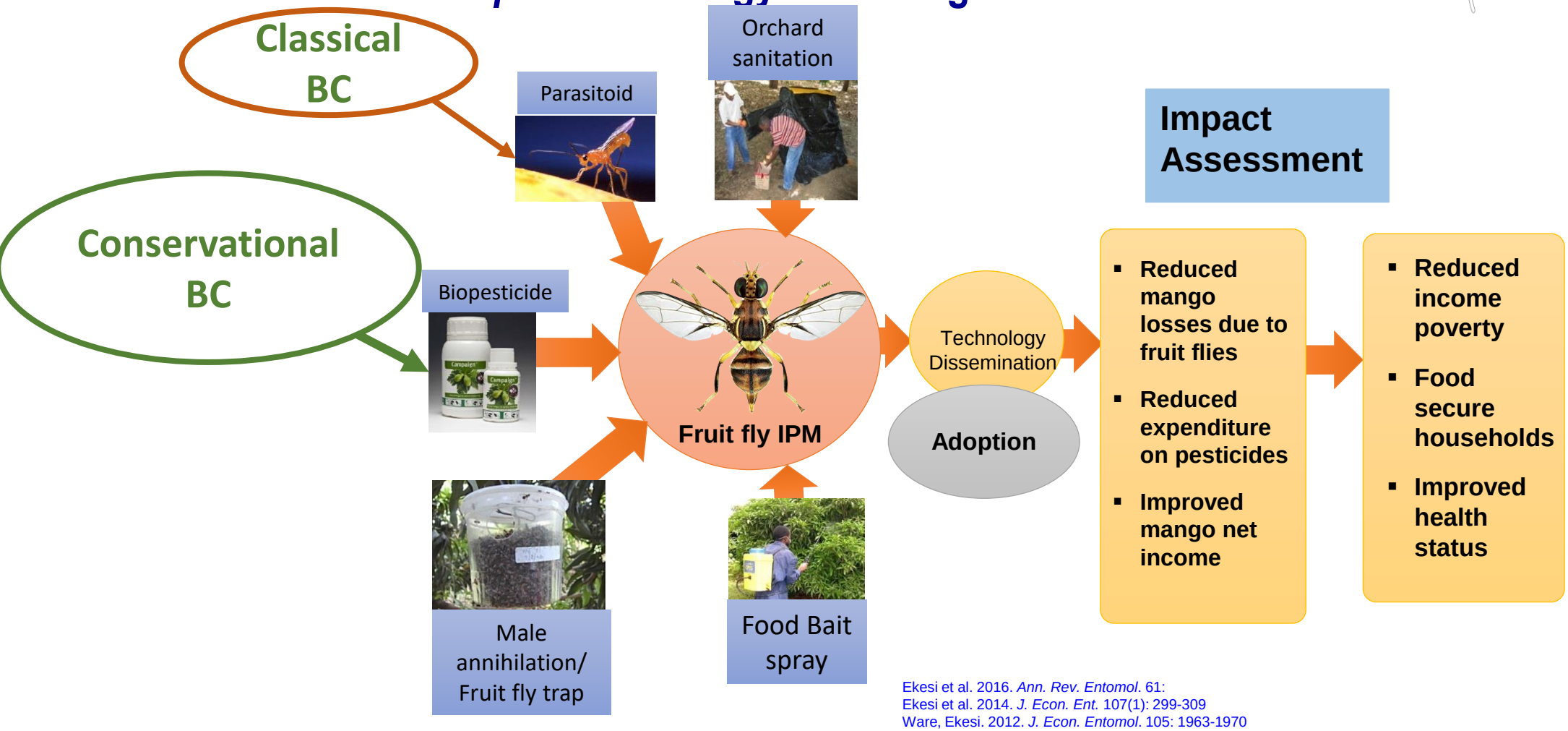
BC in an IPM approach



- BC is also often used in **an Integrated Pest Management (IPM) approach**
  - IPM involve the coordinated integration of multiple complementary methods (biological, cultural, physical etc) to suppress pests in a **safe, cost-effective, and environmentally friendly manner**

Example of BC in an IPM approach

icipe-IPM strategy for management of fruits flies



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Ekesi et al. 2011. *Acta Hort.* 911: 165-184
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Selected case studies highlighting the economic and poverty impacts of BC/IPM

Biological control of cereal stemborer pests in East and Southern Africa:

- **Objective:** assess the effects of the (classical) biological control (BC) of stemborer pests on social welfare.
- Classical biological control (BC) programme for control of stemborers conducted from 1993 to 2008, in East and Southern Africa
- Four (4) biological control agents (parasitoids) were introduced to control cereal infesting stemborer pests


Agriculture, Ecosystems & Environment
Volume 230, 16 August 2016, Pages 10-23
ELSEVIER

Assessing the long-term welfare effects of the biological control of cereal stemborer pests in East and Southern Africa: Evidence from Kenya, Mozambique and Zambia

Soul-kifouly G. Midingoyi [a, b], Hippolyte D. Affognon [a, c], Ibrahim Macharia [b], Georges Ong'amo [a, d], Esther Abonyo [a, d], Gerphas Ogola [a], Hugo De Groote [e], Bruno LeRu [a, f]

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Ref: Soul-kifouly et al., 2016

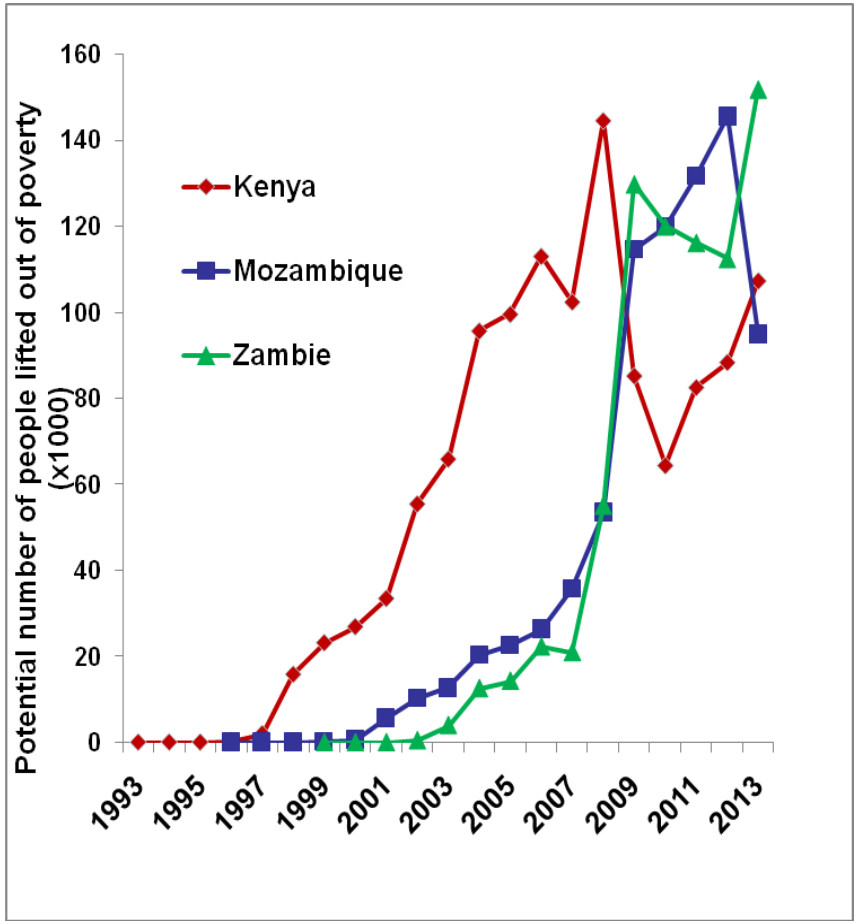
Biological control of cereal stemborer pests in East and Southern Africa:

- The BC programme contributed to an aggregate monetary surplus of **US$ 1.4 billion** to the economies of the three countries with **84%** from maize production and the remaining **16%** from sorghum production

Surplus change and return to investment in CBC

Country	BC-induced change in surplus (USD millions)	Net Present value (NPV) (USD millions)	Internal rate of return (IRR)	Benefit-Cost Ratio (BCR)
Kenya				
Maize	568.06	108.80	108.23%	238.80
Sorghum	172.45	32.65	118.99%	584.52
Total	740.50	141.52	113.08%	276.45
Mozambique				
Maize	214.63	28.52	30.66%	20.71
Sorghum	34.45	4.50	24.25%	8.36
Total	249.08	33.02	29%	11.57
Zambia				
Maize	361.88	38.34	18.76%	8.08
Sorghum	7.00	0.64	16.11%	5.18
Total	368.88	38.98	18.69%	4.51
Aggregate				
Maize	1,144.57	175.66	31%	11.60
Sorghum	213.89	46.56	81%	49.57
Total	1,358.46	271.76	67%	33.47

Trends in poverty reduction due to BC



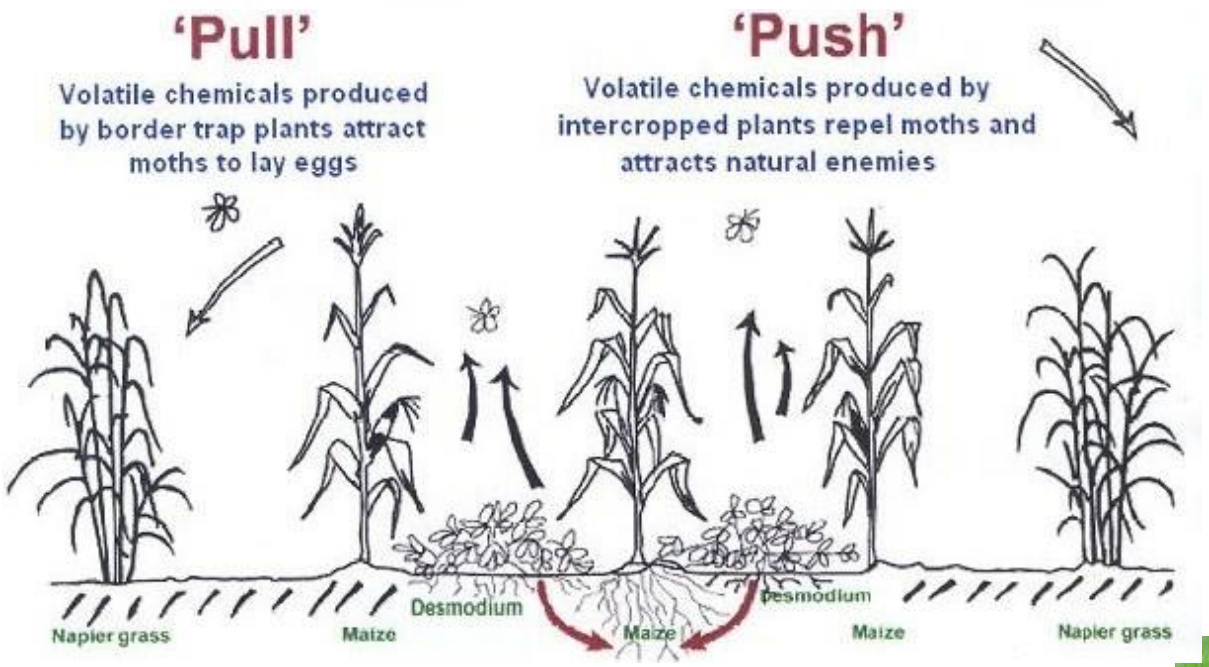
Ref: Soul-kifouly et al., 2016

People lifted out of poverty/year

- Kenya- **57,400** persons year,
- Mozambique**44, 120** persons
- Zambia **36,170** persons

0.20-0.35% of the population

Impact of Push-pull (Conservational BC)



Direct benefits of the technology

- Reduce stemborer and *striga* infestation
- Reduce soil erosion
- Improves soil fertility
- Provide fodder for livestock

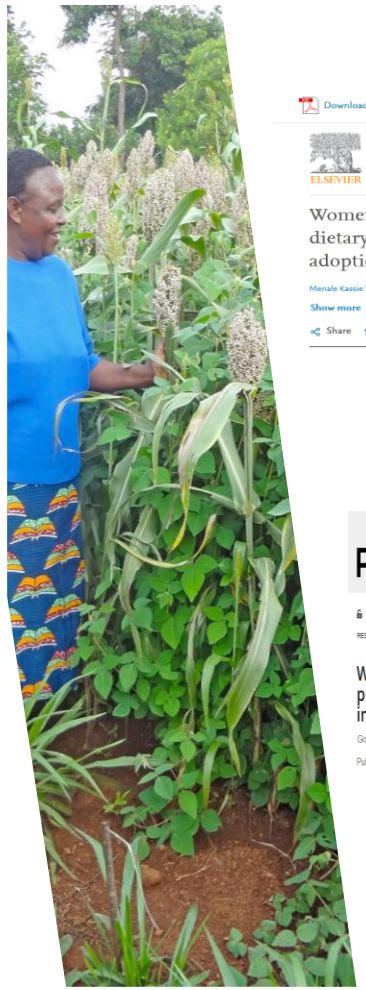
Objective: Improve cereal productivity, food security and nutrition and poverty among smallholder farmers

Impact of PPT on Women's empowerment

- Empowering women can increase maize productivity by 17%

Impact of women's empowerment interaction with technology adoption on Women Dietary Diversity Score (WDDS)

Treatment	WDDS
A) **Empowered women** from **non-PPT adopting** households s (actual = t1 and counterfactual = t0)	0.329(0.107)***
B)**Empowerment women** from **PPT adopting** households (actual = t2 and counterfactual = t3)	0.194(0.070)***
C) **Disempowered women** from **PPT adopting** households n (actual = t3 and counterfactual = t0)	0.366(0.073)***
D) **PPT adoption** for households with **empowered women** (actual = t2 and counterfactual = t1)	0.630(0.084)***

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Food Policy
Volume 95, August 2020, 101957

Women's empowerment boosts the gains in dietary diversity from agricultural technology adoption in rural Kenya

Menale Kassie, Monica Fisher, Geoffrey Muricho, Gracious Diiro

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RESEARCH ARTICLE

Women's empowerment in agriculture and agricultural productivity: Evidence from rural maize farmer households in western Kenya

Gracious M. Diiro, Greg Seymour, Menale Kassie, Geoffrey Muricho, Beatrice Wambui Muriithi

Published: May 31, 2018 • https://doi.org/10.1371/journal.pone.0197995

Economic impact of Push-pull technology

Impact PPT on maize yield

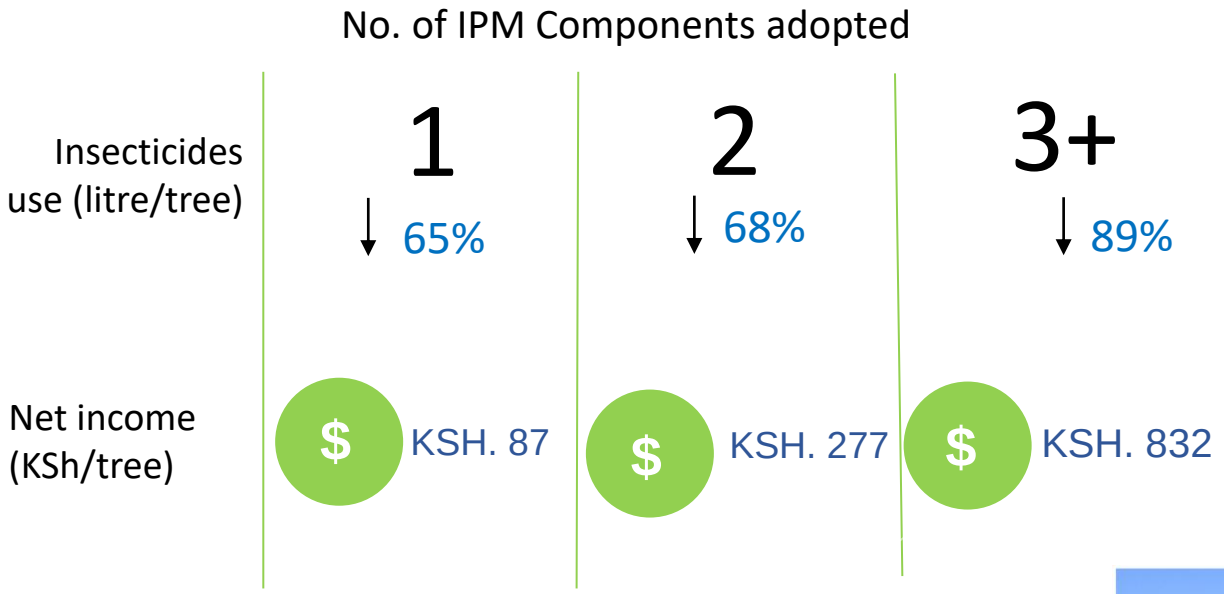
Model type	Expected yield (kg/acre)		
	Actual/observed	Counterfactual	ATT
A	B	C	D= B-C
Pooled model	1812.82	1153.57	659.25 (23.15)***
Fixed effects model	1812.82	1179.70	633.12 (26.35)***

Impact on economic surplus and poverty:

Adoption of push pull technology lead to;

- 22% productivity gains or shift in maize supply curve (K)
- US$ 65-70 million economic surplus gains at current level of adoption (ΔTS)
- 1.5-1.6% percent drop in number of poor people in western region (ΔN)

Impact of IPM for suppression of mango fruit flies on insecticides use, human health & environment in Kenya [IPM +BC]



- **30-40%** total insecticides risk reduction
- **0.7-21%** risk reduction for consumers
- **32-42%** risk reduction for environment & farm workers


JAE Journal of Agricultural Economics

Original Article | Open Access

Do Farmers and the Environment Benefit from Adopting Integrated Pest Management Practices? Evidence from Kenya

Soul-kifouly G. Midingoyi, Menale Kassie, Beatrice Muriithi, Gracious Diiro, Sunday Ekesi

First published: 14 October 2018 | https://doi.org/10.1111/1477-9552.12306 | Citations: 15

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Crop Protection

Volume 81, March 2016, Pages 20-29

ELSEVIER

Impact assessment of Integrated Pest Management (IPM) strategy for suppression of mango-infesting fruit flies in Kenya

Beatrice W. Muriithi [a], Hippolyte D. Affognon [a, b], Gracious M. Diiro [a], Sarah W. Kingori [a], Chrysantus M. Tanga [a], Peterson W. Nderitu [a], Samira A. Mohamed [a], Sunday Ekesi [a]

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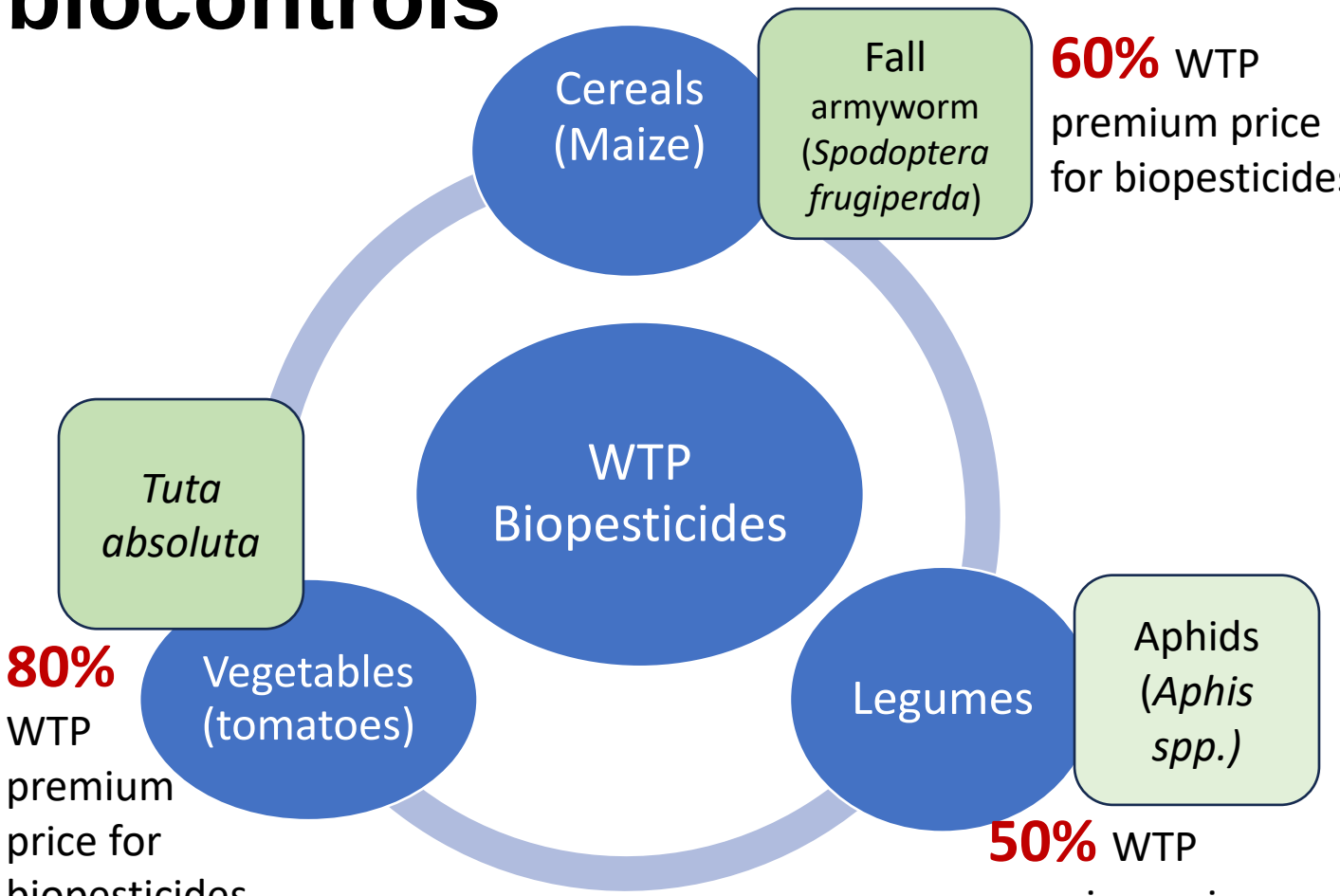
Smallholder's Willingness to pay for biocontrols



Nyangau, P., et al, (2022). Farmers' knowledge and management practices of cereal, legume and vegetable insect pests, and willingness to pay for biopesticides. *International Journal of Pest Management*, *68*(3), 204-216. [KENYA & UGANDA]

- **65%** used synthetic pesticides (main methods for pests' management)
- **70%** aware of the negative effects of chemical use

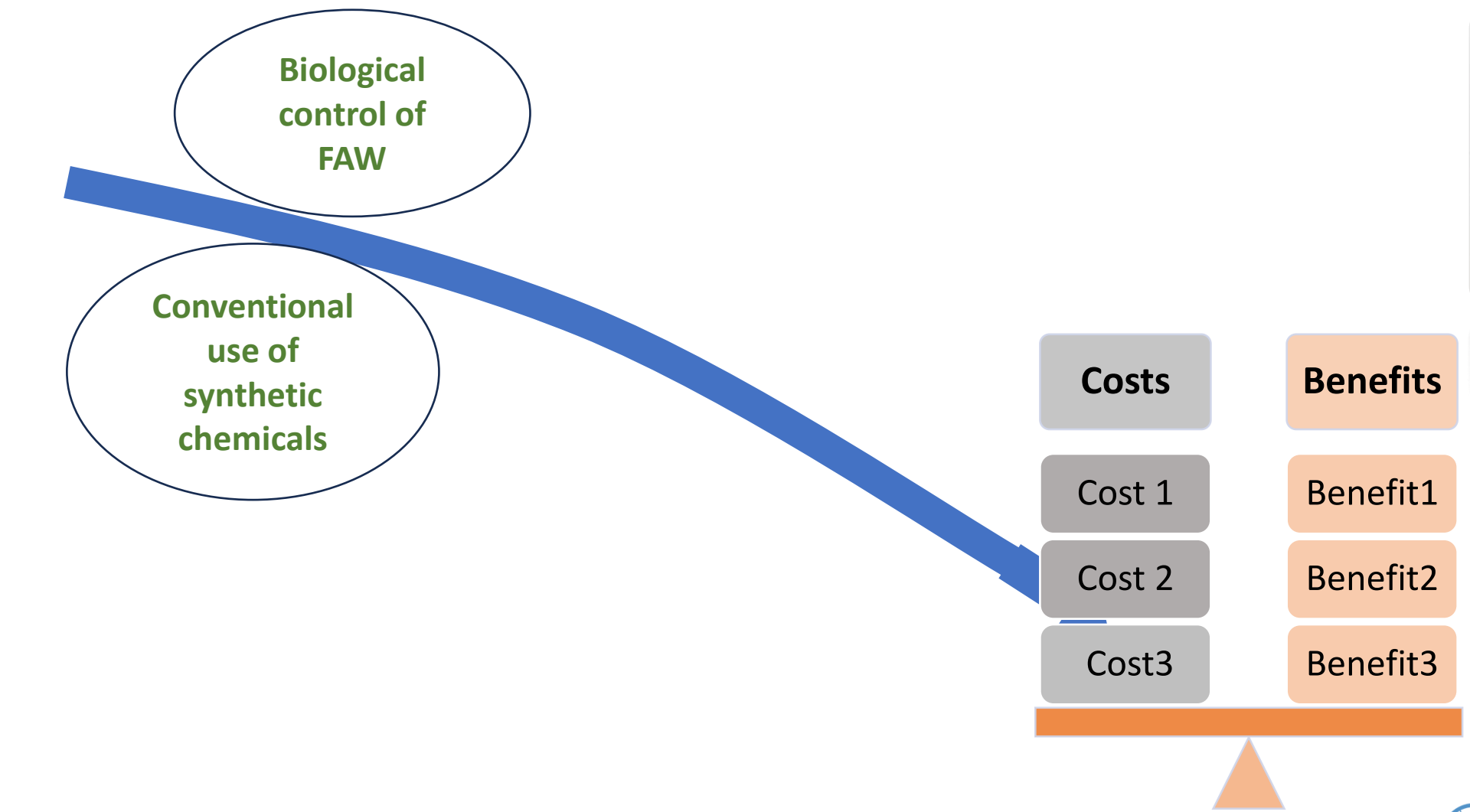
Agro-Dealers Willingness to Stock biocontrols

- **Collagen-** Most used pesticides for management of *T. absoluta* at an average price (KES 622/per litre**)**
- **82%** **Agro-dealers** were willing to stock a fungal-based biopesticide, and buy it as same price as Collagen
- **KES 1,020-** average per litre for the ICIPE 20 that the agro-dealers were willing to buy it and stock for resale.

Ogutu, F., Muriithi, B. W., Mshenga, P. M., Khamis, F. M., Mohamed, S. A., & Ndlela, S. (2022). Agro-Dealers' Knowledge, Perception, and Willingness to Stock a Fungal-Based Biopesticide (ICIPE 20) for Management of *Tuta absoluta* in Kenya. *Agriculture*, *12*(2), 180.

Metarhizium anisopliae-ICIPE 20 for *Tuta absoluta*

Cost- benefit analysis of the biological control of FAW in Kenya



- Dreamteam;
- Plant Village;
- icipe

Conclusions

- BC are cost-saving – particularly for resource poor and vulnerable community members
  - Labour saving
- BC increase food availability due to reduced pre-and post-harvest losses; increase income and other social welfare/ livelihoods indicators
  - Empowerment
- BC reduces health and environmental risks associated with use of synthetic chemicals
- BC technologies should be promoted and widely scaled out to enhance food availability and poverty alleviation
- Future pest management interventions should consider application of BC together with affordable and easy to apply (and maintain) IPM strategies to intensify the economic benefits of the pests' management

Thank you

bmuriithi@icipe.org

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Beatrice W. Muriithi Ph.D,
Social Science and Impact Assessment Unit,
International Centre of Insect Physiology and Ecology (icipe)
Duduville Campus,
Nairobi, Kenya

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