Phasing out HHP insecticides in smallholder vegetables in Ethiopia's Central Rift Valley

FAO/UNEP Rotterdam Webinar

3rd December 2021

Stephanie Williamson, Staff Scientist, PAN UK
stephanie@pan-uk.org

Atalo Belay, Project Coordinator, PAN Ethiopia
feelatalo@gmail.com

PESTICIDE ACTION NETWORK *UK*

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Ziway vegetable IPM project rationale

High and unsustainable use of numerous HHPs leading to:

- Serious levels of farmer and farm worker poisonings
- Risks to consumers of treated produce
- Risks to drinking water sources and consumers of lake fish

Contamination of water, soil & vegetation poses risks to:

- ➢ Biodiversity hotspot of Lake Ziway & wetlands
- ➢ Ecosystem service providers (honeybees & other pollinators; natural enemies of insect pests; soil nutrient recyclers)
- ➢ Livestock

Horn of Africa Regional Environment Center & PAN-Ethiopia (2015) **Potential environmental impacts of pesticides use and management practice: the case of smallholder farmers around Lake Ziway, Ethiopia. A survey report.**

Mengistie et al. (2017) **Pesticide use practices among smallholder vegetable farmers in Ethiopian Central Rift Valley.** *Envt Dev Sustainability* 19 301-324

Merga et al. (2020) **Trends in chemical pollution and ecological status of Lake Ziway, Ethiopia: a review focussing on nutrients, metals and pesticides**. African J. Aquatic Science DOI: 10.2989/16085914.2020.1735987

Insecticides used by Ziway veg producers

Insecticide active ingredient	Acute toxicity HHP	Chronic human health HHP	Environmental hazard HHP
Acetamiprid + emamectin benzoate			✓
Azadirachtin			
Chlorfenapyr			✓
Chlorpyrifos (ethyl isomer)			✓
Deltamethrin		✓	✓
Diazinon		✓	✓
DDT *PIC/POP*		✓	✓
Dimethoate			✓
Endosulfan *PIC/POP*	✓		
Indoxacarb			✓
Lambda-cyhalothrin	✓	✓	✓
Malathion		✓	✓
Profenofos			✓
Spinetoram			✓
Spinosad			✓
Unknown botanical AI	??	??	??

18 of 28 active ingredients (64%) in use qualify as HHPs according to PAN International

Onions: spray frequency 12-22 times

Tomato: spray frequency >20 times

Apply pesticides on first sight of pests or disease or on calendar basis

No field monitoring nor consideration of any other IPM principles

Testing the 'food spray' method to enhance biological control

3 components of the food spray method:

- **Managing your crop habitat** to provide a more welcoming home for *Farmers' Friends*
- **spraying the crop foliage with a food supplement** (the 'food spray') to attract predator insects
- **avoiding use of 'broad spectrum' insecticides** which will disrupt or kill our insect friends

Food spray based on dilution of waste brewers' yeast

See: www.pan-uk.org/food-spray/

Onion field trial plot with alfalfa borders for Farmers' Friends.

Field monitoring and decision making for food spraying

First spray when crop plants are very young (*5-10 days after transplanting*)

Further sprays IF the balance between Predators to Pests becomes unfavourable (*less than one Farmers Friend to every 2 Pests*)

✓**Monitor a small sample of your field every 3-4 days to check!!**

✓**Count: total number of Farmers' Friends versus total number of Pests you see**

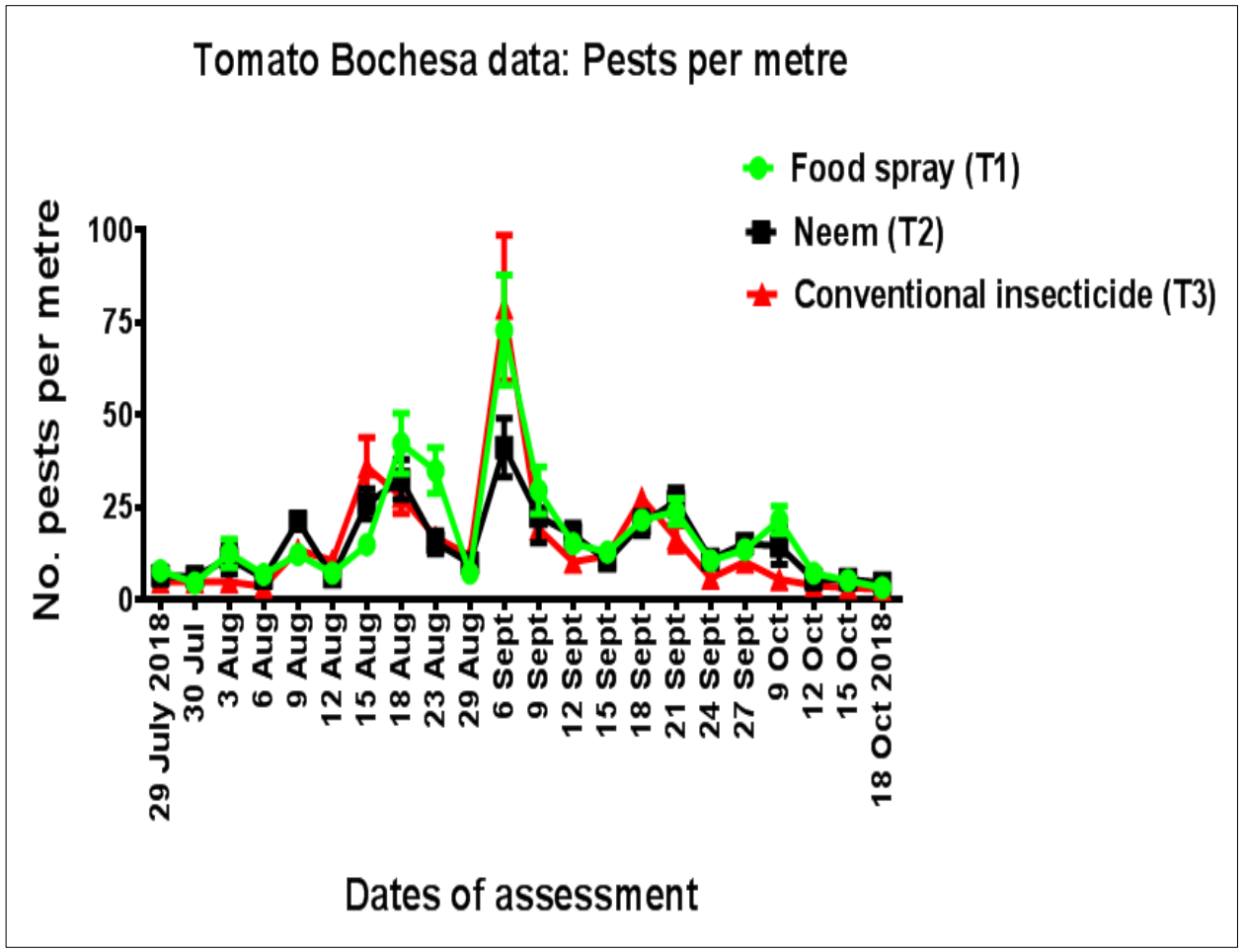
Gemeda Kebero, PAN Ethiopia veg. project field coordinator, counting pests and predators in tomato trial plot, Ziway, Sep. 2019

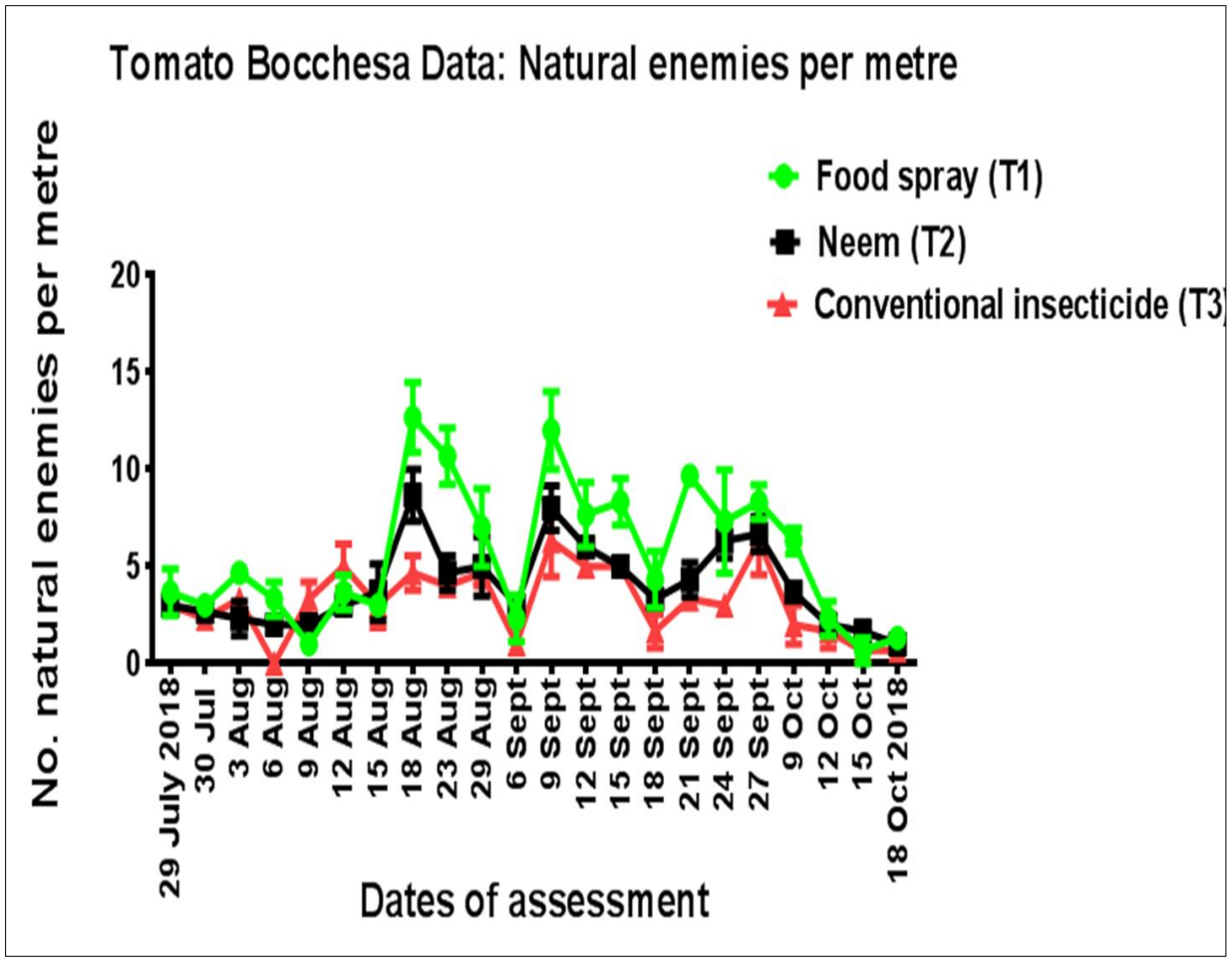
Other IPM methods introduced for pests

Method	Pest management aims and comments
Wider spacing of transplants	-Mainly a disease management method but in tomato enables workers to move more easily through the crop for better monitoring and better targeting of any applications
Application of neem seed extract	-Can be added with a food spray or as a stand-alone application if pest numbers are outstripping natural enemy control. Mainly repels pests but it can also repel natural enemies. -Best to apply only when food sprays alone fail to give enough control.
Avoiding HHPs harmful to natural enemies	-Many broad-spectrum insecticides will kill or disrupt natural enemies. Only using insecticides as a last resort and selecting those somewhat less harmful, e.g. spinosad, helps protect natural enemies attracted in with the food spray method
Applying vermicompost at transplanting and/or as a side dressing	-Helps grow a healthier, more robust crop better able to withstand pest attack. -Helps reduce volumes of synthetic fertiliser needed & avoid sappy, pest-attractive foliage from high nitrogen application -Helps conserve soil moisture and can reduce plants suffering from drought stress when they become more susceptible to pests
Sanitary pruning of mined, older and yellowing tomato leaves	-Removes some Tuta and serpentine leafminer larvae, reducing risk of bored fruits and reducing pest survival in soil and leaf litter
Thorough clean-up of all crop waste after harvest and removal from field	-Reduces survival of pests which pupate or shelter as adults in crop waste, e.g. African Bollworm, Tuta leafminer. Labour is an 'investment' for the next season's crop. -Crop waste can be composted, buried or fed to livestock or vermicompost units.

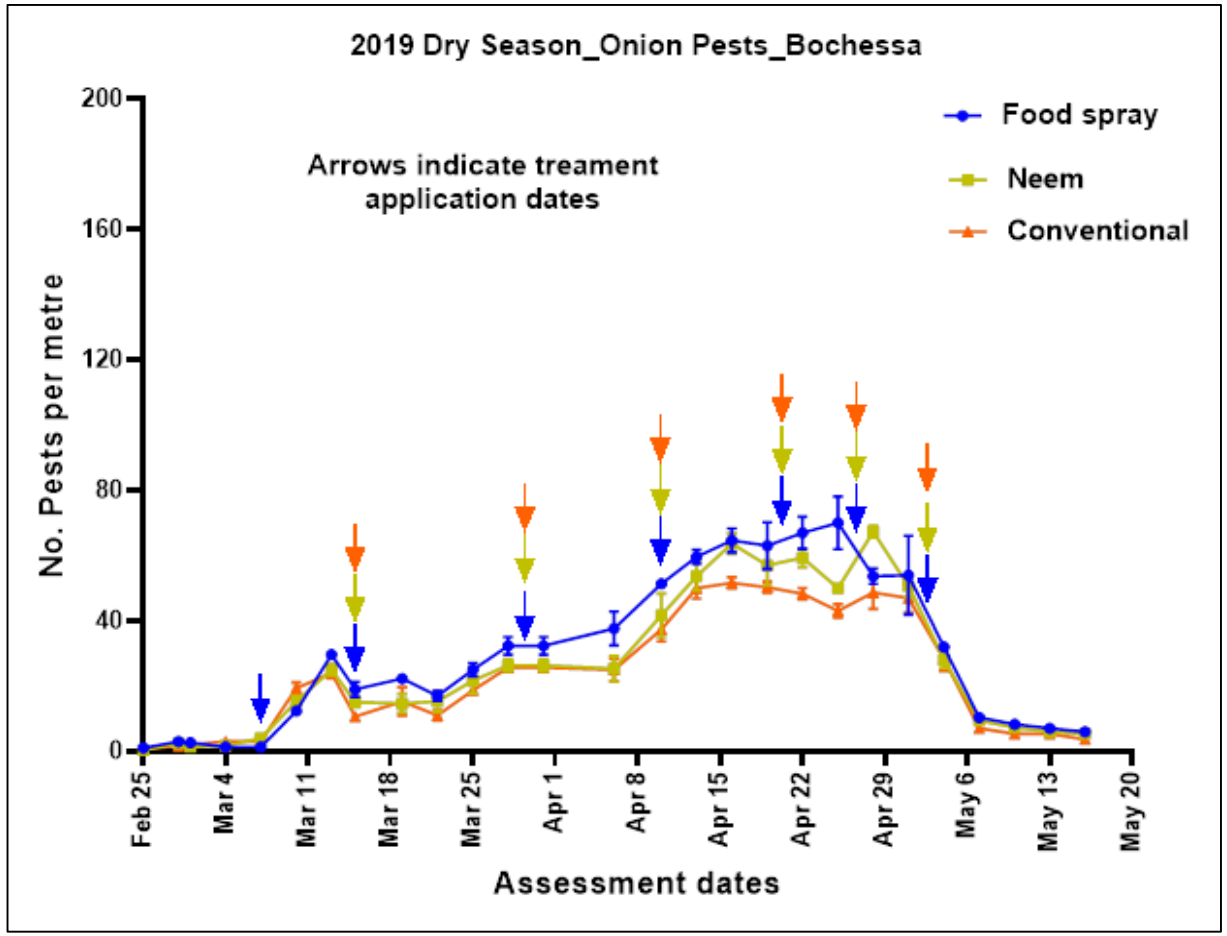
Results from the formal Food Spray Trial

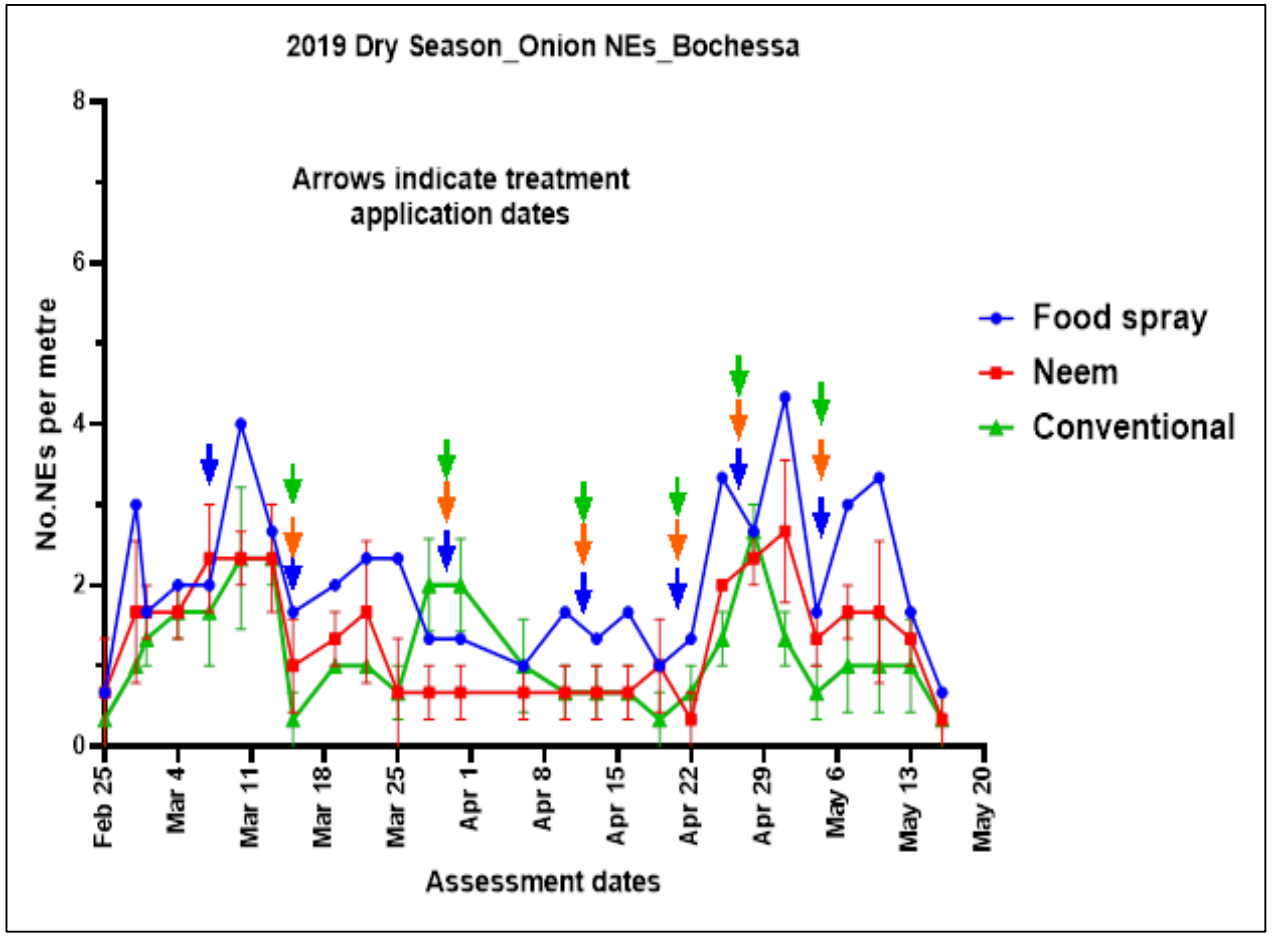
Timeline graphs of pests and NEs per meter: 2018 wet season data in Tomato





Food spray, Neem and conventional treatments onion: timeline graphs , 2019





Field trial HHP and total pesticide applications

Baseline vs end line on tomato and onion

- **Tomato**
  - Average spray frequency : 37 rounds vs 5 rounds at end line => 84% decrease in spray frequency
- **Onion**
  - Average spray frequency : 18.7 rounds vs 4.3 rounds at end line => 77% decrease in spray frequency

Reduction of HHPs use

- 50-52% decrease in number of HHP products used

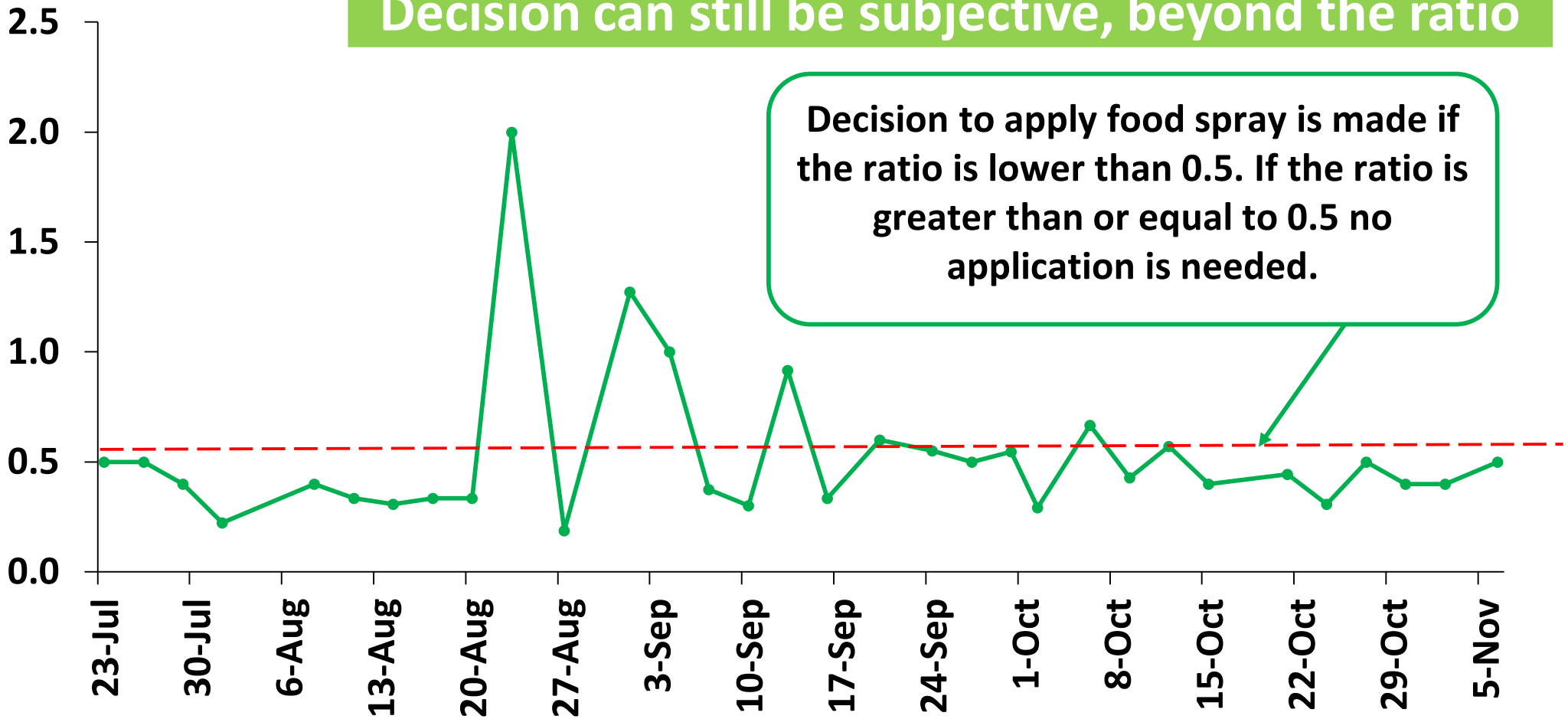
- 75-80% decrease in frequency of HHP spraying

IPM vs FP comparisons with farmers

- Set up in the smallholder plots
- IPM is done with follow ups and decisions from PAN-Ethiopian team
- FP is managed by farm owner and implements his/her own usual practices

Natural enemies to pests ratio graph from an IPM tomato plot in Bochessa from a smallholder farm in the 2019 wet season (August-November).

Decision can still be subjective, beyond the ratio



Treatments comparison of IPM vs host Farmers' Practice

Crop and site	FFS IPM plot # applications	Farmer's Practice plot # applications	Synthetic pesticide frequency reduction (%) under IPM
ONION Mr Tahale Village: Abine Germama	Food spray x 5 Neem seed x 3 + Nimbecidine x1 **Insecticides: 1** ***Spinosad*** x1	**Insecticides: 8** **Profenofos** x 6 **Spinosad** x 1 **Lambda-cyhalothrin** x 1	88%
Nov.2019	Baking soda x 2 **Fungicides: 4** **Mancozeb** x 2 Mancozeb+metalaxyl x 1	**Fungicides**: **9** **Mancozeb** x5 **Mancozeb**+metalaxyl x 2	56%
TOMATO Mr Shoh Village: A. Germama	Food spray x 5 Neem x 2 **Insecticides**: **2** **Spinosad** x2	**Insecticides: 8** **Lambda-cyhalothrin** x 2 **Chlorfenapyr** x4 **Profenofos** x 1 **Deltamethrin** x 1	75%
Jul .2020	Baking soda: 0 **Fungicides**: **4** Metalaxyl +Copper oxychloride x1 **Mancozeb**+metalaxyl x1	**Fungicides**: **10** Metalaxyl +Copper oxychloride x 2 **Mancozeb**+metalaxyl x2	60%

Economics example from onion in 2019 wet season, Abine Germama Village

Items	IPM	Farmers' Practice
Total Yield (Kg)	**4,900**	**4,850**
Price per Kg	14	14
Total sale	**68,600**	**67,900**

Total production cost of onion in IPM and FP

Item	IPM production Cost	FP Production Cost
Pest & Disease control cost	**2,678**	**3,972**
Soil fertility and polyfeed cost	1,615	1,615
Labour cost	14,450	14,450
Input costs	1,200	1,200
Total Production cost	**19,943**	**21,237**

Net income from each treatment

Item	IPM	FP
Total Sale	68,600	67,900
Production cost	19,943	21,237
Net income	**48,657**	**46,663**

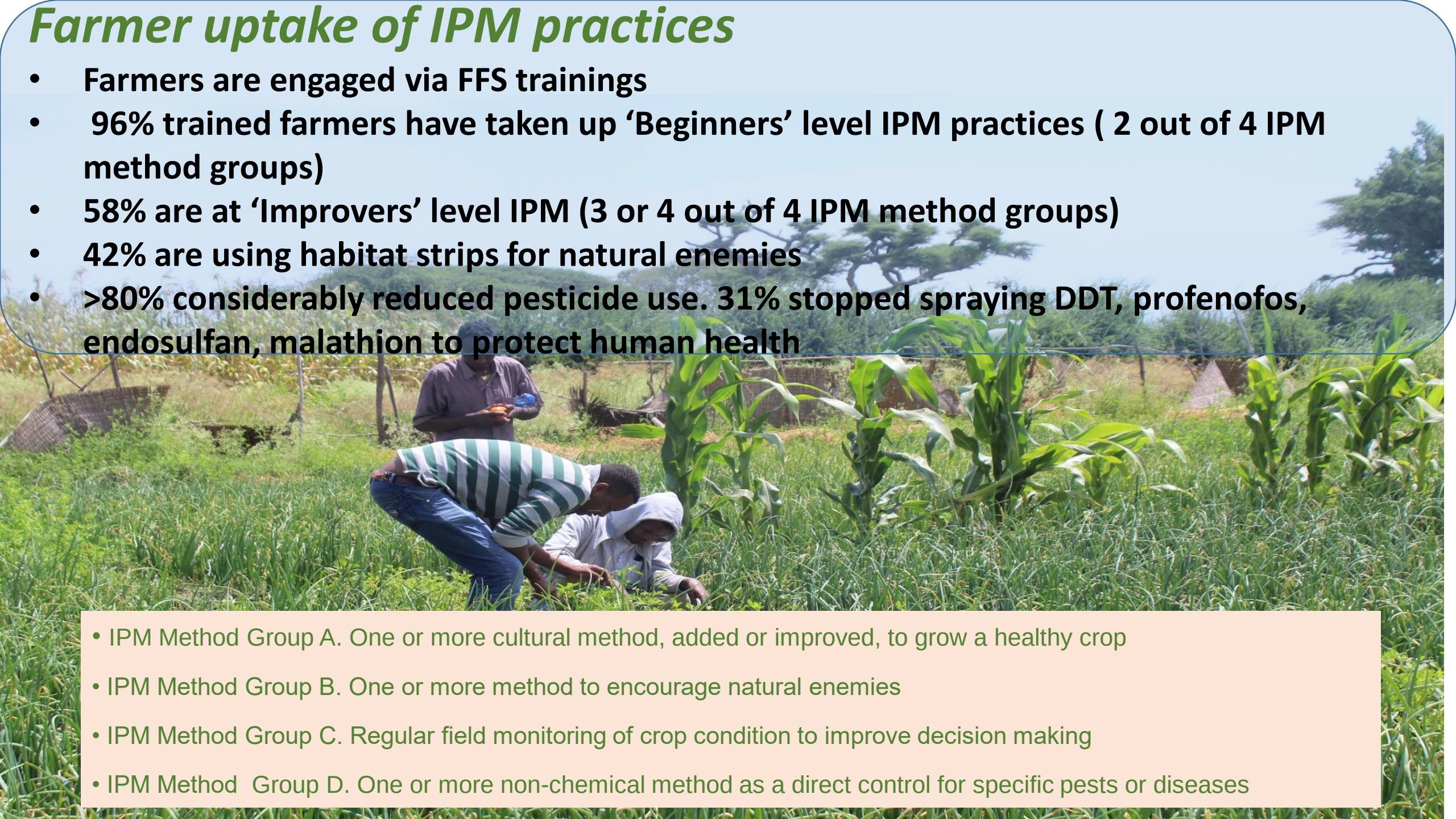
Figures per 0.25ha equivalent, typical smallholder field size
Costs in Ethiopian birr. £GBP= 45.6 ETB (Jul. 2020)

Averages across all IPM vs Farmers' Practice plots 2019-2021

% change for IPM produce	**Onion** n = 9 plots	**Tomato** n= 3 plots
Yield	+2%	-8%
Pest and disease management costs	-53%	-71%
Total production costs	-6%	-35%
Net income	+9%	+35%
Spray frequency synthetic pesticides	-77%	-81%

Farmer uptake of IPM practices

- **Farmers are engaged via FFS trainings**
- **96% trained farmers have taken up ‘Beginners’ level IPM practices (2 out of 4 IPM method groups)**
- **58% are at ‘Improvers’ level IPM (3 or 4 out of 4 IPM method groups)**
- **42% are using habitat strips for natural enemies**
- **>80% considerably reduced pesticide use. 31% stopped spraying DDT, profenofos, endosulfan, malathion to protect human health**



- IPM Method Group A. One or more cultural method, added or improved, to grow a healthy crop
- IPM Method Group B. One or more method to encourage natural enemies
- IPM Method Group C. Regular field monitoring of crop condition to improve decision making
- IPM Method Group D. One or more non-chemical method as a direct control for specific pests or diseases

Current work and next steps

- Trials on Vermicompost
  - To replace the use of synthetic fertilizers so farmers can combine the plant protection alternatives with soil fertility enhancement methods
- Support farmers for further adoption of the IPM methods, trial new alternatives
- Inputs, mainly food spray, neem seed and alfalfa seeds are provided for early adopter farmers
- Organise farmers in groups for ease of access to the IPM inputs
- Market linkages

To find out more:

Visit our web page www.pan-uk.org/food-spray/ for:

- **The Food Spray Manual: *A Trainer's Guide (2017)***
- **Farmers' Friends and Cotton Pests: *Identification Guide for Ethiopian Cotton Fields (2019)***
- ***Cotton without Highly Hazardous Pesticides:* Ethiopian experiences in growing high quality, high yield cotton using agroecological methods (2018) https://www.pan-uk.org/cotton-in-ethiopia/**

Thanks for listening!!

Acknowledgements:

Funding for trialling the food spray method in vegetables in Ziway, Ethiopia, was kindly provided by IDH (the Sustainable Trade Initiative, from the Netherlands) and The JJ Charitable Trust (in the UK).

We also thank the Ziway Board of Agriculture and Ziway Plant Health Clinic for their invaluable collaboration.