Protocol Title:	Incentives for scaling the adoption of integrated pest management technologies: Experimental evidence from Uganda.
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1. Abstract

Crop pests hamper efforts to increase agricultural productivity and improve the livelihoods of the poor in developing countries. In these contexts, pesticide adoption is typically low due to high costs and technical requirements, while concerns regarding the sustainability of pesticide use remain due to the risks they pose to human health and their decreasing effectiveness over time. Africa's increasing trade connectedness exposes smallholders to new pests that demand new ways to combat them. Among the most harmful new pests is the fall armyworm (FAW) that has spread across Africa since 2016. Though affordable integrated pest management approaches such as the Push-Pull Technology (PPT) have been developed to reduce the economic injury of FAW, their adoption remains low, partly because farmers have little to no knowledge of these technologies. The typical extension system, based on Train and Visit (T&V) has challenges including a high farmer to extension worker ratio, poor accountability, lack of incentives for extension workers, lack of access to recently updated information, or the need for constant re-training. One approach to overcoming these challenges involves targeting and training lead farmers, who can then disseminate the new technologies among their peers. However, lead farmers incur costs when disseminating information to other farmers and therefore are usually reluctant to do so without external incentives. Our study aims to assess the effectiveness of the lead farmer model in technology dissemination, while also evaluating the impact of different approaches to lead farmer selection as well as cost-effective incentive schemes to increase adoption rates.

2. Background and Significance

Crop pests and diseases continue to hamper efforts to increase crop productivity and lift the poor out of poverty in most developing countries. This problem is more rampant in sub-Saharan Africa where a rise in crop productivity is urgently needed for millions of smallholder farmers. Though pesticides for use against most common pests are available, their adoption is low due to high costs, and the need for very detailed technical knowledge which most farmers may not have access to. Further, the effect of pesticides on the health of the farmers and the environment is of great concern. Pests' resistance to pesticides has also been on the rise, making the pesticides less effective.

Africa's increasing trade connectedness with other countries exposes it to new pests that demand new ways to combat them. An example of such a new pest is the fall army worm (FAW) that has spread across Africa since it was first reported in 2016, causing more than $16 billion in crop damage losses. New pests such as FAW's prevalence are exacerbated by climate change.

Though affordable technologies such as FAW resistant varieties and other integrated pest management approaches such as push-pull technology have been developed to reduce the economic injury of FAW on smallholder livelihoods, their adoption remains low. This low adoption is partly because farmers have no knowledge of these technologies. If farmers are not informed about these new technologies, they will not know how to implement them, or if they are uncertain about their benefits, adoption will fail. The typical extension system, based on Train and Visit (T&V) has challenges including a high farmer to extension worker, accountability challenges, lack of incentives for extension workers, lack of access to recent updated information or the need for constant re-training. For example, Uganda has an average farmer to extension worker ration of 1:1,800. One approach to overcoming these challenges involves targeting and training so-called lead (or model) farmers—often recruited from the subset of successful, entrepreneurial, and relatively well-educated farmers. After receiving some training, these lead farmers are supposed to share information with their co-villagers and peers.

Lead farmers incur costs when disseminating this information to other farmers and therefore are usually reluctant to do so without external incentives. Several studies analyse incentives for information sharing within groups, communities, or peer to peer. Our study aims to contribute to this literature by assessing the effectiveness of the lead farmer model in technology dissemination, while also evaluating the impact of different approaches to lead farmer selection and incentive schemes for increased adoption among their peers.

3. Study Objectives

Main Objective:

i. Evaluate a technology dissemination approach that provides lead farmers with better tools to generate adoption among their peers using Information and Communication Technologies (ICTs), demonstration plots, and sustainable own production of key inputs.

Specific Objectives

ii. Evaluate how the choice of lead farmer affects technology adoption.
iii. Evaluate different incentive schemes to motivate lead farmers to generate higher adoption rates among their peers.

4. Administrative Organization

The research team will be co-led by Yanyan Liu and Eduardo Maruyama, from the Markets, Trade and Institutions Unit of the International Food Policy Research Institute. IFPRI will contract the International Centre of Insect Physiology and Ecology (ICIPE) to implement the interventions in the field and Homeland Data Services Ltd. (HDS) to conduct the data collection activities.

5. Study Design

Main intervention randomization: Approximately 120 villages will be randomly assigned into two treatment arms and a control group (40 villages in each).

- T1: Lead farmers in treatment group 1 villages will host a demonstration plot for maize production under the push-pull technology approach to combat FAW infestations.
- T2: Lead farmers in treatment group 2 villages will host a demonstration plot for maize production under the push-pull technology approach to combat FAW infestations, and will also get access to smartphones, airtime, and (remote) extension support.
- C: No project activities will be conducted in control villages beyond data collection activities.

Secondary treatments randomization: Treated villages (T1 and T2) will be further randomized into different (1) lead farmer selection methods, and (2) different incentive schemes for lead farmers.

The key problem studies by the project is the low adoption rates of the push-pull technology, an integrated pest management approach to combat FAW infestations among maize producers. The primary outcomes for our analysis will be maize productivity measures (harvest, yields, losses) and household welfare indicators (farm income), and the secondary outcomes will be the adoption rate of PPT among treated villages (to assess effectiveness of incentive schemes and lead farmer selection approaches).

6. Study Procedures

- Subject selection procedures:
    - The study will be conducted in Kumi district in the Eastern region of Uganda.
    - All villages with less than 100 households in Kumi district from maize producing areas will be eligible for the study.
    - All communication and interactions with local farmers will be conducted in the local language(s).
    - No members of vulnerable population groups will be recruited or targeted by the study.
- Recruitment procedures:
    - The data collection and field intervention teams from the project will seek authorization and support from local authorities at all levels (district, parish, subcounty and village). Through these authorities and leaders, farmers will be mobilized to attend information meetings to learn about the study.
- Consent process:
    - Consent will be obtained at household level listings (prior to the baseline survey data collection).
    - The consent process will be conducted by Homeland Data Services Ltd. field supervisors and enumerators, using an informed consent document prepared by IFPRI.
- Randomization procedures:
    - Eligible villages (in maize producing areas of Kumi district with less than 100 households) will be randomly assigned into treatment arm 1 (T1), treatment arm 2 (T2), a control group (C), or set aside as a replacement. We estimate the budget will allow 120 villages to participate in the study (between T1, T2, and C).
    - Treated villages (in T1 and T2) will go through a secondary randomization to assign them different lead farmer selection criteria and lead farmer incentive schemes.
- Study assessments and activities

- Data collection: Village listing (desk review), household listing, baseline household survey, and follow-up household survey.
- Reporting: Midline progress report and Final Impact evaluation assessment.

7. Privacy and Confidentiality Protections

- Household survey data will be collected in a private space (individual homes).
- Survey data will be collected using electronic tablets, which will submit to a secure server and delete form the tablet completed interviews at the end of very survey day.
- Survey data from the tablets sent to the secure server will be encrypted.
- Identifiable information from the surveys will be removed from the rest of interview data and stored in a separate, secure server.

8. Risk and Benefits

- No potential risks are foreseen from participating in the study.
- Monetary costs of adopting PPT will be covered by the project through the free provision of the required seeds and technical support.
- For treated farmers, benefits include reduction in maize losses from FAW infestations, and reduction in pesticide use and costs.

9. Data Analysis Plan

- Village and household level outcomes will be analyzed using both a difference-in-difference and an ANCOVA econometric approach, relying on the cluster randomization for adequate identification.