Impact Evaluation of Farmer Field Schools in Mozambique

Mozambique

P172877

Keywords: Agriculture in Developing Countries (O13), Technology Diffusion (O33), Agricultural Extension Services (Q16).

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IE Profile Indicators

No.	Indicator	Description
1	IE code	P172877
2	IE Title	DIME Mozambique Rural Development Impact Evaluations
3	IE TTL	Paul Christian, DIME1
4	IE Contact Person	Astrid Zwager, DIME1
5	Region	AFR / AFCS2
6	Sector Board/Global Practice	Agri & Food Global Practice
7	WBG PID	N/A
8	WBG Project Name	N/A
9	Associated with another IE (Yes, No)	Associated with the IEs administered through the same program IE code
10	Project TTL	N/A
11	Intervention	Farmer Field School and agricultural input subsidies
12	Main Outcomes	Farmer knowledge, technology adoption and yields
13	IE Unit of Intervention/Randomization	Community
14	Number of IE Units of Intervention	400 communities
15	IE Unit of Analysis	Farmer
16	Number of IE Units of Analysis	4000 farmers
17	Number of Treatment Arms or Iterative Experiments	3
18	IE Question 1 (Treatment Arm 1 or Iterative Experiment 1)	What is the impact of FFS on farmers' knowledge and technology adoption of improved practices and inputs and yields?
19	Method IE Question 1	Randomization at the community level
20	Mechanism tested in IE Question 1	Information
21	IE Question 2	What is the complementary impact of subsidies on farmers' knowledge and technology adoption of improved practices and inputs and yields?
22	Method IE Question 2	Random assignment at the farmer level
23	Mechanism tested in IE Question 2	Financial
24	Gender-specific treatment (Yes, No)	No
25	Gender analysis (Yes, No)	Yes, if there is stratification/power for gender-specific analysis
26	IE Team & Affiliations	Paul Christian, Florence Kondylis, John Loeser, Astrid Zwager
27	Estimated Budget (including research time)	USD1mln
28	CN Review Date	August 2020
29	Estimated Timeframe for IE	October-2020 to October-2023
30	Main Local Counterpart Institution(s)	EU Delegation to Mozambique (EUD), Food and Agriculture Organization (FAO), Ministry of Agriculture and Rural Development (MADER)
31	Sources of Funding	EUD Mozambique

EXECUTIVE SUMMARY

Most Mozambicans live in rural areas (INE, 2017) and over 80% of the population derives its livelihood primarily from agricultural activities (Cunguara and Hanlon, 2010). The agriculture is largely characterized as low productivity subsistence farming, with limited adoption and use of technologies (Baez et al., 2018). Access to information and agricultural extension is limited; only 6% of farmers reported receiving extension services in 2015 (Baez and Elabed, 2020). Extension services struggle to reach poorer farmers or female headed households (Cunguara and Moder, 2011), nor is there evidence that these services have clearly resulted in improved agricultural outcomes (Baez and Elabed, 2020).

This impact evaluation (IE) seeks to build evidence on agricultural extension provision, leveraging the upcoming Farmer Field School (FFS) program which will be rolled-out in the context of the EU financed PROMOVE-Agribiz, and implemented by the United Nations Food and Agricultural Organization (FAO). The FFS methodology has been promoted as an improvement over the traditional top-down public extension system which provides generalized recommendations. Instead, farmers learn together through group discussions and hands-on learning activities, which focus on identifying local agricultural challenges and proposing context-feasible solutions. Typically, an FFS includes the establishment of a "learning plot" to test and observe the productivity gains from a new agricultural input or practices in comparison with conventional practices.

The identification strategy for this evaluation is based on a randomized phase-in of communities per extension agent (EA). Assignment will thus be clustered at the community level, with farmers with a community assigned together to participate in FFS during the first wave of enrollment or not. The project is expected to establish a total of at least 720 FFS, working through 102 EA that are trained by FAO in the FFS methodology. The research team established the catchment for each EA and assigned each a random pipeline of communities in which to establish an FFS. Key indicators that will be tracked at the farmer level include knowledge and adoption of promoted technologies, crop yields and total agricultural production. The IE will initially capture outcomes for four agricultural seasons over two years, with preliminary results available following the midline survey in late 2021 and full results from early 2023.

The learning agenda will develop throughout the project lifecycle, and aside from the initial evaluation of the impact of the FFS methodology, the team will explore additional research questions that will generate knowledge on how to overcome challenges often faced by agricultural extension systems more broadly, such as: i) how to design incentive and monitoring systems for extension agents to ensure service delivery, ii) how to empower facilitators / local lead farmers to expand the reach of extension models through further dissemination of information, and iii) evaluate initiatives to overcome the constraints faced by female community members to become facilitators / local lead farmers, as well as study the impact of facilitator gender on farmer outcomes.

The research described in this CN links closely to the CN "Optimal Incentivizes for Adoption of Improved Agricultural Inputs", which describes the impact evaluation of the FAO-implemented eVoucher

interventions. To shed light on different constraints to adoption, the FFS and eVoucher intervention roll-out will be done in such a way that it allows us to assess the impact of the individual interventions as well as their complementarities, providing for a richer understanding of constraints to adoption more broadly. The impact evaluation is part of a large program of impact evaluations to generate evidence on rural development in Mozambique, which aim to address two high level policy questions: i) How to promote the sustained adoption of improved agricultural production practices? and ii) How to improve the linkages between producers and commercial markets?

1. Background and Key Institutional Features

Despite strong and sustained economic growth over the last two decades, poverty in Mozambique has remained high, particularly in rural areas (Baez and Elabed, 2020). National economic growth was primarily in capital-intensive and import-dependent sectors, while rural poverty remained entrenched, particularly in the agricultural zones of the Northern and Central provinces (Baez et al., 2018). 67% of Mozambicans live in rural areas (INE, 2017) and over 80% of the population derives its livelihood primarily from agricultural activities (Cunguara and Hanlon, 2010). However, the agriculture sector accounts for less than 32% of GDP (Suit and Choudhary, 2015). Increasing agricultural productivity and dynamism appears therefore to be a prerequisite for more inclusive economic growth.

Low agricultural productivity can largely be attributed to limited adoption and use of technologies, and to the continued prevalence of subsistence agriculture (Baez et al., 2018). In order to overcome binding constraints to rural households, the recent Mozambique Rural Income Diagnostic (Baez and Elabed, 2020) identifies i) increasing rural infrastructure investments, ii) increasing the availability and adoption of high-quality inputs, and iii) aligning incentives of value chain actors to improve commercialization as the key set of policy actions for rural income growth.

A comprehensive and widespread agricultural extension system could be used to promote the final two of these constraints through knowledge dissemination of improved agricultural inputs and best-practice techniques. Yet, only 6% of farmers reported receiving extension services in 2015 and on average there are around 4,000 farming households for each public extension officer to cover (Baez and Elabed, 2020). Extension services struggle to reach poorer farmers or female headed households (Cunguara and Moder, 2011), nor is there evidence that these services have clearly resulted in improved agricultural outcomes (Baez and Elabed, 2020).

Low prevailing education levels also play a strong role in learning from extension services. In 2009, over 90% of Mozambicans aged 15-34 had completed primary school or less. Within this category, who are now the 25-44 age group, agriculture is an especially dominant source of livelihood, employing over 90% of those with no education (Cho and Feda, 2015). This CN will focus on the role of information and models to transferring knowledge to farmers and describe the complementarities we will explore by overlaying this evaluation with a second impact evaluation looking at subsidies.

This impact evaluation (IE) seeks to build evidence on agricultural extension provision best practice in northern Mozambique, leveraging the upcoming Farmer Field School (FFS) program of PROMOVE-Agribiz, which will be implemented by the Food and Agriculture Organization (FAO) of the United Nations. The FFS methodology has been promoted as an improvement over the traditional public extension provision that has shown limited widespread technology adoption and knowledge transfer to farmers.

This Concept Note focusses on the design of the overall IE, however the learning agenda will develop throughout the project lifecycle, and aside from the initial evaluation of the impact of the FFS methodology, the team will explore additional research questions that will generate knowledge on how to overcome challenges often faced by agricultural extension systems more broadly, such as: i) how to design incentive and monitoring systems for extension agents (EAs) to ensure service delivery, ii) how to empower facilitators / local lead farmers to expand the reach of extension models through further dissemination of information, and iii) evaluate initiatives to overcome the constraints faced by female community members to become facilitators / local lead farmers, as well as study the impact of facilitator gender on farmer outcomes.

The research described in this CN links closely to the CN “Optimal Incentivizes for Adoption of Improved Agricultural Inputs”, which describes the impact evaluation of the FAO-implemented eVoucher interventions. To shed light on different constraints to adoption, the FFS and eVoucher intervention roll-out will be done in such a way that it allows us to assess the impact of the individual interventions as well as their complementarities, providing for a richer understanding of constraints to adoption more broadly. The impact evaluation is part of a large program of impact evaluations to generate evidence on rural development in Mozambique, which aim to address two high level policy questions: i) How to promote the sustained adoption of improved agricultural production practices? and ii) How to improve the linkages between producers and commercial markets? The program is managed under the ASA activity “DIME Mozambique Rural Development Impact Evaluations (P172877).

2. Description of the Intervention

This section describes the Farmer Field School methodology in detail. The description of the subsidy program is provided in the eVoucher specific CN. The FFS is a group-based learning approach, which was developed by FAO and first implemented in Indonesia in 1989. Since then, the methodology has been applied in over 90 countries in Africa, Asia and South America (FAO, 2018) and adopted by various NGOs. The FFS process combines technical assistance and training with a set of observational and participatory learning activities, such as comparative experiments, field observations and group analysis. The FFS methodology represents a departure from the traditional extension service as it is customarily structured in Mozambique and most sub-Saharan African countries. Farmers meet regularly with a trained facilitator, often an EA. Topics discussed range from agricultural practices to nutrition. Participants are encouraged to identify the topics most relevant to their local context. Instead of receiving top-down generalized recommendations or specific inputs, farmers are directly involved in group discussions and hands-on learning activities, which focus on identifying local agricultural challenges and proposing context-feasible solutions. Typically, an FFS includes the establishment of a “learning plot” in order to test and show the productivity gains from a new agricultural input or practices in comparison with traditional practices. Through the experimentation process in the learning plot, farmers observe the productivity gains from using different farming techniques and learn how to adapt such practices to their specific needs. Although this IE focuses on agriculture production systems, the same FFS methodology can also be applied to livestock and fisheries production.

The FFS combines group discussions of a broad set of topics of interest with field-based experimentation of agricultural practices. The themes to be discussed in the FFS are aligned with the wider PROMOVE-Agribiz objectives and include adoption of sustainable agricultural technologies, commercial farming and access to markets, personal finance, nutrition, hygiene and gender issues. The agricultural practices to be experimented in the learning plot are chosen among a set of conservation farming techniques. The learning crop is chosen by the farmers among the region’s main crops: maize, cassava and rice in the main season, and horticulture crops in the secondary season. Crop choice is complemented with intercropping and crop rotation productive systems with leguminous crops such as beans, cowpea, groundnut and other cover crops. The project will support the implementation of these learning plots by providing certified seeds, inputs and technical assistance. FFS members are directly involved in all phases of the production cycle, from land preparation to harvest. Farmer groups work together with the EA performing hands-on tasks such as analyzing the general status of the plants, measuring the growth of the crop, identifying the presence of pernicious (or beneficial) insects, following the level of infestation of the pest, understanding the agro-climatic conditions and their impact on soil fertility. FFS meets once a week and is generally composed of a group of around 25-30 smallholder farmers. The activities run throughout an entire agricultural campaign, i.e., covering both primary and secondary cropping seasons.

The FFS model was first introduced in Mozambique in 2001 in the context of the “Special Food Security Project” implemented by FAO, which implemented 124 FFSs between 2001 and 2005. Moreover, FAO also implemented the program “Support to Accelerate Progress Towards MDG1c in Mozambique”,[1] supporting 25,775 farmers (FAO, 2019b). FFS are also implemented in Mozambique by Care International and other organizations. The forthcoming FFS program is to be implemented by FAO in 10 districts in Nampula and Zambézia provinces in northern Mozambique under the EU financed PROMOVE-Agribiz program. In Nampula the project districts are Angoche, Malema, Meconta, Mogovolas and Ribáuè, while in Zambézia the districts are Alto Molócuè, Gurúè, Mocuba, Namacurra and Nicoadala. Four of these ten districts (Malema, Ribáuè, Alto Molócuè and Gurúè) were part of the MDG1 FFS project. The FFSs are directly implemented by public EAs from the District Services for Economic Activities (*Serviços Distritais de Actividades Económicas* – SDAE) government offices. Around 100 EAs will establish FFSs in 720 communities by the end of the project in 2024.

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[1] The program was designed and implemented by FAO in partnership with the Government of Mozambique and with financing by the European Union (EU). The project was implemented between June 2013 and June 2019 in seventeen districts in the provinces of Beira, Manica, Nampula, Sofala, Tete and Zambézia.

To assess the ability of the FFS methodology to successful transfer knowledge and increase adoption of improved inputs, we have worked with FAO to define a core curriculum of practices and accompanying learning goals. The sustainable land management (SLM) practices that will be promoted include row planting, mulching, intercropping, rotation, zero-tillage, and contour farming. Other related activities, which are considered as complementary to SLM techniques, are the production of organic or fermented fertilizer ("Biol"), composting and green manure. They will be targeted to the main crop selected by the FFS for that season. The learning plot will also be used to show the returns to the modern inputs that are covered by the eVoucher intervention that will be rolled-out by FAO in parallel to the FFS. They include improved seeds, inorganic fertilizer, post-harvest pesticides for seed conservation and agricultural services. The FFS methodology is based on a participatory process to define the topics to be discussed, but these core practices will be covered in all FFSs in a relatively standardized way and form the basis of the measurement strategy to evaluate impact in knowledge and adoption.

During the establishment process of the FFS, the EA identifies an FFS facilitator among the group members who will be responsible for keeping the FFS active in the following production cycle. Following the first FFS cycle, which covers a full agricultural year and concludes with the "graduation" of its members, all selected "farmer facilitators" will receive an intensive training from FAO, which is analogous to the one that EAs received at the beginning of the project. This allows the FFS to continue with fewer visits from the EA and so become self-sustaining over time.

3. Literature Review

Technology innovation is one of the key drivers of economic and rural development. Despite the existence of profitable agricultural technologies, such as improved seeds and chemical fertilizers, adoption has remained stubbornly low in sub-Saharan Africa. Consequently, agricultural yields have been generally low and flat over the last 40 years in comparison to the rest of the world. Information failures have been recognized to play a major role in hindering technological diffusion process. To address this concern, agricultural extension services, which nowadays represent a large share of government spending on the primary sector, aim to promote the diffusion of innovative farming practices (Goyal and Nash, 2017). In a decentralized model of extension networks, information flows from researchers to extension workers, and from extension workers to contact farmers (CFs). CFs are then expected to complete the lab-to-farm technology diffusion by training peer farmers who live in the same community (Pamuk et al., 2014).

This IE advances the literature on agricultural extension service by evaluating the FFS methodology as a novel extension methodology in the context of smallholder farming in Mozambique. The literature on FFS to date is quite mixed and mostly based on non-experimental methods, such as linear regressions controlling for confounders, propensity score matching and difference-in-differences techniques. Godtland et al. (2004) find that farmers participating in a potato FFS in Peru have higher knowledge about integrated pest management practices. Similarly, Feder et al. (2004a, 2004b) use panel data covering 8 years in Indonesia and find modest gains in knowledge among trained farmers; however, they do not find significant effects of the program on pesticide use and yields. Davis et al. (2012) show that participation in FFSs in Eastern Africa increased crop productivity and agricultural income among women, low-literacy, and medium-land-sized farmers. Larsen and Lilleør (2014) find a positive impact of an FFS intervention in Tanzania on food security but no impact on poverty. Friis-Hansen and Duveskog (2012) suggest that the most important impact of FFS participation lies in farmer empowerment and increased subjective well-being.

To the extent of our knowledge, the only RCT that directly relates to our IE, is Emerick and Dar (2020). The study, set in India, looks at one salient feature of the FFS methodology, the "farmer field day", which happens at the end of the cropping season to allow FFS first users and demonstrators to share information about the technology they have been trained on with neighboring farmers. Non-FFS farmers are invited to visit the demonstration plot so to observe and discuss the experimentation and verify its main benefits. The results show that farmer field days cause a 40 percent increase in the uptake of an improved seed by reducing learning frictions in a cost-effective manner.

Despite the lack of rigorous evaluations using experimental design and sound identification strategy to study the causal impact of FFS on agricultural productivity and income, extension models that share key aspects of the FFS methodology provide some insights on the potential effect and mechanisms of the intervention. An emerging literature focuses on ways to tailor agricultural extension programs so to enhance technological adoption among smallholder farmers. Kondylis et al. (2017) evaluate the impact of augmenting the CF model with a direct CF training on the diffusion of SLM practices in central Mozambique. Analogous to the FFS model, CFs employ demonstration activities and receive on-site feedback from EAs with the objective of supporting experiential learning among peer farmers. The hypothesis tested in this randomized experiment is whether a change in CF demonstration effort, endogenously induced by the centralized training, affect the process of diffusion to other farmers in the community. The findings unveil that, even if directly training CFs leads to a large increase in adoption among CFs, higher levels of CF adoption do not significantly spill over to farmers within the community.

One potential strategy to tackle informational deficiencies is to involve more women in communication tasks. Recent research shows that knowledge acquisition and adoption of new practices is sensitive to the gender of EAs and CFs. Kondylis et al. (2016) find that female farmers learn more effectively about SLM techniques from other female farmers. Conversely, Beaman and Dillon (2018) use network data from Malian villages and show that female farmers are generally less socially connected than male farmers and therefore are less likely to play a connecting role between other community members who are otherwise not connected. Based on these findings, they suggest that targeting information via social networks may reinforce existing gender information inequalities. BenYishay et al. (2020) examine the drivers of gender gaps in participation in extension services in rural Malawi. In this context, the ratio between male and female extension workers is 8 to 1, even though half of maize farms are managed by women. In a sample of 143 villages, men and women were randomly assigned the task of learning about a new conservation agricultural technology, who would then present it to others to convince them to adopt it in their own fields. The authors find no gender gap in the knowledge and adoption of such technology. However, other farmers are less willing to learn from female communicators, whom they perceive to be not as good at farming as their male counterparts. Despite this, other farmers learn just as much about the technology when the communicator role is reserved for women and they experience similar farm yields. The authors also find suggestive evidence that this effect is driven by social norms and attitudes.

Besides information failures, farmers often face other constraints to technology adoptions, such as low input availability (or quality) and lack of credit (see, e.g., Carter et al., 2019, in Mozambique). In this scenario, an intervention that only tackles one of these constraints may not be sufficient to have an economically meaningful impact on agricultural productivity. Deutschmann et al. (2019) test this hypothesis by studying the One Acre Fund small farmer program in Kenya, which bundles direct training with loans for high-quality inputs and crop insurance. This program succeeded in boosting agricultural yields and profits. While the randomized controlled trial (RCT) did not randomly vary the three components of the intervention, heterogeneity analysis suggests that relaxing information constraints – through weekly training on optimal planting practices – does not by itself explain the program's success. In the context of irrigation schemes in Rwanda, Jones et al. (2020) show that failures in land and labor markets contribute to the yield gap by hindering technology adoption.

Second, this IE contributes to the literature addressing measurement challenges in household surveys. The measurement of skills in the developing country context, especially regarding agriculture knowledge, is mostly based on methods that were validated in developed countries. This poses the risk that these survey measures suffer from large measurement error, which, in turn, would have substantial implications for empirical work. Kondylis et al. (2015) use a household survey from central Mozambique – recording subjective and objective responses – to estimate the measurement error from self-reported adoption and knowledge of three conservation farming practices, which are also central to the FFS intervention, i.e., intercropping, mulching, and strip tillage. Despite the significant gaps in human and physical capital, they do not find any obvious differences in measures of knowledge and adoption as well as in error in self-reporting between men and women. The exposure to a training is negatively correlated with knowledge misreports and positively associated with adoption misreports, while other determinants of reporting error, such as land fragmentation, farm size and recall decay, differ by gender. Laajaj and Macours (2020) draw on information on skills, agricultural practices and production on a sample of more than 900 Kenyan farmers. They find that cognitive skills are measured with a high degree of reliability and internal consistency, while technical skills on agriculture knowledge and know-how suffer from large classical measurement error, which could lead to attenuation bias. The FFS intervention provides an ideal scenario for further understanding agricultural skill measurement in rural settings in developing countries and, eventually, testing methodological ways to improve on the reliability and validity of current standards of survey design.

Finally, our project relates to the literature looking at teacher characteristics and pupil education outcomes. Growing literature focusing on teacher value-added and using randomized experiments show that teacher quality is a key determinant of student learning (World Bank, 2018). One relevant observable factor that explains teacher quality is subject knowledge. Metzler and Woessmann (2012) explore within-teacher within-student variation in Peruvian primary schools and find that teacher subject knowledge has a statistically significant impact on student achievement: namely, one standard deviation increase in teacher test scores in a specific subject raises student test scores by about 10 percent of a standard deviation. Bold et al. (2017) also show descriptive evidence supporting the claim that low subject-specific knowledge reduces teacher effectiveness in developing countries. In addition, teacher effort and pedagogical skills are deemed to be complementary ingredients of teacher quality. As FFSs represent a platform of participatory agricultural education, we provide evidence on whether the patterns observed in the economics of education literature matters for agricultural extension.

4. Policy Relevance

The project has tremendous potential for informing policy at various levels. First, within the context of the PROMOVE-Agribiz program, the lessons learned from the overall FFS evaluation as well as reports from the detailed monitoring data will support the teams on whether to make mid-course corrections to maximize impact. Throughout the IE, the research team and Maputo-based analyst will communicate findings from the evaluation and progress of the project's implementation between all stakeholders to jointly identify opportunities for follow-up learning. Initial findings of key challenges will inform the design of follow-up research questions.

At the national level, there is significant scope for using preliminary and full IE results to inform the national policy for agricultural learning and technology transfer. Currently, extension support services have been orientated by the Strategic Plan for the Development of the Agricultural Sector 2011-2020 (PEDSA) and the Extension Master Plan 2007-2016. Both strategies have reached the end of their mandate period and are due to be redesigned shortly, commencing with the PEDSA II in mid-2021. Preliminary data from this IE (and other DIME IEs in Mozambique) can be utilized to inform strategic direction, as well as support decision making in the National Agricultural Investment Plan (PNISA II) that implements the PEDSA II strategy over the forthcoming decade. Determining which agricultural extension model to promote (and under which context) should be a high priority for the newly formed National Directorate of Family Farming Support (DNAAF) of the Ministry of Agriculture and Rural Development (MADER). The monitoring and evaluation system of FFS visits and activities established as part the IE can also be embedded in the national FFS monitoring database housed within DNAAF. The DIME team will train DNAAF officials on data collection procedures and supervising data collection platforms at the central level, as well as analyzing the data generated to inform decision making. DIME will also provide technical support on scaling up the monitoring framework to cover non-project extension services.

Third, at the international level, the impact evaluation will provide evidence to support the design of the large community of FFSs, which are implemented by FAO and other organizations throughout the world. It is expected to create an information flow between DIME, FAO Mozambique and the Global FFS Platform to share the IE experience from the design, implementation and the knowledge products produced. Finally, we will aim to contribute to closing the knowledge gap on how to improve extension services in developing countries more broadly by not only testing the overall impact of the FFS methodology, but also understanding common challenges faced in other approaches and testing general mechanisms. Examples of such are the design of incentives and monitoring of local service providers, how to empower local farmers to play in diffusing knowledge, and how to increase participation of women as FFS facilitators.

The different ways in which the research team will engage with stakeholders at these different levels are further described in Section 12. The extent to which the evaluation affects policy will be reported yearly and tracked through DIME's 'myIE' monitoring system.

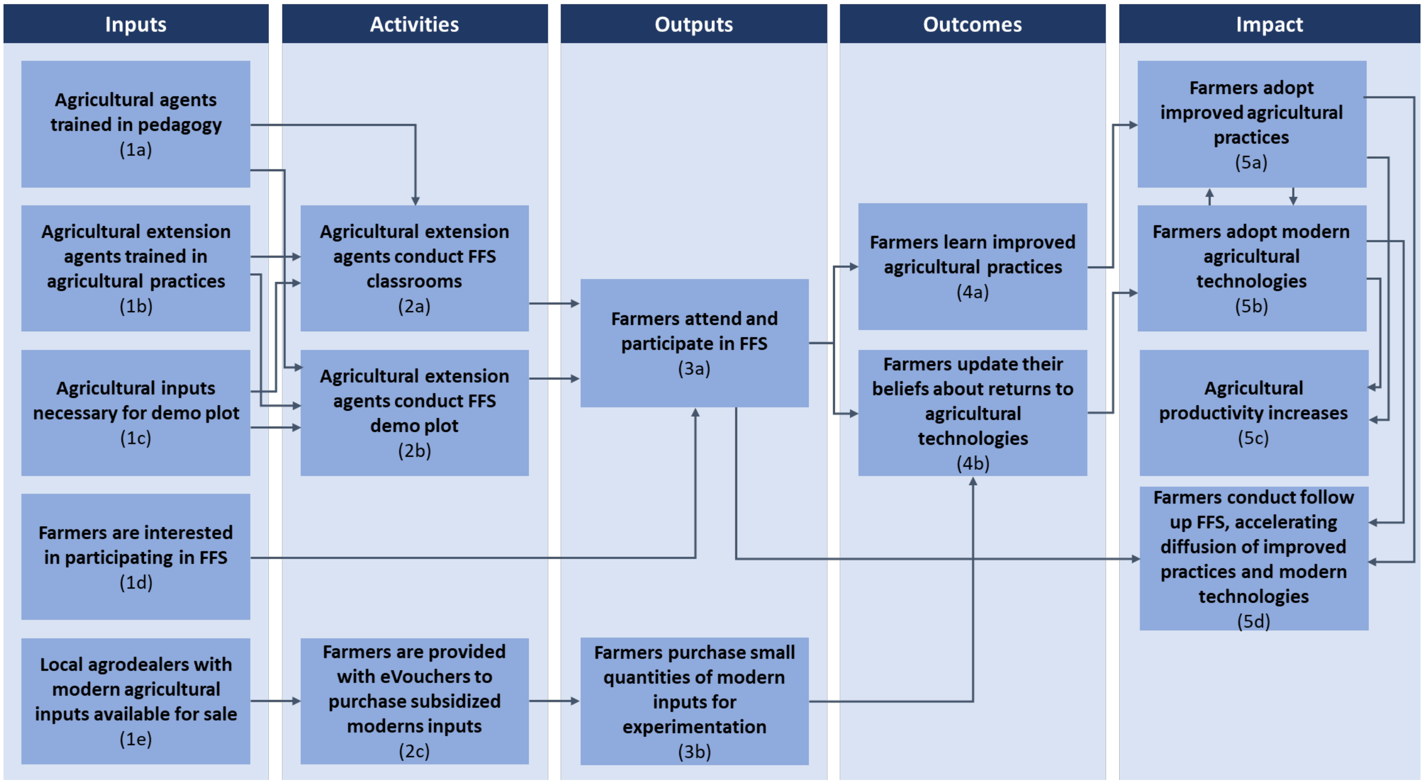
5. Theory of Change

The theory of change in Figure 1 below presents the hypothesized causal chain of the FFS intervention, and its interaction with the eVoucher intervention. Agricultural EAs deliver the FFS, where they organize farmer groups into weekly meetings ("classroom"), in which they discuss agricultural practices and technology, and apply lessons to a learning plot they cultivate together during the meetings. At the conclusion of each agricultural season, EAs and farmers jointly determine whether the farmers have successfully learned what they sought to from the FFS and in turn "graduate". Simultaneously, farmers are provided with eVouchers that enable the purchase of modern agricultural inputs at subsidized prices, with a focus on small packages that enable experimentation.

For the FFS to take place, EAs must conduct these FFSs (2a) using their knowledge of agricultural practices (1b) and training on pedagogy they have received from FAO (1a). The learning plots they cultivate jointly with the farmers (2b) require agricultural inputs provided by FAO (1c). If there is sufficient demand from farmers for an FFS (1d), then farmers will attend and participate in the FFS, including the classroom sessions and learning plots (3a). For the eVoucher distribution and redemption process to be implemented, local agrodealers must be in place with modern agricultural inputs available for sale (1e), before farmers are provided with eVouchers to purchase these inputs at subsidized prices (2c). If prices are sufficiently low, farmers will purchase these inputs (3b).

As a result of the FFS, and if agricultural EAs are sufficiently well informed and pedagogically trained, farmers will learn improved agricultural practices (4a) and update their beliefs about the returns to agricultural technologies used on the learning plots, including fertilizer (4b). eVouchers interact with these impacts, as farmers learn from experimenting with modern agricultural inputs on their own plots. Experimentation with subsidized inputs and learning from the FFS may complement (if learning from experimentation reinforces "classroom" learning) or substitute (if learning from experimentation and classroom learning provide identical information) in shifting these outcomes. As a result of this learning and updated beliefs, farmers will adopt improved agricultural practices (5a) and modern agricultural technologies (5b), which in turn will drive increases in agricultural productivity (5c). Finally, farmers who have adopted these practices and technologies because of the FFS will see the value of the FFS and will conduct a follow up FFS in their communities (5d), further diffusing the practices and technologies adopted due to the FFS through their communities.

FIGURE 1: THEORY OF CHANGE FFS



6. Hypotheses/Evaluation Questions

The hypotheses derived from the theory of change are:

- (3a → 4a+4b) Farmers who participate in the FFS will learn about improved agricultural practices, and positively update their beliefs about the returns to modern agricultural technologies.
- (3b → 4a+4b) Farmers who receive eVouchers will learn about improved agricultural practices, and positively update their beliefs about the returns to modern agricultural technologies.
- (3a+3b → 4a+4b) FFS and eVouchers may complement or substitute in causing farmers to learn about improved agricultural practices, and positively update their beliefs about the returns to modern agricultural technologies.
- (1a+1b+3a → 4a+4b) Farmers will learn more from agricultural extensions agents who are particularly knowledgeable about improved agricultural practices and are pedagogically skilled.
- (3a → 4a+4b) Farmers who did not participate in the FFS will learn from farmers who did participate in the FFS.
- (3b → 4a+4b) Farmers who did not receive eVouchers will learn from farmers who did receive eVouchers or through increases in their access to modern agricultural inputs.

- (3a+3b → 4a+4b) The spillover effects of FFS and eVouchers may complement or substitute in causing farmers to learn about improved agricultural practices, and positively update their beliefs about the returns to modern agricultural technologies.
- (3a+3b → 4a+4b → 5a+5b) Farmers who participate in the FFS or receive eVouchers will increase their adoption of improved agricultural practices that they learn about, and of modern agricultural technologies that complement those practices or about which their beliefs positively update.
- (3a+3b → 4a+4b → 5a+5b → 5c) Farmers who participate in the FFS or receive eVouchers will see their agricultural productivity increase as they have adopted practices and technologies which increase their productivity.
- (3a → 5d) Farmers who participated in the FFS will value it as a methodology for promoting improved agricultural practices and will use the FFS methodology to spread these practices to others in their community.

Which in turn lead to the following evaluation sub-questions: What are the impacts of FFSs on…

- (3a → 4a+4b) farmers' knowledge about agricultural practices and their beliefs about the returns to agricultural technologies?
- (1a+1b+3a → 4a+4b) farmers' knowledge about agricultural practices and their beliefs about the returns to agricultural technologies, and how do these impacts vary with the knowledge and pedagogy of agricultural EAs?
- (3a → 4a+4b) the knowledge about agricultural practices and the beliefs about the returns to agricultural technologies of farmers who did not participate in the FFS?
- (3a → 4a+4b → 5a+5b) farmers' adoption of improved agricultural practices and modern agricultural technologies?
- (3a → 4a+4b → 5a+5b → 5c) agricultural productivity?
- (3a → 5d) the community led implementation of future FFSs?

And what are the impacts of eVouchers on…

- (3a+3b → 4a+4b) the impacts of FFS on farmers' knowledge about agricultural practices and their beliefs about the returns to agricultural technologies?
- (3a+3b → 4a+4b) the impacts of FFS, both for farmers who did and did not receive eVouchers and for farmers who did and did not participate in FFS, on the knowledge about agricultural practices and the beliefs about the returns to agricultural technologies?

Each evaluation sub-question corresponds to a hypothesis, and each hypothesis was derived from a set of nodes and their precedents on the theory of change. The primary evaluation question is on the one intervention (FFSs).

7. Evaluation Design and Analysis

7.1 Treatment and Control Groups

The project will be implemented in ten districts of the northern provinces of Nampula and Zambézia, namely Angoche, Malema, Meconta, Mogovolas, Ribáuè, Alto Molócuè, Gurúè, Mocuba, Namacurra, and Nicoadala. FAO selected which of the EAs in these districts would participate in the program and trained a total of 102 EAs. The identification strategy for this evaluation is based on a random phase-in of communities per EA. Assignment will be clustered at the community level.

Community selection. First, the research team conducted a full listing of all communities currently being serviced by each of the participating EAs.[2] This list includes a total of 881 communities with a minimum number of 6 communities per EA. The final target of the project is to establish at least 720 FFS. Second, the order in which each EA will establish their FFSs are randomized according to the following roll-out schedule:

A. 2 FFSs in the primary cropping season of 2020/2021 (total of 204);
B. 2 FFSs in the secondary season of 2020/2021 (total of 204);
C. 1 FFS in the primary season of 2021/2022 (total of 102);
D. 1 FFS in the secondary season of 2021/2022 (total of 102); and
E. 1 FFS in the main season of 2022/2023 (total of 102).

The first two FFS will be our main treatment group and the last two communities in the EA schedule will serve as control group, whom will initially not receive any additional support besides the business-as-usual extension service. Cohort C will not be part of the IE and in fact is not identified yet. Jointly with FAO we will aim to introduce this cohort to extend the period over which we assess the impact. The exact roll-out schedule is still under discussion and in particular maybe affected by the Covid-19 crisis, which is delaying roll-out of the FFS. The schedule above is therefore indicative with two main take-aways: 1) the design is based on the random order in which EAs start new communities and 2) the period over which we will be able to assess the impact over will be limited to the time between the first 2 and the last community to enter. If the schedule needs to be compressed, this can still be done randomly and will thus not invalidate the design, it does however shorten the time period over which we can cleanly attribute changes in knowledge, practices, and production to the intervention.

In cases where EAs listed more than six communities, only a subset of communities will be selected randomly. Each EA will also conduct an initial pilot FFS, which will not be part of the IE but is used to ensure proper implementation and pilot data collection protocols.

[2] Communities that had previously participated in the MDG1 project or are not accessible throughout the main season are excluded.

Farmer selection. Interested farmers are signed up in an initial village meeting, during which the EAs explain the concept of the FFS. It is expected that all farmers that are interested will be able to participate, but groups will be limited to around 30 members. To identify potential participants in both our treatment and control groups, the listing is performed in both the first two and last two communities prior to launching the first FFSs. The EA will only be informed which two out of the four communities are to be served first after the listing is completed. The listing will be our sampling frame for the baseline data collection.

We do not expect to encounter ethical concerns as a result of the random phase-in. The process results in nearly all communities in the catchment of the selected EAs being served by the program. Any exclusion of communities is therefore mostly a result of the EA selection, which results from capacity constraints rather than priorities of the impact evaluation. There may be some slight oversubscription, for which the randomization is the most transparent way of prioritizing communities. Interested farmers within the community will be able to participate. The identification strategy alters only the order in which farmers receive support from the intervention and not the ultimate list of beneficiaries.

Complementarities with the eVoucher intervention. To assess the impacts of the FFS, the eVouchers and their complementarities, we will generate experimental variation to farmers' access to each of these interventions. To test for complementarities, we will randomly select a subset of FFS's and within those a subset of farmers to also be eligible to receive the eVoucher intervention.

7.2 Model Specification for Quantitative Data Analysis

To estimate the impacts of FFS, we will estimate the following specification:

$$y_{i,v,t} = \beta_{1,t} FFS_v + \delta_t y_{i,v,0} + \gamma_{s(v),t} + \epsilon_{i,v,t}$$

Where i indexes households, v indexes villages, and t indexes time periods. y is an outcome variable of interest, FFS_v is a dummy variable indicating that village *v* was randomly assigned to be an FFS village, and $\gamma_{s(v),t}$ is a set of randomization strata-by-time period dummies. Analysis controls for baseline values of the outcome of interest ($y_{i,v,0}$) to improve precision. The coefficient $\beta_{1,t}$ is the parameter of interest and reflects the village level intention-to-treat (ITT) effect of FFSs, which includes effects of participation and any within village spillover effects. Statistical inference will be conducted using randomization inference.

In addition, we are interested in whether characteristics of EAs modify the impacts of FFS. Let $x_{e(v)}$ be a vector of characteristics of the agricultural EAs assigned to village *v*: specifically, a measure of their knowledge of agricultural practices and a measure of their knowledge of pedagogical practices. We will then estimate:

$$y_{i,v,t} = \alpha_t FFS_v + FFS_v \times x'_{e(v)} \beta_{2,t} + \delta_t y_{i,v,0} + \gamma_{s(v),t} + \epsilon_{i,v,t}$$

The coefficient $\beta_{2,t}$ is the parameter of interest and reflects the differential effect of FFS when agricultural EAs are particularly knowledgeable about agricultural and/or pedagogical practices. As randomization of an FFS is stratified across EAs, the control $x_{e(v)}$ is subsumed by the randomization strata controls. Additionally, as agricultural EAs and their knowledge are not randomly assigned, we interpret these coefficients as suggestive of causal effects of EA knowledge. Lastly, as this analysis regards the effect of an EA characteristic, robust standard errors are clustered at the agricultural EA level.

If statistical power permits, we will also survey a set of households in each village that were not initially sampled as likely FFS participants. Let $Interested_{i.v}$ denote that household i expressed interest in participating in an FFS. We will then also estimate

$$y_{i,v,t} = \beta_{3,t}FFS_v + \beta_{4,t}Interested_{i,v} \times FFS_v + \alpha_t Interested_{i.v} + \delta_t y_{i,v,0} + \gamma_{s(v),t} + \epsilon_{i,v,t}$$

We now have two coefficients of interest. First, $\beta_{3,t}$now captures the spillover effects of FFS, i.e., the effects of FFS on households that did not initially express interest in participating. Second, $\beta_{4,t}$captures the direct effect of FFS, i.e., the additional effect of FFS on households that expressed interest in participating. To control for differences between the two groups of households, α_t captures differences between interested households and uninterested households in control communities.

Next, we are interested in the interaction between FFS and eVouchers. Let $eVoucher_v$ denote that village *v* was assigned to receive eVouchers. Note that assignment of villages to receive eVouchers will be stratified against FFS assignment within randomization strata. We will then estimate

$$y_{\{i,v,t\}} = \alpha_{1,t}FFS_v + \alpha_{2,t}eVoucher_v + \beta_{5,t}FFS_v \times eVoucher_v + \delta_t y_{i,v,0} + \gamma_{s(v),t} + \epsilon_{i,v,t}$$

$\beta_{5,t}$ now captures the interaction between FFS and eVouchers: if it is positive, then FFS and eVouchers are complements, but if it is negative, then FFS and eVouchers are substitutes.

Lastly, if statistical power permits, we are interested in the impacts of eVouchers on households that did not participate in the FFS.

$$\begin{aligned} y_{i,v,t} = {} & \alpha_{1,t}FFS_v + \alpha_{2,t}Interested_{i,v} + \alpha_{3,t}FFS_v \times Interested_{i,v} + \alpha_{4,t}eVoucher_v \\ & + \alpha_{5,t}Interested_{i,v} \times eVoucher_v + \beta_{6,t}FFS_v \times eVoucher_v + \beta_{7,t}FFS_v \times Interested_{i,v} \times FFS_v \\ & + \delta_t y_{i,v,0} + \gamma_{s(v),t} + \epsilon_{i,v,t} \end{aligned}$$

$\beta_{6,t}$ is the differential effect of eVouchers on non-interested households in FFS communities relative to non-interested households in non-FFS communities. It captures the interaction between eVouchers and the spillover effects of FFS. $\beta_{7,t}$ is the difference between this effect and the differential effect of eVouchers on interested households in FFS communities relative to interested households in non-FFS communities. It captures the interaction between eVouchers and the direct effects of FFS. Lastly, a similar analysis is possible using households assigned and not assigned to receive eVouchers; for parsimony we do not present it here, but intuitively this allows the separate estimation of the interaction between FFS and the direct and spillover effects of eVouchers.

Estimating an ITT using random assignment avoids concerns of endogenous take-up. Differential non-response or attrition is a potential concern and will be tested for. If we find evidence of differential non-response or attrition, Lee (2009) bounds will be reported on all outcomes.

We plan to register this IE in the AEA RCT registry. We do not have a plan to address multiple hypothesis testing currently, but a common practice is to control false discovery rate following Anderson (2008) across all primary outcomes. Our primary outcomes are listed in Section 0.

7.3 Sample Size Calculations

The randomization of treatment assignment is done at the cluster ("*povoado*" or community) level while the unit of observation, at which surveys are administered, is the household. Therefore, our sample size is limited by the number of communities that will be part of the experiment and the number of farmers that will be surveyed in each of the communities. The IE encompasses around 400 communities, 200 in the treatment arm and 200 in the control group. In each of these communities, a random sample of 12 farmers, who were listed by the EAs as being interested in participating in an FFS, will be surveyed, resulting in a total sample of 4,800 farmers. Given these parameters on cluster size and the number of observations within each cluster, we calculate the minimum detectable effects (MDEs) assuming a power of 0.8, an alpha of 0.05, and an intra-cluster correlation (ICC) of 0.1. Below we present the power calculations for the main indicator directly targeted by the intervention, i.e., technology adoption of a set of key farming practices, and the final outcome of interest, i.e., agricultural yields, defined as total revenue per hectare cultivated.

Technology adoption

Let's assume, for simplicity, that technology adoption is measured by a binary variable (for example, a dummy for improved seeds and fertilizer use, or a summary index of conservation farming practices ranging between 0 and 1). According to data from a smallholder survey collected in an adjacent region of Mozambique (Kondylis et al., 2015; 2017), 35% of farmers use organic fertilizers in their main plot, 6% pesticides and 1% chemical fertilizers. On the other hand, adoption of SLM techniques, such as mulching, row planting, and strip-tillage, vary between 5 and 20%. This implies that the standard deviation (SD) of these outcome variables is lower than 0.5 and decreases with average adoption. As a result, the MDE of an increase in technology adoption ranges from 2 to 9 percentage points, i.e. a percentage change of 200 to 18 compared to the baseline level.

Table 1. MDE of Binary Outcomes

Mean	Standard Deviation	MDE	MDE (% change)
0.01	0.09	0.02	200
0.05	0.21	0.03	60
0.10	0.30	0.04	40
0.25	0.43	0.05	20
0.50	0.50	0.06	12

An alternative way to look at this is by defining technology adoption as a standardized variable with mean equal to 0 and SD equal to 1.[3] In such case, the MDE would be 0.12 SDs, assuming the scenario above.

In the case of incomplete take-up, e.g., some of the initially interested farmers drop out from the FFS group, we divide the MDE by the rate of program compliance. For instance, a program take-up of 75% (50%) would increase the MDE to 0.16 (0.24) SDs.

Yield

Our sampling frame for yield is the same as above. Using data from a recent DIME survey in the project provinces, mean maize revenue per hectare (MZN/ha) is 5,400 with a standard deviation of 6,732 and ICC 0.1. With a baseline and one follow up survey, assuming a correlation coefficient between measures in the two phases is 0.35, we should be able to detect an impact of 750 MZN, i.e., roughly a 14% increase in yield outcomes.

Interaction with eVoucher Program

We also run power calculations for estimating the MDE of the interaction between the FFS and the eVoucher programs. In particular, we are interested in the interaction coefficient between the two treatment indicator variables. For simplicity, we present results for the technology adoption binary outcome. When the program assignment is balanced across arms, the standard errors for the interaction are double than the standard errors for the single treatment impact. Columns (2)-(3) in Table 2 shows MDE as a function of baseline means, assuming the sampling frame and parameters specified above. In columns (4)-(6), we add a conservative projection for the case where only half of the communities in the FFS experimental sample are eligible for the eVoucher randomization, which results in a sample size of 200 clusters.

[3] Different farming techniques can be combined in a summary index by taking the equally weighted average of the normalized variables. The aggregation implies significant gains in statistical power to detect effects that go in the same direction within a domain (Kling et al., 2007).

Table 2. MDE of Binary Outcomes

	400 clusters		*200 clusters*	
Mean	MDE	MDE (% change)	MDE	MDE (% change)
(1)	(2)	(3)	(4)	(5)
0.01	0.03	300	0.05	500
0.05	0.08	160	0.11	220
0.10	0.10	100	0.15	150
0.25	0.15	60	0.21	84
0.50	0.17	34	0.25	50

8. Data Collection and Management

8.1 Main Outcomes of Interest

We will measure the main variables along the theory of change.

Table 3. Main Outcomes of Interest

Outcome Type	Outcome Name	Definition	Measurement Level	Source
Primary				
Farmer	Yield/ha	Total Revenue per hectare cultivated	Individual/ plot	Household survey
Farmer	Net Yield	Total Revenue from crop harvest net input costs	Individual/ plot	Household survey
Farmer	Profits	Total income received from crop sales net input costs	Individual	Household survey
Secondary				
Farmer	Attendance	Average number of sessions attended per month	Individual	Monitoring system Household survey
EA	Attendance	Average number of sessions led per month	Individual	Monitoring system Household survey
Farmer	Test score	Knowledge of promoted practices	Individual	Household survey
EA	Test score	Knowledge of promoted practices	Individual	EA survey
Farmer	Adoption	Adoption of promoted practices	Individual/ plot	Household survey
Learning plot	Adoption	Adoption of promoted practices	Plot FFS	Monitoring system Household survey
Learning plot	Yield	Total Revenue per hectare cultivated	Plot FFS	Monitoring system Crop cuts
Facilitator	Gender	Dummy variable	FFS	Monitoring system Household survey
Farmer	Food security	Minimum dietary diversity for women (MDD-W)	Individual	Household survey

8.2 Quantitative Instruments

Monitoring system

The team will set up a high frequency monitoring system that will record the details of each EA visit to a community. More details are provided in Section 9.5. The surveys will capture information on farmer attendance, EA visits to each community, topics discussed, and activities performed on the learning plot. The surveys will be administered on tablets and submitted weekly by the EAs.

Agriculture household surveys

Multi-module agriculture household surveys are planned for a sample of farmers in all 200 treatment and 200 control FFSs. The sample will include the identified facilitator in each FFS as well as a random sample of farmers from the group of initially signed up farmers. The surveys will capture relevant information to compute yield and profit, such as self-reported landholdings, crop choice, harvest, sales and input use (labor, fertilizer, pesticides and seeds) as well as general household characteristics. The yield data will be collected separately by plot and crop. Other secondary outcomes that will be captured in the household survey are knowledge and adoption of promoted agricultural practices, beliefs on the returns to the promoted practices, participation in the FFS, access to extension services and indicators of nutritional security and diversity. At least two large scale surveys are planned: the baseline survey is expected to be collected in September 2020 and cover the main and secondary season of the 2019/20 agriculture season. The second survey is planned for September 2021 (still before FFSs are established in the control communities), with an endline survey planned to follow at September 2022.

Knowledge test

The knowledge test of agricultural best-practice was developed based on the knowledge test used in Kondylis et al. (2017), which promoted similar practices, and jointly with master trainers from FAO adapted to the FFS curriculum. The test uses multiple-choice questions and captures the core curriculum of promoted practices, such as row planting, mulching, intercropping, rotation, fallowing, zero-tillage, contour farming, composting and organic fermented fertilizer. The test was piloted with several EAs and will undergo extensive piloting before inclusion in the agriculture household surveys. The knowledge test was applied at the beginning and the end of the EA training, prior to them establishing any of the FFSs in our sample and will be included in the household survey. The results are presented in Annex A and summarized in the brief "Farmer Field School – Building Capacity of Extension Agents".

Extension agent survey

During the same period as the household survey, all EAs that are engaged with implementing FFSs will be surveyed. The survey will include cover basic characteristics, training and experience, knowledge test on agricultural practices, and experience and beliefs on the returns to promoted practices.

Learning plot

As described in Section 3, the FFS group is expected to establish a learning plot in each of the FFS communities. The weekly monitoring system will capture the GPS location of the plot perimeter, the types of demonstrated agricultural practices, weekly inputs used, and activities performed. The team will partner with FAO and the local university in Nampula to develop a measurement protocol to capture yields on these plots through crop cutting.

8.3 Management of Data Quality

All data collection activities will be closely supervised by the Maputo based Analyst and Field Coordinators based in Nampula and Zambézia. Where possible we will collect indicators through different sources to corroborate the data.

The agriculture data collection instruments are based on experiences from four previous impact evaluations carried out by DIME in the agriculture sector in Mozambique, and will be piloted extensively in the field prior to going starting the data collection to ensure they are appropriate for the local context. Enumerators will participate in extensive training of the questionnaire and functioning of the tablets. Training will include classroom and field training. Enumerators will be selected based on their performance during the training. The data will be collected electronically and follow all DIME Analytics standard quality control measures, including within survey consistency checks and running of detailed daily quality checks. Checks will verify internal consistency of submitted interviews as well as track enumerator performance. Audits will be performed by recording parts of the interview and performing back-check interviews by a different team of interviewers. Cross-checking of the data will allow us to provide immediate feedback to the field teams in case of divergences or other problems.

Quality control measures of the monitoring system are discussed in Section 9.5 below.

8.4 Ethical Issues

Prior to initiating field work, the research team and survey firms will inform all relevant authorities of their activities. Prior to collecting data in any community, a meeting will be held with local leadership. All survey participants will be carefully informed about the data that will be collected throughout the study, the purpose of the surveys and the fact that their participation is voluntary. Only after participants provide consent will their data be collected.

Strict protocols will be put in place to ensure data remains confidential. Appropriate security protocols will be observed in the transfer or transmission of datasets when sharing Personal Identifiable Information (PII) during data transfers and other forms of communications as well as for the storage of this data. The World Bank data protection policy will be strictly adhered to and can be accessed through this link.

8.5 IE IMPLEMENTATION MONITORING SYSTEM

The team will set up a high-frequency monitoring system to document the delivery of the FFS intervention. Each of the EAs will be equipped with a smartphone with data collection software preinstalled. Each phone will contain several short survey forms to be filled in by the EA at different stage of the FFS. The EA will be given a small incentive, which also covers the cost of submitting the forms to the server each week via the phone network, which will be paid upon submission of the form, independent of number of visits performed.

Through this system we will collect:

- **Registration of interested farmers in the treatment and control groups**: during the first visit to the community and following the group meeting with the villagers, the EA will list all the interested farmers and record their name, gender and phone contact. The procedure will be the same in both treatment and control communities. Farmers who are part of the same household will be identified during this phase. In addition, the EA will identify the main crop in the community and the potential facilitator of the group.
- **Member registration**: starting from the first session, the EA will register all the participants of the FFS group as well as retrieve information on basic socio-demographic characteristics, agriculture and membership to other community groups. Also, president, treasurer and secretary of the FFS will be nominated and recorded.
- **Learning plot**: one survey will be submitted after the establishment of the learning plot in order to collect data on both the parcel using modern inputs and SLM practices and the parcel with no innovation. The survey will record the GPS location of the plots and include questions on land ownership, area cultivated, crop, seeds, fertilizer and farming practices adopted. A second survey will be submitted after the harvest in order to record inputs and labor employed over the course of the production cycle as well as measure the agricultural output.
- **Attendance and weekly activities**: the team will track the EA visits and the activities taken place in the FFS through short weekly forms. The survey will document whether a session took place or not, and the reason why not in the latter case. Member attendance in each session will be taken and the EAs will record which topics were covered and which agricultural activities were implemented in the learning plot, focusing on the core farming practices promoted by the project.

The quality of the data will be checked by adding capturing a timestamp, GPS location and submission of a photo of the farmers in attendance. The team will set up a dashboard to display the information as well as monitor submissions in real time. Our field team will be communicating with the EA to resolve any challenges to submit the forms as well as follow up with any inconsistencies identified in the submitted data. This information will be corroborated with the information from the household surveys.

9. STUDY LIMITATIONS AND RISKS

Like with most impact evaluations and field experiments, there are a number of limitations and risks. Where possible we will minimize such risks.

The primary threat to internal validity arises from challenges with implementing the randomization process as planned or violations of the stable unit treatment value assumption (SUTVA). If extension agents change their implementation plans, for example by implementing FFS in communities assigned to be control, not implementing FFS in communities assigned to be treatment, or enrolling farmers in FFS, maintaining exogeneity means analyzing the impact of planned FFS rather than FFS actually implemented. Non-compliance with plans therefore limits our power and restricts the estimated average treatment effect to the subset of FFS where assignment was implemented as planned. This risk will be mitigated by field coordinators staying in both provinces in regular communication with field teams to ensure that they understand and respect the implementation plans, even when implementation staff turnover.

Violations of SUTVA could occur if households, extension agents, or communities respond to their treatment assignment other than through the impact of the treatment. For example, extension agents associated with other projects could choose to target communities assigned to be our control group, specifically because they are not currently receiving extension support through the FFS in the first phase. We will carefully inform both treatment and control communities that they will be receiving FFS in the coming years and coordinate with other known providers of extension to document and understand risks to SUTVA.

The primary threats to external validity arise from whether farmers and farmers groups selected are representative of the type of populations who would be involved in similar interventions if they were to be employed elsewhere. The project is being implemented at scale and will cover a large number of communities in the project districts. The districts and EAs to be included in the project were based on project criteria. Therefore, it is likely that the groups and locations ultimately selected for this intervention are similar to those who would end up participating if the project were planned again. The treatment communities are selected randomly among all eligible communities.

The scalability of the intervention is not in question as it is currently widely being implemented by FAO.

10. IE Management

10.1 Evaluation Team and Main Counterparts

Table 4. IE Team and Main Counterparts

Name	Role	Organization/Unit
Florence Kondylis	Senior Economist	DIME / WB
Paul Christian	Economist	DIME / WB
John Loeser	Economist	DIME / WB
Astrid Zwager	Research Officer	DIME / WB
Steven Glover	Field-based Analyst	DIME / WB
Aniceto Matias	Field Coordinator Zambézia	DIME / WB
António Tembe	Field Coordinator Nampula	DIME / WB
Matteo Ruzzante	Research Assistant	DIME / WB
Claudia Pereira	Assistant Representative – Programme	FAO
Máximo Ochoa	FFS coordinator	FAO
Ilona Gruenewald	Programme Manager	EUD Mozambique
Daniel Gonzalez-Levassor	Programme Manager	EUD Mozambique
Licínia Cossa	Head of Department of Extension and Communication	MADER-DNAAF
Carla Mahumane	M&E Officer	MADER-DNAAF

10.2 Work Plan and Deliverables

Table 5. Milestones, Deliverables, and Estimated Timeline

Milestones	Deliverables	Completion Date*
Data collection plan and pilot	TORs Questionnaires	Done Done
Data collection (Baseline)	Field work monitoring Cleaned baseline datasets	April-May 2021 June 2021
First data analysis	Presentation Policy Note Baseline report	July 2021 August 2021 August 2021
Implementation of intervention aligned to evaluation	Listing Monitoring reports	Done Starting in October 2020
Follow-up data collection plan	TORs Questionnaire	July 2021 August 2021
Data collection (Follow-up 1)	Field work monitoring Cleaned data datasets	September-October 2021 December 2021
Preliminary IE results and policy notes	Presentation Policy note Technical IE note	February 2022 March 2022 May 2023
Data collection (Follow-up 2)	Field work monitoring Cleaned data datasets	September-October 2022 December 2022
Final IE results and policy notes	Presentation Technical IE note Policy note	March 2023 May 2023 May 2023
Dissemination of findings	Presentations	Ongoing

Note: dates to be adjusted based on roll-out of field activities

10.3 Budget

This Impact Evaluation is part of the DIME ASA which seeks to generate evidence in the rural development sector in Mozambique. Specifically, this IE is one of five impact evaluations DIME will deliver under its partnership with the EU Delegation to Mozambique. The EU-funded PROMOVE-Agribiz program has a specific component that seeks to increase evidence-based policymaking in the rural development sector. Implementation of this component will be led by DIME and is funded through a contribution to the DIME i2i Trust Fund. The funding covers all costs related to the research team time and travel, research assistance, field coordination, data collection and dissemination.

11. PLAN FOR USING DATA AND EVIDENCE FROM THE STUDY

The impact evaluation is part of a large program of impact evaluations to generate evidence on rural development in Mozambique as well as the global DIME AADAPT program on agricultural adaptations and natural resource management. We will be actively involved in the dissemination of evidence acquired during the lifecycle of the project to policy makers, practitioners and academics to maximize potential for policy influence within the PROMOVE-Agribiz program, at the national sector level and globally.

Throughout the lifecycle of the project we engage with the relevant stakeholders, most importantly FAO, EUD and MADER, to identify relevant research questions, both at inception and over the course of implementation. Baseline and monitoring data will help FAO identify potential challenges to achieving envisioned results and allow for additional piloting to overcome those to inform mid-course corrections and contribute to improving final outcomes. Discussions with MADER allow us to include topics of interest that may guide policy design of the extension network more broadly.

The team will leverage several existing structures to define and publicize the development of the research agenda, inform of the progress of the impact evaluation implementation, as well as engage in policy dialogue discussions at the national level. These would be: 1) the quarterly Program Technical Committee meetings of PROMOVE-Agribiz, 2) the Mozambique Agriculture and Rural Economic Development (AgRED) donor working group, 3) World Bank research events in the country office, 4) academic conferences held in Mozambique, and 5) the Agricultural Policy Research Platform hosted by the DPCI and 6) presentations at relevant ministries such as MADER. Upon completion of each impact evaluation we will work closely together with all national stakeholders to elaborate relevant policy briefs and organize regular dissemination events. A final report will be produced by the research team to be shared with direct project and policy stakeholders to summarize learning, solicit suggestions and improvements, and generate new uses for the resulting data. However, the objective of the program is not only to produce individual pieces of research but to build a community of practice for evidence-based policy making in Mozambique linking policymakers, researchers, development agencies, and other stakeholders.

At the global level we will leverage the DIME AADAPT network, through which we are working with different stakeholders in the development arena. The AADAPT portfolio includes more than 20 impact evaluations in 12 countries across Africa, South Asia, Latin America, and the Caribbean. The network brings together governments, project managers from different MDBs, multiple donors and academics. The results will be disseminated widely across the community of practice through the annual workshops as well across the similar projects.

Finally, we plan to develop a series of ambitious research papers from the experiment and the results and engage the broader academic community to both contribute to and shape the knowledge from this IE. We hope that such academic work is widely regarded in seminars and conferences and eventually published in an academic economics or general interest journal of the top caliber.

All data will be made available online through the IE database, following the World Bank's open data policy. Progress and policy impact will be tracked through DIME's 'myIE' monitoring system throughout the project.

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ANNEX A – EXTENSION AGENT KNOWLEDGE TEST RESULTS

The EAs responsible to establish and conduct FFSs are identified jointly by FAO and the district SDAEs. In total 103 EAs were identified to initiate the formation of FFS. Of those, 24 EAs (from the districts of Alto Molócuè, Gurúè, Malema, and Ribáuè) had previously participated in the MDG1 FFS program, while a group of 79 EAs (from the ten districts targeted by the new wave to be implemented) had no previous experience with FFS. Prior to starting, all selected EAs receive a training on the FFS methodology as well as all the agricultural practices that are being promoted to farmers. EAs were trained by FAO in two different waves: first, the new group of EAs took part in a two-week training in November-December 2019 and, in a second stage, the MDG1 EAs were involved in a one-week refreshment training in March 2020.[4]

To measure knowledge gains as a result of the training, the DIME team administered a pre- and post-training test in the first and last day of each of the two trainings. This test focused on the FFS curriculum (i.e., mostly on conservation farming techniques) and comprised a mix of multiple choice and true or false questions. In Figure A1 we compare the distribution of pre- and post-training test scores, defined in terms of percentage of correct answers, splitting the sample between newly trained and MDG1 EAs.[5] Before the training (dashed lines), the group of EAs who already participated to the MDG1 FFS program (light blue) had, on average, a better knowledge score than the newly trained group (dark blue).

Both groups experienced a substantial increase in knowledge as a result of the training, indicated by the shift to the right of both solid post-test score distributions. The average gain in knowledge was equal to 8.39 percentage points (i.e., a 14.62 percentage change compared to the initial level) and statistically significant (p-value < 0.001). As expected, the newly trained group experienced larger knowledge improvement, in fact completely catching up with the experienced group. This might be due to the fact that the first training was longer (two weeks vs. one week) and that newly trained EAs had not been exposed to some of the topics covered by the training yet, and therefore had more room for improvement. To assess individual knowledge gains, we compare the pre- and post-test scores for each individual EA in Figure A2. Each dot represents the two scores for a given EA. Any position above the 45^0 line indicates an improvement from pre- to post-test. The results show improvements across the board: 76 percent of the EAs performed better in the post-training test than in the pre-training test.

[4] For logistical reasons, the new EAs were trained in sub-groups: two groups in Gurúè, Zambézia, (November 11-22 and November 25-Dececember 6) and one in Namialo, Nampula (November 25-December 6). On the other hand, the MDG1 EAs were trained in Alto Molócuè, Zambézia (March 9-13).

[5] For the sake of comparison between different sub-groups, we use an Epanechnikov kernel function with half-width equal to 3.5 percent.

Figure A1: Distribution of pre- and post-Knowledge Test Scores by Training wave

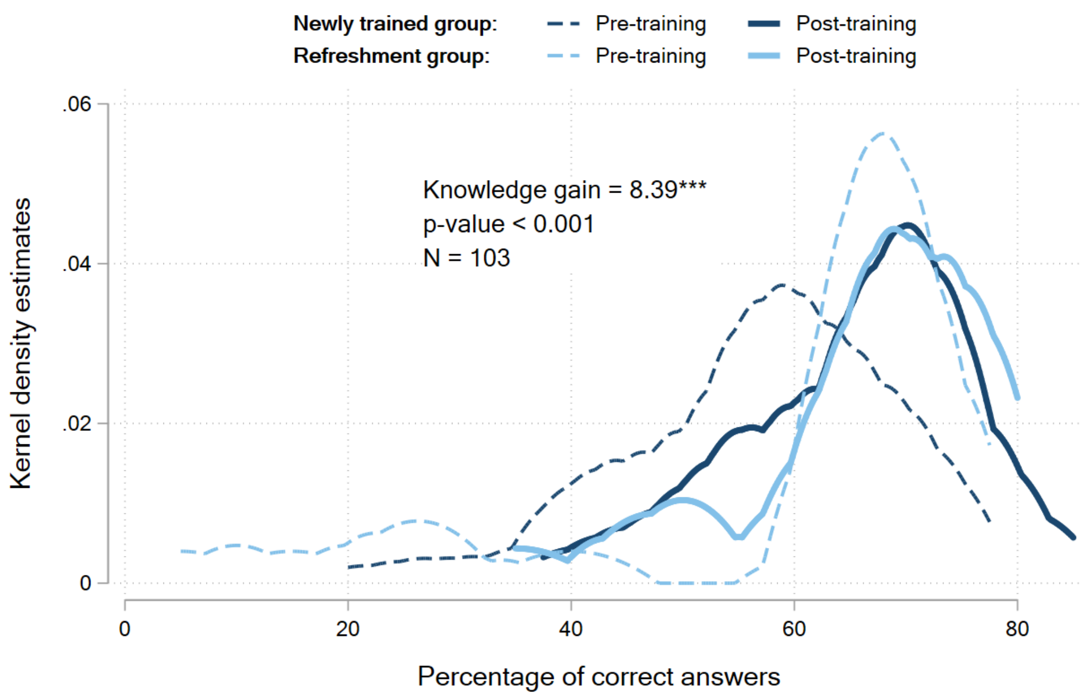

Figure A2: comparing Pre- vs. post- training knowledge test scores for each EA