Optimal Incentivizes for Adoption of Improved Agricultural Inputs

Mozambique

P172877

Keywords: Subsidies (H23), Agriculture in Developing Countries (O13), Agricultural Inputs (Q12).

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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 (if IE is evaluating a WBG operation)	N/A
8	WBG Project Name (if IE is evaluating a WBG operation)	N/A
9	Associated with another IE (Yes, No)	Associated with the IEs administered through the same program IE code
10	Project TTL (if IE is evaluating a WBG operation)	N/A
11	Intervention	Agricultural input subsidies
12	Main Outcomes	Use of improved agricultural inputs and yields
13	IE Unit of Intervention/Randomization	Input retailer, community, farmer
14	Number of IE Units of Intervention	300 communities, 3000 farmers
15	IE Unit of Analysis	Farmer, plot, crop
16	Number of IE Units of Analysis	3000 farmers
17	Number of Treatment Arms or Iterative Experiments	3 types of control groups and 4 treatment arms
18	IE Question 1	Do subsidies increase farmers use of improved agricultural inputs such as seeds and fertilizer and yields?
19	Method IE Question 1	Random assignment
20	Mechanism tested in IE Question 1	Incentives
21	IE Question 2	How much do changes in the subsidy rate for improved inputs change take-up of these inputs? Do changes in subsidy rates differentially affect take-up among different types of farmers such as poorer households or women?
22	Method IE Question 2	Random assignment
23	Mechanism tested in IE Question 2	Incentives
24	Gender-specific treatment (Yes, No)	No
25	Gender analysis (Yes, No)	Yes
26	IE Team & Affiliations	Paul Christian, Florence Kondylis, John Loeser, Astrid Zwager
27	Estimated Budget (including research time)	USD1mln
28	CN Review Date	July 2020
29	Estimated Timeframe for IE	September 2020 to September 2022
30	Main Local Counterpart Institution(s)	EU Delegation to Mozambique (EUD), Food and Agriculture Organization of the United Nations (FAO), Ministry of Agriculture and Rural Development (MADER)
31	Other Sources of Funding (Yes, No)	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 most common agricultural practices are characteristic of subsistence farming, with limited adoption and use of technologies (Baez et al., 2018). In 2015, only 6% of smallholder farmers in Mozambique utilized chemical fertilizers and few who did apply them in amounts well below recommended standards (Baez and Elabed, 2020). Similarly, just 1% of smallholder farmers used improved seed varieties (*ibid.*).

Agricultural input subsidy programs (ISPs) have been widely used as a policy instrument to boost the adoption of high-yielding seeds and inorganic fertilizers among smallholder farmers, whilst also addressing food security and nutrition concerns. The Impact Evaluation (IE) described in this Concept Note (CN) studies the electronic voucher (e-voucher) subsidy for agricultural inputs that will be offered by the Food and Agriculture Organization of the United Nations (FAO) in Mozambique under the European Union (EU)-funded PROMOVE-Agribiz programme.

The IE will measure the impact of e-vouchers on the adoption of improved agricultural technologies and crop productivity, as well exploring how adjustments to current subsidy rates would affect take-up by different groups (such as women, the food insecure, and those in remote areas) in the short and long run, and the consequences of changing adoption on productivity. The IE design will also permit the identification of the principal factors that determine a farmer's willingness and ability to pay (WTP) for fertilizer and other agricultural inputs and assess whether experience with the eVoucher changes the WTP for inputs over time. In order to maximize program and policy impact, the IE will test varying subsidy levels and input combinations early on to inform program implementation in subsequent years, as well as exploring the impacts of the program on agrodealer/retailer input supplies and sales over time. The data systems that will be put in place in the context of the intervention and its IE will be leveraged to identify constraints in the linkages between farmers and retailers and to design and evaluate pilot interventions to mitigate these gaps in the current market for inputs.

To answer the relevant research questions, randomization will be used to generate comparisons at three levels: agrodealer/retailer, community and farmer. Key indicators that will be tracked at the farmer level include take-up of the voucher, use of promoted agricultural inputs, Willingness to Pay for promoted agricultural inputs, access to inputs, crop yields and total agricultural production.

This impact evaluation (IE) aims to generate substantial evidence about demand and supply side determinants and constraints to widespread adoption of modern agricultural inputs in Mozambique. The impact evaluation is part of a large program of impact evaluations collectively designed 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.

In 2015, only 6% of smallholder farmers in Mozambique utilized chemical fertilizers with the few adopters using amounts well below recommended standards (Baez and Elabed, 2020). Similarly, just 1% of smallholder farmers used improved seed varieties (*ibid*.). These levels are significantly lower than in neighboring countries, while the cost of fertilizer in Mozambique is around 35% higher than in Tanzania and around three times more expensive than the global average (*ibid*.). Such low rates of improved input adoption can largely explain crop productivity gaps with neighboring countries. Low utilization rates may be a function of limited knowledge, constrained supply, weak demand, high prices and low quality, which taken together inhibit the development of a dynamic and sustainable agricultural input market in Mozambique.

Agricultural input subsidy programs (ISPs) are common in many developing countries, especially in sub-Saharan Africa, as a policy instrument to boost the adoption of high-yielding seeds and inorganic fertilizers among smallholder farmers. Earlier attempts of ISPs, which mainly consisted of "universal" input distribution by state-owned enterprises, were gradually phased out as a result of the 1990s structural adjustment reforms. However, following the 2003 Maputo Declaration, where African governments committed to allocate at least 10 percent of the national budget to agriculture development, at least ten countries, accounting for more than half of the region's population, adopted "second-generation" ISPs and now devote between 15 to 25 percent of public spending on agriculture to ISPs (Jayne et al., 2018). This second wave of ISPs was designed to fix some of the limitations of the previous programs by improving targeting of beneficiaries and engaging the private sector (Morris et al., 2007).

The first experience of a smart ISP in Mozambique was introduced in 2009,[1] which followed seed voucher programs implemented by FAO from 2001. Based on this experience, FAO introduced the first eVoucher program under the "Millennium Development Goal 1c Sub-Program" (MDG 1c), which was implemented by the now Ministry of Agriculture and Rural Development (*Ministério da Agricultura e Desenvolvimento Rural* – MADER) in thirteen districts over five provinces (Manica, Sofala and Tete in the Beira Corridor, Nampula and Zambézia in the Nacala Corridor) between 2014 and 2019. The program was funded by the EU, managed by FAO as part of the broader United Nations (UN) program "Support to Accelerate Progress Towards MDG1c in Mozambique", and the intervention aimed at giving farmers access to certified seeds, fertilizers and insecticide as well as supporting the development of agricultural input markets and supply chains (FAO, 2019).

This impact evaluation (IE) will generate rigorous evidence about demand and supply side determinants and constraints for modern agricultural inputs in Mozambique. The IE studies the electronic voucher (eVoucher) subsidy for agricultural inputs that will be offered by the United Nations Food and Agriculture Organization (FAO) in Mozambique under the European Union (EU)-funded PROMOVE-Agribiz programme. The IE will assess the impact of eVoucher on the adoption of improved agricultural technologies and crop productivity, as well exploring how adjustments to current subsidy rates would affect take-up by different groups (such as women, the food insecure, and those in remote areas) in the short and long run, and measure the consequences for changing adoption on productivity impacts. The IE design will also permit the identification of the principal factors that determine a farmer's willingness and ability to pay (WTP) for seeds, fertilizer and other agricultural inputs and assess whether experience with the eVoucher changes the WTP for inputs over time. In order to maximize program and policy impact, the IE will test varying subsidy levels and technology compositions early on to inform program implementation in subsequent years, as well as exploring the impacts of the program on agrodealer/retailer input supplies and sales over time. The data systems that will be put in place in the context of the intervention and its IE will be leveraged to identify constraints in the linkages between farmers and retailers and to design and evaluate pilot interventions to mitigate these.

The research described in this CN links closely to the CN "Impact Evaluation of Farmer Field Schools in Mozambique", which describes the impact evaluation of the FAO-implemented Farmer Field School (FFS) interventions. To shed light on different constraints to adoption, the FFS and eVoucher intervention roll-out will to coordinated in manner that allows the assessment of 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).

[1] An RCT was done in a sub-set of districts and documented by an evaluation in Carter et al. (2013): the results are described in the literature review section below.

2. DESCRIPTION OF THE INTERVENTION

The IE described in this CN will leverage the forthcoming eVoucher program which will be implemented by FAO in 10 districts in Nampula and Zambézia provinces in northern Mozambique under the EU's 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. Three of these ten districts (Ribáuè, Alto Molócuè and Gurúè) were part of the Millennium Development Goals (MDG1) eVoucher intervention described above.

Like the previous experiences, the eVoucher will have multiple values and levels of farmer co-payment, which will be defined by the project parties, to target both smallholder and emerging farmers. The subsidies will allow producers to purchase different packages of certified seeds, inorganic fertilizers and/or post-harvest insecticides at a discounted price from agrodealers and their retailers. The eVoucher program under MDG1 offered farmers subsidies for two levels of input purchases, summarized in Table 1 below. Subsidies were provided in the form of nominal voucher coupons and redeemable by the intended beneficiary named in the certificate at authorized private agricultural dealers/outlets and retailers. After a piloting stage of the project, the voucher certificates were embedded in an electronic payment system, which allowed voucher transactions to be recorded in real time on a centralized database. The exact eVoucher packages and subsidy levels to be offered by FAO are still under design. Subsidized crops will be selected according to local demand, agro-ecological conditions and market opportunities. Crops that will be prioritized include maize, beans and vegetables.

TABLE 1 -- MDG1 EVOUCHER PACKAGES

	Voucher Value	Copayment by farmers	Eligible inputs
Package A ("subsistence farmers")	35 USD (2,000 MZN)	25% (500 MZN)	- Certified seeds (OPV): maize, beans. - Post-harvest insecticides.
Package B ("emerging farmers")	130 USD (7,000 MZN)	45% (3,000 MZN)	- Certified seeds (OPV, hybrid): maize, beans and oleaginous crops. - Fertilizers (Urea, NPK). - Post-harvest insecticides.

Note: A third package was introduced for a 12,000 MZN input package at a 50% subsidy rate. This voucher was rarely used.
Source: FAO, 2019. "Voucher value" is the total value of inputs received, including both the copayment from farmers and the amount covered by FAO.

Participating agrodealers (and their associated retailers) will be selected by FAO through a detailed selection process prior to the start of the project. This selection is to be preceded by a mapping exercise, which will support the identification of new agrodealers (and retailers), as well as identifying gaps in area coverage and firm capacity. Only agrodealers who present logistical, managerial and financial capacity to store and distribute large quantities of inputs, as well as their market presence and development plans to expand coverage, will be selected. Farmers that meet the project eligibility criteria will be identified and registered for the eVoucher by the eVoucher Service Provider, under the guidance and supervision of FAO, and district-level government officials and extension agents. Priority will be given to farmers that

participate in the Farmer Field School program also being implemented by FAO under PROMOVE-Agribiz. The roll-out strategy of the intervention among eligible agrodealers (and their retailers) and farmers will be critical for the IE and is described in more detail in Section 7.

3. LITERATURE REVIEW

The take-up of agricultural profitable technologies have been historically low and stagnant in sub-Saharan Africa, which has not experienced the so-called "Green Revolution" that boosted agricultural production over the last five decades in Asia and Latin America thanks to the increased adoption of high-yielding seeds and inorganic fertilizers (Evenson and Gollin, 2003). The reason why farmers in developing countries dot not take advantage of lucrative technologies, whose expected returns far exceed their marginal costs, remains an economic puzzle. Recent literature has identified liquidity constraints, lack of reliable supply, informational barriers, risk aversion and behavioral biases as concurrent factors explaining this low-technology poverty trap (Foster and Rosenzweig, 2010). In such context, one-off subsidies that make inputs affordable over a certain period have the potential to relax some of the market failures at play by encouraging farmers to experiment and learn about the subsidized technology. This, in turn, might allow them to get richer and save for the post-subsidy seasons, sustaining long-term demand in the input market and, therefore, stimulating private sector development.

Randomized controlled trials (RCTs) on fertilizer subsides have found that the returns to fertilizer are high. Duflo et al. (2008) run a series of field trials in rural Kenya, aimed at measuring the profitability of fertilizer on real-world farms, where conditions are sub-optimal compared to experimental farms. They estimate the mean rate of return to adopting the most profitable quantity of top-dressing fertilizer to be 36 percent in a season and 69.5 percent over a year. However, other levels of fertilizer use, including the combination recommended by the Ministry of Agriculture, are unprofitable for farmers in the study sample. This suggests fertilizer returns to be highly contingent on the quantity used, the availability of complementary inputs and the possibility that official recommendations might not be properly tailored to the local context. Other non-experimental studies have found that, after accounting for program crowding out and diversion, standard economic benefit-cost ratios are generally unfavorable – ranging from 0.77 to 0.89 – in Kenya, Malawi and Zambia (Jayne et al., 2013). These findings suggest that across SSA, fertilizer subsidies have the potential to be highly cost effective but ensuring this requires targeting subsidies to productive users and profitable input combinations.

The RCT most relevant to our context is described in the following paragraph. Carter et al. (2013) evaluate a voucher system for input subsidies targeted to maize smallholder farmers, which was launched by the Government of Mozambique as a two-year pilot of the large-scale ISP described in Section 3. A field experiment was designed and implemented with 5,000 farmers in the central province of Manica. Half of the eligible household in the study sample were randomly selected to receive voucher coupons, which could be used to purchase a technology package of certified seeds and chemical fertilizers, with a 27 percent cash co-payment. The program had modest uptake rates, well below 50 percent, which the

authors attribute mostly to farmers' liquidity constraints. Among farmers who redeemed the vouchers, the evaluation measured a significant increase in the use of seeds and fertilizer. Carter et al. (2019) expand on the first study and find substantial impacts on technology use, agricultural output for both maize and non-maize crops, and living standards lasting into subsequent years after the subsidy ended. Interestingly, spillovers to beneficiary farmers' social networks, rather than sustained adoption by direct recipients of the subsidy account for the vast majority of subsidy-induced gains. Farmers who purchased the subsidized package showed higher beliefs about expected returns to the new technologies, suggesting that the program alleviated informational market failures and stimulated learning by both direct recipients and their peers.

We aim at improving on measurement of demand for inputs by eliciting farmers' willingness-to-pay (WTP). Following Berry et al. (2020), we apply the Becker-DeGroot-Marschak mechanism (BDM, Becker et al., 1964), which is an incentive-compatible elicitation method, in order to estimate revealed preferences for the value of agricultural inputs, and we contrast it to self-reported take-it-or-leave-it (TIOLI) responses to assess its performance in a developing-country field setting. To the extent of our knowledge, we are the first to embed BDM measures into a field experiment on agriculture, a sector where heterogeneity in returns is likely to be of great importance.

Methodologically, the IE relates to the latest body of research on instrumental variable (IV) econometric techniques. Departing from binary and ordered versions of IV models (Imbens and Angrist, 1994), recent work has extended identification and estimation of treatment effects to unordered discrete choice models with multivalued treatments, heterogeneous agents, and multiple instruments (Heckman and Pinto, 2018; Mountjoy, 2019). This allows us to estimate impacts of progressive input subsidies on our outcomes of interest.

Heterogeneity in input returns has been highlighted as a possible explanation for low adoption among smallholders (Suri, 2011). Given that the BDM mechanism provides a direct and precise observation of the heterogeneity in WTP and randomizes the treatment status conditional on the elicited WTP, it enables us to precisely estimate heterogeneous treatment effects by using BDM price draws as instruments. In this regard, progress on estimating marginal treatment effects with discrete instruments have been made by Brinch et al. (2017). We apply these approaches to estimate heterogeneity in crowd-out and learning across farmers in response to changes in input subsidy schedules, which is crucial to inform optimal pricing and targeting policies.

4. Policy Relevance

The project has tremendous potential for informing policy at various levels. First, within the context of the PROMOVE-Agribiz program, the team will collect detailed data to ensure early lessons can be drawn to informing mid-course corrections to maximize impact. The team will track early targeting and willingness to pay results to allow for adjustments of the subsidy to ensure goals of inclusion are on track.

To address concerns of sustainability, uptake rates and willingness to pay among different groups of farmers will be measured over time. This data will be used to provide guidance on how to phase-out the subsidy over time. Throughout the IE, the Maputo-based analyst and DC-based research team will communicate findings from the evaluation and progress of the project's implementation between all stakeholders to jointly identify opportunities for continual and follow-up learning.

At the national level, there is significant scope for using the evidence generated from the IE to inform the national policy for input adoption and guide other programs in this area. Agricultural input subsidies accounted for around $8m USD (204m MZN) a year between 2013-17 (in 2009 prices) of public expenditure in Mozambique (Piccioni et al., 2019), which equated to around 4% of the agriculture budget. Due to the significant resource allocation in this area the issue of performance and sustainability is therefore of great importance, as well as how ISPs compare with other policy alternatives. Currently, the Strategic Plan for the Development of the Agricultural Sector 2011-2020 (PEDSA) is undergoing a redesign for the upcoming decade. Under this national strategy, the promotion of technology transfer to smallholders will likely be a highly salient issue for increasing agricultural productivity. Determining an effective mechanism for the sustained adoption of improved inputs should therefore be a high priority for all sector stakeholders, especially given the different competing models that have been undertaken to date. While IE results may not be ready in time to contribute to the PEDSA II in mid-2021, evidence can be utilized to support decision making in the National Agricultural Investment Plan (PNISA II) that implements the PEDSA II strategy over the forthcoming decade. The DIME team will engage with officials from the National Directorate of Development of Family Farming (DNDAF) of MADER throughout the course of the IE to provide evidence on the intervention and inform policy discussions.

Third, at the global level, the impact evaluation will provide evidence to support the design of subsidy schemes for the adoption of new technologies by shedding light on general mechanisms such as how subsidy levels affect targeting, gains produced by different groups and sustainability. These types of programs compose a large share of government[2] and donor funded activities and evidence to support their design can have large fiscal implications.

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 the figures below presents the hypothesized causal chain of the eVoucher intervention, they are separated into demand (Figure 1) and supply side (Figure 2) effects.

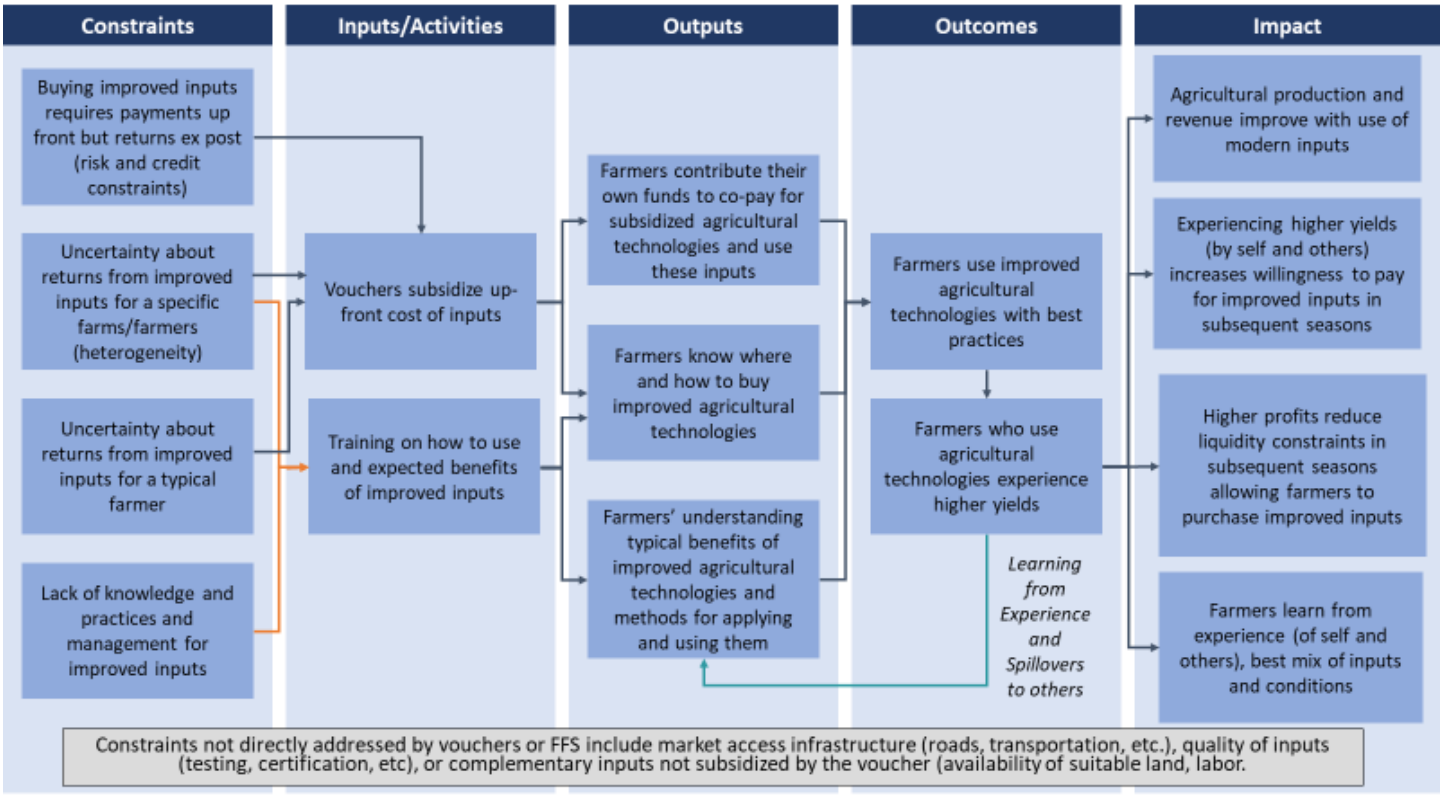
[2] For example, ISPs in Malawi and Zambia composed 15% and 30% state agriculture expenditure respectively between 2013 and 2017 (Piccioni et al., 2019).

Farmer demand for improved inputs

The rationale for providing input subsidies to boost adoption of improved inputs by farmers is based on the underlying assumption that farmers underinvest due a combination of factors such as credit constraints, risk aversion, and present bias, as detailed in column 1. By lowering the price of inputs, eVouchers aim to reduce the upfront cost of initial adoption, and thus release the credit constraint, as well as their willingness to experiment by reducing the cost/expected benefit ratio of the initial investment. As farmers increase their adoption during a first season, they will receive more information on the returns to the inputs for their specific plots and crops as well as increase the ability to pay for inputs at planting in subsequent seasons through increased yields and profits.

Other farmers who do not receive the eVouchers in the first year, but observe others that do, may also learn about the return to the inputs for farmers similar to them. Such information spillovers may increase adoption even for farmers that did not receive the eVouchers.

FIGURE 1 – THEORY OF CHANGE, DEMAND SIDE



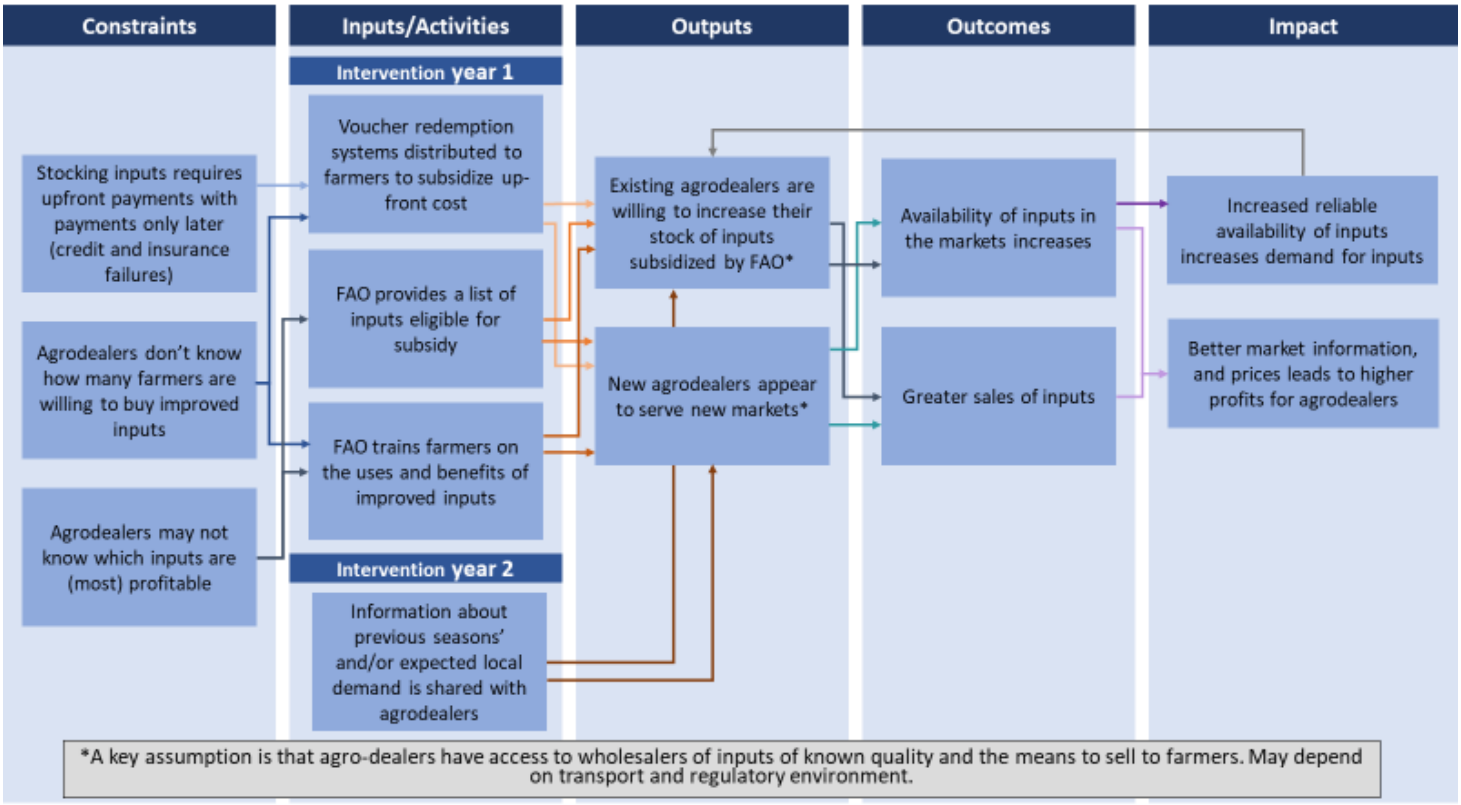
Retailer supply of improved inputs

Retailers face low and/or uncertain demand for inputs from farmers, inhibiting their willingness to stock inputs. As the eVouchers are distributed to communities in the retailer's catchment areas, they will expect to see an increase of demand for the inputs. Based on the number of eVouchers distributed and expected redemption rates, retailers increase their stock of inputs, increasing the availability of inputs in the

market. If the eVoucher program enables retailers to expand their businesses, this may increase input availability even in control communities within the catchment of a treated retailer, potentially increasing demand in these areas also if uncertainty or accessibility of available inputs is a constraint to adoption.

Using the information system setup for the eVouchers, the team will consider piloting additional interventions to strengthen the demand and supply links between farmers and retailers by improving availability of information on demand as well as empowering farmers to provide feedback on what they need and quality of inputs.

FIGURE 2 – THEORY OF CHANGE, SUPPLY SIDE



6. Hypotheses/Evaluation Questions

As described in the Theory of Change, we expect the eVoucher program to affect both the demand for and supply of improved agricultural inputs. The research questions are divided into these two sides, while we also expect there to be substantial feedback loops between supply and demand. Our ability to answer each of these research questions hinges on the feasibility to identify a proper counterfactual through random assignment among eligible units at different levels – farmers, communities and retailers. The feasibility of randomization at each of these levels will determine which of the below questions can be answered. The details of the randomization and considerations for analysis are described in Section 7.

Demand for improved inputs by farmers:

- Do subsidies increase farmers use of improved agricultural inputs such as seeds and fertilizer?
- How much do changes in the subsidy rate for improved inputs change take-up of these inputs?
- Do changes in subsidy rates differentially affect take-up among different types of farmers such as poorer households or women?
- How does the elasticity of take-up with regard to subsidy rates change after experiencing a subsidy (i.e. does the subsidy necessary to ensure take-up decrease over time as farmers gain more experience with the inputs?)
- What are the complementary inputs or constraints (such as liquidity constraints, risk etc.) that influence adoption of improved inputs or elasticity of adoption with respect to subsidy rates?
- Does agricultural training, through FFS, affect the elasticity of adoption with respect to subsidy rates?
- How much do improved inputs improve farmers' yields, revenue, and profits?
- Do different farmers have different returns or perceived/expected returns to the use of improved agricultural inputs?

Supply of improved inputs in communities:

- Does increased demand for agricultural inputs, due to subsidies, increase the availability of and farmer access to subsidized and complementary inputs available for sale? And does this spill over to farmers / communities currently not receiving the subsidies?
- Do subsidies for agricultural inputs affect prices of inputs available in local shops?

This CN will focus on the impacts of the delivery of the eVouchers on demand and supply. Based on early results and leveraging the eVoucher data systems, further IEs may be developed to pilot follow up interventions to understand how supply and demand links can be strengthened to ensure sustainability beyond the project. An example of a follow up research question could be:

- Does providing information on previous season's demand change availability of inputs or match of inputs with local conditions?

Related IEs to be developed in the future will be documented in their own dedicated CN.

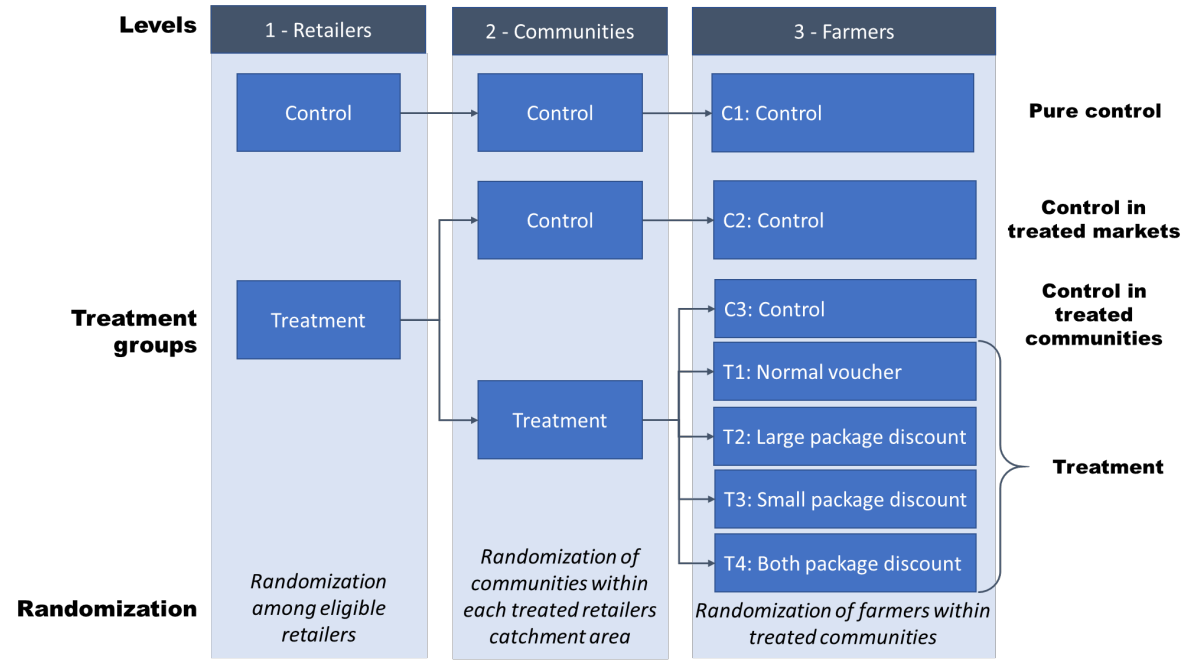
7. Evaluation Design and Analysis

7.1 Treatment and Control Groups

To answer the proposed research questions, we require three levels of comparisons and randomization, all based on a phase-in strategy among eligible units. Here we describe the details of the randomization

at each level and how each of these contribute to allowing us to answer the research questions listed in Section 6. The full design will lead to the groups shown in Figure 3, which we will reference in the section below.

FIGURE 3 – IMPACT EVALUATION DESIGN



1. Agrodealer/Retailer level

FAO will provide a list of all the eligible agrodealers who have been vetted by FAO as eligible to redeem the eVoucher and able to stock the relevant inputs, in addition to all retailers through which the agrodealers will sell inputs directly to farmers (typically including the agrodealer themselves). A proportion of retailers will be assigned to start receiving eVoucher redemption platforms and the ability to redeem eVoucher in the first year while the remainder will not.[3] The remaining eligible retailers will form the retailer control group. These retailers will not participate in the eVoucher until at a minimum after the main agriculture season of 2021-22.

Comparison of treatment and control retailers will allow us to assess impacts of providing the subsidies to farmers in their catchment on their supply. Moreover, this ensures we have pure control groups at the lower, community and farmer, levels also. Meaning that we identify farmers that are linked to retailers that have no other communities in their catchment being treated (group C1 in Figure 3). This is important to allow for measurement of spillovers as we describe below.

[3] As of end of May 2020, a list of agrodealers was not yet available, so it has not been possible to make a final decision on what proportion of agrodealers should be enrolled in the first phase. Tentatively, we expect the proportion to be approximately 70% receiving vouchers in the first phase with the remaining 30% not assigned. Having a higher share assigned to the early treatment group gives us more power to compare sub-treatments within the group receiving eVouchers such as receiving vouchers with different subsidy levels.

Community level within retailer catchments

During the agrodealer/retailer listing and enrollment process, their catchment area will be identified. FAO staff will ask each agrodealer/retailer to make a list of communities where they think farmers would purchase inputs and redeem eVoucher at their retail locations (fixed or mobile), and from which of the listed retailers those communities would be able to source their inputs. This will be done prior to the randomization at retailer level to ensure this information is available for both treatment and control retailers. In the initial phase-in of the evaluation, a proportion of the communities in the catchment of each treated retailers would be visited to distribute vouchers and be briefed on the voucher uptake, while the remainder would not be enrolled in the eVoucher system.[4]

The randomization of communities among treatment retailers will result in some communities receiving vouchers in the initial roll-out period, while others do not receive the vouchers, while being serviced by the same retailer. This allows us to identify market level spillover by comparing farmers in control communities among treated retailers (Control group C2 in Figure 3, which have other communities in their catchment that are being treated) with pure control communities (C1, none of the communities in their retailer's catchment are being treated). This comparison allows us to estimate the demand for a given package of inputs cleanly from spillovers that may cause demand for inputs to shift by changing availability in the market even for farmers who buy at market rates.

The randomization process of the eVouchers will take into account the randomization carried out for the Impact Evaluation of Farmer Field Schools in Mozambique, which will result in communities assigned to receive 1) both the FFS and eVouchers, 2) only eVouchers, 3) only FFS, and 4) neither.

2. Household level within treatment communities.

Eligible households will be identified among potential Farmer Field School participants in both treatment and control (spillover and pure) communities. The process of identifying FFS participants is described in more detail in the FFS CN. Within each treatment community vouchers, we will survey 10 households.[5] These households will be further randomly subdivided into:

- C3: Control group (2 households): These farmers receive no vouchers during the first year of the study.

And 4 treatment arms:

[4] As in the question of proportion of retailers to assign to the treatment group, we tentatively expect to assign a higher share of eligible communities to participate in treatment than not, because we want to maximize power not just between communities receiving vouchers and not, but also between sub-treatment groups such as treatment and control. Tentatively, we expect to assign 70% and 30% treatment and control.

[5] Additional households may be selected to receive the standard eVouchers in each community depending on FAO targets. The proportions will be agreed upon, yet these households will initially not be included in the analysis.

- T1: Normal voucher group (2 households): This group receives a voucher which entitles the household to purchase either of the two FAO packages at the standard subsidy rate.
- T2: Large package discount voucher group (2 households): This group receives a voucher which entitles the household to purchase the small package of inputs at standard FAO subsidy rates, but the larger voucher at a 50% higher subsidy rate (i.e. to unlock the voucher for the larger of two values of inputs, this group pays half the co-pay that the farmers in the normal voucher group would have to pay)
- T3: Small package discount group (2 households): Receives a voucher entitling the household to redeem the larger package at the standard subsidy rate but gets an additional 50% subsidy on the smaller package.
- T4: Discounted voucher for both packages (2 households): Receives a voucher entitling the household to redeem either the larger or smaller package at a 50% higher subsidy relative to the normal voucher group.

Comparing households with the standard voucher (T1) to control households in pure control communities (C1) will give us the overall impact of providing households with the eVoucher. Comparing control households in treated communities (C3) will allow us to identify spillovers to farmers in treatment communities, while facing market prices. Comparison across the different treatment groups within treatment communities will allow for the identification of demand responses to changes in subsidy rates (T1-T4).

7.2 Model Specification for Quantitative Data Analysis

Optimal subsidy problem:
The goal of the optimal subsidy for agricultural inputs is to maximize production from inputs:

$$\text{Max} \sum_{i=1}^{N} \sum_{q=1}^{Q} D_{qi} * agrevenue_i(q) - D_{qi} * \Big(p(q) - \big(1 - s(q)\big) * p(q)\Big)$$

- D_{qi}: indicates whether farmer *i* buys a package of inputs of size and composition *q*
- $\text{agrevenue}_i(\text{q})$: is the revenue from agriculture of a farmer who buys package *q*
- $p(q)$: is the market price a farmer would have to pay to buy package *q*
- $s(q)$: is the subsidy rate on the price of package *q*, and is between 0 and 1, where 1 represents a full subsidy (free distribution).

The first term, $D_{qi} * agrevenue_i$, is the earnings from agriculture of a farmer who adopts package *q*. The second term, $D_{qi} * \Big(p(q) - \big(1 - s(q)\big) * p(q)\Big)$ is the expenditure that the social planner (implementer, donor, government, etc) has to make when farmer i decides to purchase package *q*, paying the difference between the market price, *p(q)*, and the share of this price paid by the farmer. Put simply, the goal of the

subsidy program is to maximize the revenue earned by farmers eligible for the subsidy per dollar spent on the subsidy.

The welfare maximizing level of subsidy for a given package *q* will be one for which the following condition holds:

$$\partial Agrevenue_{qi}\, D_q / \partial\, s(q) = \partial s(q)\, D_q / \partial\, s(q)$$

We are therefore interested in measuring the response in total revenue earned in a target community for a change in the subsidy rate *s*. As outlined in the theory of change, changes in agricultural earnings in response to a change in the subsidy rate will arise through multiple channels. First, individual farmers will be induced to adopt a package when the subsidy for that package is higher. These farmers and their households will earn higher returns based on their (potentially heterogenous) returns to using inputs. Additional returns will also emerge through social or economic externalities of individual farmers' use spilling over to other farmers. Specifically, farmers may learn about inputs and their returns through other farmers and prices or availability of inputs in local markets may adjust to subsidies. We address these multiple channels through the multiple layers of randomization.

Household adoption and returns to inputs using randomly assigned vouchers:
The simplest research question we are interested in answering is whether being offered any voucher increases the likelihood that farmers used improved inputs such as fertilizer. For this, we can estimate the simple specification[6]:

$$D_{i,v,t} = \beta_{1,t} voucher_{ivd} + \delta_t D_{i,v,0} + \gamma_{d,t} + \epsilon_{i,v,t}$$

where $D_{i,v,t}$ is a set of outcomes including whether a household *i* living in community *v* in the catchment area of agrodealer/retailer *d* used a particular input (fertilizer, certified seeds), whether the household purchases inputs of an amount close to the eVoucher quantities (1,500 MZN – 2,500 MZN, or 6,000 MZN – 8,000 MZN), of the quantity of particular inputs purchased in the period survey round *t*. The coefficient $\beta_{1,t}$ gives the effect of being assigned by randomization to receive a voucher on demand for inputs. Given that fertilizer use in Mozambique is low, the degree to which vouchers increase use of inputs like fertilizer is a parameter of interest by itself.

However, we are interested not only in whether any vouchers increase use of fertilizer, but also learning how the size of the voucher and the degree of subsidy affects take-up of the vouchers and ultimately yields and production. Within communities receiving vouchers, we will randomly assign as noted above households to receive vouchers of different sizes, with a subsidy rate on either the large or small voucher or both. We can then estimate the following regression:

[6] This version tests the impact of offering a voucher to a specific household. Similar specifications could test the average treatment effect

$$D_ijdt = \alpha + \beta_{voucher} voucher_{ivd} + \beta_{small} voucher_{ivd} * discountsmall_{ivd} + \beta_{large} voucher_{ivd} * discountlarge_{ivd} + \beta_{both} voucher_{ivd} * discountboth_{ivd} + \delta_t D_{i,v,0} + \gamma_{d,t} + \epsilon_{ijdt}$$

Because we randomly assign farmers to two levels of variation in the subsidy rate of both of the voucher sizes, $\beta_{small}, \beta_{large}, \beta_{both}$ measure the changes in adoption for an increase of the subsidy rate from the standard subsidy rate to the higher subsidy (additional discount) rate.

In addition, we can interpret the various vouchers as instruments for the impact of input use on yields. If we assume that input subsidies increase agricultural revenue only through the channel of increased input use, then discounts for small packages are an instrument for the impacts of low input use on yields, while discounts for large packages are an instrument for the impacts of high input use on yields. Using all of our experimental variation, we have four instruments (each of the voucher arms) and two endogenous variables (low input use, high input use) that we can use to estimate the returns to low and high input use.

However, the returns to low and high input use may vary across farmers. The impact of using a small or large package of improved inputs on revenue will be a combination of impacts arising from the following changes in the subsidies:

- Some farmers who would not have used improved inputs from the market will be induced to purchase inputs (new adopters of small package)
- Some farmers who would have purchased a large package of inputs will be induced by the subsidy on the small package to buy the small package instead (small package crowd-out)
- Some farmers who would have purchased a large package of inputs will be induced by the subsidy on the package to buy the small package, but top up their purchase, potentially buying more inputs than they would have under the small package (small package crowd-in)
- Some farmers who would not have purchased any improved inputs will be induced by the large package subsidy to buy the large package (new adopters of large package)
- Some farmers who would have purchased the small package will be induced by the large package subsidy to buy the large package (large-package intensifiers)
- Some farmers who would have purchased the large package will use the savings from the large package subsidy to purchase more (large-package crowd-in)

To separate impacts among these compliers, we follow recent developments in the econometrics of selection models (Kline & Walters, 2016; Mountjoy, 2020). This builds on our initial instrumental variable approach, which estimates an average return to small and large fertilizer packages among households induced to shift into small and large packages, respectively. By modeling selection explicitly, we can also estimate the degree to which the most productive farmers, or the farmers with the greatest capacity to scale their farms, have higher or lower returns to small and large fertilizer packages.

Heterogeneity of farmers and willingness to pay by type

To answer the question of how to target subsidies to those whose combination of take-up and production given a subsidy rate would yield the highest return relative to the cost of the subsidies. Estimating this sort of targeting using only variation in price subsidies, would mean interacting the voucher with household characteristics. To be powered on both heterogeneity and local changes in subsidy rates, the sample size would have to be very large, because we would have to use subsidy rates. To be able to conduct counterfactuals on different price changes with heterogeneity, we will use willingness to pay bids to measure the denominator of the welfare maximizing subsidy level equation. During the baseline survey, a subset of farmers will participate in a willingness to pay exercise called a Becker-DeGroot-Marschak mechanism[7] for "top-up vouchers," which can be used in addition to the standard FAO vouchers.

This exercise will allow us to measure demand for small and large quantities of inputs at subsidy levels that we do not observe. Specifically, under a quasilinearity assumption, willingness-to-pay for small and large quantities of inputs is sufficient to know the set of farmers that will purchase small and large quantities of inputs at *any* counterfactual subsidy schedule.

Among the sample of farmers who do the BDM exercise[8], we can estimate the following regression:

$$D_{i,v,t} = \beta_{1,t} subsidy_{rate} * voucher_{ivd} + \delta_t D_{i,v,0} + \gamma_{d,t} + \epsilon_{i,v,t}$$

where subsidy is any possible subsidy rate, using a seemingly unrelated regression correction as in Berry, Fischer, and Guiteras (2020).

Finally, we will interact the voucher with characteristics X where we care about targeting to understand the implications for both demand and agricultural revenue for farmers with characteristics *X* as in:

$$D_{i,v,t} = \beta_{1,t} X * voucher_{ivd} + \delta_t D_{i,v,0} + \gamma_{d,t} + \epsilon_{i,v,t}$$
$$y_{i,v,t} = \beta_{1,t} X * voucher_{ivd} + \delta_t D_{i,v,0} + \gamma_{d,t} + \epsilon_{i,v,t}$$

Where *X* is a characteristic such as a farmer's maximum willingness to pay as measured in the BDM, or measures from behavioral games such as risk aversion or present bias.

Community assignment of vouchers

At the community level, we can use the fact that we are assigning both communities to receive vouchers and individuals within the communities to separately estimate the effect of providing vouchers directly to individuals and to others in the community who do not directly receive the vouchers using the following regression where we separately include an effect of being in a community receiving a voucher ($voucher_{jd}$) and the effect of directly receiving a voucher ($voucher_{ivd}$):

$$D_{ivdt} = \beta_{-rec} voucher_{vd} + \beta_{rec} voucher_{vd} * voucher_{ivd} + \delta_{-rec,t} D_{i,v,0} + \delta_{rect} D_{i,v,0} + \gamma_{d,t} + \epsilon_{i,v,t}$$

[7] Protocols and results from a pilot of this exercise are in Annex 1.

[8] These farmers will be a proportion of the farmers surveyed.

Where the impact of having vouchers in community v enters separately and also with the interaction for farmer i individual receiving the voucher. The effect of directly receiving a voucher is β_{rec}, while the effect of being in a voucher community but not receiving a voucher is β_{-rec}.The vouchers on non-voucher recipients captures spillovers that happen both through market channels and learning about the effect of vouchers.

In addition to take-up, we will also estimate the impact of spillovers on yields, replacing *D* with agricultural revenue in the above.

Retailer outcomes

Assuming we are able to get a) a list of agrodealers, b) a list of the full set of retailers that each can work with, and c) the communities that those retailers could reach and serve, we can also estimate impacts on retailer outcomes as well.

Retailer level outcomes we will measure include availability of each input eligible for FAO subsidies during the survey period and prices for those inputs. For an outcome (binary availability or price per unit) y_{pd} for product *p* sold by retailer *d*, we can estimate:

$$y_{pd} = \beta * voucher_{dt} + \gamma_{rt} + \epsilon_{it}$$

Where $voucher_{dt}$ is an indicator for whether FAO enrolls retailer d to be able to redeem vouchers in round t and γ_{rt} is strata round fixed effects, where strata are most likely districts. Since retailers will receive vouchers from the first year, we will not have baseline, pre-voucher, observations for these outcomes, so we can measure impacts of the voucher on these retailer outcomes only if randomization at the retailer level is feasible. In addition, randomization across retailers allows us to estimate the impacts on communities of being in the catchment of a treated retailer.

7.3 Sample Size Calculations

The experimental design of the IE envisions two levels of treatment assignment. The first randomization is done at the cluster ("*povoado*" or community) level. The second layer of randomization is done at the household level within treated communities: 20% of eligible farmers do not receive any eVoucher, and 83.33% (i.e. 10 out of 12) farmers receive a voucher, with this set evenly divided between four levels of subsidy. The unit of observation, at which surveys are administered, is the household. Namely, we propose to have a random sample of 12 farmers per community, among those who were listed as being eligible to receive an eVoucher coupon. Given these parameters on number of observations per cluster and saturation rate in the treatment group, we first present power calculations for the impact of being assigned to any type of eVoucher. Then, we look at the power to detect a different effect between the four input packages within treated communities. The outcomes of interest for this section are the main indicator directly targeted by the intervention, i.e., technology adoption of subsidized inputs, and the final outcome of interest, i.e., agricultural yields, defined as total revenue per hectare cultivated.

Across-community treatment assignment

Based on Carter et al. (2013), we assume the impact of being assigned to receiving a voucher (regardless of the type/size of the package) on the probability of taking up the voucher to be 0.22 percentage points (pp). We start by estimating the minimum number of clusters we would need to detect this effect on take-up. Using a power of 0.8, an alpha of 0.05, and an intra-cluster correlation (ICC) of 0.1, the sample size per arm required under cluster randomization is 12 communities (i.e., 22 in total). If the impact on take up is half of the one observed in Carter et al. (2013), i.e., 0.11 pp, the total number of clusters needed would increase to 50.

The second outcome in the theory of change is the adoption of the high-yielding inputs, such as certified seeds and chemical fertilizer. We use the intent-to-treat (ITT) effect during the subsidized time period found by Carter et al. (2019) observed, which is equal to 0.16pp for both ma 'fertilizer on maize' and 'improved maize seeds'. Assuming the same parameters as above, we would need to have a sample of 190 clusters, evenly split between treatment and control, to detect the underlying minimum detectable effect (MDE).

Finally, we run power calculations for productivity estimates. In particular, we consider baseline revenue yields from a recent survey with more than 1,000 smallholders DIME performed in the project provinces – mean maize revenue per hectare (MZN/ha) is 5,400, with standard deviation of 6,732 – and the ITT effect from Carter et al. (2019) – i.e., a 0.19% yield increase for subsidy-recipient households – to benchmark the MDE. With a baseline and one follow up survey, assuming a correlation coefficient between measures in the two phases of 0.35, 328 communities will give us enough power to detect a change in such outcome.

Within-community treatment assignment

We now focus on the within community variation generated by the different price schedule offered to beneficiary farmers: for each 12 farmers in a treated community, 4 are assigned a voucher which entitles them to redeem a small package and 4 a large package of inputs. A scenario with 28 clusters yields a minimum detectable difference in take-up of 0.21 pp. Doubling (tripling) the number of clusters to 56 (84) would allow us to detect a difference of 0.15 (0.12) pp.

8. Data Collection and Management

8.1 Main Outcomes of Interest

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

TABLE 2 -- 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
Retailer	Sales	Total sales	Individual	Retailer survey
Retailer	Profit	Total sales net of costs	Individual	Retailer survey
Secondary				
Farmer	Adoption of inputs	Share of cultivated land using improved inputs Total spending on improved inputs	Individual/plot Individual	Household survey eVoucher monitoring system
Farmer	WTP for inputs	Revealed and stated willingness to pay for input package	Individual	Household survey eVoucher monitoring system
Farmer	Access to inputs	Distance to nearest location where inputs can be bought	Individual	Household survey Community survey
Farmer	Prices of inputs	Unit price of inputs	Individual	Household survey Retailer survey
Retailer	Availability of inputs	Retailer reported availability of inputs from the FAO subsidized list	Retailer	Retailer survey

8.2 Quantitative Instruments

eVoucher monitoring system

The eVoucher will implemented through a fully electronic system. Eligible farmers will receive a personal card upon registering, and agrodealers and retailers will have a dedicated console where transactions will

be recorded. Farmer registration will capture the name, location and contact details of the farmer. The system records the retailer ID, where and when an eVoucher is redeemed, the farmer ID, along with details of the transaction, such as the type, quantity and price of the inputs purchased.

Agriculture household surveys

Multi-module agriculture household surveys are planned for a sample of farmers in all 204 treatment and 204 control FFSs. Within each community 12 farmers will be interviewed, at least 2 assigned to each subsidy level (C and T1-T4). The surveys will capture relevant information to compute yield and profit such as self-reported and mapped 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 during the household survey are access to improved inputs, knowledge and adoption of improved input, beliefs on the returns to the promoted inputs. Through behavioral games we will collect other measures such as risk aversion or present bias.

Willingness to pay

To assess farmers beliefs about the return and willingness to invest in modern inputs we will measure their Willingness to Pay for different input packages, as well as observe their actual redemption of the eVouchers at different subsidy levels. The benefit of the WTP measures is that these allow for tracing the full demand curves for the input packages, not just the ones that will be offered in practice. We will collect both stated and revealed preference measures during the agriculture household surveys. The exercise is based on a scale-up of a pilot that was performed in February 2020 that tested and validated the protocols on 60 farmers in Nampula (see Annex 1).

These indicators will be tracked over time, 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 campaign. The second survey is planned for September 2021.

Agrodealer and retailer mapping and survey

FAO is preparing a mapping of eligible agrodealers and retailers in the two provinces. We will complement this effort by performing a listing of known entities among extension agents in all districts and treatment and control communities. A survey of retailers will be conducted in parallel to the baseline household survey to capture input prices and sales, profits from other services, market structure and eVoucher experience.

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 practice. 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.

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 in particular 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 eVoucher electronic system will be leveraged to track treatment assignment and voucher redemption over time. The system allows us to track transactions at each participating agrodealer and retailer in real time via a centralized system hosted by the eVoucher service provider. Moreover, the system permits the implementation of the experimental protocols directly into the eVoucher platform, where registered farmers can be offered different tiers of subsidy level or input packages at the retailer, community and household level, based on the randomized assignment. The eVoucher platform will record: i) the time and date of the transaction, ii) GPS coordinates of the transaction, iii) the farmer name and ID, and iv) the agricultural inputs purchased and the price.

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 internal validity of our primary comparisons is high. The IE randomizes assignment of vouchers and subsidy schedules at both the individual and the community level, meaning that we are both well powered to detect changes in take-up and yields and able to account for spillovers of impacts from some treatments to another. We may be limited in our ability to detect long term changes if vouchers are phased-in to control communities. Additional follow-up surveys can be done in seasons after 2022, but phasing-in vouchers into the control group may interfere with clean identification of the impacts of vouchers, especially if later stages of the vouchers are not implemented in an identical manner as in earlier phases. Our data are subject to the same constraints as mostly field experiments in agriculture. Relative to the typical experiment, the eVoucher system allows us to more directly measure take-up, though yields and input choices will be self-reported by farmers, rather than measured directly during harvests.

The project is being implemented at scale and will cover a large number of communities in all districts of the PROMOVE-Agribiz programme. The eVoucher program will be rolled out in the provinces of Nampula and Zambézia, the most populous provinces, as well as having the highest rates of poverty, in Mozambique. Donors are increasingly shifting their support in the rural sector to these areas and generating evidence on the constraint to adoption of modern inputs in these areas will be relevant to these efforts. Beyond the Mozambican context, similar types of interventions are implemented in many countries. The treatment communities are selected randomly among all eligible communities and therefore representative of the entire program area. Treatment farmers are selected among potential FFS participants, meaning results are most applicable to farmers with a similar profile. The IE aims to shed light on underlying mechanisms that will affect the final impacts of the subsidies, which broadens the scope for learning from this IE, as these will likely be important for other similar projects, regardless of composition and level of the subsidy or other local conditions.

10. IE MANAGEMENT

10.1 EVALUATION TEAM AND MAIN COUNTERPARTS

TABLE 3 -- 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
Alberto Di Grazia	eVoucher Specialist	FAO
Joaquim Mazive	Monitoring and Evaluation	FAO
Ilona Gruenewald	Programme Manager	EUD Mozambique
Daniel Gonzalez-Levassor	Programme Manager	EUD Mozambique
Hiten Jantilal	Agronomist	DNDAF-MADER

10.2 Work Plan and Deliverables

TABLE 4 -- MILESTONES, DELIVERABLES, AND ESTIMATED TIMELINE

Milestones	Deliverables	Completion Date*
Data collection plan and pilot	TORs Questionnaires	Done Done
Willingness-to-pay field pilot	Final instrument and protocol	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	Agrodealer/retailer and community listing Randomization Monitoring reports Database of voucher redemption	Done Done September-April 2021 April 2021
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 March 2023
Dissemination of findings	Presentations	Ongoing

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 DPP of MADER 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 Bank's open data policy. Progress and policy impact can be will be tracked through DIME's 'myIE' monitoring system throughout the project.

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ANNEX 1: WILLINGNESS-TO-PAY PROTOCOLS AND PILOT

WTP Protocols

The WTP exercise involves observing farmers who make an incentivized choice between cash in-hand and the opportunity for discounts on inputs in the future. The exercise gives participants the opportunity to 'bid' for input vouchers on-top of any eVoucher package they are due to receive. The top-up vouchers are valued at 1,000 MZN and 5,000 MZN. Unlike the eVoucher, no copayment is attached to these vouchers, which can be redeemed at a local agrodealer participating in the project.

Protocols for the 1,000 MZN WTP exercise are as follows:

1. A reserve price to purchase the voucher ("envelope price") is defined in secret in advance of the exercise and placed in an envelope. E.g. 400 MZN.
2. Farmers are asked what they are willing to pay for a top-up voucher for the value of 1,000 MZN to purchase agricultural inputs, knowing that:
    a. If their bid price is below the envelope price, they get to keep the value in the envelope in cash. I.e. their preference is for the cash over the voucher.
    b. If their bid price is equal or above the envelope price, they get to "purchase" the 1,000 MZN voucher. I.e. their preference is for the voucher over the cash.
3. The bid price is recorded.
4. Repeat steps 1-3 for the 5,000 MZN voucher.
5. A voucher value is randomly selected to be paid out. At this point the envelope price is revealed. The outcome for that option is implemented (cash value or voucher are given).

WTP Pilot, February 2020

A pilot to test the protocols of the WTP exercise for agricultural inputs was held in two communities over two days (Namiconha and Saua-Saua) in Ribaue in February 2020. Protocols were developed and validated with FAO and presented to the team at DNAS-MADER, who expressed no objection to the protocols. The former farmer group had experience with the eVoucher as part of MDG1 and FFS project, and while the later did not have access to the MDG1 eVoucher but now has a PROMOVE-Agribiz FFS. Three extension agents and their supervisor from the SDAE in Ribaue were trained by a team from DIME and FAO on the application of the WTP protocols on the day prior to the pilot. 30 farmers participated in each farmer group.

During the interview farmers were also requested to state their WTP for a hypothetical agricultural input package based on a description of those promoted under the eVoucher program of MDG1 (See Table 1 in Section 2). They were not told the retail value of these packages, which was for 2,000 MZN for a package of hybrid maize seeds, and 7,000 MZN for a package of hybrid maize seeds and fertilizer.

Figure 4 shows the results of the pilot exercise. In general, the share of the total package value offered by the participants is similar for the differing package values and types of bid (incentivized or stated). It appears that there is a large uptake for the 2,000 MZN stated preference package at around 25%, which is likely due to some tacit knowledge of the prior voucher system (a 2,000 MZN package required a 500 MZN copayment). This WTP exercise will be scaled up in the baseline survey, with around 5,000 households stating their WTP preferences for agricultural input packages. 30% of these households will perform the WTP exercise under incentivized conditions, with the remaining 70% doing so under unincentivized conditions.

FIGURE 4 – INCENTIVIZED AND STATED WILLINGNESS TO PAY OF PILOT FARMERS