RWANDA

Program of impact evaluations in agriculture

Concept Note

Development Impact Evaluation Initiative (DIME)

March 2013

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Background

This Concept Note presents the ongoing program of impact evaluations (IE) the Development Impact Evaluation (DIME) team is leading jointly with the Government of Rwanda and in collaboration with the Global Agriculture and Food Security Program (GAFSP). The IE program is being implemented following the Land and Water Husbandry project's (LWH) sector-wide approach, and involves a wide variety of actors, including the private sector and civil society organizations. This CN details the work program built so far under this IE program. By rigorously testing alternative delivery mechanisms, partners working on the ground are learning to best respond to the farmers' needs. As these results feed back into Rwanda's agricultural strategy, the impact of development investments increases and more lives are changed. This work is aligned to the President's initiative on the Science of Delivery and constitutes one of the three proposed pilots (health in Nigeria, agriculture in Rwanda and financial capability in Brazil) to help demonstrate how the Bank can use experimental science to support countries find solutions to important development issues (maternal and child mortality, rural poverty, and shared growth, respectively) in 3 different contexts. These pilots take a sector-wide and iterative approach to resolve identified problems in close collaboration with governments and partners.

Strategic context

The Government of Rwanda considers agriculture an engine for the economy (cf. Rwanda Vision 2020; Rwanda's Economic Development and Poverty Reduction Strategy) and aims to reduce poverty and achieve food security through commercialized and professional agriculture, as well as increased export earnings and industrialization. This calls for improved and sustained productivity through investment in farmer-participatory land care, water-harvesting, and intensified irrigation in the hillsides. The Land and Water Husbandry (LWH) project is working to meet this objective.

Financed by IDA, USAID, CIDA, and GAFSP, the LWH project is a flagship program in the Government's overall poverty reduction and agricultural strategies, both for the agricultural sector and for the country as a whole. LWH uses a modified watershed approach to introduce sustainable land husbandry measures for hillside agriculture on selected sites and develops hillside irrigation for sub-sections of each site. The project has three components: (a) Capacity Development and Institutional Strengthening for Hillside Development, which aims to develop the capacity of individuals and institutions for improved hillside land husbandry, stronger agricultural value chains, and expanded access to finance; (b) Infrastructure for Hillside Intensification, which provides the essential hardware for hillside intensification to accompany the capacity development of the first component; and (c) Implementation through Ministry of Agriculture and Animal Resources (MINAGRI's) SWAP structure which aims to ensure that project activities are effectively managed within the government program.

The IE work program echoes this SWAP structure and works to build knowledge across all pillars of the strategy along the project's development path. As such, the IE design is designed to inform project design overtime, allowing for course corrections and shifting its focus as implementation. This version of the CN presents the first step of a series of IEs that will support the delivery of MINAGRI's strategy.

Implementation arrangements and capacity building

The impact evaluation (IE) of the LWH is aligned with the program's sector-wide approach structure. It supports the implementation by testing alternative delivery mechanisms and building knowledge feedback loops under each key pillar of MINAGRI's poverty reduction and agricultural strategies. In practice, this is done through three main channels: (1) an IE team that merges research, operations and project management, implements the IE, with the day-to-day technical support of a full-time field coordinator based in Kigali; (2) the knowledge agenda is a working document that adapts to the needs on the ground; and (3) results yield actionable recommendations that back operational decisions with hard evidence.

First, the DIME team has been working closely with operational and program management staff from both MINAGRI and the Bank from the inception of this IE program. The team consolidated the design of the IE over the cover of a DIME capacity building workshop (Naivasha, Kenya, April 2012) during which training was provided on IE evidence and methods and case studies on the use of IE in project management. The team then traveled to Rwanda and adapted the design to the capacity and needs on the ground. The first interventions were launched in June 2012. Throughout the process, the MINAGRI and WB teams are supported by a full-time DIME field coordinator based in Kigali who oversees day-to-day IE activities and ensure full communication across the various entities (research, operations and management).

Second, the Rwanda IE program is a flexible instrument that accumulates learning to increase program impact and adapts to emerging needs on the ground. As the LWH implementation moves through its development path, the focus of the IE shifts on to new areas of work. For instance, LWH irrigation investments are set to start in FY14/15. The team is currently working to identify the learning gaps and operational need that IE could help address under the irrigation component and will start implementing the agreed design in time to support implementation. Similarly, as results come out of the rural finance and extension component of the IE in FY13, these will inform new testing for FY14 and subsequent agricultural seasons.

Finally, operations work with research to set the learning agenda and address their most pressing operational questions, and the resulting IEs are implemented jointly. This ensures a high level of buy in and commitment from the government team to use IE results to shape their policies. Results are produced in real time using computer assisted personal interviewing technology with significantly shortens the field-to-analysis period. Missions are organized around main dissemination dates and ahead of season planning to ensure the absorption of the analytical findings into the operational schedule.

Partners, clients and audience

Direct Audience. The direct audience for this IE program and its outputs consists of the MINAGRI team, the Bank operations team, the Rural Finance Organizations (RFOs) as well as the NGO (One Acre Fund Rwanda, Tubura). Each of these actors is involved in the implementation and supervision of at least one component of the IE program. The objective is that, by the end of a cycle of IE, each partner will have become an informed consumer of IE.

In addition, this program of IE contributes to a large, global research agenda on aid effectiveness in agriculture (DIME-**aadapt**), which counts over 30 participating projects in over 20 countries. The Rwanda IE team has taken part in two capacity building and dissemination events of the **aadapt** community so far (Dakar, 2011; Naivasha, 2012), and will share the results and experience from the ongoing IE work in future events, thus reaching a wide audience of policymakers worldwide. In addition, the CMU's ownership of the activity will ensure its impact in the policy dialogue both at the country and sector levels. Brown-bag seminars will be organized between DIME and the CMU to ensure that the country office staff is aware of the work and learning coming out of this program, and that the IE work is aligned to the Bank's agricultural strategy in Rwanda.

Client Ownership. The proposed impact evaluations have been designed and are being implemented in close collaboration with MINAGRI, as well as the partner RFOs and NGO. Each study responds to the interest expressed by the government of Rwanda and its partners to use their interventions as learning vehicles to improve their potential efficacy and effectiveness on the ground.

Research Impact. In addition to delivering evidence on key operational questions, the Rwanda IE program produces high-quality research papers that have been and will be presented at research BBLs at the Bank (e.g. DECRG and DIME seminar series, AFRCE seminar series), events and trainings as well as international development conferences. Finally, the findings will be published in the DIME working paper series and submitted to peer-reviewed economics and field journals, thus reaching a wide audience of researchers and graduate students worldwide. All data will be made available online on the databank for IE, following the Bank's open data policy.

Structure of the CN

The concept note presents the designs and identification strategies for the three planned impact evaluations studies under the Rwanda IE program so far. We first outline the design of the *Evaluating the Overall LWH Approach* to measure the impact of the program. Second, we describe the design of two experiments to measure the value added of behavioral mechanisms in *Rural Finance* and *Securing High-Quality Private Extension* to increase the impact of the program. A short final section concludes and opens onto the future of the program.

Evaluating the Overall LWH Approach

The overall LWH approach will be evaluated to document the effect of the LWH project on household livelihoods. This section outlines the empirical strategy used to identify the causal effect of participating in LWH on the project development objectives outlined in the results framework: increased productivity of targeted irrigated and non-irrigated areas ($/ha), and increased share of commercialized products. In addition, GAFSP-wide M&E indicators will be tracked, such as household income and food security.

Background

Evaluating the overall impact of LWH is important to allow MINAGRI to effectively plan for its future activities. LWH covers a relatively small area of 30,250 ha, eventually affecting approximately 20 watersheds. From the perspective of MINAGRI, LWH can be seen as a pilot program for comprehensive agricultural overhaul. LWH includes major infrastructure investments such as hillside terracing, irrigation dams, and post-harvest storage. The project aims to operationalize MINAGRI's strategy to encourage mono cropping of cash crops, as opposed to the traditional system of inter-cropping for household consumption.

The LWH approach contrasts with MINAGRI's countrywide Crop Intensification Program (CIP), the country's flagship program to increase agricultural productivity In that sense, CIP provides a counterfactual scenario to the LWH project areas, as it is being implemented in both treatment and control sites. The proposed evaluation of the LWH approach will therefore measure the additional effect of LWH provides when combined with CIP. Evaluating the LWH approach is particularly relevant as the government is considering adding more elements to CIP, such as irrigation and post-harvest storage. The results from this evaluation will help inform scale up decisions from the government and the donors community moving forward.

Motivation & Literature Review

There is not much previous research that can reliably predict the effect of a program such as LWH. This is not entirely surprising, as although there have been comprehensive agricultural projects in many countries, LWH is unique due to Rwanda's hilly geography. The project operates on steep hillsides and their valleys, concentrating on reducing hillside erosion through terracing and tree planting. Additionally, the construction of small dams for irrigation relies on the sloping hills to provide water to fields on lower ground.

The most relevant work already completed is an evaluation of Rwanda's Rural Sector Support Project (RSSP). RSSP is similar to LWH in many ways but concentrates on marshlands as opposed to steep hillsides. An evaluation of RSSP was carried out by the consultancy Oxford Policy Management, which found that agricultural productivity (measured in RwF/acre) nearly doubles in RSSP sites compared to a comparison group. However, due to the different geography of RSSP sites as well as differences in the type of irrigation promoted, this only offers a rough estimate of the potential effects of the LWH approach. Additionally, the RSSP study is a retrospective evaluation and used propensity score matching without referring to initial site selection criteria.

Implementation

LWH is rolling out in three phases: Phase 1A, 1B, and 2. The 4 phase 1A sites began operations in 2010, while the 3 phase 1B sites started in mid-2012. Phase 2 sites are slated to start in 2013. For Phase 2, 37 sites have been identified with the potential of 29,000 ha. Feasibility studies will be conducted from January 2013 to December 2013 to select the 10,000 ha, which will be implemented in Phase 2.

Each LWH project area is called a 'site' and corresponds to a watershed in a specific valley. A site is divided into three areas, qualified by their position relative to the proposed dam location: command area, water catchment area, and command area catchment. The command area lies downstream from the proposed dam and contains the land to be irrigated. The water catchment area is upstream from the dam, while the command area catchment is the hillsides downstream from the dam but above the command area, which will not receive irrigation. Figure 4 shows the example of Nyanza 23, a Phase 1A site.

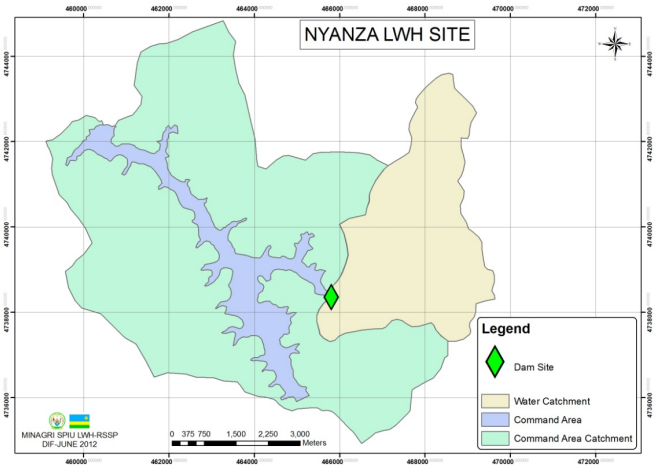

Figure 1: Map of Nyanza-23 (Phase 1A site)

Evaluation Design

The proposed evaluation will focus on Phase 1B and 2 sites. The impact evaluation will formally document the entire impact of the project in these sites, using as a comparison group similar pre-identified sites that will not receive LWH project activities. The main identifying assumption is that the only difference between pre-identified sites that receive LWH and those that do not is the project. The main identification strategy of this design is to use pair-wise matching to identify sites considered eligible to receive LWH, but that will not receive the program. Hence the validity of the estimates will be restricted to basins similar to those selected in this phase of the project.

While the evaluation is designed to measure the overall impact of the project, the division of sites into separate zones will provide some information as to the effect of different components. Since only the command area will receive irrigation, comparison of treatment to control catchment areas will capture the effect of the land husbandry interventions, while comparison of command areas will capture the effect of land husbandry plus irrigation.

Within each LWH site, activities will take place through farmer groups formed by the project. These groups (or around 20 farmers) cultivate contiguous plots of land and will receive agricultural training, financial services, marketing strategies, etc. to increase their capacity for cropping intensification. Hence, all assigned interventions within the project area will be evaluated at the group level.

Selection of control sites

There are a number of reasons to think that pair-wise matching will provide unbiased measures of the overall impact of the project. LWH will only be implemented in a small subset of suitable valleys, and the pre-identification of the sites was well documented. Many sites were considered for inclusion in the LWH, and data was collected on their geography, weather, and land use patterns. These data can be used to identify similar sites to those receiving LWH

As Phase 1A sites commenced project operations prior to the DIME team's engagement with the project, the evaluation focuses on Phase 1B and Phase 2 sites. For each site, a pre-identified nearby site with similar characteristics was chosen to serve as a comparison group. Comparison sites for Phase 1B sites were chosen in consultation with project engineers, based on the following selection criteria:

- **Location:** Must be near the project site, but not on an adjoining hillside to limit spillover effects
- **Agro-climatic zone:** Comparison sites must be in the same agro-climatic zone as treatment sites. This requires similarity in altitude, rainfall and temperature. All selected sites are in the "eastern plateau" agro-climactic zones, and have similar agro-climactic properties.[1]
- **Slope:** Comparison sites must have a similar degree of slope on the hillsides
- **Soil type:** Comparison must be suitable for cultivation of similar crops.
- **Land Use Patterns:** Must be similar across treatment and comparison; for example, since LWH focuses on agricultural production, sites where cattle-farming is the primary activity were not eligible for the project and, therefore, cannot serve as comparison sites.
- **Size:** Comparison sites will be defined such that the ratio of the command area to the rest of the site is similar to the project sites. The size of the comparison site watershed depends on the hypothetical dam location.

LWH selected 3 comparison sites for Phase 1B, each of which was matched to 1 project site.[2] Table 1 describes the characteristics of project and comparison sites. The main measurement for project effect will be a difference-in-differences (DID) estimator between treatment and comparison sites.

[1] Site-specific climate data is not available, as there are limited rainfall stations in Rwanda.

[2] Working with such a small number of clusters implies that general statistical asymptotic properties will not be met for correction of standard
[2] Working with such a small number of clusters implies that general statistical asymptotic properties will not be met for correction of standard
errors (e.g. Moulton, 1996). The team will therefore explore non-parametric correction methods such as bootstrap methods.

Site Name	Status	Slope	Main Crops	Command area as % of site	Distance from treatment site	Original Reason for non-selection
Rwamagana 34	Treat	0-6%: 6.9% 6-16%: 28.2% 16-40 %: 53.6% 40-60%: 10.2% >60%: 1%	Maize, sorghum, cassava, irish potato, sweet potato, tomato, bananas	5.6	NA	NA
Rwamagana 2	Control	0-6%: 5.6% 6-16%: 24.2% 16-40 %: 68.1% 40-60%: 2.0% >60%: 0.04%	Maize, sorghum, cassava, irish potato, sweet potato, tomato, bananas	7.8	6 km (from Rwamagana 34)	Was not part of original consideration.
Rwamagana-35	Treat	0-6%: 3.0% 6-16%: 20.1% 16-40 %: 58.4% 40-60%: 14.2% >60%: 4.3%	Maize, sorghum, cassava, beans, irish potato, sweet potato, tomato, bananas	4.5	NA	NA
Rwamagana-33	Control	0-6%: 2.3% 6-16%: 10.1% 16-40%: 61.8% 40-60%: 17.8% >60%: 8.1%	Maize, sorghum, cassava, irish potato, sweet potato, tomato, bananas	3.0	5 km (from Rwamagana 2)	Too many cattle ranchers in command area. However, control site boundaries were redefined to exclude pasture area.
Kayanza 4	Treat	0-6%: 3.9% 6-16%: 17.7% 16-40 %: 55.5% 40-60%: 18.3% >60%: 3.1%	Maize, sorghum, cassava, beans, irish potato, sweet potato, tomato, bananas	5.2	NA	NA
Kayanza 15	Control	0-6%: 5.8% , 6-16%: 18.9% 16-40%: 52.2% 40-60%: 20.3% >60%: 2.8%	Maize, sorghum, cassava, beans, irish potato, sweet potato bananas	9.8	10 km (from Kayana 4)	Too many settlements in command area so monetary and social costs for resettlement would be higher. But same stream passing through Kayonza-15 and Kayonza-4 so irrigation potential is similar.

Table 1: Treatment and comparison sites

Data

The data collected for the impact evaluation will come from comprehensive, multi-module household surveys. These data will allow the impact evaluation work to document the impact of the project on many of the outcome variables in the operational results framework, but will also expand the analysis to

other outcomes of interest (in particular, rural finance and extension services modules are systematically implemented on the overall sample). The survey will report on the following indicators, which are part of the results framework:

- Net Productivity of irrigated areas
- Net Productivity of non-irrigated areas
- Use of Irrigation
- Use of improved farming methods
- Share of commercialized products
- Participating Farmers using improved methods, by gender
- Usage of services from formal financial institutions
- Use of soil/erosion management techniques

Although they are outside of the results framework, we will also gather data on other indicators which could be influenced by LWH:

- Income
- Consumption
- Labor supply
- School enrollment
- Access to extension services and technology adoption
- Food consumption and security
- Housing quality
- Ownership of livestock
- Access to finance (credit and savings)

The first round of the baseline survey (May/July 2012) covers the three control and treatment sites for phase 1B.[3] A baseline for Phase 2 sites will take place before implementation, likely late 2013 – early 2014. Follow-up surveys will be completed one, two and four years after project implementation, with the first phase 1B follow-up taking place in March 2013, following the Season A harvest.

Data from the baseline survey shows that control and treatment sites are similar with respect to a number of observable characteristics. Table 3 shows that the treatment and control groups are balanced for a number of relevant variables.

[3] The LWH team also conducted a baseline household survey in the Phase 1A sites, giving indicative data that has been used to inform the evaluation design.

	Treatment Observati	Control Observation	Treatment Mean	Treatment SD	Control Mean	Control SD	Difference in Means	P Value
Household								
Female Headed Household	1609	353	0.249	0.757	0.258	0.521	-0.009	0.811
Number of Children	1609	353	2.424	4.460	2.484	2.530	-0.060	0.749
Household Head Completed Primary	1609	353	0.260	0.956	0.229	0.589	0.030	0.484
Cow	1608	353	0.317	2.981	0.399	1.449	-0.083	0.482
Income (Rwf)								
On-Farm Income	1609	353	49206	423816	54657	218118	-5451	0.746
Off-Farm Income	1609	353	69350	310310	89396	201321	-20045	0.204
Total Household	1609	353	121501	615555	150226	338040	-28725	0.291
Expenditure								
Weekly Expenditure	1609	353	4970	12015	4510	9474	459	0.477
Yearly Expenditure	1609	353	148422	1014792	137879	534210	10543	0.795
Food Expenditure	1609	353	4638	9202	4208	5461	430	0.311
Agricultural Output								
Gross Yield (Rwf/Ha)	1283	294	850957	3740181	811600	2010307	39357.44	0.814

P value reports the results from a clustered T test of equality of means between treatment and control
Weekly Expenditure covers frequent expenses such as transportation and communication, excluding food
Yearly Expenditure covers infrequent expenses such as housing, school fees, and purchase of livestock
All variables winsorized at 1% upper tail except yields. Yields trimmed at top and bottom 2% tails.

	Treatment Observations	Control Observations	Treatment Mean	Treatment SD	Control Mean	Control SD	Difference in Means	P Value
Household Characteristics								
Female Headed Household	1609	353	0.248	0.774	0.258	0.526	-0.010	0.787
Number of Children Age 0-17	1609	353	9.476	5.631	9.428	2.815	0.048	0.826
Household Head Completed Primary Education	1602	352	0.218	0.857	0.207	0.540	0.010	0.785
Household Owns a Cow	1608	353	0.317	2.981	0.399	1.449	-0.083	0.482
Income (Rwf)								
On-Farm Income (Rwf)	1609	353	49206	423816	54657	218118	-5451	0.746
Off-Farm Income (Rwf)	1609	353	77032	334852	100548	221417	-23516	0.179
Total Household Income	1609	353	128283	676159	159501	367396	-31218	0.293
Expenditure								
Weekly Expenditure	1609	353	4920	12521	4510	9606	410	0.532
Yearly Expenditure	1609	353	145650	957033	135663	508146	9986	0.796
Food Expenditure	1609	353	5419	8528	5018	5164	401	0.313
Agricultural Output								
Yield (Rwf/Ha)	1281	293	837022	3566386	802546	1911860	34476.440	0.985

P value reports the results from a clustered T test of equality of means between treatment and control
Weekly Expenditure covers frequent expenses such as transportation and communication, excluding food
Yearly Expenditure covers infrequent expenses such as housing, school fees, and purchase of livestock

Table 2: Overall Impact Balance Tests

Sampling & Power Calculations

Within-site sampling strategy: within sites, the sample aims to be geographically representative and to include multiple members of farmer groups. The first criteria is important because LWH could have different effects for different parts of the site, especially in regard to places that are irrigated (the command area) versus those that are not (catchment area). In order to achieve this, we stratify our sample based on the village, which is an administrative unit lower than the site. The amount of people sampled in each village is proportionate to the size of the village. The second criterion is important to allow the project to test innovations within site (such as the rural finance and extension components, explained later in the document), as the unit of intervention is the group level. Although, in year 1, the impact evaluation will test alternative implementation modalities in Phase 1A and 1B sites, Phase 2 sites will be the focus of subsequent iterations in testing innovation. As explained above in the rural finance and extension service sections, these within-site impact evaluations will rely on variations across farmers groups and, thus, require sampling sufficiently high numbers of groups at baseline and follow up. To obtain reasonable precision of the estimates we chose to sample 5 people per group.

As group formation is the first stage of the project, groups are not formed at baseline. This makes sampling at the farmer group level particularly challenging in Phase 1B and Phase 2 sites. In addition, control villages will not form groups.

To address this issue we construct "synthetic" farmers groups by mimicking group formation as per the LWH criteria.[4] Within each sampled village, we randomly select one farmer to be sampled. We then ask each selected farmer to list four other people who have contiguous or near-contiguous plots. These four people then become part of the survey sample, and the five respondents together constitute a survey cluster. Since farmer groups are made based on geographic proximity, these clusters are each likely to be assigned into a single farmer group.

In sum, our sample in Phase 1B sites consists of:

- Rwamagana 34: 90 groups & 5 HH per group i.e. 450 HH(population: ~1800 HH)
- Rwamagana 35: 120 groups & 5 HH per group i.e. 600 HH (population: ~2400 HH)
- Kayonza 4: 90 groups & 5 HH per group i.e. 450 HH (population: ~1800 HH)

The number of sites available for the impact evaluation is constrained by the total number of LWH sites being developed. However, the expected effects of LWH on productivity are extremely high, making identification possible even with a small sample size. In the 4 Phase 1A sites, monitoring and evaluation data shows an increase in average agricultural productivity ($/ha) from 1384 to 3027, which is an increase of .71 standard deviations[5]. (This does not include any irrigation, which has yet to happen in Phase 1A.) Additionally, the within-site intra-cluster correlation coefficient (calculated from the baseline

[4] As the LWH starts forming groups in 1B sites, the baseline listing and sampling frame will be used to guide the operations. This should increase the probability that our synthetic groups overlap with the actual LWH farmers groups.
[5] Due to a large number of upper-tail outliers, the productivity data was winsorized at the upper 5% tail.

survey) is only .029. Therefore, reasonable statistical power can be achieved to identify the overall project effect, even with a small number of sites.

There are 3 treatment and 3 control sites for Phase 1B. 450-600 households were surveyed in treatment sites, and 125 households in control sites, as the project expressed interest in measuring heterogeneous treatment effects. Assuming a power of 85% and a sample per site of 125 people[6], this gives a minimum detectable effect size (MDES) of .57, which is below what we expect based on the Phase 1A sites.[7] Therefore, even with only three treatment sites the evaluation is expected to have sufficient power.

In Phase 2, there will be approximately 13 treatment sites[8], and 13 identified control. If we use the same sample of 125 people per site, this gives a MDES of .21. The exact number of people to survey for Phase 2 will be based upon the data gathered during the Phase 1B survey and the needs for the team to test innovations within the sites.

[6] The increase of surveyed people in the treatment sites without increasing the control sites increases power over these assumptions, but only marginally.
[7] All power calculations were performed assuming a probability of Type I error of 0.05.
[8] Phase 2 will cover 10,000ha out of 29,000ha across 37 potential sites identified as suitable. The total number of sites to be included is not yet determined, but assuming a standard size for all sites we derived the estimate of 13 treatment sites

Rural Finance

Background

LWH is designed to cause a major reorganization in the livelihoods of its participants. LWH idea is to induce people to switch from subsistence farming to cash cropping. Cash cropping has two challenges: first, income comes in the form of money instead of food, and this money must be managed over the year to ensure that the household has enough to eat. Second, cash cropping is more intensive, and households must purchase inputs (seeds, fertilizer, etc.) before each planting season. Overcoming these challenges requires financial management and savings and credit services. Recognizing this need, the LWH rural finance component includes developing relevant financial products and promoting them to farmers.

In the early years of LWH, participants receive many inputs (such as fertilizer, seeds, or infrastructure improvements) either for free or heavily subsidized. However, for the project gains to be sustainable, systems must be put into place to allow farmers to keep using these inputs. Current systems in LWH sites include savings and credit cooperatives (SACCOs) or other Micro Finance Institutions that provide basic savings and loans, or loans bundled with fertilizer purchase (the model of Tubura[9], the primary fertilizer provider in most LWH sites). The project is interested in providing more options for inputs financing; in the long run they hope that farmers will purchase inputs using savings as opposed to taking loans. However, exactly what type of savings product would be most effective is not clear.

To help farmers increase input use and decrease reliance on credit for input, MINAGRI is piloting and rigorously testing the introduction of input saving accounts designed to help farmers exert increased self-control and save a portion of their previous season B income for the coming seasons A and B. Specifically, the impact evaluation team is helping MINAGRI develop and pilot two types of savings accounts inspired by recent impact evaluation findings:

- A **Targeted Savings Account,** which allows people to set aside money for purchasing agricultural inputs, but has no withdrawal restrictions.
- A **Commitment Savings Account,** in which withdrawals are restricted to times when input purchases are made.

Motivation & Literature Review

Rwandan farmers face an extremely tight planting calendar (Figure 2), with harvest and planting times for the two main crop seasons A and B nearly overlapping: Season A ends in January/February and Season B starts in February.[10] Many Season A crops (such as beans) require drying or other post-harvest processing before marketing. Hence, farmers rarely have disposed of their harvest from Season A by the time they need to buy inputs for Season B. This implies that farmers will either need to take credit for inputs or reduce input use. Taking loans can be costly, as interest rates are high. On the other hand, saving for the future helps individuals smooth their consumption, can help achieve higher input use, and

[9] Tubura is the Rwandan branch of One Acre Fund
[10] Cf. http://www.fao.org/giews/countrybrief/country.jsp?code=RWA

has benefits even in the presence of non-predatory lending institutions such as Tubura, which provides agricultural extension to client farmers and allows repayment in small installments over the season. Moreover, a saving scheme where farmers are encouraged to save at harvest can act as a buffer stock, allowing them to use their savings at planting time and repay their loan over time without impacting consumption levels. Taking into account some degree of risk aversion, a farmer's decision to purchase fertilizers (both at the extensive and intensive margins) is likely a (convex) function of their perceived ability to repay.[11] Under this traditional assumption, savings could even increase usage of inputs through increased use of credit for inputs.

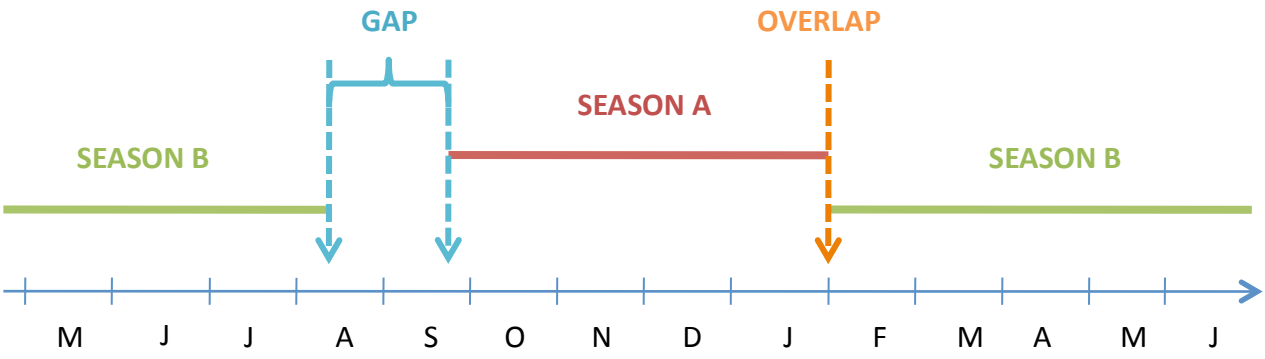

Figure 2: Seasonal calendar

Despite the theoretical benefits of savings and the fact that many people report wanting to save more, savings rates remain low in many parts of the world. In Rwanda, less than 20% of the rural population saved at a financial institution in the past year.[12] One way to explain this behavior is that people may have 'time-inconsistent' preferences: an individual's discount rate depends on the period in which it is measured.[13] In practice, time-inconsistent discount rates can imply that individuals are more willing to save the money they will earn in the future than the money they have now (also called hyperbolic discounting). In terms of saving behavior, this means that certain individuals may want to restrict their future consumption decisions now by limiting their ability to withdraw in the future. Commitment savings products are designed to do just that—enable individuals to decide now to save the money they will earn in the future, and thus help people save more by solving this time-inconsistency issue.

A number of recent studies have examined demand for commitment savings products and looked at their effect on savings. Ashraf et al[14] find that people in the Philippines who are offered a commitment savings account have savings 81 percentage points higher than those who were offered normal savings, even though the authors cannot rule out that this is the result of a displacement from savings in other

[11] In other words, a farmers' utility function will be concave with respect to her perceived risk of default on a loan.
[12] Savings rate for rural population aged 15+ in 2011, according to the Global Financial Inclusion Index
[13] A review of the theoretical literature on time inconsistent preferences can be found here: Bernard Caillaud, Bruno Jullien, Modelling time-inconsistent preferences, European Economic Review, Volume 44, Issues 4–6, May 2000, Pages 1116-1124, ISSN 0014-2921, 10.1016/S0014-2921(99)00061-6.
[14]. Ashraf, D.S. Karlan, W. Yin. Tying Odysseus to the mast: Evidence from a commitment savings product in the Philippines. Quarterly Journal of Economics, 121 (2) (2006), pp. 635-672.

forms to that particular institution. Take-up of the commitment savings account is low (28.4 percent), but it is higher among people who exhibit greater patience in the future than in the present, as would be predicted by a theory of hyperbolic discounting.[15] Brune et al[16] offer a similar commitment product in Malawi, and find similar results: low take up (20%), but higher savings among those offered the commitment account, and large effects on agricultural input use and crop sales.

While these studies show that commitment accounts can increase the amount saved, they leave questions unanswered as to which behavioral mechanisms cause individuals to save more when they have access to savings products with limited withdrawal properties. The proposed study would make four main contributions to the literature. First, the Brune et al study shows that the positive impact on farmers' saving and use of agricultural inputs came from extra savings made to ordinary accounts, not to the commitment account. One interpretation is that the budgeting exercise and exposure to the idea of a commitment product induced a desire to save, and that the actual withdrawal restrictions were not important. The proposed study will isolate the effect of withdrawal restriction to understand whether this is a necessary feature of this type of account, by comparing a targeted savings account with a limited withdrawal account.

Second, the impact of offering savings products with limited withdrawal properties on consumption behavior is likely to vary a lot across contexts. For instance, while the evidence from Malawi shows an increase in the use of productive inputs, results from the Philippines suggest that effects on participants' savings choices may not last. Although the participants in Ashraf et al's experiments initially increased their savings, after two years the savings had diminished to a level statistically indistinguishable from the control group.[17]

Third, neither of the above works concentrated specifically on saving for agricultural inputs. Duflo et al[18] tested the impact of a pre-purchase of inputs program on input use. They find that offering the opportunity to purchase fertilizer at the harvest of the previous season drastically increases fertilizer use, with similar effects as a 50% discount on fertilizer during the following season. These results demonstrate the potential of a pre-commitment device in getting farmers to invest in productive technology. The present study makes a novel contribution by testing the impact of limited withdrawal product on input use, where the entire budgeting exercise focuses on planning for agricultural input purchases in the next two seasons. This is particularly policy-relevant as, in the context of Rwanda, using pre-purchase of inputs such as done by Duflo et al in Kenya is not straightforward: fertilizer providers have regional monopoly, limited geographical coverage, and change each year. In addition, the rural finance organizations do not bear any responsibility for facilitating access to inputs. Hence, should

[15]Time preferences are measured by varying the time horizon in a series of hypothetical investment questions.
[16]Brune, Lasse, Xavier Gine, Jessica Goldberg, and Dean Yang (2011). "Commitments to Save: A Field Experiment in Rural Malawi", University of Michigan, May (mimeograph).
[17] Ashraf N, Karlan D, Yin W (2006a) Household decision making and savings impacts: further evidence from a commitment savings product in the Philippines, mimeo Yale University.
[18]Duflo, Esther, Michael Kremer and Jonathan Robinson (2009), 'Nudging farmers to use fertilizer:
theory and experimental evidence from Kenya,' Harvard mimeo

innovative savings products targeted to input savings have a significant impact on usage, this study will have broader policy implication, all else being equal.

Finally, this IE benefits from unique data to empirically identify complementarities between savings and credit. This will be done by matching administrative data from the main provider of credit in the area, the Tubura NGO, to the RFOs administrative records and the survey data. The reasons Tubura offers a particularly good opportunity to look at these complementarities are that (1) they are the main provider of seasonal inputs in the area, and our experiment specifically targets input savings; (2) we have access to their client database, both current, retrospective, and future (beyond the duration of the experiment). As they record not only amount of credit taken but also repayment rate week by week, we can not only look at the impact of our intervention on take up, total amount purchased (both for new and existing clients), and repayment profile over the seasons. This is of particular interest as the buffer stock model of savings and credit predicts complementarity across, as well as a smoother repayment pattern. However, Tubura is not the only source of inputs to consider: they do not provide credit for seeds and durable productive assets. The impact of the products on the demand for credit for durable assets will be scrutinized using administrative data from the main loan suppliers in the areas (our partner RFOs).

Research Questions

Specifically this evaluation seeks to answer the following questions:

- What are the determinants of take up for the new saving products?
- Does savings promotion cause people to use savings instead of loans to purchase agricultural inputs, or are savings complements to input loans? Specifically, among farmers that opted to purchase inputs through Tubura's loan program, does having access to commitment / targeted savings products help smooth consumption? Does it have an impact on the week-by-week repayment profile?
- Are there complementarities between savings and credit? Can we measure these complementarities both at the extensive and intensive margins?
- Is the commitment savings product more effective than the targeted savings product in increasing the use of agricultural inputs and decreasing loans?
- Are withdrawal restrictions associated to significant welfare losses, and to what extent do they offset the benefits of the product in helping farmers invest in productive inputs?

This evaluation will provide real-time learning to the LWH team and will inform the implementation moving forward, allowing for course corrections and scale up decisions. As the new products are being tested in sites that are already developed (Phase 1A), the results will be used to plan the rural finance offerings of existing and future sites (Phase 1A, 1B and 2).

Implementation

LWH collaborated with local rural finance organizations to develop a number of savings products and promote them at the level of the LWH farmers' groups. Using an experimental design, the evaluation

will document the relative impact of these products and identify behavioral mechanisms through which certain product characteristics affected farmers' savings decisions. The following products and trainings were offered.[19]

1. **Agricultural Financial Planning (offered to all groups)**: As part of LWH's extension services, an agronomist visits each farmer group to help them plan for the following seasons. The agronomist demonstrates how and help each individual farmer calculate, based on the crops planned for the area and land size, the amount and the cost of various inputs (seeds, fertilizer, etc) needed in the coming 2 seasons. The output from each group session is a form which individual entries indicating targets for seeds, fertilizer, and compost use at the farmer level. The form is both collected for the project's administrative record and kept by the farmers for book keeping. This training is a pure planning exercise, delivered separately from any rural finance product or input purchase plan promotion.
2. **Savings Awareness Campaign (offered to all groups):** Representatives from the local rural finance organization (RFO) visit farmer groups to promote formal savings, and especially savings for agricultural inputs. RFO representatives remind people that using savings to pay for agricultural inputs is more cost-effective than using loans, and that saving in a bank is safer than saving at home. The training includes a budgeting exercise to teach farmers how to classify expenditure as necessary and unnecessary, short term and long term, so that they can decide on the level of future savings they need.
3. **Targeted Savings Treatment (Account Promotion & Registration):** In addition to the Savings Awareness Campaign, farmers receive a brochure promoting targeted savings. After the training, the RFO representatives offer group members an opportunity to open a targeted savings account, and assist with registration. The registration form clearly states the target amount of savings that each farmer sets him/herself for Season A and Season B (based on the calculations made in the Agricultural Financial Planning Process). To complete the registration process, the representative pastes a sticker in each group member's passbook[20] indicating the target amount of savings, to remind a farmer of how much she plans to save.
4. **Commitment Savings Treatment (Account Promotion & Registration):** In addition to the Savings Awareness Campaign, RFO representatives explain that "locking their money away" will help them resist other temptations to consume non-essential goods. Farmers receive a brochure promoting commitment savings. After the training, the RFO representatives offer group members an opportunity to open a commitment savings account, and assist with registration. When a farmer signs up for the commitment savings account, she chooses two targets and two corresponding withdrawal dates after which she will be allowed to withdraw money. Farmers are only allowed a single withdrawal after the first date, and can withdraw the rest after the second date. Farmers are

[19] As long as customers are already members of the participating rural finance organization (RFO), the only fee for opening an individual account is Rwf 700 ($1.17) to cover the passbook. If the individual already has a savings account, there is no additional cost for registering for a new product. The new savings products pay an interest rate of 5% per annum.[19] Upon signing up, customers are encouraged to transfer money from other accounts, such as their group account, or sign up for automatic deposits into the new account.

[20] Each member of the RFO owns a passbook (individual account users each have one; group account members will share one). It is a simple booklet that is used to record each transaction and is kept by the user.

encouraged to choose dates that correspond to the next two seasons' planting times, since each targeted amount is supposed to help them purchase inputs for each season.[21]

The interest rate proposed on the piloted products is fully on par with that offered in the normal savings account. Hence farmers would only take up the new products to benefit from the targeting/commitment properties. The SACCOs in Rwanda are private-public partnerships and, thus, benefit from subsidies, especially in the form of capacity building and infrastructure. There is a fee to open an individual account (USD 7-11/RwF 4,000-5,700).

Evaluation Design

The evaluation takes place in two LWH Phase 1A sites, Karongi 12 and 13, as these sites have both received the LWH interventions and have established RFOs that have the capacity and coverage to provide the financial products and afford sufficient statistical power. The project's rural finance component is aimed to be implemented in more advanced sites, where land husbandry work is already underway. These sites satisfied this criterion and the local RFOs we willing to take part in the experiment. There are 80 established farmer groups[22] registered with the local RFOs. The 80 groups are randomly assigned to the following three treatment arms (stratified by site):[23]

1. **Agricultural Financial Planning + Savings Promotion (20 Groups)**
2. **Agricultural Financial Planning + Savings Promotion + Targeted Savings Treatment (20 Groups):**
3. **Agricultural Financial Planning + Savings Promotion + Commitment Savings Treatment (40 groups)**

Participants in the training are only offered the opportunity to register for the specific product promoted to their group. To simplify implementation and increase compliance, farmers can only sign up for the savings product assigned to their group, even when visiting their RFO office. Therefore, the difference between the savings treatments is identified by a pure randomized assignment to a specific product. This setup allows us to distinguish a number of effects. To see the effect of targeted savings, we can compare treatment arms 2+3 to arm 1. To see the additional effect of the commitment account we can compare arm 2 to arm 3. This design is illustrated in 1 below:

[21] Although this was not enforced, 89% of farmers who signed up for season A fixed a date within the planting window, and 88% for season B.
[22] For a definition of farmers' groups, see p.9 under Evaluation Design.
[23] In the interest of statistical power, we elected to place the priority on the commitment savings

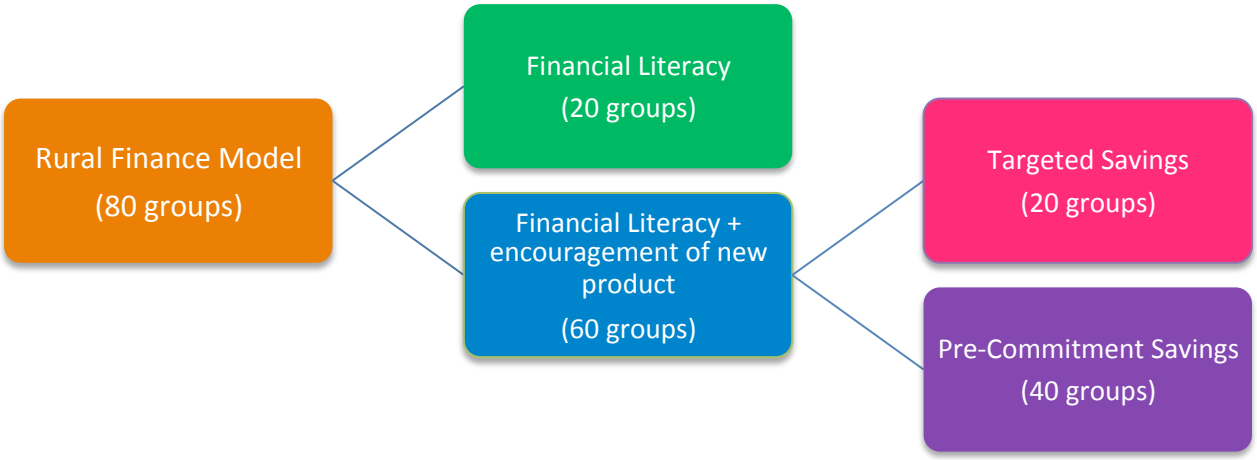

Figure 3: Rural Finance Evaluation Design

While having a pure control group might have been ideal, timing and implementation capacity only allowed for 2 RFOs to be trained and supported on the new products. The RFOs covering the largest number of LWH only added up to 80 groups, limiting our overall power and number of possible treatment arms. Given the current state of the literature on commitment savings, the largest gap is not necessarily to identify the benefit of access to saving products and budgeting exercise, but more to measure the additional impact of the access to the products vs. budgeting. In addition, carrying out the budgeting exercise has the benefit of providing a counterfactual for the targets in the control group. More broadly, this is ultimately more informative in the Rwandan context, as the budgeting exercise is part and parcel of the national agricultural policy. In future rounds of testing, we will work to add a control group, especially as the team looks to test similar products outside the project area.

Data

There are a number of ways in which increased access to savings could have an effect on livelihoods, and a range of data both administrative and from household surveys will be used to measure these impacts. Administrative data sources include: the RFOs, Tubura, and the LWH zone agronomists. RFO administrative data includes usage of financial products and transaction data (at the individual and group level) pre- and post-introduction of the new products. Data from Tubura is available for all farmers in our study group that have taken up a loan for inputs. This includes weekly repayment data going back to Seasons A and B 2011/12 and extends to Seasons A and B 2012/13. This will allow us to test hyperbolic discounting and measure the differential in input use across seasons and between treatment and control groups. LWH zone agronomists collect data on input planning and usage each season.

We use the group-level agronomist data for Seasons A and B 2012 to perform check for balance in observables across treatment arms and verify the validity of the randomization. Table 3 presents balance tests comparing the group that received only financial literacy to those groups offered a savings

product. The difference in means between the treatment arms is not significant for any of the variables tested.

	Offered Savings Account	Financial Literacy Training Only	Total Groups	Financial Literacy Mean	Financial Literacy SD	Offered Savings Mean	Offered Savings SD	Mean difference	P Value	
Input Purchases (per person in Rwf)										
Seeds	57	18	75	78185.27	40694.23	97049.31	71246.29	-18864.05	0.1631133	
NPK	57	18	75	15916.29	8284.182	19756.47	14503.71	-3840.181	0.1631133	
Pesticide	57	18	75	3449.023	2314.225	4648.051	2920.359	-1199.029	0.0765683	*
Labor	57	18	75	27923.31	14533.65	34660.47	25445.1	-6737.161	0.1631133	
Total Inputs	57	18	75	125473.9	64487.04	156114.3	112227.1	-30640.42	0.1518244	
Other Characteristics										
Total Income	57	18	75	178471.4	154682.1	251415	285608.5	-72943.52	0.1669516	
Yield (tons/ha)	57	18	75	0.9502932	2.391151	0.6361148	0.4667773	0.3141783	0.582857	
P value is from a T test of equality of means between the two study arms. * = significant at 10% level										

Table 3: Tests of Balance for Rural Finance

The IE team plans to conduct follow-up household surveys after the harvest for both season A and season B 2013.

We plan to examine the following indicators:

- Number of commitment/targeted accounts opened (administrative data from RFOs)
- Amount of savings; total and in each account (administrative data from RFOs)
- Usage of agricultural inputs (HH survey; administrative data from LWH)
- Income, especially from harvest (HH survey; administrative data from LWH)
- Financing strategy for inputs (HH survey; administrative data from Tubura)
    - Take up, size, and weekly repayment patterns of loans for inputs through Tubura
- Credit – Savings may be a substitute for credit, but could also be a complement (HH survey; administrative data from RFO)
- Livestock- purchases/sales may substitute for or complement formal savings (HH survey)
- School enrollment and school fees - families often use savings for schooling costs (HH survey)
- Health insurance – families often use savings to pay for Mutuelle de Sante (HH survey)

Sampling and Power Calculations

This evaluation takes place in two Phase 1A sites, Karongi 12 and Karongi 13. All 80 groups that currently have accounts at the two selected RFOs will be included in the intervention. The survey sample will include all group members, to account for selection bias into training and take up and compute the intent-to-treat (ITT) effect of the program.

Although the sample size was constrained by the reach of the micro-finance organizations, power calculations provide estimates of the minimal detectable effect size (MDES) of this design. The baseline

data shows very little use of inputs, making calculations of intra-cluster correlation unreliable. Due to the small ICC for yields (discussed in a later section) and the homogeneity of groups, we assume a "small" ICC of 05.[24] Within-group ICC is likely smaller than within-site ICC, but we use the within-site estimate to be conservative. We perform calculations for a size of .05, power of .85, and assuming 20 people sampled per group.[25] The calculations are performed for the ITT estimate, which will be the primary impact estimator.

There are two treatment-arm comparisons of interest: commitment savings versus targeted savings, and all people offered accounts versus the "control" group that receive agricultural financial planning and savings promotion only. The results from the power calculations are shown in Table 4.

Estimation	Number of Clusters (balanced equivalent)	Respondents per Cluster	MDES
Commitment vs. Targeted Savings	53	20	.26
Savings Product Promotion vs. Savings Promotion	60	20	.24

Table 4: Rural Finance Power Calculations

To interpret these effect sizes, we can compare to the similar study conducted by Brune et al. In this study being offered a commitment savings account increases the amount of savings by .26 standard deviations, and the amount spent on inputs by .19 standard deviations. Based on these benchmarks, the design is likely to have satisfactory power to detect effects on savings, but may be slightly underpowered to detect changes in input use. For comparisons between the commitment savings and targeting savings arms, the power to detect an effect of .19 (as seen in Brune et al) is 58%. For the effect of being offered any account versus just receiving training, the power is 63%.

[24] Baseline data on savings is not available.

[25] As the number of groups in the different treatment arms are not equal, power calculations were performed using "balanced equivalent". The total "balanced equivalent" number of clusters is equal to two times the harmonic mean of the number of clusters in each treatment arm. This strategy is suggested in the user's guide for the Optimal Design software, which was used to conduct the power calculations. This guide can be found here: http://hlmsoft.net/od/od-manual-20111016-v300.pdf.

Securing High-Quality Private Extension

Background

Effective agricultural extension services are crucial for the success of the agricultural transformation LWH envisions. Farmers require new phytosanitary information and assistance to correctly implement the ambitious recommended technology packages and fully benefit from the project approach. However, the ratio of public extension workers to farmers is estimated to be as low as 1:13,000.[26]

A key and innovative component of the Government of Rwanda's agricultural extension strategy is 'progressive disengagement from extension service in favor of private extension delivery.'[27] LWH serves as a test case for how to operationalize this strategy. Recognizing the challenges and costs of public extension services, the LWH team is working in close collaboration with the One Acre Fund NGO (known in Rwanda as Tubura) to deliver high-quality, private extension services to the project farmers. The GoR's strategy is to use public and private extension services as complements and not substitutes, and they work to fulfill different needs. Public extension is active on the planning side, and interacts with farmers on the intensification strategy, while private services are used for more topical, on-farm guidance side. Yet, there is limited experience with private extension delivery, and many unanswered questions surrounding the best ways to ensure that the quality of service meets farmers and government expectations. MINAGRI has targeted this component for an impact evaluation to provide rigorous evidence for the strategy of extension privatization going forward.

MINAGRI's overarching concern with privatizing agricultural extension is that if farmers are going to pay for agricultural extension, they must receive (and demand) high-quality and timely service delivery. The impact evaluation of the agricultural extension component tests whether introducing farmer feedback mechanisms will insure the quality of private extension services through either of two possible channels. First, a feedback tool at the level of the users might provide more accurate information to the service provider, and thus allow for more accurate response. Second, empowering the farmers to provide feedback through scorecards could result in farmers demanding better service where they are not satisfied, beyond reporting it on the cards. The long-run objective is to ensure that the quality of the service is sufficiently high and to ensure high farmers' take up and increased productivity through increased accountability.

The proposed impact evaluation will pilot innovative strategies to encourage farmers to demand better service provision and hold Tubura's field staff accountable.[28] It will test three feedback tools: scorecards, advocacy groups and a free client hotline. Innovative implementation modalities will be compared

[26] Land Husbandry, Water Harvesting and Hillside Irrigation Project Appraisal Document. World Bank, 2009. Pg 2
[27] Land Husbandry, Water Harvesting and Hillside Irrigation Project Appraisal Document. World Bank, 2009. Pg 9
[28] The team is exploring correlating the results from this scorecard experiment to repayment performance data at the field officer level and, in a second round of testing (2013/14), to design and evaluate new performance-based incentive schemes that align with both Tubura and farmers' objective function.

within each approach. Scorecards are hoped to increase feedback to the field team as well as engage the farmers into demanding higher quality standards and reporting problems.

Motivation & Literature Review

Extension Services: Public agricultural extension services get mixed reviews in the literature. Birkhaeuser et al.[29] find no significant relation between extension provision and on-farm productivity for traditional training and visit extension programs in SSA. Evenson[30] and Dercon et al[31] identify some successes, while Anderson and Feder[32] propose an organizational enquiry into which model of extension (public or private) can deliver higher results.

Feedback Mechanisms: The concept of a 'citizen report card' was first developed by civil society organizations in Bangalore, India, in 1993 in response to concerns about the quality of public services. Citizen report cards provide citizen feedback on various policies / programs, and are meant to serve as social accountability mechanisms that identify poor performance and stimulate improvement.[33] They are part of an approach to making services work for the poor that emphasizes "client power." This approach has gained prominence in the last decade; the World Development Report 2004 "Making Services Work for Poor People" emphasizes the need to increase poor citizens' voice and participation.[34] However, as Duflo and Banerjee (2006)[35] document, despite widespread enthusiasm, few programs that increase beneficiary control have been rigorously evaluated, and the evidence so far is mixed. In addition, feedback mechanisms appear to yield varying degrees of impact on quality and quantity of service provision, as well as on usage. To some extent, this could be attributable to the low level of scrutiny the literature has placed on implementation protocols. As Duflo and Banerjee (2006) discuss, mediated vs. mechanized protocols could mean the difference between success and failure for this class of interventions.[36] While all citizen report cards and feedback mechanisms elicit user feedback on services, there is no consensus on the best way to elicit that feedback, and little research as to whether the way in which the report card is implemented matters.

As most citizen report card interventions are in health or education, the few rigorous evaluations that have been done are also specific to those sectors. For example, Bjorkman and Svennson (2009)[37] show that community monitoring of public health facilities—through a citizen report card implemented in a

[29] Birkhaeuser, Dean, Evenson Robert, and Gershon Feder. 1991. "The Economic Impact of Agricultural Extension: a Review." Economic Development and Cultural Change, 39(3): 607–650.
[30] Evenson, Robert, 2001. "Economic impacts of agricultural research and extension."Handbook of agricultural economics, Volume 1, Part A, 2001, Pages 573–628.
[31] Dercon, Stefan, and Daniel O. Gilligan, John Hoddinott and Tassew Woldehanna, 2009. "The Impact of Agricultural Extension and Roads on Poverty and Consumption Growth in Fifteen Ethiopian Villages," American Journal of Agricultural Economics, Agricultural and Applied Economics Association, vol. 91(4), pages 1007-1021.
[32] Anderson, Jock R., and Gershon Feder, 2003. "Rural extension services." World Bank Policy Research Working Paper 2976.
[33] Empowerment Case Studies: Citizen Report Card, Bangalore
[34] World Bank Development Report (2004)
[35] Banerjee, Abhijit, and Esther Duflo, 2006. "Addressing absence". Journal of Economic Perspectives, American Economic Association, vol. 20(1), pages 117-132, Winter.
[36] As cited in Banerjee and Duflo (2005), see mediated feedback process in Kremer and Chen, 2001, and mechanized process in Duflo et al., 2011.
[37] Martina Björkman and Jakob Svensson, 2009. "Power to the People: Evidence from a Randomized Field Experiment on Community-Based Monitoring in Uganda," The Quarterly Journal of Economics, MIT Press, vol. 124(2), pages 735-769, May.

random subset of communities in Uganda—contributes to the improvement of the quality and quantity of health care, as health unit staff exert greater effort to serve the needs of the community. There are few examples of citizen report cards in agriculture. One exception is Mogues et al (2009)[38], who find extraordinarily high rates of satisfaction with extension services in Ethiopia: 92% of men and 94% of women who received extension or expert advice report being 'very satisfied'. However, only 8% of those farmers reported adopting any new practice or use of inputs (whether improved or conventional) over the last two years. This is potentially due to methodological concerns with the satisfaction survey questions.

The literature on citizen empowerment presents mixed evidence on the impact of feedback loops scorecards in boosting citizens' empowerment, and it would at best offer a partial solution to improve service delivery. In a sense, the main concern within both Tubura and MINAGRI on the quality of service provision is that extension workers' incentives (Field Officers, FOs) may not be aligned with farmers' interests. Indeed, Tubura's main performance indicator for an FO is repayment rate and number of clients; this raises concern over the content of their interactions with farmers. Introducing "softer" measures of performance in their assessment is therefore of interest both in reinforcing satisfaction and demand for the service. A second stage in the experimentation (seasons A/B 2014) might be to introduce farmers' feedback to an FO's performance review, especially if we find that farmers' repayment rate and demand correlate with quality of service.

Research Questions

The theory of change underlying this impact evaluation is that farmers can learn to hold their service providers accountable to delivering high-quality services if they are trained and/or induced to do so. The impact evaluation will test two dimensions of that theory, looking respectively at supply and demand mechanisms for farmers' feedback.

Specifically, this impact evaluation seeks to answer the following questions:

- Do scorecards empower farmers to demand better services?
- What type of scorecard will be most cost-effective at providing actionable and accurate information?
- Will new feedback tools lead to better service provision?
- Does the behavior of Tubura's field officers change when scorecards are introduced in their area?

This evaluation will provide real-time learning to the LWH team and will inform the implementation moving forward, and will provide evidence to inform future collaboration between MINAGRI and Tubura.

[38] Tewodaj Mogues, Marc J. Cohen, Regina Birner, Mamusha Lemma, Josee Randriamamonjy, Fanaye Tadesse and Zelekawork Paulos, 2009. "Agricultural Extension in Ethiopia through a Gender and Governance Lens". IFPRI discussion paper Discussion Paper No. ESSP2 007.

Implementation

Scorecards: Three types of scorecards will be implemented by an independent survey firm: a graphic-based scorecard (designed for respondents with low literacy levels), a questionnaire-style scorecard administered in person by a trained enumerator, and a questionnaire-style scorecard administered over the telephone.

Feedback loops: A natural extension of the scorecard experiment is to test the impact of scorecards as an empowerment mechanism to get farmers to assess and internalize the quality of service they receive in their decision to provide feedback. Ultimately, this could also affect their decision to purchase the service in the future and spill over to other, non-Tubura consumers in the community. As the scorecards will be applied only in a random number of farmers groups, we will be able to capture this effect by measuring differences in the amount and nature of farmers' feedback across groups receiving the score cards and those who will not, and track the overall demand for Tubura services in the community. A motivating concern is that farmers might not provide feedback through just any channel, and that the choice of the channel could have a large impact on the quantity and quality of feedback the service provider will receive.

Tubura will test 3 alternative demand-side approaches to farmer feedback.

1. Monitoring Training + Logbook collected by Field Manager (FM): the designated Tubura group leader (GL) is trained to be a group advocate, and given a logbook. She is required to record feedback from the group on a monthly basis, with the assistance of the FM.
2. Monitoring Training + Logbook collected by M&E Officer: the designated Tubura group leader (GL) is trained to be a group advocate, and given a logbook. She is required to record feedback from the group on a monthly basis, with the assistance of the M&E officer.
3. Monitoring Training + Hotline Training + Logbook
4. Control: the "status quo" is that Field Managers (FMs) keep a logbook and record feedback from farmer groups whenever reported. However, farmers do not have direct access to their local FM on a regular basis, making this exercise often fruitless. In these groups, there is no advocacy training or structure given to filling out the logbook.

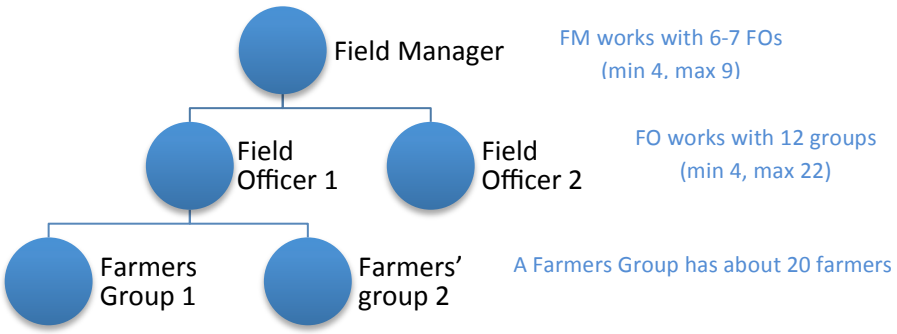

Figure 4: Tubura field operations -- organizational chart

Evaluation design

The evaluation takes place in two types of LWH sites: established sites in Karongi and Rutsiro districts (LWH Phase 1A), and new sites in Rwamagana district (LWH Phase 1B). In all these sites, agricultural extension is provided by Tubura. In the 2012-2013 agricultural seasons, Tubura works with 180 groups across the two sites.

Scorecards: The 180 groups were randomly assigned to the following 4 scorecard treatment arms[39]:

1. Control – 90 groups
2. Farmer Report Card A (Visual): 30 groups
3. Farmer Report Card B (In-person): 30 groups
4. Farmer Report Card C (Telephone)**:** 30 groups

While the scorecards will vary in the depth of information collected, they will partially overlap in their content, allowing the team to measure their respective impact on both information accuracy and on farmer empowerment. The scorecards will then be used both for Tubura to assess the quality of their service both overall and at the group and FO level, and the results will be shared with the treatment groups in subsequent rounds of scorecard data collection, just before each interview.

Feedback loops: A second, cross-cutting randomization assigned the groups to the following 4 feedback loop treatment arms:

1. Monitoring Training + Logbook collected by Field Manager: 44 groups
2. Monitoring Training + Logbook collected by M&E Officer: 44 groups
3. Monitoring Training + Hotline Training + Logbook: 44 groups
4. Control (Status Quo): 48 groups

Comparing the intensity and quality of feedback receive across these three channels will allow us to measure farmers' reporting bias along the social distance between the monitor and the farmers (logbook collector), and compare mediated to non-mediated feedback mechanisms.

[Falsely] announcing scorecards to service providers: A third, cross-cutting randomization assigned half of the groups in which Tubura will inform its Field Officers (FO) of the treatment status (whether or not scorecards will be implemented). This provides a "placebo" set of groups where the FOs will be told that scorecards might be happening but will not be. Similarly, half of the scorecard groups will not be announced to the FOs. Comparing announcement to no announcement will allow us to measure to what extent awareness of the scorecards can itself boost efforts of the field team, as follows, where $Y_{i|j}$ is the FO performance in treatment i conditional on announcement status j, with i taking the values Treatment Scorecards ($_{Ts}$) and Control Scorecards ($_{Cs}$), and j taking the values FO announcement (A) and no FO announcement (NA).

[39] These various types of scorecards will only be compared for measurement issues and to assess differences in farmers' reaction as an empowerment mechanism. When estimating interactions between scorecard and other treatments, all scorecard types will be pooled in one treatment to ensure adequate statistical power.

- This test will only bring results if FOs systematically adjust their behavior to the presence/announcement of scorecards; if not, the announcement has no effect on anything ($|Y_{Ts|A} - Y_{Cs|NA}|=0$)
- Assuming FOs adjust their performance and $|Y_{Ts|A} - Y_{Cs|NA}|>0$
    - FOs can **perfectly tell** where the scorecards happen: if so, we should see that $[Y_{Ts|A}-Y_{Ts|NA}]=[Y_{Cs|A}-Y_{Cs|NA}]=0$
    - FOs **cannot tell at all**, and adjust their performance to announcement only we should see $[Y_{Ts|A}-Y_{Ts|NA}]-[Y_{Cs|A}-Y_{Cs|NA}]=0$ with $|Y_{Ts|A}-Y_{Ts|NA}| >0$, $|Y_{Cs|A}-Y_{Cs|NA}|>0$
    - FOs can **imperfectly tell** and, thus, imperfectly adjust to the announcement, we should see $|[Y_{Ts|A}-Y_{Ts|NA}]-[Y_{Cs|A}-Y_{Cs|NA}]|>0$ with $|Y_{Ts|A}-Y_{Ts|NA}| >0$ and $|Y_{Cs|A}-Y_{Cs|NA}|>0$

In sum, this design allows us to distinguish the effect of introducing farmer feedback mechanisms, and to compare the different implementation modalities, as is illustrated in Figure 5 below:

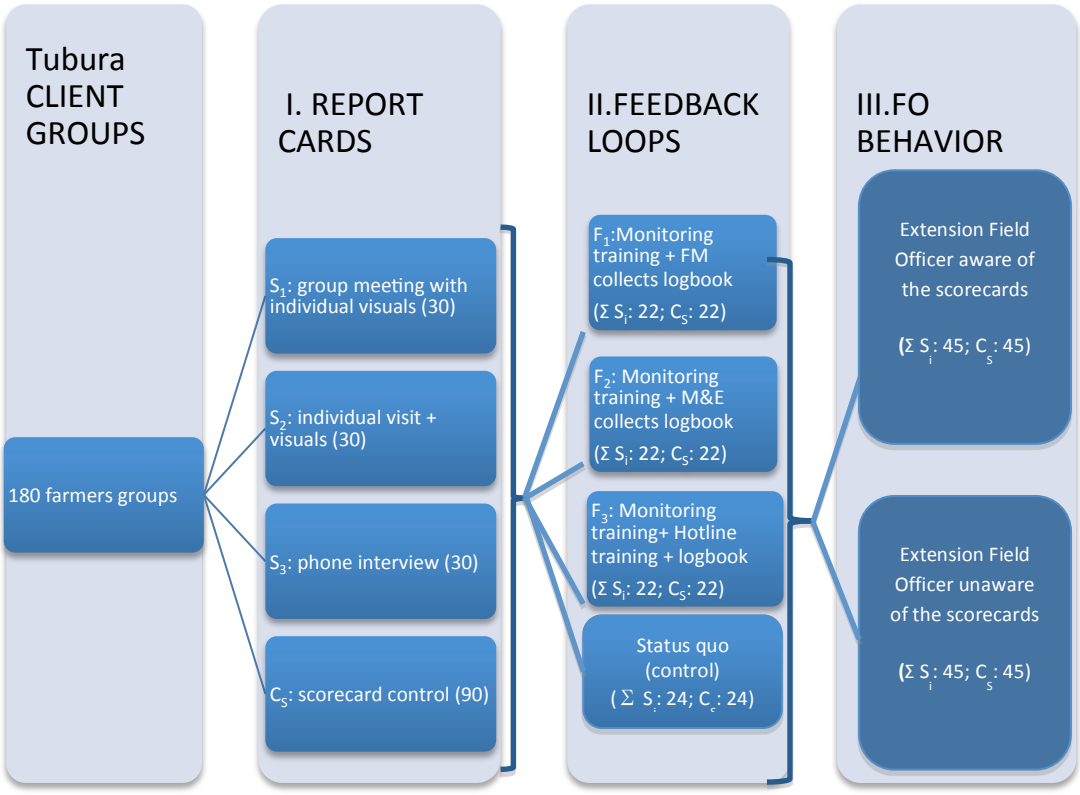

Figure 5: Extension Evaluation Design

Data

There are two primary agricultural seasons in Rwanda, one which goes from September – January/February (Season A) and one from March – July/August (Season B). Tubura's agricultural extension training program spans these two seasons. Thus, in order to collect real-time feedback, the

report cards will be distributed at three different times. The first report card in November 2012, after planting and fertilizing for Season A; the second in February 2013, at the Season A harvest; and the third in July 2013, at the season B harvest.

The scorecard data will be complemented with household surveys, which will be implemented at the end of each agricultural season: March-April 2013 for Season A and August-September 2013 for Season B. Key modules of the household surveys will include:

1. Knowledge of improved technologies and crops (disaggregated by gender)
2. Use of improved technologies and crops (both extent and quality of the application)
3. Access to agricultural information
4. Agricultural production and marketing
5. Satisfaction with extension services
6. Empowerment, through a series of hypothetical scenarios with multiple choice answers
7. Increase in demand (at the extensive margin within group: members turnover; at the intensive margins: new groups joining in the neighborhood of the treated pilot groups)
    - Geo-references for Tubura groups (using group leaders' house)

Sampling and Power Calculations

This evaluation includes 180 farmer groups across two Phase 1A sites (Karongi-12 and Karongi-13, the same sites as the rural finance evaluation), and two Phase 1B sites: Rwamagana-34 and Rwamagana-35.

The scorecard interventions will target all members of the farmer group, approximately 20 households per group. A follow-up household survey will be conducted with a sample of 12 households per farmer group, for a total sample of 2160 households. The sample of 12 individuals per farmer group will give us sufficient power to detect fairly small effects; at 85% power the minimal detectable effect size is .17 standard deviations.[40] This level of precision is important, as we do not expect the introduction of farmer feedback to induce large changes in farmer behavior in the short-term and since even small effects will be of interest to MINAGRI and Tubura.

[40] This calculation assumes an intra-cluster correlation of .05, which is a standard "small" amount. We assume ICC will be small because the groups are closely situated geographically.

Conclusion

The present CN presents the Rwanda program of impact evaluations in agriculture and details the FY12/14 work program. However, while the activities described in *Rural Finance* and *Securing High-Quality Private Extension* will be finalized over the FY2014, the program will keep testing innovations and extend its work beyond these specific evaluations. As soon as preliminary results are available for these two sets of innovative interventions, the IE team will disseminate the findings to the government team and initiate a new process of critical thinking to continue building knowledge in these areas. Parallel to this process, the dialogue between DIME and the government will continue and expand to new areas—such as irrigation and operations and maintenance of rural infrastructure. Hence, the CN of the Rwanda program of IE in agriculture is a working document that reflects a joint Bank-Government of Rwanda work program that will keep evolving and adapting to the learning acquired and the needs on the ground. We expect that the life span of this program will, at the minimum, extend to FY2016.