Application to the
Research Support Budget

Optimizing Irrigation Investments through Support for Land and Labor Markets in Rwanda

Florence Kondylis (Development Impact Evaluation, World Bank)
John Loeser (Development Impact Evaluation, World Bank)
Jeremy Magruder (University of California - Berkeley)

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Motivation

Over the last decade, Rwanda's economy has grown at a rapid pace and transformation of the agriculture sector remains a key focus of the government's efforts to reduce poverty and increase employment (National Strategy for Transformation, 2018). Implementing policies including the Crop Intensification Program and land use consolidation beginning in 2007 and 2008 respectively, the government has sought to boost smallholder production, but there remains significant room for improvement. Within this context, over the last decade, the World Bank has supported the Government of Rwanda through various projects in its efforts to modernize the agriculture sector, focusing on strategic investments in productivity-enhancing infrastructure including hillside irrigation and terracing, extension, and rural finance.

We focus on farmer responses to the development of large-scale hillside irrigation investments in Rwanda. Irrigation investments have enormous potential to improve the lives of smallholder farmers who otherwise depend on rain-fed agriculture, through increasing yields, adding additional cultivating seasons, and reducing risk. Existing work in 3 of these irrigation investments confirms the productive potential of these sites: using a spatial regression discontinuity approach that leverages technical features of the irrigation system, we find that the presence of irrigation allows farmers to adopt horticultural crops, primarily in the dry season when cultivation would be impossible without irrigation. This additional season of commercial cultivation increases yields and cash profits by approximately 50-68% (Jones et al, 2020). At the same time, we see a massive adoption gap. Four years after the water began flowing, only approximately 30% of farmers are utilizing the irrigation water.

This number would be even lower absent land rental markets: we find that plots with irrigation access are about 11 percentage points more likely to change cultivators than plots without irrigation access (more than doubling the baseline rental-out rate percent effect). In fact, of the total returns to irrigation, we estimate that approximately 25% of the benefits of irrigation would not be realized without rental markets. This fact, combined with the relatively low take-up of irrigation suggests that land markets may be one possible strategy of increasing surplus, as farmers who rent the land may be more willing to cultivate horticulture and achieve higher surplus, net of rents, than the owners. It also suggests that there may be some important frictions in how land is rented: despite the very high returns to cultivating horticulture using irrigation, a great deal of land (55%) in the irrigation sites is cultivated only during the rainy seasons 3 years after the water began flowing, and only staple crops are cultivated on the vast majority of those landholdings.

Our proposal resolves this constraint by introducing at random a formal written contract, co-signed by the village leader and sponsored by the Rwandan Agricultural Board (RAB). A small pilot study found a high take-up of this contract (we conducted focus groups with 22 farmers in one of the existing irrigation sites, distributed 30 copies of the contracts, and 10 of these contracts were ultimately used for land rentals), and farmers reported that the greater security allowed by the complete contract allowed them to rent land to farmers more distant in the social network.

Focus group discussions also highlighted some information gaps: informal systems to learn about farmers interested in renting in or out land are restricted to a few village "gossips" who are not considered to be particularly reputable sources for information. This may also contribute to a pattern of land rentals which are systematically close in the village networks. In addition to introducing complete contracting, we would introduce a farmer broker to collect and disseminate information on the supply and demand for land rentals. In doing so, we would create a novel, randomized test for whether land market frictions prevent farmers from capable of capitalizing on transformational technological change, and whether contracts

and/or brokerage institutions can resolve these frictions.

Our study builds off these insights to test whether (a) land market frictions restrain adoption of a new, and highly profitable technology and (b) whether an intervention approach to resolve frictions related to information and contracting relaxes these constraints. In this proposal, we build on an existing data collection that allows a truly rare chance to look at how farmers respond to transformative technological change.

In addition to the overall impact assessment of contract and information treatments, we would also measure whether smoothing land market frictions facilitates trade to more distant parts of the village network. We have already (through co-funding) conducted a 50% census in these villages where we collected data on data on farmer landholdings, commercial behavior, and SES. We also elicited network connections to this census in the (also co-funded) baseline and the 1st follow up survey. These steps generate a reasonably high-quality network map which can be extrapolated effectively using Aggregate Relational Data (ARD, Breza et al 2017). This will allow us to test whether network distance of transactions increases with the contract or simply with greater information exposure through the matchmaking meeting. In turn, we can measure whether these more distant transactions are associated with more efficient use of the new technology.

Research Questions

The primary research questions the IE aims to address is 'What is the effect of easing frictions in the land market on agricultural productivity?'. More specifically, the question can be broken down into the following components.

a. Are coordination/information key constraints in rental markets?
b. Alternatively, is there a rural-institution gap? What is the value of a well-specified government-approved contracts in facilitating transactions?
c. To what extent can land market interventions affect the spread of land rental transaction within the networks? (e.g., expand radius of contracting beyond existing social relationships)

Literature Review and Theory of Change

Improving land and labor markets are promising avenues to maximize the impact and sustainability of irrigation investments. With efficient land rental markets, any heterogeneity in the presence of other constraints can lead to a reallocation of land towards farmers who are unconstrained in their choices and to a source of higher, less risky income to the (constrained) landowner. While we have some evidence that enhanced land tenure leads to greater investments on the farm (e.g. Ali et al 2016, Ali et al 2014, Bandiera 2007, Besley 1995, Besley and Ghatak 2010, Brasselle et al 2002, Deininger et al 2011, Goldstein and Udry 2009, Goldstein et al 2018, Hornbeck 2010), presumably through resolving land market frictions associated with incomplete property rights, we have less evidence on the role of land market frictions which may exist even in the presence of tenure, or on whether land markets can be leveraged to achieve more efficient use of a new and highly profitable technology which may be capable of achieving transformative outcomes.

We consider the impacts of land market frictions on agricultural productivity in a simple conceptual framework. In our context, smallholder farmers apply agricultural inputs and labor to arable land to produce agricultural output. When markets are efficient, the marginal products of these inputs and factors

of production are constant across households (Hsieh & Klenow, 2009). In contrast, heterogeneity in these marginal products implies inefficient allocations, as inputs and factors could be reallocated from low marginal product to high marginal product households, increasing total production while holding input and factor use fixed.

Alternatively, phrased, heterogeneity in marginal products is equivalent to unrealized gains from trade. Frictions may prevent transactions between households with heterogeneous marginal products: a small household with a low marginal product of land may fail to rent or sell its land to a large household with a high marginal product of land if frictions prevent this transaction.

In land markets, multiple frictions may prevent transactions. First, property rights may be incomplete. In many developing countries, including Rwanda, land markets are dominated by rental transactions rather than sales. Rental transactions in Rwanda are typically agreed upon orally, and as a result commonly have simple terms: they are typically in units of one year (while there are 2-3 agricultural seasons per year in Rwanda), and they are typically paid annually up front in cash (minimizing scope for default by tenants). Single season rentals enable additional gains from trade in the presence of transitory shocks (such as income shocks) or seasonal shocks (such as seasonal migration) to marginal products, while sharecropping or hybrid payment arrangements can smooth credit constraints. The complexity of terms may be limited further when households are socially distant, as more complicated terms are more difficult to enforce. Written contracts make it possible to clearly specify more complicated terms, allowing more flexible contracting. This may be particularly beneficial for households that socially distant, as they make enforcement more feasible.

Second, information about rental opportunities may be limited, as households may not know which farmers have land available to rent out or which farmers are interested in renting in land. This is particularly plausible in Rwanda, where households do not live adjacent to their plots, so households are not always socially familiar with households that cultivate neighboring plots. Farmer brokers can enable transactions between households who do not regularly communicate about potential land transactions by identifying households with land available to rent in and/or rent out but who are not aware of the transaction opportunity. As these households are more likely to be socially distant, brokering these relationships may complement or substitute more complete property rights, such as those provided by the introduction of written contracts.

Intervention

We implemented two treatments, which were cross randomized at both the village and individual level in April-May 2019. The study site consists of 110 villages in the catchment area of the most recently developed hillside irrigation site in Rwanda – in Rulindo and Gicumbi districts.

First, contracts: we suggest that formal, written contracts that specify the property, dates of land use rights, crops to be grown and rental prices to be paid (in cash or in kind), co-signed by village leaders may encourage rental transactions, particularly transactions between farmers who may be less closely related and where trust of good-faith contracting may be lower. In 55 of the 110 villages, we introduced contracts at a village meeting and provided copies to the village lead farmer (the lead farmer is both a local authority on agriculture and receives a stipend from RAB to disseminate information). That lead farmer was provided a list of farmer names selected at random from village census list and encouraged to discuss contracts with as many people as possible, prioritizing the selected names from the list. We also provided the lead farmer

with a small incentive to successfully reach this listing, verified through audits a week after the meeting. We anticipate that (a) at the village level, the availability of formal contracts leads to additional rentals and (b) at the individual level, contract promotion leads to increased rentals. A copy of the contract is available in the appendix.

Second, information. In 55 of these 110 villages, we asked the lead farmer to serve as a "farmer broker." At the village meetings, enumerators discussed land rentals and introduced this new role of the lead farmer. That lead farmer was provided a list of farmer names selected at random from village census list and encouraged to discuss rental interests with as many people as possible, prioritizing the selected names from the list. Discussing rental interests involved understanding which farmers are interested in renting in or out land, whether their interest is greater for plots in the irrigated site or outside of the irrigated site, and whether the farmer is willing to have this information shared with interested parties in the village.

Once this information was elicited, the farmer broker returned to the selected list of farmers (through the randomization) and shared information about potential matches. Once again, the records of the lead farmer were audited, and they received small incentives to pursue this activity. We hypothesize that solving this information friction will lead to additional rentals and rentals to individuals who are more distant in the social network. We additionally hypothesize that there may be complementary impacts of the two interventions as both information and contracting may be simultaneous constraints preventing rental contracts from being executed between distant parties.

Our intervention design that was implemented is therefore:

	Contract Villages	No-Contract Villages
Information villages	28 villages (T3)	27 villages (T1)
No Information Villages	27 villages (T2)	28 villages (C)

Timeline

As illustrated in Figure 1, we have (through co-funding) (i) completed a 50% village census in all 110 villages; (ii) implemented a baseline survey in late 2018 covered the 2 rainy and 1 dry season in 2018; (iii) worked with the Rwanda Agriculture Board to implement the intervention in advance of the dry season in 2019; (iv) implemented a follow-up survey in late 2019 covering the 2 rainy and 1 dry season of 2019.

We plan on implementing a top-up intervention in the early Fall, which will consist of providing farmer brokers with contracts to distribute in their villages and to encourage the sharing of information around potential rentals.[1] We seek support from RSB to implement the 2nd follow-up survey in late 2020 to capture outcomes from the two rainy and one dry season in 2020.

[1] These plans are subject to the lockdown and the feasibility of field-based interventions taking place in September this year.

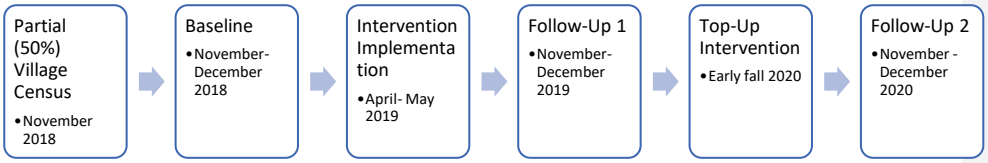


Figure 1: Timeline

Data

Sample and power calculations

The construction of the irrigation canal in a new site in Northern Rwanda was completed in Summer 2018. The site encompasses 110 villages and about 14000 farmers, from which we conducted a 50% census and drew an evaluation sample of 2400 farmers (about 22 per village, where we oversampled in villages with greater fractions working on irrigated land).

Commented [RK1]: @John: can you please review to see if this makes sense?

Since we've already collected baseline data, we estimate power using baseline regressions of outcomes of interest on treatment. We adjust these calculations for ANCOVA specifications with multiple rounds of data (assuming serial correlation = 0.50), which improve precision relative to an analysis using a single round of data and no baseline variables (as these regressions simulate).

Table 1: Minimum Detectable Effect (80% power,5% significance level)

Variable	Variable Mean	Variable SD	MDE in SD	Total number of clusters	Total number of clusters per arm	Total number of farmers
Impacts of contracts (T2 + T3) – (T1 + C)						
Profits (RWF/Ha)	37500	160000	0.06	110	55, 55	2400
Irrigation take up	0.1	0.30	0.06	110	55, 55	2400
% land with rentals	0.1	0.30	0.06	110	55, 55	2400
Impacts of information (T1 + T3) – (T2 + C)						
Profits (RWF/Ha)	37500	160000	0.06	110	55, 55	2400
Irrigation take up	0.1	0.30	0.06	110	55, 55	2400
% land with rentals	0.1	0.30	0.06	110	55, 55	2400

We are powered to detect a 3pp (30%) increase in land rentals, a 3pp (30%) increase in adoption of irrigation, and an 18963 RwF/ha (50%) increase in profits for each treatment. To interpret these magnitudes, suppose an intervention increases land rentals by 7.5pp (75%). Consistent with our theory of change, we assume these new land rentals are primarily from farmers who have a low marginal product on the land to farmers who have a high marginal product. As 40% of the land farmers own is irrigable, suppose 40% of transactions cause land to be newly irrigated; we would then expect to see a 3pp increase in irrigation. In previous work, we show adoption of irrigation increases Season C profits by 400,000 RwF/ha. We therefore expect a 12000 RwF/ha increase in profits. In this case, we would be powered to detect effects on land rentals and adoption of irrigation but would not be powered to detect effects on profits.

Data collection

The main source of data for this IE is a multi-module agriculture household survey which is administered a panel of sampled households from the 110 villages.

These household surveys present a one-time snapshot of the overall effect of the project interventions and serve as a compliment to the monitoring data collected over the course of project interventions and take-up. The household survey closely mirrors the surveys which have been extensively tested and used previously in the Rwandan context.

The survey instrument focuses on collecting in-depth information on agricultural production for each season at the plot-crop level, irrigation take up at the plot level, and crop sales to be able to accurately capture the impacts of the each of the outcomes of interest. These are supplemented with modules on household characteristics such as household composition and consumption and assets. The rich datasets generated in the large-scale household surveys will enable the team to present a credible estimate for each outcome of interest.

A listing activity was conducted prior to the baseline in 50% of the households in these villages, where we collected data on farmer landholdings, and commercial behavior. So far 2 rounds of the agriculture household survey data have been collected for the same panel of households – Baseline and the first follow up.

Key Indicators

Table 2 lists the primary and secondary outcome indicators for the study and Table 2 lists the survey modules in the household questionnaire.

Table 2: Key Indicators

Outcome Type	Outcome Name	Definition	Level
Primary	Land transactions (rentals, sales)	Decision to sell/buy or rent out/in by plot, whether contract was used and how the information around the plot was sourced, social distance between landlords and tenants, land rental disputes	Agricultural plot
Primary	Gross Agricultural Yield	Total value of output per hectare	Agricultural plot
Primary	Net Agricultural Yield	Total value of output per hectare	Agricultural plot

		minus total value of inputs (including labor) per hectare	
Secondary	Adoption of high-value crops	Choice of crop(s) cultivated, per season	Agricultural plot
Secondary	Input usage	Choice of inputs used, per season	Agriculture plot
Secondary	Irrigation use	Take up of irrigation, per season	Agriculture plot

Table 3: Summary of Household Survey Modules

Module	Content	Level
Identification	Identification of enumerator and respondent; informed consent	Household
Household Roster	Sex, age, education, employment, migration	Household member
Plot Roster	Plot identification, ownership status, cultivation by season, past land transactions	Plot
Crop Production	Crops produced, amount of seed, amount harvested, amount consume, amount sold, amount lost to spoilage	Crop, by plot and by season
Irrigation Use	Use of irrigation, source, method, frequency	Sample plot
Farm Labor	Use of household and hired labor for agriculture	By plot and by season
Agricultural Inputs	Quantity, source, and amount spent on all organic and chemical inputs	By plot and by season
Irrigation (general)	Experience with irrigation, knowledge of maintenance, participation in maintenance activities, participation in trainings	Household
Extension	Interaction with public, private, and not-for-profit sources of agricultural extension	Household, by season
Housing	Construction material of walls and floors, source of drinking water, sanitation	Household
Farmer Group	Participation in farmer group, cooperative, water user group, and water user association	Household
Social Networks	Interactions, transfers to/from, and loans to/from, community work with neighbors and members of water user groups	Household
Income & Expenditures	Disaggregated income over the past 1 year; disaggregated expenditures over the past 1 month (frequent categories like communications and transportation); disaggregated expenditures over the past 1 year (infrequent categories like school fees and health insurance)	Household
Animals & Assets	Total owned; sales and purchases over the past one year for: cows, goats, pigs, poultry, radios, mobile phones, furniture, bicycles, hoes and shovels, and other agricultural equipment	Household
Rural Finance	Bank accounts; formal savings; contributions to ROSCAs	Household
Credit	Number of loans requested; amount and purpose of loans received	Household
Shocks	Crop failure in the past year associated with drought; amount of loss and means of coping	Household, by season
Future Expectations	Future expectations and perceptions of agricultural production, household wellbeing, impacts of irrigation, asset purchases, participation in contract farming	Household
Food Security	Food Consumption Score (developed by World Food Program)	Household
Plot mapping	Plots are mapped, soil judged for evidence of effective irrigation use	Plot

Empirical Strategy

Model Specification for Quantitative Data Analysis

Given the randomized 2x2 intervention design, we plan on three regressions:

1. a pooled treatment regression at the village level, which estimates,

$$y_{iv} = \beta_0 + \beta_1 Contract_v + \beta_2 Broker_v + \epsilon_v$$

2. a disaggregate treatment regression, which estimates, and

$$y_{iv} = \beta_0 + \beta_1 Contract_v + \beta_2 Broker_v + \beta_3 Contract_v * Broker_v + \epsilon_v$$

3. utilizing the encouragement design for the contracting and broker treatment,

$$y_{iv} = \beta_0 + \beta_1 ConTarget_{iv} + \beta_2 BrokerTarget_{iv} + \beta_3 ConTarget_{iv} * BrokerTarget_{iv} + \alpha_v + \epsilon_i$$

Where $Contract_v$ indicates that the written contracts were introduced in village *v*, $Broker_v$ indicates that village *v* received the farmer broker intervention and $ConTarget_{iv}$ and $BrokerTarget_{iv}$ indicates that farmer *i* in village *v* was targeted to receive contract or broker support.

In all regression specifications, we cluster standard errors at the village level, as the village-level treatment is randomly assigned at the village level. Regressions 1 and 2 estimate impacts of the village-level intervention, which includes the impacts of the individual-level encouragement design, while Regression 3 estimates impacts of the individual-level encouragement design. Relatively large estimated effects in Regression 3 suggests that follow up is required to shift behavior and drive impacts, while relatively large estimated effects in Regression 1 and 2 suggest lighter touch village-level intervention is enough to shift behavior.

Initial findings

Data from the baseline and first follow up provides indication on the salience around key aspects of the intervention and early indication of take-up. Across the two rounds of surveys, we have 5 seasons of pre-intervention and 1 season of post-intervention data.

We focus on two main groups of outcomes: (1) Delivery of the intervention, and (2) Expectation of take up. We define *delivery,* depending on treatment group, as households reporting visits from Lead Farmer/Farmer Broker following the village meeting and either (a) explaining the contract or (b) asking about interest in renting in/out land in the information groups. Moreover, we also include information about whether a farmer had possession of a land rental contract during the time of the survey. On the other hand, we define *expectation of take up* as households reporting possession of the contract and plan on using it in the upcoming seasons. In addition, we include outcomes related to beliefs concerning farmers' approach to renting in/out land.

For all figures in this section, we combine the treatment groups as follows:

1) Contract groups: Contract only villages (T2) + Information and contracts villages (T3)
2) No Contract groups: Control villages (C) + Information only villages (T1)
3) Information groups: Information only villages (T1) + Information and Contracts villages (T3)
4) No Information groups: Control villages (T2) + Contract only villages (C)

Figure 2 presents the outcomes related to the intervention delivery and take up. First, 36.5% of the surveyed household in contract arms were visited by the Lead Farmer and were explained the relative to 9.5% of households in control villages. 44% of households in contract villages report possession of a contract in the post-intervention period. In information villages, 22.1% of surveyed households were visited by the Farmer Broker to gauge about interest in renting in-out land by the Lead Farmer, relative to only 6% in no-information villages. Finally, regarding visits during Season B and Season C in 2019, 47% of farmers in the information groups and 30.2% of farmers in the no information groups were visited by the Lead Farmer. These figures demonstrate that the contracts side of the intervention was delivered reasonably well and presents positive signs for a first-stage.

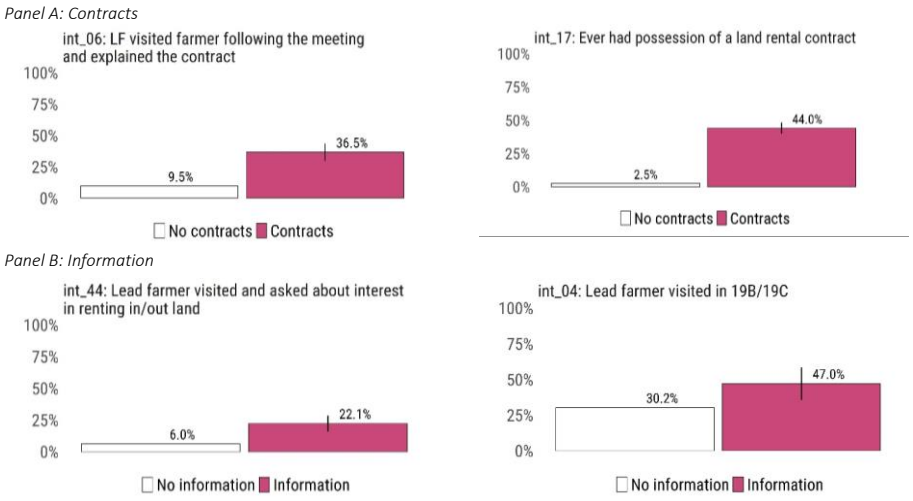
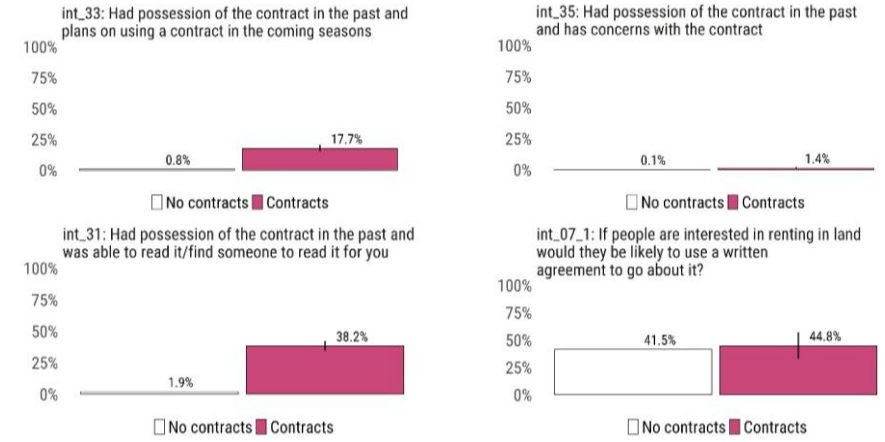


Figure 2: Take up outcomes

Figure 3 presents outcomes related to expectation of take up and future contract-use. In particular, 17.7% of farmers in the contract groups plan on using a contract in the coming seasons in comparison to 0.8% in the no contract groups. Moreover, a marginal fraction of farmers reported complaints/concerns with the contracts. In terms of beliefs regarding contract-use, about the same of farmers in the no contract groups (41.5%) and contract groups (44.8) believe that if people are interested in renting in land, they would likely use a writing agreement. Finally, the introduction of the farmer broker as the responsible repository of information on potential rentals seems to be signaling a shift norms, as farmers in information villages report a change in who they would approach for future rentals (from friends and family to the lead farmer).

Panel A: Contracts



Panel B: Information

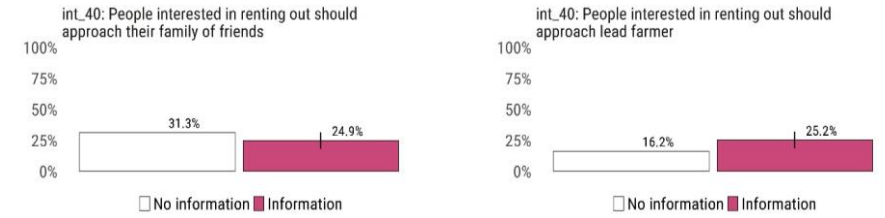


Figure 3: Expectation of take up

Policy Impact

The research team has strong reasons to expect results from this impact evaluation program to have deep policy impacts. Given the existing and planned investment in these sites, the government is extremely concerned with both the cost-effectiveness and the sustainability. Given the stated goals of scaling up several components at the heart of the project to other parts of the country, these issues are particularly salient to high-level policymakers in MINAGRI.

The research builds on an ongoing program of impact evaluation with the Government of Rwanda. The first generation of trials focused on the rural finance and agricultural extension components of the LWH project; they were designed over the course of a DIME workshop during which training was provided to the World Bank operational team and government counterparts on rigorous evaluation methods. Each trial was conducted over the course of 1-2 years, with results informing the project design as it scaled up to new watersheds. For instance, based on these results a hotline to register farmers' feedback on extension visits was scaled up to the entire service area, country-wide, boosting attendance and demand for the service. Now that the irrigation infrastructure construction is completed in four of the watersheds, the government is interested in testing strategies to secure higher sustainability of their investment and boost productivity for farmers in the sites.

The influence of the IE on policy will be secured through three main channels:

1. Building ownership within the implementation team and line ministry, from permanent secretary down to lead farmer level. Policy influence is secured by building ownership of the program at all levels of government implementation and decision making, from farmers to minister level. As described above, this is done by including all levels in the conception of the IE design. As the results come out, all levels, from farmers to minister, have ownership of the findings and appropriate them to take decisions. Engagement at all levels are done through day-to-day engagement with the teams on the ground, as well as periodical missions during which dissemination events are organized and briefs are delivered to high-level ministry staff, up to Permanent Secretary and Minister.

2. Ensuring that findings are incorporated in joint donors-GoR strategies, working with a coalition of actors in Rwanda and beyond. The research team is working closely with the WB Country Management Unit in Rwanda to build ownership of the activity and ensure its impact in the policy dialogue both at the country and sector levels. Brown-bag seminars are regularly held by the team at 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 and informs to the Bank's agricultural strategy in Rwanda. Similar efforts are made to communicate research findings to other donors in Rwanda, including DFID, the Netherlands, and the EU.

3. Building international awareness of the findings. High-quality research papers based on this research will be disseminated in international policy and academic circles (e.g. UC Berkeley, WB, international conferences, etc), in the form of events, trainings, as well as international development conferences. Finally, the findings will be published in 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, influencing empirical work beyond this specific research effort.

MINAGRI is an informed consumer of IE and has a demonstrated commitment to using impact evaluation results to inform policy design and scale-up. The government team receives day-to-day technical support of DIME staff and STCs based in Kigali, as well as periodical visits from the research team. This ensures full communication between researchers and policy actors and a high level of buy in and commitment from the government team to use research insights to shape their policies. Through this process, policymakers become informed consumers of IE and learn how to use it as a management tool. The research program is designed to yield actionable, just-in-time recommendations, with tangible impact on policy decisions. Surveys are collected using computer assisted personal interviewing technology which 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.

RSB Work Program & Expected Outputs

We are applying for funding to partially support one round of follow up data collection. Support from the RSB would complement already raised funds to be used for a comprehensive follow up household survey in 2362 households surveyed during the baseline across the 110 villages. The census, baseline data collection (completing in March 2019), intervention costs (completed in April-May 2019), and the first follow up survey (completed in December 2019) are co-funded. This proposal would fund the follow-up survey round in November-December 2020.

The primary expected research outputs from the project are two academic papers that will be submitted

to the working paper series and for publication. The first will leverage the experimental design to estimate the impacts of easing frictions in land markets on agricultural productivity and will closely follow this research proposal and is expected for December 2021. The second, slated for April 2023, will estimate the roles of physical and social geography in agricultural land and labor markets. To do so, we will use data from the household surveys on households' social networks, plot and household locations, and dyadic data on transactions in agricultural labor markets (for laborers and farmers) and land markets (for owners and tenants, or buyers and sellers).

Additionally, support from the RSB would be used for the staff and consultant time needed to support the data collection, generate policy-focused reports for our government and operational counterparts, and prepare an academic paper. The team supporting the PIs is listed in Table 4.

Table 4: Research Team

Name	Role	Organization/Unit
Saahil Karpe	Research Analyst	DIME1
Christophe Ndahimana	IE Analyst in Kigali	DIME1
Roshni Khincha	IE Analyst	DIME1
Guillaume Gatera	Field Coordinator in Kigali	DIME1

The requested budget is attached as Annex 1.

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Acronyms

CA:	Command Area
CAC:	Command Area Catchment
GoR:	Government of Rwanda

ICC:	Intra-cluster correlation
IE:	Impact Evaluation
LWH:	Land Husbandry, Water Harvesting and Hillside Irrigation Project
MDES:	Minimum Detectable Effect Size
MINAGRI:	Rwandan Ministry of Agriculture
RCT:	Randomized Controlled Trial
SPIU:	MINAGRI's Special Project Implementation Unit