



**Grant No. AID-OAA-F-13-0002**

**“Mobile Lay-Away and Rent-to-Own: Bringing an Innovative Savings Solution to the Rural Poor for Small-Scale Irrigation Pump Purchases”**

**Report to USAID for**

**Milestone 1**

**July 2013**

# Report

## Recruitment of Project Manager completed

KickStart mobilized its team to begin this project on 1<sup>st</sup> July 2013. In accordance with milestone one, we have recruited Mr. Kim Kariuki, a Kenyan national to be Project Manager for this project. Kim is also KickStart's Product Manager for our financial services within the Marketing and Innovations team. He has extensive experience in research and recent micro-finance experience with Kenya Women Finance Trust (KWFT). He has a MSc in Agriculture and Rural Development from Kenya Methodist University in Nairobi. His CV has been provided in a separate PDF attachment.

Kim will be assisted in managing this project by Mr. Augustine Kimoni. Augustine has recently joined us from Equity Bank, where he was Senior Relationship Officer for Groups. He has a BSc in Food Science and Technology from the University of Nairobi.

While Kim will be primarily based in Nairobi managing this project, Augustine will be undertaking much of the work in the field with our field team. Currently, both are working closely with our field representatives to train them on how to explain Mobile Lay-Away and Rent-to-Own to farmers. We are currently testing several variations of Rent-to-Own to see which one is most popular with farmers and which provides the lowest default rates. This testing period will last for the next three-four months, allowing us to settle on the model that will be evaluated going forward under this USAID project.

## Mobilization of Stanford University

On the 15<sup>th</sup> July 2013, we met with Mr. Jonathan Robinson, Assistant Professor at the University of Santa Cruz, Ms. Catlan Reardon, East Africa Project Co-ordinator for Innovations for Poverty Action (IPA) and Mr. Thomas Ginn, Phd student Stanford University. The purpose of the meeting was to make introductions to the KickStart project team and discuss:

1. respective roles in the project
2. the proposed change in project location
3. formulation of treatment groups
4. current status of mobile lay-away and rent to own
5. working on the ground
6. USAID milestones

The meeting was extremely useful and positive, enabling us to discuss our research partners' proposed methodology and how this can work on the ground with our field staff. The **change in project location** from the Rift Valley/Central to Eastern Kenya was not seen as problematic, and the researchers understood the reasons for KickStart proposing the change.

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We discussed the researchers' proposed **process for selecting the groups** to participate in the study, noting KickStart's interest in ensuring that groups chosen are in fact interested in learning about small-scale irrigation. On this note, it was agreed that the researchers will undertake an initial screening process to "screen in" farmers groups interested in irrigation and exclude those groups with no interest in irrigation.

We also discussed the **formulation of treatment groups**. The original formulation outlined in KickStart's proposal to USAID and in the Grant Agreement was that groups would be divided into three separate treatments:- marketing only, marketing and mobile lay-away and marketing and rent to own. KickStart had considered whether an alternative formulation - marketing, marketing and rent to own and marketing, rent to own and mobile lay-away - would be more appropriate given the organization's desire to maximize its sales (based on our theoretical starting point that a credit offer – rent to own – is likely to be more popular with farmers than a savings offer – mobile lay-away).

While the researchers understood our reasoning, they observed that, by offering mobile lay-away alongside rent to own, KickStart would run the risk of having no (or very limited) take up of mobile lay-away. While this would provide us with valuable information on farmers' preference for financial services when buying a pump, we might find ourselves with a high rate of farmer default on rent to own. Consequently, we would be left with a situation where we had little or no information on farmer interest in mobile lay-away and also an unviable rent to own business model. Given our goal of testing market interest in both mobile lay-away and rent to own, it was agreed that we would not/not change the original treatment group formulation outlined in the Grant Agreement.

Looking ahead, the researchers will now need to seek **research approval** from both the Kenyan Government and their own organizations. KickStart will also enter into a **contract with IPA** for the undertaking of the survey work in accordance with the Grant Agreement. Dr. Pascaline Dupas from Stanford University, our primary research interlocutor for this project, has informed us that this is the most appropriate contracting method, as:- (i) Ms. Reardon is an employee of IPA and her time on the project will be billed to Kickstart through IPA; (ii) IPA is incorporated in Kenya and is well positioned to recruit and train the enumerators; and (iii) both Dr. Dupas and Dr. Robinson Jon are affiliated with IPA (and their time is not being charged to this project).

It was agreed that the researchers and KickStart will maintain regular contact going forward. Ms. Reardon regularly travels to Kenya from her base in Uganda, and will work with Mr. Kariuki, the Project Manager, to ensure timely and proper implementation of the project. The two organizations will also work together to put together milestone two – the preliminary implementation plan – for delivery in August.

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## Personnel Changes

The key research personnel, Dr. Pascaline Dupas from Stanford University and Dr. Jonathan Robinson from UC Santa Cruz remain the primary research partners for this project. However, KickStart would like to inform USAID of a number of personnel changes on its side.

Samuel Kisengi, Kenya Country Manager, recently left the organization, and has been replaced (in an acting capacity) by Mr. Chris Okiri. Chris has been with KickStart since 2003, and brings tremendous field experience. He was most recently Manager of Institutional Sales for the Kenya program (partnerships with other NGOs), working closely with the field representatives and regional managers, some of whom will be involved in this project.

In addition, Charlene Chen, Director of Marketing and Innovations, left KickStart in early July. Kim Kariuki and Augustine Kimoni are now temporarily reporting to Richard Miles, a consultant with over 20 years of sales and marketing experience with companies like 3M.

Kim will also receive the full support of Guy Redding, the Director of Program and Partnership Development. Guy has over 20 years of experience in international finance, development and project management. He was most recently working for the New Zealand Agency for International Development (NZAID), the New Zealand Government's development program.



**KickStart – Washington State University (WSU) Research Study**  
**Milestone 2: Implementation Plan**

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*Mobile Layaway and Rent to Own: Bringing an Innovative Savings Solution to the Rural Poor for Small-Scale Irrigation Pump Purchases*

22<sup>nd</sup> April 2014

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## **1. Implementing partners and their roles**

This project will be implemented by KickStart and Washington State University (WSU). Overall, WSU will be responsible for managing the experimental components of the study while KickStart will be responsible for managing sales activities and the relationship with USAID DIV.

The project teams are as follows:

### KickStart Team:

John Kihia – Project Manager

Augustine Kimoni – Assistant Project Manager

Guy Redding – Director of Program & Partnership Development

Beatrice Sakwa - Director of Impact Monitoring

Ed Chan-Lizardo – Chief Program & Partnership Officer

### WSU Research Team:

Dr. Tom Byers – Principal Investigator

Dr. Doug Young – Co-Principal Investigator

Grad Researcher

Table 1 overleaf shows a summary of activities that the various implementing partners will be engaged in. Additional details can be found in Section 3.5.1:

**Table 1: List of activities (and timeline) to be performed as part of this project**

Major Activities	Comments	2013		2014										2015	2016			
		Q1-Yr.1	Q2-Yr.1	Q3-Yr.1	Apr	May	Jun	Jul	Aug	Sep	Oct	>>>>>>>>	Dec	Jan	Feb	Mar		
1. Mobilizing and Training Field Staff	We are in the process of completing the recruitment and placement of new sales reps (SRs). The current team of 4 SRs and 1 RM (Regional Manager) has been trained on the financial services to be offered.																	
1.1 Literature Review	WSU Team reviews and summarizes literature on mobile finance, small scale irrigation technology adoption, and identifying suitable MoneyMaker pump adoption areas in target Kenyan counties of Kitui, Makueni, and Machakos and on the possibility of extrapolating results from Kenya to elsewhere in Africa.																	
1.2 Questionnaire design	WSU Team constructs Rapid Appraisal – Demographic Survey, Baseline Survey, and End of Project – Impact Assessment questionnaires.																	
2. Project Preparation Meetings	KickStart and WSU have been holding a number of project preparation meetings in which we have been reviewing the various activities in greater detail that will be undertaken by each partner to ensure successful implementation of the project																	
3. Rapid Appraisal – Demographic Survey (RA-DS)Component	With support of KickStart International, the WSU Team will identify groups that meet participation criteria in terms of poverty levels, water availability, food crop production and other criteria in the three target counties. In the lead up to the RA-DS, KickStart has been identifying groups that meet the criteria and which can be visited by WSU.																	
4. Marketing	KickStart will begin the marketing of pumps and buyer registration, paying particular attention to the options available to close the various group members for cash versus lay-away and rent to own.																	
5. Pump owner registrations	Registrations happen when pump is purchased																	
6. Baseline Buyers Survey (BaseS) Component	The WSU Team will initiate the formal Baseline survey for those farmers who have bought pumps since May.																	
7. End of Project – Impact Assessment Survey Component	The EOP-IS will include BaseS participants who purchased outright, rented or purchased pumps on the KSI layaway program and a smaller group who did not acquire a pump.																	
8. Final Report																		

## 2. Study goals

The primary goals of this project are to answer three key research questions and one secondary question:

#1 How do the two financing schemes (Mobile Layaway and Rent to Own) affect the take-up rates of MoneyMaker irrigation pumps (MoneyMaker Max and MoneyMaker Hip). The finance treatment comparisons should be made separately by type of pump if both are marketed. Layaway and rent to own will be compared to each other and to cash sales. What are the key features of the financing schemes that matter?

#2 Do these new financing schemes enable a different segment of farmers to invest in a pump compared to cash-only sales? In particular: do the new financing schemes enable higher adoption rates by women? Do they enable poorer farmers to adopt the pump?

#3 Does the method of financing affect impacts on farm household wellbeing from owning/using a KSI treadle or hip pump? Are the impacts higher/lower among farmers who use a financing scheme to buy a pump compared to those who buy using cash? Are the impacts higher/lower for each financing scheme compared to households who did not take up a pump?

#4 Use literature review and survey results to determine viability at scale of each financing mechanism and to determine how these mechanisms could break down barriers for asset acquisition for African women and poorest of poor farmers generally.

### 3. Study protocol

#### 3.1 Scope of project

The project will explore trade-offs that small-scale farmers make when choosing between various financial options at the time of purchasing KickStart’s *MoneyMaker* pump.

#### 3.2 Location

The project will operate in KickStart’s Eastern Region, which is an area well supported by dealers (private sector operators who sell KSI pumps) and sales representatives (responsible for executing the sales on the ground). Priority areas in Eastern Region that will initially be considered include: Machakos, Makueni, and Kitui counties. Due to a sparse farming population density, budget constraints and low rainfall, the southern half of Kitui County may be excluded. If we are not able to identify sufficient groups to participate in the project, Muranga County in the Central Region will also be included, as well as other counties if necessary. Sales representatives will be assigned to each of the three counties, and will be responsible for closing sales as per the project.

**Table 2: List of counties and dealers in Eastern Region**

<b>County</b>	<b>Dealers</b>
MACHAKOS WSU RA 1 (Research Area 1)	Nijrang KFA Machakos Wakulima Agrovet Mamba Hardware
MAKUENI WSU RA 2	Mumu Hardware
KITUI WSU RA 3	Kithimani Agrovet At Your Service Mwingi Agrovet

### 3.3 Description of financing options

KickStart will offer three different financing options to different groups:

1. Cash only
2. Mobile Layaway and cash
3. Rent to own (R2O) and cash

KickStart is currently completing the rapid prototype-testing of a Rent to Own model that has three different payment plans (Table 3). Pumps are sold on credit to individual farmers rather than under a typical micro-finance group lending approach. By the end of April 2014, KSI will have finalized the design and processes required to support the R2O and ML financial service options to be tested under this project, based on a combination of acceptance/take-up by farmers and, in the case of R2O, satisfactory repayment levels.

Table 3 reflects the costs (in Kshs) of a Hip pump bundle (pump + hoses) under Mobile Layaway and Rent to Own. The cash price for the hip pump is Ksh 5,990.

**Table 3: Breakdown of financial services currently being offered in Eastern Region (Hip Pump Bundle)**

	<b>Mobile Layaway</b>	<b>R2O Classic, 2-month plan</b>	<b>R2O Classic, 3-month plan</b>	<b>R2O Classic, 4-month plan</b>
Pump given after:	Full payment	Sign-up	Sign-up	Sign-up
Down-payment	500	3,900	2,600	1,300
Monthly	Any amount	1,300	1,300	1,300
# months after sign-up to complete payments	Max 6	2	3	4
<b>Total to be paid</b>	<b>6,090</b>	<b>6,500</b>	<b>6,500</b>	<b>6,500</b>

The main difference between the three R2O plans is the level of required down-payment and the length of the repayment period. The trade-off with a lower down-payment is that, while it may increase take-up and bring in poor farmers who do not have the cash on hand to make a Kshs 3,900 sign-up payment (on the 2 month plan), it may also increase adverse selection, that is, take-up by farmers who will not complete the payment schedule. The cost of promotion and collection and the level of payment default for each financing option will be monitored following purchase.

*Other features of the plans:*

- In the Mobile Layaway plan, if farmers choose to cancel the plan, they will recover their deposit minus a cancellation fee of Kshs 100
- In the Rent to Own plan, farmers can quit the plan at any time and will be expected to return the pump and bundle intact so as to recover their deposit (less a cancellation fee of Kshs 300 and a rehabilitation fee of Kshs 250). If the pump is no longer operational, they will be required to charge a rehabilitation fee of Kshs 450 in addition to the cancellation fee
- Again, the ML model is currently being refined, and the final model to be tested under this project may look somewhat different to this.

### **3.4 Basic Research Design**

As stipulated in the original proposal to USAID, the Research Team will identify approximately 180 groups, comprising approximately 2,700 farmers. These groups will be randomly assigned into the three experimental treatment arms after the RA-DS.

**Group A: Cash & Mobile Lay-away** (75 groups, number of farmers approximately 1125) – These farmers will have the choice between buying cash and buying through our savings plan – Mobile Layaway.

**Group B: Cash & Rent to Own** (75 groups, number of farmers approximately 1125) – These farmers will have the choice between buying cash and buying using our credit scheme – Rent to Own.

**Group C: Cash Only** (30 groups, number of farmers approximately 450) – These farmers will only have the option to buy pumps using cash. They will not be offered Mobile Layaway or Rent to Own.

### 3.5 Indicators to be tracked

Table 4 below shows the key indicators that will be tracked as part of the project. These are standard indicators that KickStart measures for all of its impact monitoring surveys:

**Table 4: List of indicators to be tracked during this project**

<i>Dimension</i>	<i>Indicator</i>
Farmer characteristics	For RA-DS and Baseline (disaggregated by gender) <ul style="list-style-type: none"> <li>- Household income, as well as income from farming</li> <li>- Number of children in education</li> <li>-Interest in and feasibility of irrigation to grow food crops or livestock fodder</li> </ul>
Farm and farm household characteristics	Also for Baseline Survey: <ul style="list-style-type: none"> <li>- Type and Size (volume/depth) of Water Source</li> <li>- Amount of arable land</li> <li>-Amount of arable land within lift limit of MoneyMaker pump</li> <li>-Amount and type of livestock</li> <li>-Mobile phone</li> <li>-Bicycle(s)</li> <li>-Farm equipment</li> <li>-Experience with mobile savings or payments</li> <li>-Household wellbeing measures including nutrition level, health level, and</li> </ul>

	<p>educational participation of children.</p> <ul style="list-style-type: none"> <li>- Type (construction material &amp; size) of house and type of roof, Type of (if any) Latrine,</li> </ul>
Farm household characteristics	<p>For EO-IS Survey (disaggregated by gender):</p> <ul style="list-style-type: none"> <li>- Household wellbeing measures including income, nutrition level, health level, educational participation of children,</li> <li>- Type (construction material &amp; size) of house and type of roof, type of (if any) latrine,</li> </ul>
Financial service	<ul style="list-style-type: none"> <li>- Take up for pumps by either cash or services</li> <li>- Take up duration (between sensitization and subscription for either cash or services)</li> <li>- Repayment rates</li> <li>- Time taken to complete repayments (for services)</li> <li>- Dropout rates (for cash and services)</li> </ul>

### 3.6 Overview of project activities and timeline

**Activity 1:** Mobilizing and Training Field Staff  
 Team: KickStart and WSU  
 Timeline: July 2013 – April 2014

**a) KickStart Field Staff**

KickStart is finalizing the assignment of field staff for this project. A number of new field representatives have joined KickStart in early 2014, and have been undergoing organizational induction and sales training. They are being managed by the Regional Manager, who reports to the Assistant Project Manager. Overall responsibility for project implementation rests with the

Project Manager. Field staff are being trained in the different financing plans. Each field rep will be assigned 20-25 farmer groups broken down as follows:

- Group A (Cash and Mobile Layaway): ca. 10
- Group B (Cash and Rent to Own): ca. 10
- Group C (Cash only): ca. 5

This means that our field team members will have equal odds of making sales. It will also avoid possible bias in results, which could arise from having higher performing sales reps focused on using one particular marketing method. To further ensure that field staff only use the relevant marketing method for a particular group, it will be made clear to them that they will not make a commission for any sale they make to a group which was not supposed to be offered that financing option.

#### **b) Research Staff**

Overall responsibility for conducting the survey research rests with WSU. WSU will design and implement a rapid appraisal demographic survey to identify the population from which a random sample can be derived in three counties of the Eastern Region of Kenya. The Co-PI has recruited a WSU graduate student to undertake US-based survey data analysis. The PI and Co-PI will co-ordinate, with the Kenya based enumeration staff, the research activities in the field. Four Kenyan enumerators, two male and two female, will be selected by WSU (following short-listing by KickStart), contracted by KickStart under short term contracts (for the initial survey work) and trained, prior to the implementation of the rapid appraisal – demographic survey work during the April/May period. One of these individuals will be selected to lead the Enumeration Team under the guidance of both the PI and Co-PI during the September/October 2014 period. It is expected that this member of the ET will have close interaction with the KSI Impact Monitoring team when the PI or Co-PI are out of country, and will operate from the

Headquarters of KSI in Nairobi. This is a key personnel position which will require exceptional skills in data collection, data entry, quality control and analytical capability.

**Activity 2: Project Preparation Meetings**

Team: KickStart and WSU

Timeline January-April 2014

KickStart and WSU have been holding a number of project preparation meetings in early 2014 to review the various activities that need to be undertaken as part of the project. During this time, we have established this implementation plan, which clearly maps out the activities that need to be implemented, their timings and the indicators to be tracked. We have also submitted documents to the Kenyan Government in order to get research approval. This is expected by the end of April.

**Activity 3: Rapid Appraisal - Demographic Survey (RA-DS)**

Team: WSU

Timeline End April/Early May 2014

The purpose of this phase is to identify approximately 180 groups in the three counties (Muranga may also be added if necessary to identify sufficient groups), which will participate in the research. A team of trained enumerators, under the supervision of WSU's PIs, will meet with the Chairperson of each group, together with a couple of the group members, to undertake a Rapid Appraisal – Demographic Survey (RA-DS) to collect information on the characteristics of the group. This information will be used to determine whether the group should be included in the research (or excluded because it doesn't meet certain criteria e.g. too wealthy) and to stratify the randomization of groups into the three experimental arms by gender composition. Information will include:

- a list of the farmers in the group as possible,

- if they have access to water on their farms,
- if they already irrigate any crops and if so how, etc.)/ baseline level of experience/interest in irrigation.
- group size,
- frequency of group meetings, and
- the types of activities in which the group is involved
- the nature of any government or other NGO support (groups receiving microfinance or savings support will be excluded from the research).

Farmer groups may be identified during the (RA-DS) in a number of ways:

- selecting groups already being targeted by KickStart (though not met yet),
- identifying groups working with other NGOs as identified by KSI,
- asking traditional authorities, local chiefs, village leaders and other government officials for names and lists of existing farmers groups,
- visiting farmers at their home to ask them if they are members of any group (including saving groups/ROSCAs, co-ops, crop or livestock husbandry groups, adult education, health care, or other groups with a purpose of improving livelihoods) and asking if they can attend the next group meeting.

Notification of the appropriate government officials and sub-chiefs of the pending survey activities in the sub-regions will be important.

Importantly, to ensure that KickStart field reps do not spend time trying to sell pumps to groups that are not interested in irrigation, there will be a screening process to screen out uninterested groups and ensure groups have access to a close water source. WSU will consider the development of a grid system that can be overlaid on the Eastern Region counties targeted. These can then be utilized to select areas where rivers, tributaries and possible access to shallow wells may be identified. The Research Team believes this can be done remotely before implementation of the RA-DS.

The enumerator burden, at the RA-DS stage, should be on collection of information to identify groups (including physical locations), which will participate in the research and provide the pump buyers who will be interviewed as part of the Baseline Survey (BaseS). Enumerators will also identify, district heads, traditional leaders and village heads. Their actions will support data collection activities during the BaseS and support education campaigns undertaken by KSI's marketing arm.

**Activity 4: Marketing**

Team: KickStart

Timeline: From start of May until end of October 2014

After the groups have been sampled and surveyed, KickStart's field staff will start visiting each of the 180 groups to undertake marketing activities. These activities will include:

- demonstrating and teaching the farmers about the pumps;
- teaching the farmers about irrigation and irrigation farming;
- how to maximize the use and impacts of a MoneyMaker pump; and (for Groups A and B)
- explaining the relevant financing options.

KickStart staff will attend the groups' own regular meetings rather than impose their own meeting schedules on groups.

Each group will be visited three times over a six month period with a standard time allocated for each meeting (the first meeting is likely to be 1-2 hours, with lesser time allocated for meetings 2 and 3). A kit will be produced explaining to the field reps how these meetings will be run and what concepts will be introduced and when. In this way, each group will receive a similar type and intensity (activity, number and length of visits) of marketing activities.

KickStart will give group members their telephone contact information and invite the members to contact them if they want more information or want to order/buy a pump. The agents will

also visit individual farmers to close sales, and will implement the regular/required follow-ups by SMS/phone to encourage the Layaway/Rent to Own buyers to make their payments. Although each group will be visited three times, a sale to an individual farmer can be concluded at any stage. Reps will keep a record of groups meetings (including sales made at each meeting) and individual farmer follow-ups (including phone calls), so we can measure the time and cost to close a sale for the different financing options. Reps will maintain records through using a daily diary and then inputting this information into KickStart’s “Hot Prospects” system.

There will also need to be careful workforce planning so that groups being offered different financing options are not located close to each other (running the risk of groups becoming aware of other financing options and demanding the same).

**Activity 5: Pump owner registrations**

Team: KickStart

Timeline: Rolling basis starting with start of Activity 4

All pump buyers fill out a Guarantee Form, which provides various details including name, gender and address. Those registering for Rent to Own and Mobile Lay-Away also fill out a separate registration form, providing similar information to the Guarantee Form plus additional information such as group name and the name of the group Chair person. This information will be useful when conducting the Baseline Survey.

The Research Team will be able to link up these Registration Forms to the initial sampling list and baseline surveys, and with that information will be able to measure take-up in each group and compare characteristics of buyers across the financing schemes.

**Activity 6: Baseline Survey (BaseS)**

Team: WSU

Timeline: Start September to end October 2014

A Baseline Survey (BaseS) will be administered to all farmers who have bought a pump since May. If more than 600 farmers have bought a pump in this period, the BaseS will be limited to a sample size of 600 farmers, and participants will be randomly selected. An elongated survey period (2 months) will allow us to capture more buyers in the survey. WSU will visit Kenya in early September for the first 2-3 weeks to get the survey started, and then leave the enumerators to continue with the remaining survey work until the end of October.

The BaseS will allow us to better understand the starting characteristics of the pump buyers:- wealth/assets, education level, household structure, amount of arable and irrigable land, livestock and crops grown, access to water, prior irrigation, house and roof type and other household wellbeing characteristics.

These variables will be utilized to statistically predict participation in each finance scheme for purchasing pumps. Descriptive statistics will assist in comparing adopters and non-adopters within each treatment and by delivery mechanism from baseline data. Next, the proportion of adopters by treatment and financial method will be statistically compared. The WSU Team will report p-levels for each statistical comparison. For example, “Layaway increases adoption over Cash Purchase at the xx% confidence level.” We will also solicit information on the prevalence of poverty and per capita expenditures affecting the nutrition and health care status of the household and educational activities of household children to address some concerns captured by USAID’s “Feed the Future” indicators. In order to align with KSI’s and USAID’s needs. A portion of the survey questions on these characteristics will be adapted from Feed the Future, *Influence Indicator’s with Revised WEAI Module*, Vol. 8 (Oct. 2012) and *Women’s Empowerment in Agriculture Index*.

**Activity 7: End of Project Impact Survey (EOP-IS)**

Team: WSU

Timeline: December 2015 (15-18 months after pump acquisition)

An End of Project Impact Survey (EOP-IS) will be administered to (a) farmers who bought a pump using one of the three financing options and (b) a small sample of farmers who did not purchase the pumps but were part of the groups included in the BaseS. Given budget constraints which may exist, a target of up to 600 participating and non-adopting farmers will be surveyed. Non-adopters will be enumerated using the same survey questionnaire as the adopters, but including additional questions to explore their reasons for not renting or buying a pump.

Binomial logistic regression will be used to estimate the influence of each socio-economic variable and other characteristic on the probability of adoption for each treatment, and multinomial regression will be used as statistically permissible.

KickStart estimates that it takes between 6 and 12 months for farmers to learn how to best use their pumps and to reach a level of steady-state returns. Therefore the research team will plan to conduct the follow-up survey with each farmer approximately 15 to 18 months after the pump acquisition so we can measure changes to annual farm household characteristics over two dry season periods. Dry season incomes and nutrition status will be important assessment targets.

### **3.7 Monitoring and Evaluation Plan**

There are two main aspects to our M&E activities for this project.

#### ***a) Monitoring take-up and time to close a sale***

KickStart's field staff assigned to this project will be required to keep records of the group meetings that they attend (as they should be attending three meetings for each group so that each group receives the same level of marketing exposure), including details of individuals attending meetings.

As described in Activity 5, farmers sign a Guarantee Form when they take possession of a pump and, in the case of R2O and ML, a registration form. The information on these forms will allow us to monitor take-up rates under different financing options. By collecting information on when farmers first attend a meeting and then comparing it to the date they buy the pump or register for R2O or ML, we will be able to measure the average time it takes to close a sale using different financing options.

From the mobile money transaction data, we will be able to observe the time needed to complete saving for payment of the pump through the Mobile Layaway program, as well as the cancellation rate. We will also be able to monitor Rent to Own payments and any defaults or time delays on the rental payments. And we will keep track of the costs of implementing the different schemes so we can determine their relative cost-effectiveness. In particular, we will determine how many visits are needed to guarantee on-time payments or any payments in the Rent to Own group.

To obtain comparable data from Cash buyers, field staff will keep records of all group members participating at each group meeting. We will then observe how many group members were able to follow through with the pump purchase, and the average time and number of follow-ups it took to close the sale.

## **b) Measuring impact**

The impact of the different financing options on indicators such as dry season household income will be measured through WSU undertaking the End of Project Impact Survey described in Activities 6 and 7.

“Group lists” will be used to identify interested parties who did not buy in Year 1. WSU will survey a sample of not more than 180 Group members who did not buy or rent a pump. This will allow the research team to (a) explore the participants’ reasons for not adopting and (b) to discover whether some confounding variable influenced wellbeing for both adopters and non-adopters. With a complete list of group members from the RA-DS and the work done by the KSI staff prior to the RA-DS, and a complete list of adopters from Guarantee documents, non- adopters can be identified by a process of elimination. If necessary, the research team can also elicit help of group chairmen/chairwomen to identify lists of non-adopters from which to sample. This permits answering the question of whether measured wellbeing differences between the Baseline and End of Project Survey are due to the financing treatments, or due to a confounding factor such as exceptionally good or bad weather at one of the end points. Qualitative information that can provide a better understanding of key issues that potential pump buyers, users, and promoters of the different financing schemes face, can also be gathered during this survey activity period.

If take-up of Mobile Layaway or Rent-to Own schemes is lower than expected, it will enable us to better understand potential downsides and refine marketing messages used to introduce the schemes, and/or design features of the schemes (e.g., details of the cancellation policy, timing requirements, commissions for retailers, etc.) to make them more successful.

## 4. Key outcomes

The ultimate outcome we are seeking under this project is to gain insights into which financing options: cash, mobile lay-away or R2O offer the most effective and cost effective means to promote the greatest take-up of KickStart's irrigation technology by different segments of the poor, smallholder farmer market. We will then be able to scale up the provision of effective financial services across KickStart's Kenya and other country programs. Breaking the outcomes down further:

### *a) Take-Up/ Purchase of Pumps*

The first outcome of interest is the effect of the financing schemes on take-up (research question #1). We will compare take-up of the pumps across the groups and between the three arms of the study after 6 months of promotion to understand the impacts of Mobile Layaway and Rent to Own and how they increase access to the pumps.

### *b) Characteristics of Buyers and How they Vary Across Financing Schemes*

We will analyze the baseline characteristics of buyers who bought using the three different financing options to see if there are any significant differences (e.g. poorer people using rent to own, more women buying on a ML basis) .

### *c) Impacts on Farming, Income, Nutrition, Educational Participation, and Health Activities*

Finally we will answer question #3 by examining how the impacts of the pumps vary as a result of the type of financing available to the buyers. To do this we will calculate the change in incomes and other outcomes of interest between the "Baseline survey" and the "End of Project – Impact Survey". This will enable us to measure the differences in impacts of a MoneyMaker pump between farmers who buy the pumps using Mobile Layaway, Rent to Own or Cash.

## 5. Anticipated challenges and proposed measures

Table 5 below shows some of the anticipated challenges and measures that we propose to resolve them:

Table 5: Various anticipated challenges and proposed measures

Challenges	Proposed measures
<p>Insufficient sample size for Mobile Lay-Away due to (a) farmer concerns over the scheme and/or (b) competing savings schemes in which the farmer is involved.</p>	<ol style="list-style-type: none"> <li>1. Training of staff to explain the benefits of ML and address any concerns of farmers.</li> <li>2. Improvements to ML marketing collaterals</li> <li>3. Tweaking of the ML model over the next three months to address any issues previously identified.</li> <li>4. Wherever possible, targeting farmers that are not actively involved in other savings schemes.</li> </ol>
<p>Cross-selling (offering services to the wrong groups)</p>	<ol style="list-style-type: none"> <li>1. Rigorous training to the KickStart field team to ensure that they understand the protocol.</li> <li>2. Penalties to discourage cross-selling</li> <li>3. Requiring that KickStart field teams only offer cash or services to the designated groups, especially over the first 6 months of intensive marketing</li> <li>4. Separating the groups receiving different marketing activities by a significant distance.</li> <li>5. Clustering sales under similar protocols in different areas.</li> </ol>
<p>Difficulty in locating Baseline Farmers who</p>	<p>Use of GPS coordinates to identify baseline</p>

<p>purchased a pump in order to acquire financial information and to re interview them in the End of Project – Impact Survey.</p>	<p>RA-DS and BaseS survey respondents at the village level.</p>
<p>Receiving required administrative authorizations and in-field support to perform the Rapid Appraisal – Demographic Survey in a timely manner</p>	<ol style="list-style-type: none"> <li>1. Complete forms for research permit and obtain the same in a timely fashion.</li> <li>2. Enlist the support of KSI to inform sub-chiefs and local government authorities about the research and arrange global access to research area.</li> </ol>



**KickStart – Washington State University (WSU) Research Study  
Milestone 3: Baseline Assessment Report**

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*Mobile Layaway and R2O: Bringing an Innovative Savings Solution to the Rural  
Poor for Small-Scale Irrigation Pump Purchases*

**3<sup>rd</sup> June 2014**

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## 1. Pilot trials/testing

The Mobile Lay-Away (ML) financial service was originally launched and piloted in 2011. The feedback KickStart got from the farmers was that it would be of great help if the farmers could get pumps before they complete payments, as this will allow them to generate income that will help them make full payment. Therefore the Rent to Own (R2O) financial service was an idea which emerged from the lessons learnt from the ML pilot. As ML had already been tested, we have been focusing on the trial/testing and revision of the R2O model during this planning phase of the project. This, so that we arrive at the optimal model to provide as a treatment during the research phase. The R2O service targets individual buyers as opposed to groups, the most common approach for microfinance institutions. This is because agricultural loans are perceived to be more risky and thus group members are less willing to guarantee fellow members.

During the first three months of the project, three R2O models were designed and tested. These were:

- R2O Classic/"Supa" - This is where a farmer makes a deposit up-front upon registration and the balance is paid within two months
- R2O Buddy/"Rafiki" – This is where two farmers contribute towards the deposit and get a pump and pipes to share. The balance is then paid by Farmer One over two months. Farmer Two looks for another farmer to make a deposit in order for him/her to get a pump.
- R2O Purchase/"Kodesha ununue" – This is where two farmers contribute towards the deposit and get two sets of pipes and a used pump to share. The two farmers then have to pay the balance over four months, whereupon they each get a new pump.

The sales team was trained on each model. The three models were piloted, with marketing starting in July 2013. Eight farmers enrolled for R2O Classic/"Supa" while no farmer enrolled for the R2O Buddy/"Rafiki" or R2O Purchase/"Kodesha ununue". By the end of the first three months, it was apparent that farmers were not interested in the second and third models. Consequently, a decision was made to drop R2O Buddy and R2O Purchase to focus on R2O Classic/Supa (with some modifications).

The payment terms for R2O Classic were adjusted so that farmers had three options. A farmer had to make a choice between three payment periods. There were two, three and four month plans. With these three payment plans, a total of 64 farmers signed up, bringing the total to 71 by the end of January 2014.

In January 2014, the model was further revised, as farmers who signed up for short payment periods were running into default, because they had insufficient time to make money from the use of the pump before payments became due. We thought through the cash flow cycle of a vegetable farmer using the pump -from the time s/he gets the pump to the time s/he earns some income from irrigated agriculture. This was particularly important, because the aim of R2O is to reach poorer farmers with no credit facilities and no other major income source to generate savings and thus finalize payment within the 3-4 months period.

As a result of our analysis, a five month R2O model was designed. The model works as follows:

- i) Farmers are approached as a group, and the ones who are interested in a pump are signed up.
- ii) The sales person registers the farmer and a 20% deposit plus registration fee is paid.
- iii) The farmer then makes subsequent rental payments equivalent to 10% of the value of the product at the end of months 1,2 and 3.
- iv) At the end of the 4<sup>th</sup> month, the farmer pays 25% of the total value of the product (it is after four months that vegetable farmers typically harvest their crops and make sufficient money to make larger payments)
- v) The final 25% is paid at the end of the 5<sup>th</sup> month.

This model has run from February-April 2014 - a period within which a total of 51 farmers signed up. Rental payments by customers have also been consistent, with no default experienced with this group. This is the model that KickStart will promote and provide as a treatment during the research phase of the project. One adjustment will be that any rental amount not paid is carried forward and thus those farmers who take longer to finalize payment will pay more, as a rental charge will be accumulating as long as the farmers have the pump. This is meant to discourage both late payment and ad hoc payments

Table 1 overleaf shows the summary of the final R2O Model that will be marketed to farmers and provided as a treatment during the research phase.

**Table 1 – Final R2O Model**

	<b>Current Model</b>	
Model plan	<b>5 month plan (Kshs)</b>	
Product	<i>Hip</i>	<i>Max</i>
Retail price	5,990	12,690
Sign-up Fee	100	250
Deposit 20%	1,300	2,700
1st month rent	650	1,340
2nd month rent	650	1,340
3rd month rent	650	1,340
4th month rent	1,670	3,410
5th and final rent	1,670	3,410
<b>Total rental payments</b>	<b>6,690</b>	<b>13,790</b>
<b>APR</b>	<b>28%</b>	<b>21%</b>

As at the end of April, a total of 122 farmers had been registered with the R2O service since inception, and 40 had completed and 52 were on track (were making the payments as per the signed up schedule).

ML has also been marketed to farmers during the project period. During the reporting period, a total of 11 customers have been signed up. Uptake of ML may have been adversely affected as it has been promoted alongside R2O. It is our assumption that, given the choice, farmers are more likely to opt for R2O, as they can take the pump home immediately (after placing the deposit) rather than waiting until they have saved enough under ML. This will not be the case during the research phase, as groups will be divided into three treatment groups:- (i) cash only, (ii) cash or ML, (iii) cash or R2O. In this way, ML will not be competing with R2O, and we will be able to see what sort of farmers opt for ML and how it affects take up.

## **2. Review and update of functional requirements**

Procedures for review of the customer, application, registration, mapping, payments process and schedule and customer follow-up have been put in place. Detailed criteria for selecting farmers have been established (see Appendix 1). This is to ensure that farmers receiving any of the services have the necessary characteristics to benefit from the pump while they lack other alternative financing services.

We have designed an application form for interested farmers to be used at the group stage (Appendix 2).

This is the preliminary stage of the product introduction at the group level. The next stage aims at addressing the interested individuals. After the group meeting, and before people disperse, those who are interested in signing up are taken through another product exposure. Those who have the deposit amount and want to register for the product are taken on board and fill in all the other product documents. This includes a Hire Purchase agreement, which is the binding document between him/her and KickStart. It is at this point that all the details of the customer are taken, pictures and documents filled and money sent through Mpesa to KickStart (Appendix 3).

The farmer then fills out a Sale Rep Payment Record. This specifies the rental payment dates and amounts that have been agreed upon. This form is used by the Sales Rep to follow up on late payments (Appendix 4). The farmer also gets a copy of the payment schedule.

The Product Dispatch Voucher is filled in by the dealer (and signed by the farmer) once all the signed paper work has been done for the product dispatch. The sales rep serves as the witness for the product dispatch (Appendix 5).

In case a farmer wants to opt out of the R2O service, we have designed an Exit Form that the farmer fills with all the calculations of what they will forfeit clearly spelled out (Appendix 6) *(The form is being adjusted for the marketing period so that any exiting farmers understand that all the unpaid rental fees will be deducted from the deposit)*

### **3. Partnership description and Strategy**

The design of the project is such that the entry point to the farmers is the group. KickStart has identified several partners who are already working on the ground with groups of farmers. The project staff have gone around the project area, and profiled many institutions and organizations working with various farmers. KickStart seeks to work with farmers groups comprised of poor people who want to improve their farm income and have access to water. This means that, for an organization to qualify, they need to be working with this kind of farmers. We have specifically identified that, by working with local Community Based Organizations (CBOs) and local NGOs, we have a greater probability of reaching poorer farmers. We have also identified that there are institutions working with farmer groups to promote water catchment and harvesting both for domestic use and irrigation. These are ideal as project partners. Other NGOs are building the capacity of the farmers to start up businesses. These again are ideal for working with KickStart.

The Strategy has been to engage institutions, and agree on a Memorandum of Understanding. KickStart staff will work with partner staff in reaching out to farmer groups. During the marketing phase of the project, KickStart will market the MoneyMaker pump to the groups and individuals interested in buying a pump through either cash, R2O or ML using the treatment assigned by the researchers. The group listing has been completed, and the list sent to Washington State University for us during the Rapid Appraisal – Demographic survey (starting mid-May). A total of 210 groups are involved in the RA-DS survey. None of the groups participating in the study has yet been exposed to any KickStart marketing. This is because Washington State University first needs to stratify the groups and assign them to the three different treatments.

Currently we are working with the Ministry of Agriculture, the County governments of Machakos, Kitui and Makueni, CARITAS KITUI, Sasol Foundation Kitui, World Vision, Hand in Hand East Africa, Build Africa, Inades Formation, Farm Africa, Kenya Agriculture Research Institute (KARI), ICRAF, Christian Impact Mission (CIM), Kenya Red Cross, University of Nairobi, AMREF and Kenya Rainwater Association amongst others.

On a separate note, research permits have been obtained for Professors Byers and Young from the National Council of Science and Technology in the Ministry of Education. The researchers will be arriving in Kenya in May to undertake the RA-DS.

#### **4. Update/Test back end System**

We have developed a couple of systems to support the project and the staff in the delivery of the project outputs:

**ML** – We have inter-linked the customer registration process with the KickStart ERP system so that all the data for the customer is located on the ERP system. When a farmer is registered his records are identified by the system through his telephone number. Whenever a farmer remits a ML payment, an automated SMS is sent to him confirming the payment and showing the balance due based on the product he registered for. This helps to build the farmer’s confidence in the service while instantly providing him with the current state of his ML account. Somebody else can still send money on behalf of the farmer as long as they use the farmer’s account number (telephone number).

**R2O** – The farmer is registered using his ID numbers. Once the KickStart sales representative registers a farmer, the Project System Administrator opens a file for the customer and adds the customer details into an excel spreadsheet. Whenever the farmer makes payment through Mpesa, his account in the Mpesa system is automatically updated. Every day the Project System Administrator uploads this data into the Excel spreadsheet. Farmers are then sorted based on their payment status. Those whose payment due date is between 0 – 30 days past due are rated as “On track”. Those whose payments are

between 30-60 days past due are rated as “delinquent”. And those whose payments are more than 60 days overdue are in “default” status.

Once the farmer data has been clustered into the above categories, each set of data for a Sales Rep is sent to them through email so that they can take action with regards to any farmers in the delinquent or default categories.

**“Hot Prospects System”** – KickStart has developed an IT based system that assists the sales reps to follow-up on the customers through the sales process. When the Sales person engages a farmer, with the intention of making a sale, and the sales does not happen, they determine what prevented the farmer from purchasing a pump. The barriers could range from lack of money, to understanding the working of the pump to other priorities. They then engage the farmers and agree on a future date when the sales process can continue, with the intention of overcoming the barrier and closing the sale. They then rate the farmer as “Very hot”, “Hot” or “Warm”:

- Very hot farmers: those who have money at hand, are convinced that the pump would improve their lives, but need to consult with their spouses or check that the pump would work in their circumstance.
- Hot farmers: those who are convinced about the pump but lack money to purchase the pump at once (ideal candidates for R2O and ML).
- Warm: those who like the pump and think that it is a great investment but have other priorities that they need to deal with before they think of purchasing the pump.

Once the sales rep gets the personal details of the prospective customers, records their barriers and agrees on the next step, action and timing, the information is put into the Hot Prospects System. On a weekly basis, the system generates a work-plan for every sales rep that helps them to serve the customers better. This system has been in place at KickStart for some time, but has been re-worked and focused on the USAID-DIV project goals.

**Follow-up of the field team activities** – KickStart has designed an SMS interactive program to monitor the activities of its field team under the project. It uses the mobile phone SMS platform to make daily reports on agreed activities and results. A set of questions is sent to the sales reps at a specific time each day. Once the sales rep responds to the first question, this prompts the interactive system to send the next question. The process continues until all the questions have been answered. This allows the manager and the sales rep to have a daily interaction from the same platform. A daily consolidated report is generated by the system, which helps the Regional Manager to ensure that sales reps are focused on the project activities and outputs.

## **5. Review and update of marketing Materials**

A special brochure was designed for the promotion of the MoneyMaker pump in the project area (see Appendix 7)

A single leaf flier has also been designed for the R2O service. The flier describes the service and the payment process to the potential customer. The flier is meant to be a “take home”, so that a farmer can make the decision in consultation with his/her partner (see Appendix 8).

Finally, we have also designed a ML brochure, which describes the service and the process of registration (see Appendix 9).

## **6. Training and development of KickStart staff**

Training of KickStart’s field staff on the R2O and ML services has been an iterative process, reflecting the piloting/testing of a number of different models over the last six months. Since January, it has been clear that the five month R2O is the preferred model to be tested during the research phase. The sales reps are now fully conversant with that model and with ML, and have been marketing these services for several months.

Staff members are fully conversant with the objectives of this project and the importance of marketing to different groups according to the three different treatments to ensure the integrity of the research results. They have been trained on how to position the financial services and not just the pump and its accessories.

Finally, staff members have also been trained on some important basic facts on agriculture and crop requirements. This is meant to aid farmers with limited knowledge on crop production to gain some tips on the type of crops to grow, common diseases and pests and pricing. This has been very useful to the staff in project delivery, as it builds trust and credibility with the farmers, hopefully improving farmer impacts and resulting in more pump sales.

## **7. Training and development of dealers**

There are eight dealers in the project area. They are:- KFA Machakos, Ninjiran, Mamba in Machakos County, Mumu Hardware and Key J in Makueni County; Kithimani, At Your Service and Mwingi Agrovets in Kitui County. All have been trained on the ML and R2O services. This dealer engagement has enabled us to identify any issues with the ML and R2O. For example, with R2O, dealers are supposed to release the pump to the farmer against the payment of a deposit, with repayment over a number of months. However, the dealer will have to pay KickStart for the pump before the farmer has fully paid for it, creating a cash-flow issue for the dealer. We are actively working with our dealers to develop a solution to this, so that they are not dis-incentivized to promote the R2O service. This issue is being addressed before the Marketing phase of the project commences.

## **Appendix 1 - Criteria for selecting farming group in the USAID-DIV project**

1. A structured group. This is a group with clearly recognized officials and rules to guide it, when it meets. It does not have to be registered with the government of Kenya.
2. A farming group and members have access to land for farming with the intention of improving income from the farm
3. Some members of the group are interested in carrying out horticulture or intensive farming
4. Members have access to water (natural sources or harvested). The water should be accessible to their farms and we will take the photograph of the same.
5. Have no access to financial credit facilities from either a financial or NGO sector. It is okay to have access to a saving process.
6. The Chairman and the Treasurer of the group are willing to vouch for the member, who wishes to sign up for the R2O service by co-signing the registration form.
7. The group size to be not less than 10 members and not greater than 30 members to enhance members' knowledge of one another.
8. For groups accessed through Partners, farmers working with a CBO and not an International NGO are desirable for R2O in order to get to the poorer target group for the financial products
9. For ML, it is desirable that the group is an independent group not necessarily working with any development partners
10. That the member is ready to start using the pump immediately once they acquire it through R2O.

## Appendix 2 – R2O Application Form

### FARMER INFORMATION.

First Name \_\_\_\_\_ Middle Name \_\_\_\_\_ Last Name \_\_\_\_\_

Gender: F  M  Date \_\_\_\_\_

National ID Number \_\_\_\_\_ District \_\_\_\_\_ Division \_\_\_\_\_

Location \_\_\_\_\_ Sub-location \_\_\_\_\_

Address P.O. Box \_\_\_\_\_ Code \_\_\_\_\_ Town \_\_\_\_\_ Road/Estate \_\_\_\_\_

Residence Town \_\_\_\_\_ Village \_\_\_\_\_ Mobile Number \_\_\_\_\_

Name of spouse \_\_\_\_\_ Mobile number of spouse \_\_\_\_\_

What product are you interested in? Product Name MM HIP  MM MAX

What is size of your farm? \_\_\_\_\_

Do you have water source? \_\_\_\_\_

Are you irrigating? \_\_\_\_\_

What type of irrigation are you using? \_\_\_\_\_

Do you belong to a group? \_\_\_\_\_

What's name of the group? \_\_\_\_\_

What's your position in the group? \_\_\_\_\_

What's the cost of the product you are applying for? Kshs. \_\_\_\_\_

How much can you afford as deposit? Kshs. \_\_\_\_\_

What's the location the event is taking place? \_\_\_\_\_

Which date should you be visited and sign agreement? \_\_\_\_\_

## Appendix 3 - R2O Contract

I, \_\_\_\_\_ having been explained and understood the terms and conditions of the R2O service and having undertaken to join the same, do hereby agree to make payments in accordance to the terms and conditions outlined below;

Borrower Name \_\_\_\_\_ Signature \_\_\_\_\_ Date \_\_\_\_\_

Sales Rep Name \_\_\_\_\_ Signature \_\_\_\_\_ Date \_\_\_\_\_

### I. TABLE 1. TERMS AND CONDITIONS

Pump Type		Amount (Kshs)		Sign up date:		Sign up amount (Kshs)
Payment period				Completion date:		

### II. TABLE 2. REPAYMENT SCHEDULE

Rental Payment Dates	Amount (Kshs)	Balance
<b>Total</b>		

**To make a rental payment:**

- Select Pay Bill from your MPESA menu
- Enter KickStart's Business Number: 503900
- Enter your account number:

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- Enter the amount you wish to pay  
(minimum of Ksh 100)
- Enter your MPESA PIN
- Confirm details are correct and press OK

**Notes:**

- I. Each time you send a rental payment, you should receive a confirmation SMS from MPESA.
- II. You can send as many payments as you wish on a daily, weekly or monthly basis and also make payments ahead of time so as to finish ahead of time. We encourage you not to wait until the date indicated above to send a payment, rather send what you have so that by the payment date indicated, your account has enough to cover your obligation.
- III. **Delinquency Policy:** If payment is not received by the date indicated above, then borrower is considered to be delinquent and KickStart reserves the right to SMS, call and/or visit your home as well as impose late fees.
- IV. **Default Policy:** After 30 days of delinquency, KickStart reserves the right to visit your home and repossess the pump as well as impose cancellation and repossession charges. All unpaid monthly rental fees will be due for collection.
- V. The pump remains the property of KickStart International until payment is fully completed and a Guarantee form issued to the farmer.





## Appendix 5 – Product Dispatch Voucher

*To be completed for all farmers*

Dealers Name: \_\_\_\_\_

This is to confirm that on Day \_\_\_\_\_ Date \_\_\_\_\_ Month \_\_\_\_\_ Year \_\_\_\_\_, the farmer name \_\_\_\_\_ ID Number \_\_\_\_\_ has collected the following items from dealer \_\_\_\_\_ as part of the R2O program.

Item	Description	Quantity (#) (A)	Retail Price (KES) (B)	Total Cost (KES) (A*B)
<b>Pumps</b> (Indicate full pump name, serial number and confirm that the complete bundle was collected)	1.  2.			

**Signed by:**

Farmer Name \_\_\_\_\_ Mobile number \_\_\_\_\_ Signature \_\_\_\_\_ Date \_\_\_\_\_

**Witnessed by:**

Sales Rep Name \_\_\_\_\_ Mobile number \_\_\_\_\_ Signature \_\_\_\_\_ Date \_\_\_\_\_

Dealer Representative \_\_\_\_\_ Mobile number \_\_\_\_\_ Signature \_\_\_\_\_ Date \_\_\_\_\_

## **TERMS AND CONDITIONS**

- i. This voucher should be completed for every R2O customer when they come to collect the pumps from the dealer. This should be done in the presence of the sales rep and dealer and signed by both parties.
- ii. Kindly indicate all of the items that the client collected from the dealer shop and the retail cost for each
- iii. Sales rep to take clear pictures that are legible and send them to KS via dropbox (with the hard copy to follow to KS HQ)

## Appendix 6 – Exit Form



### EXIT FORM

#### 1. CLIENT INFORMATION

First Name \_\_\_\_\_ Middle Name \_\_\_\_\_ Last Name \_\_\_\_\_

National ID Number \_\_\_\_\_

#### 2. DETAILS ON EXIT

Date of proposed exit of client \_\_\_\_\_

Reason for exiting:

I don't want the pump

Inability to pay for the pump

Expulsion by the group

Other \_\_\_\_\_

Explain reasons for leaving \_\_\_\_\_

---

#### Calculation of Final Dues

Total payments made by client (to-date): Kshs \_\_\_\_\_

Less;

- Cancellation fees Kshs \_\_\_\_\_

- Depreciation fees Kshs \_\_\_\_\_

- Late fees Kshs \_\_\_\_\_

Amount to be refunded: Kshs \_\_\_\_\_

**Note: Cancellation fees (Kshs 300), late fees (Kshs 200 Monthly), Depreciation fees (4% per month value of the pump)**

Signature of Client: \_\_\_\_\_ Date: \_\_\_\_\_

Signed on behalf of the Group by:

Chairperson \_\_\_\_\_ Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Treasurer \_\_\_\_\_ Signature: \_\_\_\_\_ Date: \_\_\_\_\_

#### TERMS AND CONDITIONS

- i. Customers will be required to complete the exit form at least 1 month before the last date that they expect to be part of financial services
- ii. For group clients, group officials will need to approve the exit of the customer from the R2O Service
- iii. Clients who opt out of R2O or savings programs will be charged cancellation fees

**OFFICIAL: FOR KICKSTART USE ONLY**

<b>Designation</b>	<b>Name</b>	<b>Comment</b>	<b>Signature</b>	<b>Date</b>
Sales Rep				
Regional Manager				
Project Coordinator				



**KickStart – Washington State University (WSU) Research Study**  
**Milestone 4: Report on Training & Marketing of Farmers**

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*Mobile Layaway and R2O: Bringing an Innovative Savings Solution to the Rural  
Poor for Small-Scale Irrigation Pump Purchases*

19<sup>th</sup> August 2014

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## 1. Promotion and Training of Groups

KickStart sales staff have been trained on how to carry out training and marketing of the various treatments to farmer groups. This has enabled them to carry out a process that convinces the members within the group to purchase pumps through the provided services. Content for the training was developed that allows the delivery of the training and marketing to take a common and similar content to different groups.

During the training the groups are taken through the following steps:

- Introduction to KickStart
- Introduction of why irrigation is important – reduce the risk of crop loss, allows growing of high value crops, allows for growing of crops during the dry season, generating more money because of higher prices
- Gathering farmers' feedback on the opportunities for irrigation in their area.
- Getting farmers' feedback on the challenges of irrigation in their area
- Introduction, description and demonstration of the pump
- Invitation for farmers to try the pump and ask questions
- Invite those who wish to purchase to show by raising their hands
- Introduce the financial service
- Describe the registration process
- Register those who are interested
- Introduce the second visit content and the value for farmers to attend and learn more about irrigation, the pump and how easy it is to acquire a pump.

During the second visits we :

- Get feedback from the group members on the reaction of their spouses/friends from the first training and marketing
- Explain how easy it is to get a MoneyMaker pump
- Introduce agropreneurship – Basic agronomic training on common horticultural crops
- Introduce water harvesting techniques
- Provide tips on crop pricing, grading, marketing and bulk marketing as a group
- Demonstrate the pump
- Register some more farmers

All the groups are taken through the above stages with each group deep diving into specific treatment. Staff members were provided with FAQ sheet and answers to ensure that similar questions are responded to in a similar manner across board.

### **Important Note**

Under this research project, the intention is to assign farmer groups to one of three different marketing treatments:- cash only, cash or rent-to-own (R2O) and cash or mobile lay-away (ML). The assignment of groups to the different treatments can only take place after the Rapid Appraisal Demographic Survey (RA-DS) has been completed by our research partner, Washington State University (WSU). WSU undertook the RA-DS in May-June 2014 (see forthcoming milestone 5 report), and provided a draft final report to KickStart at the end of July. This report includes details of the assignment of the different farmer groups participating in the research to the three different treatments. Given the timing of the RA-DS, KickStart has, to this point, been training farmer groups on all three payment options (cash, R2O and ML) and farmers have had the choice of paying using any of those three options. From August 2014 onwards (having assigned new farmer groups to the three different treatments), farmers within a particular group will only be exposed to training and marketing for the payment option relevant to that group. So, for example, a farmer will no longer have the option of buying on a R2O or ML basis.

## **2. Promotion and training of “Marketing Only Groups**

The Marketing Only Groups service is the process that KickStart has used in selling pumps for the past 15 years. It is therefore a process with which staff members are very familiar.

During the period March through July 2014, we trained groups of farmers on procurement of pumps through cash only. The trained groups were provided a platform through which KickStart prepared itself for the Study marketing phase of the project which kicked off at the end of July. During the period, a total of 132 pumps were sold through this process. We exposed the product to around 300 groups. There are still some “hot prospect” farmers within these groups that are being followed by the sales team.

The pump is sold to the farmers as a bundle which has an 18 meter delivery pipe and a 10 meter suction pipe. Farmers must make a full payment of the bundle before they can take the pump home. For the MoneyMaker Max the farmer pays a total of Kshs 12,690, while for the MoneyMaker Hip pump the farmer pays a total of Ksh 5,990.

The sales pitch for the Marketing only groups is as follows:

- MoneyMaker Max together with 10 meters HDPE pipe and 18 meters hose costs Kshs 12,690 with ready cash.
- MoneyMaker Hip together with 10 Meters HPDE pipe and 18 meters hose costs Ksh 5,990 with cash at hand

- If you have cash now and want a pump, I will sell it to you at the prices above.
- The nearest dealer if you need to purchase one after the meeting is At Your Service in Kitui town.
- The pricing of the pump is better than 2 goats or a heifer.
- With 25 cocks @Ksh 500 each you can buy 1 Max while 11 Chickens are equivalent to 1 Hip pump.
- The money you have saved with the group will grow faster if you invest it in a pump today than the interest that you get in future if you saved.

### **3. Promotion and training of Mobile Layaway Groups**

Mobile Layaway has been marketed to farmers groups during the reporting period. Over 100 groups have been exposed to this financial service and given the advantage of buying the pumps through the “no risk” process. When farmers purchase pumps through Mobile Layaway, they pay the normal cash retail price for the bundled pump but over a period of months (the number of months depends on how fast they save, but historically it has averaged around six months); there is also a small registration fee. For the MoneyMaker Max the total amount paid by the farmer is Ksh 12,940 (compared to a cash price of Ksh 12,690), while for the MoneyMaker Hip pump, the total amount paid by the farmer is Ksh 6,090 (compared to a cash price of Ksh 5,990).

A farmer is required to pay the registration fee of Ksh 250 if the product is the MoneyMaker Max or Kshs 100 for the MoneyMaker Hip product. S/he is also required to make a deposit that is not less than the registration fee. The farmer is then contacted on a regular basis by the sales rep to ensure that they make regular savings payments to KickStart over the next six months. The sales staff is paid part of the commission at the registration stage and the rest at payment completion to ensure that they remain motivated in following up with the farmer. Initially the follow-up is done by an officer from headquarters using SMS messages. When the farmer hits 70% of the full payment, the sales rep who registered them takes them through an accelerated phase, where phone calls are made to the customer to encourage full payment. This has worked well and the farmers who have registered find it easy to remember to continue saving.

Unfortunately, during this reporting period only nine customers have been signed up to Mobile Lay-Away. To a certain extent, this was expected, as farmers have been given the choice to buy in cash, on a rent to own basis or using Mobile Lay-Away. For those farmers that cannot afford to pay cash, there is, not surprisingly, a preference to take a pump home immediately on credit

(R2O) rather than saving and having to wait to get the pump for six months. . Now that the Rapid Appraisal Demographic Survey has been completed and farmer groups have been stratified into the three different treatments, farmers within the groups chosen for the Mobile Lay-Away treatment will only have a choice between paying cash or signing up for Mobile Lay-Away. Groups chosen for the R2O treatment will only have a choice of cash or R2O. In this way, Mobile Lay-Away will have a greater chance of success, and we expect the number of Mobile Lay-Away registrations to rise. If they do not, this will be a strong indication that there is insufficient farmer interest in a Mobile Lay-Away financial service, and thus an important and useful finding of this research project.

The sales pitch for Mobile Layaway is as follows:

- For you in this group, if don't have cash, you can still own the pump if you start saving today through Mobile Layaway
- You start by registering today on a form that I have with me
- You can then pay a registration fee and make a saving equal or more than the registration fee.
- For MoneyMaker Max the registration fee is Kshs 250 while for the MoneyMaker Hip it is Kshs 100
- I will send the registration details to the headquarter through an sms
- You will be registered in the KickStart system and you will receive an sms message in your phone indicating that you have registered and the amount you have deposited
- Whenever you get money, send it to your KickStart account and you will receive a SMS acknowledging receipt and informing you of your updated savings balance
- When you have completed all payments you will receive a message indicating that you have completed payment
- KickStart will authorize the dealer to release a pump to you
- All payments are made through your Mpesa telephone account to KickStart account – simple!!!
- Your Money is safe in the KickStart account and in case you are no longer interested or you want your money back, all the savings less the registration fee will be refunded to you.

## 4. Promoting and training of “Rent to-Own Groups

R2O is a five months hire purchase arrangement for farmers. It involves farmers being approached as a group and taken through the product components.

The R2O model works as follows:

- i) Farmers are approached as a group, and the ones who are interested in a pump are signed up.
- ii) Farmers are signed up individually i.e. this is not a group lending micro-finance approach whereby each group member guarantees loans to the other members.
- iii) The sales person registers the farmer and a 20% deposit plus registration fee is paid.
- iv) The farmer then makes subsequent rental payments equivalent to 10% of the value of the product at the end of months 1,2 and 3.
- v) At the end of the 4<sup>th</sup> month, the farmer pays 25% of the total value of the products.(it is after four months that vegetable farmers typically harvest their crops and make sufficient money to make larger payments)
- vi) The final 25% is paid at the end of month 5.

During the reporting period, a total of 31 farmers were registered for R2O. During the same period, a total of 26 farmers completed their payments (some of these may have been farmers that signed up to R2O before the reporting period). Table 1 shows the R2O model that we have explained and marketed to the farmers.

**Table 1 – Final R2O Model**

	<b>Current Model</b>	
Model plan	<b>5 month plan (Kshs)</b>	
Product	<i>Hip</i>	<i>Max</i>
Retail price	5,990	12,690
Sign-up Fee	100	250
Deposit 20%	1,300	2,700
1st month rent	650	1,340
2nd month rent	650	1,340
3rd month rent	650	1,340
4th month rent	1,670	3,410
5th and final rent	1,670	3,410
Total rental payments	<b>6,690</b>	<b>13,790</b>
APR	24%	16%

The R2O sales pitch to farmer groups is as follows:

- For this group, if you don't have enough cash, you can still get the pump through a financial service called Rent-to-Own
- It's like the way you live in a rental house paying monthly rent
- The difference is that after 5 months the pump will be yours completely
- The price of the MoneyMaker Max is Kshs 13,790
- The price of the MoneyMaker Hip is Kshs 6,690
- First make Kshs 2,950 for the MoneyMaker Max or Kshs 1,400 for the MoneyMaker Hip at the registration.
- You will take the pump home with you on that day after filling any all the necessary documents for identification
- At the end of the 1<sup>st</sup> month you will pay a monthly rental fee of Kshs 1,340 if you signed for the MoneyMaker max or Kshs 650 if you signed up for the MoneyMaker Hip.
- You do the same at the end of the 2<sup>nd</sup> and the 3<sup>rd</sup> month.
- At the end of the 4<sup>th</sup> month you will have harvested a crop from the farm so you can afford to make a much larger fourth payment of Ksh 3,410 for the MoneyMaker Max or Kshs 1,670 for the MoneyMaker Hip.
- At the end of the 5<sup>th</sup> month you make your final payment of Ksh 3,410 for the MoneyMaker Max or Kshs 1,670 for the MoneyMaker Hip pump
- The pump will be yours from that point. You will get a Guarantee form and a certificate of payment completion.
- You pay slightly more for the pump under R2O to cover interest costs. However, you have the convenience of paying for a pump over time and taking it home immediately to start making money from irrigation.
- All payments are made through your Mpesa telephone account to KickStart account – simple!!!



**KickStart – Washington State University (WSU) Research Study**  
**Milestone 5: Rapid Appraisal Demographic Survey**

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*Mobile Layaway and R2O: Bringing an Innovative Savings Solution to the Rural  
Poor for Small-Scale Irrigation Pump Purchases*

25<sup>th</sup> August 2014

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Executive Summary

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## Executive Summary

In May 2014, the Washington State University (WSU) research team, comprising Dr. Tom Byers and Professor Doug Young, arrived in Nairobi to undertake the Rapid Appraisal Demographic Survey (RA-DS).

The purpose of the RA-DS was to identify farmer groups that would participate in this research project, and to assign selected farmer groups into the three different marketing treatments:- cash only, cash or mobile lay-away (ML) and cash or rent to own (R2O).

Prior to WSU's arrival, KickStart field staff had identified many farmer groups across the three counties, Machakos, Makueni and Kitui, that had potential to participate in the research study. During the RA-DS, group leaders of 256 groups were contacted (initially by phone and then in person) to elicit information about the group and group members. In particular, the RA-DS identified groups whose members have access to water for irrigation and the potential to use a KickStart pump for the purpose of irrigating. Groups who failed this criterion were eliminated, as there would be little sense in marketing irrigation pumps to groups that have no access to water.

Group leaders were questioned about their members' gender, access to water, assets, risk of hunger, and dominant food and cash crops along with other pertinent information. GPS coordinates were taken for assisting in project development. Agricultural and socio-demographic information on the counties in which the groups are located was also collected.

The RA-DS was executed under the leadership of Byers and Young. They were supported by a small team of four local enumerators (two male, two female), as well as by KickStart's field team in Eastern province.

A detailed account of the process for conducting the RA-DS - including the recruitment and training of enumerators and the sampling and survey process - can be found in the following appendices to this report:

- Appendix 1: Process, Clustering and Sample Size Derivation
- Appendix 2: Summary of Results
- Appendix 3: Estimation of Minimum Sample Sizes

In summarizing the appendices we find that, out of the 256 groups initially identified, 98 have been randomly selected for participation in the research, comprising 3,917 group members. The 98 groups are located within 28 separate clusters. A total of 71 clusters were constructed. Twenty-eight of these clusters met spatial and topographical requirements for inclusion. Clusters are dispersed by topography and geography. Clusters represented by highlands, rivers

and plains areas offer natural, topographical and spatial barriers to information transfer. The researchers have ensured a distance of at least 15 kilometers between clusters, when possible, to ensure that groups that have been allocated to one treatment are not aware of the treatments allocated to other groups. For example, we do not want a group that has been allocated to the “cash or ML” treatment to become aware that another group has been offered the “cash or R2O” treatment, as the first group is likely to also demand that it be offered R2O. This could undermine the research. While the researchers cannot guarantee that groups exposed to a particular treatment won’t become aware of the other treatments, ensuring a minimum distance of 15km between clusters minimizes this risk.

Starting in August, KickStart’s sales representatives have begun marketing our pumps and the specific treatment (i.e. finance/payment options) to the 98 groups. This training and marketing effort will continue until November-December 2014. At this point, there should have been sufficient pump sales to undertake the Buyer Baseline Survey. Byers and Young will return to lead that survey, with the intention of working with the same team of local enumerators.

Part of WSU’s work has also been to compute (using appropriate statistical sampling methodology) the minimum sample size for the Buyer Baseline Survey and End of Project Impact Survey. Based on its in-depth analysis outlined in Appendices 2 and 3, and in order to get statistically valid research results, WSU has recommended sampling 300 pump buyers/households for the Buyer Baseline Survey and End of Project Impact Survey, with 100 allocated to each of the three finance treatments (originally, it had been thought that we would need to have a total sample size of 600 pump buyers). It has also recommended that an additional 100 non-pump buying households be surveyed at the end of the project to act as a control group.

In conclusion, the RA-DS has been successfully completed, and KickStart marketing to the participating groups using the three different finance/payment options is now underway. The RA-DS has set the foundation for the Buyers Baseline Survey and End of Project Impact Survey. When completed, results will:

- statistically demonstrate how Mobile Layaway and Rent-to-Own financing schemes affect take-up of MoneyMaker irrigation technology in comparison with each other and to “cash” sales,
- statistically show if the different financing schemes enable higher adoption among women, among poor households, and other groups, and
- statistically reveal the effects of pump acquisition by different financing schemes on household livelihood indices, especially on women and poor households.

# Appendix 1

## **Mobile Layaway and Rent-to-Own: Bringing an Innovative Savings Solution to the Rural Poor for Small-Scale Irrigation Pump Purchases**

### **Rapid Appraisal – Demographic Survey**

#### **Process, Clustering and Sample Size Derivation**

**Thomas E. Byers, Douglas L. Young,  
Patrick Kirui, Teresiah Gitau, Jennifer Mueni and Andrew Wanyonyi**

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Kirui is KSI/WSU Enumeration Team Leader and Coordinator, Gitau, Mueni, and Wanyonyi are Enumeration Team Members<sup>1</sup>

**31 July 2014**

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<sup>1</sup> The authors are grateful for the invaluable assistance of Mr. John Kihia, KSI Country Director - Kenya and Beatrice Sakwa, KSI Director, Impact Evaluation and Monitoring for their invaluable insights and assistance at KSI Headquarters and in the field. Augustine Kimoni, KSI Coordinator - Innovations, Joseph Kilonzo, KSI Field Manager and Betty Vatta, KSI Administration Coordinator provided support that was instrumental to the success of the RA-DS. Of course, the authors want to recognize the other KSI senior and junior staff, who are too numerous to mention here, but who were instrumental in the success of the RA-DS.

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## Acronyms

<b>BaseB</b>	<b>Baseline Buyers Survey</b>
<b>ETLC</b>	<b>Enumeration Team Leader and Coordinator</b>
<b>EOP-IS</b>	<b>End of Project Impact Survey</b>
<b>IRAD</b>	<b>International Research and Agricultural Development</b>
<b>KSI</b>	<b>KickStart International</b>
<b>NACOSTI</b>	<b>National Commission for Science, Technology and Innovation</b>
<b>RA-DS</b>	<b>Rapid Appraisal – Demographic Survey</b>
<b>SES</b>	<b>School for Economic Sciences</b>
<b>WSU</b>	<b>Washington State University</b>

## Introduction

Washington State University entered an agreement to provide services to KickStart International (KSI). This report provides results, to date, on progress being made to meet the WSU obligation to KSI. Milestone 1 is met by detailing the process and results of a Rapid Appraisal Demographic Survey (RA-DS).

Included here is a discussion of the process and provision of results in two specific categories; 1) the identification of groups, spatially and topographically, from which clusters have been identified allowing KSI to begin its marketing campaign and 2) the process by which sample size was derived providing the foundation for future baseline and end of project surveys. Supplementary and supporting documentation is attached to this report.

## Background

Washington State University's International Research and Agricultural Development Unit (IRAD) communicated with KickStart International to explore opportunities for partnering on a collaborative study and program entitled "Mobile Layaway and Rent-to-Own: Bringing an Innovative Savings Solution to the Rural Poor for Small-Scale Irrigation Pump Purchases". Agreement was reached to undertake a research component of the project funded by the United States Agency for International Development's "Development Innovations Ventures" sub-contracted through KSI to WSU.

Thomas E. Byers, Ph.D. Associate Director of North Africa and Asia Programs, International Research and Agricultural Development Unit, PI, and Douglas L. Young, Ph.D. Professor, School for Economic Sciences, Co-PI collaborated with KSI to develop an appropriate and collaborative research and development project.

The project address differences which may exist between financing methods that can improve opportunities for women and bottom of the pyramid (BOP) rural families to purchase small scale irrigation systems. In May, 2014 the Rapid Appraisal – Demographic Survey (RA-DS) was implemented in three counties of Kenya, Machakos, Makueni and Kitui.

## Milestone One – Objective and Linkage to Other Research Milestones

The Rapid Appraisal – Demographic Survey (RA-DS) objective for the study, “Mobile Layaway and Rent-to-Own: Bringing an Innovative Savings Solution to the Rural Poor for Small-Scale Irrigation Pump Purchases,” is summarized below:

*The RA-DS was designed to identify and elicit information and commitment from Group Leaders, located in the three target counties, about their members’ and their Group’s interest in participating in the study. Agricultural and socio-demographic information on the counties in which the groups are located and (b) identification of households for KSI’s subsequent pump marketing campaign were identified during the activity.*

*The RA-DS identified groups whose members have access to water for irrigation and the potential to use a KSI treadle or hip pump for the purpose of irrigating. Groups who failed this criterion were eliminated. Group leaders were questioned about their members’ gender, access to water, assets, risk of hunger, and dominant food and cash crops along with other pertinent information. GPS coordinates were taken for assisting in project development.*

*The RA-DS sets the foundation for two follow-on surveys; a baseline buyers (BaseB Survey) and end of project impact survey (EOP-IS). When completed, results will:*

- (1) statistically demonstrate how Mobile Layaway and Rent-to-Own financing schemes affect take-up of MoneyMaker irrigation technology in comparison with each other and to “cash” sales,*
- (2) statistically show if the different financing schemes enable higher adoption among women, among poor households, and other groups, and*
- (3) statistically reveal the effects of pump acquisition by different financing schemes on household livelihood indices, especially on women and poor households.*

*The RA-DS is the first step toward determining viability at scale of each financing mechanism and also how these mechanisms might break down barriers for asset acquisition for rural African farmers more generally.*

## **Team Building and Training**

The WSU research team members arrived on-site May 10<sup>th</sup>, 2014 to begin work with KickStart International. Several Team and RA-DS development tasks were undertaken during Week 1 beginning May 12, 2014.

During the first days of the engagement these tasks included:

- Introductions to KSI staff that would be assisting in the effort,
- Interviews of prospective enumerators, undertaken on Day 2,
- Hiring four enumerators (2 female and 2 male) on Day 2, and
- Beginning training activities on Day 3.

Conscious efforts were introduced on Day 3 to integrate KSI staff, enumerators and WSU staff into a seamless “Research Team”. The Team development continued as KSI staff members were encountered in field. Introductions were made to KSI field managers and sales representatives over the next few weeks.

Classroom training began on Day 3, having been interviewed and hired on Day 2. The focus of the classroom training was to introduce the individual enumerators to the objectives of the project, to the expectations for the RA-DS, and to the survey instrument. During this training process, the enumerators began to learn more about each other and the WSU researchers and the KSI staff who worked as part of the Team.

On Day 4 a key training and “bonding” activity was introduced. This was built around the translation of the survey instrument into Kiswahili. During this process, full participation by the enumerators was encouraged and facilitated. Another important Team building effort was introduced to increase cohesiveness and solidify the enumerators’ status as full members of the larger Team. Team members were asked not only to translate the survey instrument but also develop a key question focused upon nutrition in the household. This was generated by the enumerators and Co-PIs, polished and translated into Kiswahili.

## **Non-Kenyan Researcher Requirement to Meet with County Administration**

Prior to arrival in Country both WSU researchers had received authorization to undertake research in Kenya from the National Commission for Science, Technology and Innovation (NACOSTI). One component of this authorization required the WSU researchers to visit and receive authorization to undertake research in each of the three Counties where the survey activities were to be undertaken. This task was completed in

all Counties by the first part of Week 3; the introductions and authorization to undertake research had been received from County Commissioners, County Directors of Education, and County Directors of Agriculture in Machakos, Makueni and Kitui Counties. All KSI and enumerator Team members were presented in each county to each administrator so that they would be recognized when carrying out their work across the Counties.

## Field Activities

In class training was completed at the end of Week 1. Logistical arrangements were finalized on Day 5 for movement to Kitui County and implementation of the survey in the field. The full Team departed for a first meeting with County officials on Monday, 19<sup>th</sup> May, Week 2 of the RA-DS. By the middle of Week 2 the Team was operating seamlessly after having been observed and guided toward successfully interviewing group leaders.

During this period, an Enumeration Team Leader and Coordinator (ETLC) were internally chosen by the other Team members and the Co-PIs. The ETLC was assigned a heightened degree of responsibility for field activities, data management and the safety and comfort of the other Team members after the WSU compliment had departed country.

## Field Observations

Group Leaders were introduced to the RA-DS, Kiswahili denoted survey instrument, with an initial message:

*If your group is selected to participate, we expect that you will be contacted by the MoneyMaker people in the near future about small scale irrigation. This may create new opportunities for you and your family to produce more, at different times during the year and generate revenue from your efforts. This survey will only take a few minutes. The work is being undertaken to assist farmers, like the members of your group, to develop small scale irrigation.*

The enumerators were directed not to introduce the context of “different treatments” which will form the basis for follow-up surveys. Groups will be assigned one of three treatment options.

Many of the Group Leaders were familiar with KSI staff located in their area but had come to know KSI employees as the MoneyMaker people. This branding helped when the Group Leaders were being introduced to the Research Team.

Early in Week 1 work with group leaders it was determined that:

- Additional groups should be added to meet downstream needs.
- The Team should meet with Group Leaders at locations where the Group members would meet for their regularly scheduled meetings rather than at centralized locations where more than one group would congregate.
- There was a need for inclusion of two questions dealing with ownership and quantity of goats owned by the typical group member.

These were incremental but also instrumental adjustments that allowed for:

- Larger numbers and more dispersed groups to cluster and sample from while addressing upcoming milestone requirements,
- GPS readings that were subsequently utilized with “*Google Earth*” and “*Earth Look*” to develop clusters which will become the main sampling reservoir for both Baseline Buyers Survey and the End of Project Impact Assessment Survey.
- Additional information for development of a group wealth index.

The WSU research complement left country during the middle of Week 3 and allowed the Team to continue data collection during the next three weeks. During the field activity period which continued from May 19<sup>th</sup> to mid-June, 256 groups were identified with over 6000 members represented within the Groups. This provided the foundation for clustering, randomization and selection of clusters for participation in the study.

## Data Cleaning and Input

When the RA-DS field activity was completed the Team worked electronically to clean and input data. The ETLC coordinated Kenya based activities in close communication with the WSU partners.

Under the supervision of the ETLC, data was:

- Introduced into Excel spreadsheets and an initial check for completeness was undertaken,
- Rechecked for errors and omissions using a second incremental sampling of the data undertaken to identify the prevalence of any remaining errors or omissions. These were subsequently corrected,

- Then delivered to the WSU partners for a third review utilizing an initial, aggregate data analysis run for mins/max that provided a final evaluation of the validity of the data set.

The final step confirmed that the ETLTC led reviews and corrections had been comprehensive with only one data error (1 cell of 4,352 cells) identified during all subsequent data analysis.

Simultaneously, yet independently, The Research Team was introduced to EarthPoint (<http://www.earthpoint.us/Default.aspx>), a cloud based solution that allows the user to interface GPS generated coordinates with Google Earth. This allowed the Enumeration Team Leader and Coordinator, working with the Enumeration Team to:

- Transfer of latitude and longitude data to Google Earth
- Introduce color coded search tabs,
- Link the search tabs to the individual group leaders by the County and by location where group members congregate (This becomes the target point for initial contact in upcoming BaseB and EOP-IS activities), and
- Create the opportunity to visually map individual groups spatially and across topography for the subsequent clustering of groups across the three target counties.

The use of EarthPoint and delivery of information to Google Earth took less than two days for the Research Team. The process by which the attached Cluster spreadsheet was created is presented here.

## Clustering and Randomization

In order to identify and randomize groups, treatments and subsequently identify individuals from this classification for BaseB and EOP-IS the following process was introduced:

Two hundred and fifty-six groups were contacted during the RA-DS. Out of the 256 groups, 71 clusters were generated (See the attached Clustering Process and Randomization Procedures Document [CPRP]). Clusters are dispersed by topography and geography. Highlands, rivers and plains areas offer a measure of topographical barriers to information transfer. Spatially, a distance > than 15 kilometers between treatments has been achieved in all but a few cases.<sup>2</sup>

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<sup>2</sup>From the 71 clusters, 28 clusters were selected that met spatial, topographic and group member numbers necessary to meet study requirements and still maintain physical boundaries between treatment groups. To ensure that the least amount of information possible is transferred across treatment groups, the other 43 clusters are only available for post project marketing but not currently included in the study frame.

Derivation of clusters, allocation of groups to clusters and treatments and the breakout by county of clusters, treatments and group leaders is discussed here and embodied in the attached Clustering Process and Procedures Document. The bulleted information below provides insight into the process and the results generated during a multi-step process and for guidance in reviewing the attached spreadsheets:

- Each case (represented by the Group Leader), from the Rapid Appraisal-Demographic Survey (RA-DS) Dropbox was introduced to Google Earth utilizing EarthPoint software. ([https://www.google.com/search?q=earthpoint&oq=earthpoint&aqs=chrome..69i57.4144j0j7&sourceid=chrome&es\\_sm=122&ie=UTF-8](https://www.google.com/search?q=earthpoint&oq=earthpoint&aqs=chrome..69i57.4144j0j7&sourceid=chrome&es_sm=122&ie=UTF-8))
- Locations associated with the EarthPoint data (latitude and longitude demarcations) were visually reviewed in Google Earth and prepared for clustering.
- Each group leader (case) and a subset of data associated with each leader, was introduced into a new spreadsheet for cluster generation utilizing Google Earth as a visual foundation tool.
- Each case was allocated to one of seventy-one clusters across the three counties. The qualitative allocation is based upon physical topography and spatial dispersion of cases across the three counties. (Example from the CPRP, Cases 102 93, 103, 96 fall into Cluster 1).
- Each cluster was assigned a treatment number, 1, 2 or 3, sequentially across all clusters ([1, 2, 3][1, 2, 3] [1, 2, 3][1, 2, 3], etc - See column A of the CPRP).
- Each Case was allocated a randomly generated value to allow sorting by Cluster and subsequently by Treatment and/or County.
- Cases were sorted according to random values from low to high identifying associated Cluster and Treatment affiliations.
- Treatments were color coded for visual identification
- Sorting by Treatment provides information necessary to select the “sales opportunity set” associated with each Treatment. Sales will be generated by the KSI sales force based on this opportunity set. These sales become the population for selection/or census of buyers in the Baseline Buyers Survey (BaseB Survey) and the End of Project Impact Survey (EOP-IS).
- Clusters were then selected by choosing those for each of the three treatment groups sequentially and after reviewing topographical distance or a distance greater than 15 kilometers from each other. Those which were less than 15 kilometers apart from each other were rejected from use.<sup>3</sup>

As the clustering process and procedures were being generated, secondary data and the RA-DS primary data were mined to generate descriptive statistics and minimum sample sizes for the upcoming BaseB and EOP-IS.

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<sup>3</sup> The 15 kilometer spatial barrier was included to limit, as much as is possible, the transfer of information about one treatment to members of another cluster who may have received offers of a different treatment (In this study one of three financing tool options represent the “options”). This effort will not be completely achievable due to interactions of purchasers from different locations coming together in public places. The efforts to minimize the interaction effects of such meetings on purchase choices made will reduce potential error.

## County Characteristics

Table 1 displays basic county information from both secondary and primary data sources on the target counties of Machakos, Makueni and Kitui. Kitui is the most remote in terms of distance from Nairobi and also is the most arid. As expected, the May-June 2014 RA-DS showed that Kitui lagged Makueni and Machakos in household wealth and displayed more hunger incidence. Maize and beans are the most important staple food crops in all three counties. Cash crops, including cotton, coffee, and fruit, are found in favorable

Table 1. Characteristics of Eastern Kenya Counties

County Name (RA-DS County Code)	Population	Rural	Poor	Literate	Estimated Farm Households	Groups Interviewed	Farm Households Represented	Sample Average Asset Wealth	Hungry Households
	<i>2009</i>	%	%	%	<i>No.</i>			<i>KSh</i>	%
						<i>RA-DS</i>	<i>RA-DS</i>	<i>RA-DS</i>	<i>RA-DS</i>
<i>Machakos (C1)</i>	1,098,584	48	59.6	69.7	79,098	132	1,059	34,699	46.5
<i>Makueni (C2)</i>	884,527	88.2	64.1	72.7	117,023	63	2,174	34,683	51
<i>Kitui (C3)</i>	1,012,709	86.2	63.5	74.8	130,943	61	3,644	21,648	70.1
<i>Total</i>	2,995,820				327,064	256	6,877		

### Sources:

**Populations** from (<http://www.scribd.com/doc/36672705/Kenya-Census-2009> )

**%Rural** from (<http://fs12.formsite.com/ICTAuthorityKE/OpenData2014/index.html> )

**% Poor** from OpenDataKenya (<https://www.opendata.go.ke/Poverty/Poverty-Rate-by-District/i5bp-z9aq> )

**World Bank** (<http://data.worldbank.org/country/Kenya/> )

**Kenya Open Data** <https://www.opendata.go.ke/Counties/County-Urbanization-Kitui/747f-z33c>

**Estimated Farm Households by County** computed as [(Population) x (Proportion Rural) x (0.9)] / (6 people per household)

**Groups Interviewed in RA-DS; Farm Households Represented, RA-DS; Sample Av. Asset Wealth, RA-DS; and % Hungry Households from RA-DS results**

agro-climatic niches. Farmers keep cattle, goats and donkeys in all three counties.

Machakos County is adjacent to Nairobi and offers residents greater opportunities for seasonal off-farm employment.

## Population of Interest

The conclusions of the BaseB Survey and EOP-IS will apply to the estimated number of farm households in each County. These include 130,943 farm households in Kitui, 117,023 in Makueni, and 79,098 in Machakos. With an average of six persons per household, the conclusions will apply to about two million people in the three Counties.

Cautiously, one could generalize conclusions to other African locations which share characteristics similar to the surveyed counties.

## Highlights from the RA-DS Survey

Table 1 reported household wealth and hunger incidence by county from the RA-DS. This section will focus on other highlights from the survey. Women dominated in group membership ranging from 63% in Makueni, 83% in Machakos and 84% in Kitui. Some 52 percent of households had access to irrigation water in Makueni and Machakos Counties, but only 45 percent in Kitui. Water was most commonly available from a stream or river. Mobile phone ownership ranged from 80% of households in Makueni to 92% and 96% in Kitui and Machakos. Cattle ownership ranged from 47% of households in Kitui to a high of 87% in Machakos. Eighty-three and 87 percent of households in Kitui and Machakos owned goats and 75% in Makueni. Bicycle ownership ranged from 33% in Kitui to 61% in Machakos. Few households owned motorcycles ranging from a low of 6% in Kitui to 9% in Machakos. The inexpensive Chinese brand SkyGo was most popular. Sheet metal roofing was utilized by over 80% of households in all three Counties; brick walls for houses were favored by 70% or more throughout. Some 84, 77 and 72 percent of households grew crops for sale in Kitui, Makueni and Machakos, respectively.

## Derivation of Minimum Sample Sizes

Greater details on this derivation are found in the attached document, “Estimation of Minimum Sample Sizes for Kenya Baseline and End-of-Project Surveys Based on Data from the May-June 2014 Rapid Appraisal-Demographic Survey.”

Minimum sizes for the paired household samples in the BaseB Survey and EOP-IS were based on empirical sample means and standard deviations of household wealth and proportion of hungry households from the RA-DS. Our computations show moderate total minimum sample sizes of 186 to 261 paired households in the BaseB Survey and EOP-IS to detect a statistically significant change in hunger at  $\alpha = 0.05$  and 0.10, respectively. These correspond to minimum sample sizes *per finance scheme* of 62 to 87, respectively. Because the required total sample sizes for detecting changes in hunger exceed the required sample sizes of 81 to 132 at  $\alpha=0.05$  and 0.10 for detecting wealth growth, the larger total sample sizes of 186 to 261 for hunger dominate.

These minimum sample sizes were substantially below the project’s 600 budgeted paired BaseB Survey and EOP-IS household interviews. This is good news because it will permit greater

precision in the research conclusions with above-minimum sample sizes. Furthermore, it may liberate funds for interviewing a control group that did not take up pumps. The control survey will occur during the EOP-IS. In conclusion, we propose interviewing a sample of paired households in the BaseB Survey and EOP-IS that exceeds the minimums reported above, but are below the 600 budgeted in order to conserve funds for a control group at EOP-IS. *Specifically we recommend sampling 300 total paired households in the BaseB Survey and EOP-IS (100 per finance scheme) and an additional 100 in the control group in the EOP-IS.*

## Summary and Conclusions

The Rapid Appraisal Demographic Survey provides information and guidance for both the marketing program and for the upcoming Baseline Buyers (BaseB) Survey and End of Project Impact Survey (EOP-IS). Results from the RA-DS and the process introduced to generate those results included hiring, training, logistics, identification of groups, clustering, randomization of clusters and treatments, analysis of results and reporting.

This document and the supporting material, accessible in the Dropbox, prepare the KSI Marketing Team for their upcoming campaign. In addition, the materials presented here meet requirements, perhaps surpass the requirements, for meeting Milestone No. 1 agreed to in the Terms of Reference for the Research Team.

An excellent Team participated in generating reliable and important information for guiding the Research Team and the Marketing Team in their upcoming work. This was a learning experience for all involved with a plethora of different learning experiences that kept the Team interested, motivated and ready to go to work later in the year if the Team members are available. At that time, those who return will be taking leading roles in managing the data collection improving their capabilities and generating supervisory experiences.

Derivation of minimum sample sizes for Treatments provided the Team with a realistic set of expectation based on recent primary and secondary information. These findings are encouraging in that they suggest our budget may allow the Research Team a small comfort zone within which to work.

The utilization of existing, free services such as Google Earth and Earth Point have allowed the generation of sound clusters which will be separated spatially and topographically. In addition, any upcoming needs for expansion of groups may now be made knowing there will be a very high probability of water availability.

Research results generated from the RA-DS have allowed descriptive statistics and correlations among variables to be generated for data generated during the enumeration. In addition, these

results provided opportunities for the initial development of wealth and health indices that may play an important role in the upcoming work of the Research Team.

Now the Research Team's attention will be turned toward Milestone 2 in preparation of materials and methods which will guarantee exceptional results, assuming that external factors do not intervene.

KickStart International and its superb staff provided all the support, guidance and insight that the Research Team could have hoped to receive.

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McNemar, Quinn (June 18, 1947). "Note on the sampling error of the difference between correlated proportions or percentages". *Psychometrika* 12 (2): 153–157. doi:10.1007/BF02295996. PMID 20254758.

Washington State University. 2013 and 2014. Research Proposal by WSU to KSI, 12/08/2013 and Application by WSU to NCOSTI to Do Research in Kenya, 3/25/2014).

Young, Douglas and Wu Di (July 30, 2014). "Estimation of Minimum Sample Sizes for Kenya Baseline and End-of-Project Surveys Based on Data from the May-June 2014 Rapid Appraisal-Demographic Survey" Unpublished Research Paper

## Appendices

\*Documents Listed Below are Located in Dropbox

Byers, T.E. (July, 2014) “Clustering Process and Randomization Procedures Document [CPRP]” Spreadsheet – Dropbox

Byers, T.E. and Douglas Young (May 2014). Rapid Appraisal - Demographic Survey Questionnaire” Final Questionnaire - Dropbox

Young, Douglas and Wu Di (July 30, 2014). “Estimation of Minimum Sample Sizes for Kenya Baseline and End-of-Project Surveys Based on Data from the May-June 2014 Rapid Appraisal-Demographic Survey” Unpublished Research Paper - Dropbox

Young, Douglas, Boris Houenou, Wu Di, T.E. Byers, Patrick Kirui, Andrew Wanyonyi, Teresiah Gitau, and Jennifer Mueni (July 2014). “Summary of Results of Rapid Appraisal - Demographic Survey for KSI/WSU Eastern Kenya Project”. Draft Report - Dropbox

## Appendix 2

### **Mobile Layaway and Rent-to-Own: Bringing an Innovative Savings Solution to the Rural Poor for Small-Scale Irrigation Pump Purchases**

## **Rapid Appraisal-Demographic Survey for KSI/WSU Eastern Kenya Project**

### **Summary of Results**

Doug Young, Boris Hounenou, Wu Di, Tom Byers,  
Patrick Kirui, Andrew Wanyonyi, Teresiah Gitau, and Jennifer Mueni

Young, Hounenou and Wu Di are Professor and Graduate Assistants, respectively, School of Economic Sciences, Washington State University; Byers is Associate Director North Africa and Asia Programs, International Research and Agricultural Development Unit, Washington State University; Kirui is KSI/WSU Enumeration Team Leader and Coordinator, Wanyonyi, Kitau, and Mueni are Enumeration Team Members<sup>1</sup>

1 August 2014

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<sup>1</sup> The authors are grateful for the invaluable assistance of John Kihia, KSI Project Coordinator and to selected KSI pump regional sales representatives for occasional assistance. We owe special gratitude to the 256 group leaders and their companions who patiently and forthrightly answered the questions in the survey. Without their cooperation, this survey would not have been possible.

## Project and Report Objectives<sup>2</sup>

The research project, “Mobile Layaway and Rent-to-Own: Bringing an Innovative Savings Solution to the Rural Poor for Small-Scale Irrigation Pump Purchases,” is sponsored by KickStart International (KSI) and implemented by Washington State University (WSU). The objectives of the project are:

*The WSU Research Team will undertake three survey activities: a) a Rapid Appraisal - Demographic Survey (RA-DS), b) a Baseline Survey (BaseS), and c) an End of Project Impact Survey (EOP-IS). Results from these surveys will make possible four major deliverables to meet KSI's principal objectives: (1) Results will statistically demonstrate how Mobile Layaway and Rent-to-Own financing schemes affect take-up of MoneyMaker irrigation technology in comparison with each other and to Cash sales. (2) Results will statistically show if the different financing schemes enable higher adoption among women, among poor households, and other groups. (3) Results will statistically reveal the effects of pump acquisition by different financing schemes on household livelihood indices, especially on women and poor households. (4) Our survey results and literature review will determine viability at scale of each financing mechanism and also how these mechanisms could break down barriers for asset acquisition for rural African farmers more generally.*

The RA-DS was completed during May-June 2014 in Kitui, Makueni and Machakos Counties in Eastern Kenya. The purposes of this survey were (a) to provide basic agricultural and socio-demographic information on farm households and (b) to identify groups of households for KSI's subsequent pump marketing campaign. It was essential that the RA-DS identify groups whose members had access to water for irrigation and could potentially use a pump. Groups who failed this criterion were eliminated. The RA-DS questioned group leaders about their members' gender, access to water, assets, risk of hunger, and dominant food and cash crops. Readers should keep in mind that the results in this report are second hand responses of leaders' knowledge about their member households. In contrast, samples of individual households who purchase KSI pumps will be interviewed in the BaseS and the EOP-IS. The objective of this report is to provide a detailed summary of the results of the RA-DS.

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<sup>2</sup> The sections, Project and Report Objectives, Kenya and Target Counties' Characteristics, and Population of Interest draw selectively upon our previous documents “Estimation of Minimum Sample Sizes for Kenya Baseline and End-of-Project Surveys Based on Data from the May-June 2014 Rapid Appraisal-Demographic Survey” and “August 1, 2014 Milestone for KSI/WSU Kenya Project.”

## **Survey Procedures**

KSI staff compiled lists of groups by county whose members practiced crop agriculture and who might have some interest in small scale irrigation.<sup>3</sup> These lists contained the name of the group, the name and mobile telephone number of a group leader or contact person. Byers and Young, the WSU principal investigators interviewed and selected the four BS graduate enumerators from a pool of eight and trained them. An English version of the final household information component of the questionnaire is included in the Appendix. Byers and Young had prepared a draft RA-DS questionnaire at WSU. KSI staff and the P.I.'s substantially improved and focused the questionnaire at KSI headquarters in Nairobi. The enumerators translated the questionnaire to Kiswahili.

The RA-DS field team included Byers, Young, John Kihia, lead KSI liaison for the project, and the four field enumerators. Other KSI Nairobi staff and regional pump sales representatives assisted as needed. Enumerators and KSI staff called group leaders or contacts at their mobile phones to establish general appointment times. Enumerators completed individual interviews in about 30 minutes. Locating group leaders often required more time than conducting the interview.

Byers and Young were present for the first two weeks of the field survey during which 79 interviews were completed. The P.I.'s and the enumerators held evening review sessions to discuss ways to improve survey procedures and to resolve uncertainty about some responses. Throughout the survey enumerators and P.I.'s proofed questionnaire responses and coded data for computer tabulation. The P.I.'s hand carried the initial 79 completed questionnaires to WSU and entered this data in the computer.

By the end of the first two weeks, the RA-DS the team had bonded into an efficient and collegial unit. The enumerators' demonstrated confidence in carrying on alone. The remaining 177 of the 256 total interviews were completed during June 2014 by the enumerators. These questionnaires were scanned at KSI headquarters and emailed to WSU for further proofing and computer tabulation.

KSI staff accompanied the enumerators and served as facilitators and vehicle drivers during the survey. Throughout May and June the team worked Monday through Friday and returned to Nairobi for weekends. Conditions in the field were occasionally challenging with very rough roads and lodging with variable amenities. Some members of the team suffered short term illnesses, but quickly recuperated. Lead- P.I. Byers and KSI Liaison Kihia provided excellent leadership and support for the team.

## **Follow-up Activities at WSU**

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<sup>3</sup> Treating sample means and standard deviations from the RA-DS as representative of the population assumes that these statistics came from a random sample. Technically the RA-DS came from a selected sample of groups conducting crop agriculture and with access to irrigation water; however, because the sampled groups represented a reasonable proportion of all groups in a county meeting these criteria, we assume they can be treated as a random sample of this set.

Subsequently, the WSU team placed the 256 groups interviewed in the RA-DS into 71 geographically proximate clusters and randomized three finance methods for pump acquisition over these clusters. This process is described in a separate document. Wu and Young derived minimum sample sizes for the BaseS and EOP-IS based on results of the RA-DS. This derivation is also described separately.

### Kenya and Target Counties' Characteristics

Kenya has potential in certain regions to increase cash and food crop production through irrigation (UN-FAO. Kenya Country Report, Annex 3, 2013). Arid areas in the Eastern Province, specifically in Machakos, Makueni, and Kitui Counties, which are targeted in this project, have benefitted relatively little from irrigation. As shown in Table 1, they also display high levels of poverty ranging from a high of 64.1% of the population in Makueni to 59.6% in Machakos (OpenDataKenya and World Bank). The population in Kitui is 86% rural, in Makueni 88%, and 48% in Machakos. Rural residents in all three counties grow maize, beans and other crops to feed their families. An overriding hypothesis of this research is that adoption of KSI's human-powered treadle pumps could improve family nutrition, income, and general wellbeing. Vendors for the pumps exist in Eastern Province, but inadequate financial resources to buy the pumps outright have been a major barrier to their adoption. This project will evaluate the effects on pump adoption and eventual household wellbeing of three finance methods for pump acquisition: (a) Layaway savings using mobile banking (*MPesa*), (b) Rent-To-Own following an initial down payment using mobile banking, and (c) immediate Cash Purchase. A literature review of 21 studies evaluating technology adoption and innovative financing schemes in developing countries by the WSU P.I.'s and graduate assistants revealed that mobile banking, pioneered by Kenya's *MPesa* program, had solid promise in a variety of environments (Houenou, Wu , Young and Byers, Washington State University, School of Economic Sciences, 2013).

Table 1 displays basic information regarding the target counties.

Table 1. Characteristics of Eastern Kenya Counties

County	Popula- tion, 2009	% Rural	% Poor	% Liter- ate	Est. No. Farm House- holds in County	No. Groups Inter- viewed in RA- DS	Farm House- holds Repre- sented, RA- DS	Sample Av. Asset Wealth (KSh), RA- DS	% Hun- gry House- holds, RA- DS
Kitui	1,012,709	86.2	63.5	74.8	130,943	61	1,271	21,648	70.1
Makueni	884,527	88.2	64.1	72.7	117,023	63	2,174	34,683	51.0
Machakos	1,098,584	48	59.6	69.7	79,098	132	4,400	34,699	46.5

Sources: **Populations** from <http://www.scribd.com/doc/36672705/Kenya-Census-2009>  
% **Rural** from [https://www.opendata.go.ke/Counties/County-Urbanization-\[County Name\]/747f-z33c](https://www.opendata.go.ke/Counties/County-Urbanization-[County Name]/747f-z33c)

% **Poor** from OpenDataKenya (<https://kenya.socrata.com/Poverty-Rate-byDistrict/i5bp-z9aq/>) World Bank (<http://data.worldbank.org/country/Kenya/>)

% **Literate** from USAIDKenya

([http://usaid.gov/sites/default/files/profiles/Kitui\\_Dec2011%2034.pdf](http://usaid.gov/sites/default/files/profiles/Kitui_Dec2011%2034.pdf))

<https://www.opendata.go.ke/Counties/County-Urbanization-Kitui/747f-z33c>

**Est. No. Farm Households in County** computed as [(Population) x (Proportion Rural) x (0.9)] / (6 people per household)

**Groups Interviewed in RA-DS; Farm Households Represented, RA-DS; Sample Av. Asset Wealth, RA-DS; and % Hungry Households** from RA-DS results

Kitui is the most remote in terms of distance from Nairobi and also is the most arid. As expected, the May-June 2014 RA-DS showed that Kitui lagged Makueni and Machakos in terms of household wealth and displayed more hunger incidence (Table 1). Maize and beans are the most important staple food crops in all three counties. Cash crops-- including cotton, coffee, and fruit--are found in favorable agro-climatic niches, especially in Makueni and Machakos Counties. Farmers keep cattle, goats and donkeys in all three counties. Machakos County is adjacent to Nairobi and offers residents greater opportunities for seasonal off-farm employment.

Dividing “Farm Households Represented, RA-DS” by “Est. No. Farm Households in County” from Table 1 permits computing sampling intensities. These are 1.0, 2.2 and 5.6 percent, respectively, for Kitui, Makueni, and Machakos. Machakos has a higher sampling intensity because KSI listed a larger number of groups in this county whose members practiced crop agriculture and who might have some interest in small scale irrigation. Correspondingly, KSI listed a smaller number of groups in Makueni and Kitui. Also, telephone calls to listed Kitui groups revealed that some had no access to irrigation water.

### **Population of Interest**

The conclusions of the BaseS and EOP-IS will apply to the estimated number of farm households in each County (see Table 1). These include 130,943, 117,023, and 79,098 farm households in Kitui, Makueni and Machakos Counties, respectively. With an average six persons per household, the conclusions will apply to about two million people in the three Counties. Cautiously, one could generalize conclusions to other African locations which share characteristics similar to the surveyed counties.

### **Descriptive Statistics for Numerical Data**

Tables 2.a and 2.b list descriptive statistics for the numerical answers group leaders supplied for the questions in the Appendix questionnaire. These data have limited usefulness for comparisons across counties because absolute numerical responses are

difficult to interpret without knowing the number of member households in each county. Subsequent tables will report results as proportions. Proportions are dimensionless units which may be directly compared across counties.

Attention is initially directed to the sample sizes by county in the last rows of Tables 2.a and 2.b. For every variable, these sample sizes sum to 256, the number of groups surveyed. This means there were no missing data for any variable in the survey. Enumerators and group leaders should be complimented for persevering until an answer was supplied to every question.

First we briefly define the 13 descriptive statistics in these tables. Mathematical definitions may be found in elementary statistics texts and on the Internet. The **mean** is the simple average value of the variable. The **standard error of the mean** (s.e.) can be used to construct a confidence interval around the sample mean. For larger samples, the population mean will lie within  $\pm 1.96$  (s.e.) of the sample mean 95% of the time. For example, the 95% confidence level of the average number of Kitui households with access to irrigation water is 7.40 to 11.28. The standard error may also be used to conduct hypothesis tests. One can clearly reject the null hypothesis that the population mean of Kitui households with access to water is zero because the 95% confidence interval does not include zero.

One half of the observations lie below the **median** and one half lie above the median. The **mode** is the value of the variable which occurs with the greatest frequency. The mean, median, and mode are the same in normal (bell-shaped) distributions; however, empirical distributions like those for the variables in Tables 2.a and 2.b are often not strictly normal. Readers may verify this by observing occasional dispersion among the means, medians and modes listed in the tables for a given variable in a county.

The **standard deviation** displays the average absolute deviations of data values about the sample mean. Technically it is the square root of the variance of the data. In popular





language, the **variance** measures the average of the squared deviations around the sample mean.

A more “peaked” probability distribution (or histogram) exhibits higher **kurtosis**. Our definition uses “population excess kurtosis” <http://office.microsoft.com/en-gb/excel/kurt-HP005209150.aspx> or <http://en.wikipedia.org/wiki/Kurtosis>. **Skewness** measures the symmetry of the probability distribution or histogram. Symmetric probability distributions like the normal have zero skewness. Distributions that contain a some observations much higher than the mean are positively skewed and vice versa. Most of the empirical distributions for the variables in Tables 2.a and 2.b are truncated at zero because negative units of member households, female members, cattle, bicycles, etc. are not feasible. Consequently, negative skewness would not be expected and none appear in Tables 2.a and 2.b. The strong positive skewness of many variables suggests many of the probability distributions may not be normal. Formal tests are available to test for significant departures from normality.

The **minimum (maximum)** reports the lowest (highest) value of the variable in the sample. The **range** is the difference between the maximum and minimum values. The **sum** reports the sum of all the variable values in the sample. The **sample size** was discussed above.

## **Discussion of Proportions and Wealth Results**

Table 3 reports that about half the households have access to water for irrigation with a low of 45% in Kitui to about 52% in both Makueni and Machakos. There was substantial variation in group leaders’ reports of water access as shown by the high standard deviations of proportions of 0.50 in all three counties. Some 23 to 32 percent of member households obtained irrigation water from rivers or streams, by far the most common source. Considerably fewer obtained irrigation water from sand dams, earthen dams, or shallow wells (Table 3). Some 8, 14, and 23 percent of households in Kitui, Makueni and Machakos, respectively, possessed access to adequate irrigation water on their farm. However, the survey team’s perception of background conversations suggested the group leaders might have misunderstood this question by failing to distinguish between water for general household use versus water for irrigation.

Other than housing, which was fairly standard in quality, the most common assets owned by the surveyed households were motorcycles, bicycles, mobile phones, cattle and goats. Motorcycle ownership ranged from 6% in Kitui to 9% in Machakos (see Table 4). The dominant model was the Chinese Skygo with an average value of KSh 82,500. Bicycle ownership followed the same trend across counties varying from 33% in Kitui to 61% in Machakos. Over 90% of households in Kitui and Machakos owned mobile phones and 80% in Makueni. Household cattle ownership paralleled the county patterns for motorcycles Table 3. Proportions of groups and standard deviations of proportions pertaining to irrigation water by Eastern Kenya County

County	Proportions (Standard deviation of proportions)					
	Access to Irrig. Water	Access to Adequate Irrig. Water on Farm	Irrig. Water from Sand Dam	Irrig. Water from Earthen Dam	Irrig. Water from Shallow Well	Irrig. Water from River/Stream
Kitui	0.45 (0.50)	0.08 (0.27)	0.03 (0.16)	0.06 (0.25)	0.06 (0.24)	0.32 (0.47)
Makueni	0.53 (0.50)	0.14 (0.35)	0.04 (0.20)	0.06 (0.23)	0.08 (0.27)	0.23 (0.42)
Machakos	0.52 (0.50)	0.23 (0.42)	0.05 (0.22)	0.13 (0.33)	0.06 (0.24)	0.29 (0.45)

Table 4. Proportions and standard deviations of proportions of households owning different assets by eastern Kenya County

County	Proportions (Standard deviation of proportions)				
	Motorcycles	Bicycles	Mobilephones	Cattle	Goats
Kitui	0.06 (0.23)	0.33 (0.47)	0.92 (0.27)	0.47 (0.50)	0.84 (0.47)
Makueni	0.08 (0.27)	0.43 (0.49)	0.80 (0.40)	0.60 (0.49)	0.75 (0.43)
Machakos	0.09 (0.28)	0.61 (0.49)	0.96 (0.20)	0.80 (0.40)	0.8862 (0.32)

and bicycles ranging from 47% in Kitui, 60% in Makueni and 80% in Machakos. The respective numbers for goat ownership were 84% in Kitui, 75% in Makueni, and 89% in Machakos. Goats are especially suitable for arid Kitui due to heavy growth of thorny shrubs and trees. Average numbers of livestock per household are not reported in this summary report, but are available upon request.

Sample mean household wealth was reported in Table 1. Table 5 provides more descriptive statistics for wealth and shows considerable inequality over households within a county. For example, in Machakos the poorest household possessed only KSh 882 (US\$11) in the enumerated assets while the wealthiest owned KSh 109,297 (US\$1,312) in motorcycles, bicycles, cattle and goats. During May 2014 1 KSh = US\$ 0.012.

Table 5. Household asset wealth (KSh) by Eastern Kenya County

County	Sample statistics							
	Mean	Median	Mode	Minimum	Maximum	Standard Deviation	Standard error of mean	Kurtosis
Kitui	21,648	21,956	5,000.00	1,818	65,779	12,083	1,547	1.74
Makueni	34,683	30,815	N/A	6,140	95,815	18,794	2,368	1.16
Machakos	38,117	34,563	41,500.00	882	109,297	20,907	1,820	2.01

Note: Wealth is measured as:

*Asset – Based Wealth Index of Group j = AW<sub>j</sub> =  $\sum_{i=1}^4 \pi_{ji} v_i \bar{n}_{ji}$ , where i = 1 = Motorcycle, 2 = Bicycle, 3 = Cattle, and 4 = Goats;*

$$\begin{aligned} \pi_{ji} &= \text{Proportion of the group members with asset } i = \frac{n_{ji}}{N_j} \\ &= \frac{\text{Number of members in group with asset } i}{\text{Total number of member in group } j}; \end{aligned}$$

$\bar{n}_{ji}$  = Average number of unites of asset i per member of group j;

$v_i$  = Value of one unit of asset i in average condition.      Motor Cycle (Chinese Skygo)  
= KSh 82,500; Bicycle = KSh 3,750;

Cattle of average age and gender owned = KSh 8,500; Goats of average age and gender owned = KSh 2,500.

*Note: Asset values were obtained from ten group leaders randomly chosen from three counties during May 2014 by D. Young and were relatively consistent.*

As reported in Table 6, women are heavily represented in group membership with a high of 82% in Kitui. About 83% of members attend 50% or more of group meetings in Kitui and Machakos. It is somewhat surprising that more households, 84%, grew crops for sale in Kitui because it is less favored for crop production than the other two counties. A possible hypothesis explaining this result is that Kitui residents possess fewer opportunities for off-farm employment. Consequently they are forced to sell some crop and livestock products to pay for school expenses and other necessities. As previously noted in Table 1, some 71% of Kitui households must skip meals sometime in the year whereas only about half do so in Makueni and Machakos. There was considerable variation in responses across group leaders within a county for the data in Table 6 as evidenced by the relatively high standard deviations of proportions.

Table 6. Proportions of females, of members who regularly attend meetings and of households who must skip meals during the year, standard deviations of proportions in parentheses

County	Proportions (Standard deviation of proportions)			
	Females	Reg. attend meetings	Grow crops for sale	Must skip meals
Kitui	0.82 (0.39)	0.84 (0.36)	0.84 (0.37)	0.71 (0.46)
Makueni	0.63 (0.48)	0.66 (0.47)	0.77 (0.42)	0.51 (0.50)
Machakos	0.74 (0.44)	0.83 (0.38)	0.72 (0.45)	0.46 (0.50)

Not surprisingly, residents of Machakos with greater wealth and more favorable agro-climatic resources had higher housing standards with more metal roofing and more concrete, stone or block walls (Table 7). The poorer Kitui households had relatively more traditional mud wattle walls and thatched roofs, but most had better quality roofs and walls.

Table 7. Proportions and standard deviations of proportions of households with different housing characteristics by Eastern Kenya County

County	Proportions (Standard deviation of proportions)				
	Metal Roofing	Thatch Roofing	Mud Walls	Concrete, Stone or Block Walls	Brick Walls
Kitui	0.88 (0.33)	0.12 (0.33)	0.23 (0.42)	0.01 (0.09)	0.75 (0.43)
Makueni	0.80 (0.40)	0.03 (0.17)	0.11 (0.31)	0.01 (0.09)	0.72 (0.45)
Machakos	0.92 (0.27)	0.07 (0.25)	0.03 (0.18)	0.26 (0.44)	0.70 (0.46)

### Discussion of Pairwise Correlations of Numerical Variables

Tables 8a, 8b and 8c display the pairwise correlations ( $r_{ij}$ ) among the 21 variables featured in this summary. Correlations are compared across counties. The correlation coefficient  $r_{ij}$  ranges from -1.00 to +1.00. A -1.00 correlation characterizes opposite patterns of movement, when variable  $i$

is up variable j is down. In contrast,  $r_{ij} = 1.00$  means that variables i and j move in tandem. For  $r_{ij} = 0$ , variables i and j vary in a random manner. The main diagonal in Tables 8a, 8b, and 8c is necessarily equal to 1.00 because every variable is perfectly correlated with itself.

Some relatively high positive correlations are somewhat consistent across counties and are intuitively plausible. For example, a positive correlation for ownership of different assets is plausible because wealthier households can afford all assets. Other correlations lack consistency across counties and may be spurious artifacts of the data involving often unrelated variables. Readers may explore the correlations in Tables 8a, 8b and 8c if they desire, but our conclusion is that they do not merit a great deal of attention. No attempt was made to test hypotheses regarding whether particular correlation coefficients differed significantly from 1.00, 0.00, or -1.00 of from each other. At later stages of the research, we will provide multivariate regression results of important dependent variables like wealth and hunger incidence on selected relevant independent variables. These analyses will hopefully yield more useful conclusions.

Table 8.a. Pair-wise correlations among variables by eastern Kenya County

	County	No. of Group Members	No. of Group Members Who Regularly Attend >=50%	No. of Members = Female	No. With Access to Irrigation Water	Irrig. Water from Sand Dam	Irrig. Water from Earthen Dam	Irrig. Water from Shallow Well	Irrig. Water from River/Stream	No. with Adequate Water Resource on their Farm	No. of Member Households Owning a Motorcycle	No. of Member Households Owning a Bicycle	No. of Member Households Owning a Mobile Phone	No. Member Households Who Grow Crops for Sale	No. of Member Households Who Own Cattle	No. of Member Households Who Own Goats	No. Member Households with Iron Sheet Roofing	No. Member Households with Thatch Roofs	No. Member Households with Mud Wall Houses	No. Member Households with Concrete, Stone or Block Wall Houses	No. Member Households with Brick Wall Houses	No. Member Households Who Must Reduce Meals during the Year	
No. of Group Members	Kitui	1.00																					
	Makueni	1.00																					
	Machakos	1.00																					
No. of Group Members - Regularly Attend >=50%	Kitui	0.85	1.00																				
	Makueni	0.88	1.00																				
	Machakos	0.97	1.00																				
No. of Members = Female	Kitui	0.46	0.37	1.00																			
	Makueni	0.97	0.87	1.00																			
	Machakos	0.93	0.89	1.00																			
No. With Access to Irrigation Water	Kitui	0.00	0.11	0.06	1.00																		
	Makueni	0.76	0.85	0.74	1.00																		
	Machakos	0.92	0.96	0.81	1.00																		
Irrig. Water from Sand Dam	Kitui	0.07	0.05	0.02	0.24	1.00																	
	Makueni	0.07	0.16	0.01	0.28	1.00																	
	Machakos	0.86	0.90	0.67	0.90	1.00																	
Errig. Water from Earthen Dam	Kitui	0.03	0.10	0.13	0.18	-0.06	1.00																
	Makueni	-0.04	0.04	0.02	0.08	-0.07	1.00																
	Machakos	0.02	-0.01	-0.01	0.10	-0.05	1.00																
Irrig. water from Shallow Well	Kitui	-0.03	0.02	0.06	0.32	0.01	-0.11	1.00															
	Makueni	0.08	-0.03	0.08	0.00	-0.10	-0.15	1.00															
	Machakos	-0.03	-0.03	-0.02	0.02	0.00	-0.05	1.00															

Table 8.b. Pair-wise correlations among variables by eastern Kenya County

	County	No. of Group Members	No. of Group Members Who Regularly Attend >=50% Meetings	No. of Members = Female	No. With Access to Irrigation Water	Irrig. Water from Sand Dam	Irrig. Water from Earthen Dam	Irrig. Water from Shallow Well	Irrig. Water from River/Stream	No. with Adequate Water Resource on their Farm	No. of Member Households Owning a Motorcycle	No. of Member Households Owning a Bicycle	No. of Member Households Owning a Mobile Phone	No. Member Households Who Grow Crops for Sale	No. of Member Households Who Own Cattle	No. of Member Households Who Own Goats	No. Member Households with Iron Sheet Roofing	No. Member Households with Thatch Roofs	No. Member Households with Mud Wall Houses	No. Member Households with Concrete, Stone or Block Wall Houses	No. Member Households with Brick Wall Houses	No. Member Households Who Must Reduce Meals during the Year	
Irrig. Water from River/Stream	Kitui	-0.09	-0.04	-0.11	0.68	-0.16	-0.02	-0.07	1.00														
	Makueni	0.00	0.02	0.00	0.26	0.09	-0.13	-0.20	1.00														
	Machakos	0.89	0.94	0.83	0.96	0.83	-0.10	-0.08	1.00														
No. With Adequate Irrig. Water On Their Farm	Kitui	-0.05	0.04	-0.12	0.30	-0.01	0.34	0.01	0.34	1.00													
	Makueni	0.24	0.48	0.18	0.61	0.45	-0.13	0.08	0.06	1.00													
	Machakos	0.73	0.77	0.76	0.80	0.55	-0.02	-0.04	0.86	1.00													
No. of member households owning motorcycle	Kitui	0.42	0.38	0.00	0.00	0.10	0.14	0.10	-0.08	0.11	1.00												
	Makueni	0.83	0.60	0.82	0.52	-0.02	-0.09	0.39	-0.12	0.12	1.00												
	Machakos	0.82	0.82	0.73	0.79	0.78	-0.10	0.08	0.77	0.66	1.00												
No. of Member Households Owning a Bicycle	Kitui	0.31	0.41	0.03	0.10	0.41	0.10	-0.11	0.04	0.15	0.49	1.00											
	Makueni	0.72	0.51	0.74	0.34	-0.09	-0.11	0.39	-0.16	-0.05	0.88	1.00											
	Machakos	0.95	0.95	0.86	0.91	0.86	-0.06	-0.01	0.90	0.75	0.85	1.00											
No. of Member Households Owning a Mobile	Kitui	0.93	0.76	0.41	-0.01	0.11	0.09	-0.05	-0.14	0.00	0.48	0.33	1.00										
	Makueni	0.79	0.84	0.81	0.78	0.20	-0.02	0.27	0.08	0.46	0.77	0.67	1.00										
	Machakos	1.00	0.98	0.92	0.93	0.87	0.02	-0.04	0.91	0.74	0.81	0.95	1.00										
Member Households Who Grow Crops for Sale	Kitui	0.57	0.50	0.10	0.07	0.08	-0.19	0.07	0.00	0.07	0.39	0.34	0.56	1.00									
	Makueni	0.68	0.82	0.69	0.73	0.13	0.01	-0.04	0.17	0.51	0.43	0.30	0.72	1.00									
	Machakos	0.94	0.96	0.83	0.96	0.87	0.05	-0.01	0.93	0.76	0.80	0.92	0.94	1.00									
No. of Member Households Who Own Cattle	Kitui	0.57	0.67	0.16	-0.08	0.13	0.04	0.07	-0.16	0.03	0.53	0.48	0.52	0.46	1.00								
	Makueni	0.80	0.79	0.83	0.61	0.00	-0.04	0.25	0.07	0.22	0.79	0.73	0.84	0.61	1.00								
	Machakos	0.98	0.96	0.90	0.91	0.87	-0.06	-0.03	0.91	0.75	0.81	0.95	0.98	0.92	1.00								
No. of Member Households Who Own Goats	Kitui	0.93	0.79	0.26	0.02	0.16	-0.04	0.00	-0.08	0.01	0.43	0.31	0.87	0.56	0.57	1.00							
	Makueni	0.78	0.82	0.81	0.70	-0.03	-0.03	0.31	-0.01	0.34	0.79	0.72	0.92	0.66	0.91	1.00							
	Machakos	0.99	0.97	0.92	0.90	0.87	-0.07	-0.03	0.90	0.73	0.82	0.96	0.98	0.93	0.99	1.00							

Table 8.c Pair-wise correlations among variables by eastern Kenya County

	County	No. of Group Members	No. of Group Members Who Regularly Attend >=50% Meetings	No. of Members = Female	No. With Access to Irrigation Water	Irrig. Water from Sand Dam	Irrig. Water from Earthen Dam	Irrig. Water from Shallow Well	Irrig. Water from River/Stream	No. with Ade-quate Water Resource on their Farm	No. of Member House-holds Owning a Motor-cycle	No. of Membe Households Owning a Bicycle	No. of Member House-holds Owning a Mobile Phone	No. of Member House-holds Who Grow Crops for Own Cattle	No. of House-holds Who Own Goats	No. Member House-holds with Iron Sheet Roofing	No. Member House-holds with Thatch Roofs	No. Member House-holds with Mud Wall Houses	No. Member House-holds with Concrete, Stone or Block Wall Houses	No. Member House-holds with Brick Wall Houses	No. Member House-holds Who Must Reduce Meals during the Year	
No. Member Holds with Iron Sheet Roofing	Kitui	0.81	0.77	0.29	-0.09	0.07	0.01	-0.01	-0.21	0.04	0.50	0.33	0.80	0.54	0.60	0.84	1.00					
	Makueni	0.83	0.82	0.85	0.74	0.19	-0.06	0.28	0.14	0.40	0.83	0.71	0.97	0.72	0.87	0.90	1.00					
	Machakos	0.98	0.98	0.91	0.95	0.87	0.03	-0.02	0.92	0.75	0.80	0.94	0.99	0.95	0.97	0.97	1.00					
No. Member Households With Thatch Roofs	Kitui	0.35	0.17	0.29	0.15	0.01	0.03	-0.04	0.19	-0.14	-0.11	-0.01	0.25	0.07	-0.01	0.18	-0.26	1.00				
	Makueni	0.11	0.24	0.13	0.25	0.15	-0.04	0.10	-0.13	0.31	0.11	0.09	0.25	0.15	0.16	0.33	0.19	1.00				
	Machakos	0.16	0.02	0.19	-0.08	0.00	-0.08	-0.09	-0.07	-0.06	0.12	0.16	0.12	-0.02	0.14	0.15	0.00	1.00				
No. Member Households with Mud Wall Houses	Kitui	0.38	0.25	0.22	0.29	-0.05	-0.07	0.05	0.24	0.11	-0.23	0.00	0.31	0.14	0.02	0.33	0.01	0.62	1.00			
	Makueni	0.02	0.08	0.03	0.16	0.07	-0.06	-0.01	0.25	0.09	-0.09	-0.11	0.07	0.19	-0.03	0.03	0.07	0.32	1.00			
	Machakos	0.14	0.02	0.16	-0.07	0.01	-0.08	-0.10	-0.07	-0.06	0.16	0.16	0.10	-0.04	0.12	0.15	0.00	0.82	1.00			
No. Members With Concrete, Stone or Block Wall Houses	Kitui	0.03	0.03	0.02	-0.24	-0.04	-0.02	-0.07	-0.18	-0.10	0.24	0.18	0.08	0.09	0.25	0.04	0.09	-0.09	-0.13	1.00		
	Makueni	0.65	0.49	0.67	0.36	-0.08	-0.07	0.29	-0.13	-0.03	0.74	0.74	0.58	0.32	0.66	0.61	0.63	0.18	0.02	1.00		
	Machakos	0.75	0.74	0.73	0.70	0.68	-0.03	0.09	0.67	0.59	0.68	0.76	0.74	0.68	0.75	0.76	0.74	0.12	0.12	1.00		
No. Member Households with Brick Wall Houses	Kitui	0.69	0.61	0.28	-0.16	0.12	0.08	-0.04	-0.22	-0.11	0.60	0.28	0.68	0.43	0.53	0.66	0.77	-0.10	-0.34	0.05	1.00	
	Makueni	0.80	0.79	0.81	0.69	0.19	-0.04	0.28	0.04	0.41	0.82	0.71	0.94	0.66	0.86	0.89	0.96	0.20	-0.17	0.60	1.00	
	Machakos	0.95	0.94	0.86	0.89	0.83	0.05	-0.07	0.87	0.68	0.73	0.88	0.96	0.92	0.92	0.93	0.95	0.07	0.03	0.52	1.00	
No. Member Households who Must Reduce Meals During the Year	Kitui	0.80	0.60	0.32	-0.05	0.02	0.03	-0.25	-0.03	-0.03	0.22	0.16	0.74	0.43	0.36	0.69	0.60	0.36	0.43	0.04	0.44	1.00
	Makueni	0.39	0.30	0.47	0.27	-0.04	0.13	0.30	0.25	-0.14	0.52	0.57	0.55	0.23	0.59	0.57	0.60	0.15	0.16	0.50	0.53	1.00
	Machakos	0.30	0.19	0.46	0.13	-0.06	0.26	0.00	0.13	0.24	0.08	0.19	0.28	0.13	0.23	0.25	0.24	0.43	0.38	0.09	0.30	1.00

## **Conclusions**

Many of the results in this paper displayed a similar pattern driven by rising wealth and precipitation from Kitui, to Makueni, to Machakos. For example wealth and hunger reduction was highest in Machakos and lowest in Kitui. Asset ownership followed the same pattern as did housing standards. Makueni was quite close to Machakos in most measures, but Kitui was a distant third.

A welcome result is that most households had access to irrigation water. Rivers and streams dominated as a water source.

As expected, women were more heavily represented in groups than men. Women's strong leadership role and enthusiasm for self-help activities were evident to the authors during the survey.

## References

Byers, Tom. July 2014. Group clustering reports.

UN-FAO. 2013. Kenya Country Report.

Wu Di and Doug Young. July 2014. Estimation of minimum sample sizes for Kenya baseline and end-of-project surveys based on data from the May-June 2014 rapid appraisal-demographic survey. International Research and Agricultural Development, Washington State University.

Byers, Tom, Doug Young, Wu Di and Boris Houenou. July 2014. August 1, 2014 Milestone for KSI/WSU Kenya Project. International Research and Agricultural Development, Washington State University.

## APPENDIX: SUMMARY OF RA-DS QUESTIONNAIRE<sup>4</sup>

1. County: (1. Machakos, 2. Makueni, 3. Kitui) 1 2 3
2. Area Name: \_\_\_\_\_
3. Confirm Group Name: \_\_\_\_\_
4. Name of Sub-Chief/Chief, if available, for location: \_\_\_\_\_
5. Total number of group members: \_\_\_\_\_ No. members
6. How many of your members regularly attend meetings? \_\_\_\_\_ No. members
7. How many members of your group are women? \_\_\_\_\_ No. members
8. How many members of your group are men? \_\_\_\_\_ No. members
9. How many of your members have an adequate water resource they can access to irrigate land? \_\_\_\_\_ No. members
10. Where does this water resource originate:
- a sand dam reservoir? \_\_\_\_\_ No. members
  - an earthen dam reservoir? \_\_\_\_\_ No. members
  - a shallow well of 3 meters depth or less? \_\_\_\_\_ No. members
  - a river/stream? \_\_\_\_\_ No. members
11. How many of your members have an adequate water resource on their farm to irrigate land? \_\_\_\_\_ No. members
12. Considering only those member households who have potential to irrigate land, what is the smallest area (\_\_\_\_\_ acres), the largest area (\_\_\_\_\_ acres) and what is the average area?(\_\_\_\_\_ acres) farmed?
13. How many of your household members:
- own a motorcycle? \_\_\_\_\_ No. HH
  - own a bicycle? \_\_\_\_\_ No. HH
  - own a mobile phone? \_\_\_\_\_ No. HH
14. How many of your members grow cash crops for sale? \_\_\_\_\_ No. members

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<sup>4</sup> This summary questionnaire omits an introduction concerning the survey purposes, solicitation of the group leader's consent to be interviewed (100% consented), latitude and longitude of the interview site from a GPS reading, and a map indicating the location of most group members relative to the interview site.

**15. What are these cash crops? (Please List)**

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_
6. \_\_\_\_\_
7. \_\_\_\_\_
8. \_\_\_\_\_

**16. How many of your members own cattle? \_\_\_\_\_ No. members**

**Own goats? \_\_\_\_\_ No. members**

**17. On average how many cattle per household? \_\_\_\_\_ No. Cattle**

**On average how many goats per household? \_\_\_\_\_ No. Goats**

**18. How many of your members' homes have iron sheet roofing? \_\_\_\_\_ No. members**

**19. How many of your members' houses have grass thatched roofing? \_\_\_\_\_ No. members**

**20. How many of your members' have mud walls? \_\_\_\_\_ No. members**

**21. How many of your members' have concrete, stone or blocks walls? \_\_\_\_\_ No. members**

**22. How many of your members' have brick walls? \_\_\_\_\_ No. members**

**23. How many members of your group must reduce the number of meals in their household anytime during the year?**

\_\_\_\_\_ No. members

## Appendix 3

**Mobile Layaway and Rent-to-Own:**  
**Bringing an Innovative Savings Solution to the Rural**  
**Poor for Small-Scale Irrigation Pump Purchases**

**Estimation of Minimum Sample Sizes for Kenya  
Baseline and End-of-Project Surveys Based on Data  
from the May-June 2014 Rapid Appraisal-  
Demographic Survey<sup>1</sup>**

Wu Di and Doug Young, Graduate Assistant and Professor,  
School of Economic Sciences, Washington State University<sup>2</sup>

30 July 2014

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<sup>1</sup> This second edited version contains exactly the same sample size conclusions as the original version KSI received dated 16 July 2014. This version contains greater distinction between survey-wide total sample sizes and the equal sample allocations to finance treatment. An update on budgeted interviews is also included.

<sup>2</sup> The authors gratefully acknowledge useful review comments from Tom Byers.

## **Project Objectives and Statistical Methodology**

Statistical methodology must be designed in the context of the research objectives and procedures. These are stated as follows for the current study, “Mobile Layaway and Rent-to-Own: Bringing an Innovative Savings Solution to the Rural Poor for Small-Scale Irrigation Pump Purchases,” sponsored by KickStart International (KSI) and implemented by Washington State University (WSU):

*The WSU Research Team will undertake three survey activities: a) a Rapid Appraisal - Demographic Survey (RA-DS), b) a Baseline Survey (BaseS), and c) an End of Project Impact Survey (EOP-IS). Results from these surveys will make possible four major deliverables to meet KSI's principal objectives: (1) Results will statistically demonstrate how Mobile Layaway and Rent-to-Own financing schemes affect take-up of MoneyMaker irrigation technology in comparison with each other and to Cash sales. (2) Results will statistically show if the different financing schemes enable higher adoption among women, among poor households, and other groups. (3) Results will statistically reveal the effects of pump acquisition by different financing schemes on household livelihood indices, especially on women and poor households. (4) Our survey results and literature review will determine viability at scale of each financing mechanism and also how these mechanisms could break down barriers for asset acquisition for rural African farmers more generally (Research Proposal by WSU to KSI, 12/08/2013 and Application by WSU to NCOSTI to Do Research in Kenya, 3/25/2014).*

The RA-DS was completed during May-June 2014. The substantive results of that survey are summarized in a separate report, “Rapid Appraisal – Demographic Survey Process, Clustering and Sample Size Derivation”. Objective (4) relating to “break[ing] down barriers for asset acquisition for rural African farmers more generally” will require literature review to compare conditions in other African countries to the three eastern Kenya Counties in the current research. Consequently, the objective of this document is to compute minimum sample sizes for the BaseS and EOP-IS to satisfy research objectives.

### **County Characteristics**

Surveys will be completed for three target counties in eastern Kenya: Kitui, Makueni and Machakos. Table 1 displays basic information on these counties.

Table 1. Characteristics of Eastern Kenya Counties

County	Population, 2009	% Rural	% Poor	% Literate	Est. No. Farm Households in County	No. Groups Interviewed in RA-DS	Farm Households Represented, RA-DS	Sample Av. Asset Wealth (KSh), RA-DS	% Hungry Households, RA-DS
Kitui	1,012,709	86.2	63.5	74.8	130,943	61	3,644	21,648	70.1
Makueni	884,527	88.2	64.1	72.7	117,023	63	2,174	34,683	51.0
Machakos	1,098,584	48	59.6	69.7	79,098	131	1,059	34,699	46.5

Sources: **Populations** from <http://www.scribd.com/doc/36672705/Kenya-Census-2009>  
**% Rural** from [https://www.opendata.go.ke/Counties/County-Urbanization-\[County Name\]/747f-z33c](https://www.opendata.go.ke/Counties/County-Urbanization-[County Name]/747f-z33c)

**% Poor** from OpenDataKenya (<https://kenya.socrata.com/Poverty-Rate-byDistrict/i5bp-z9aq/>) World Bank (<http://data.worldbank.org/country/Kenya/>)

**% Literate** from USAID Kenya ([http://usaid.gov/sites/default/files/profiles/Kitui\\_Dec2011%2034.pdf](http://usaid.gov/sites/default/files/profiles/Kitui_Dec2011%2034.pdf))

<https://www.opendata.go.ke/Counties/County-Urbanization-Kitui/747f-z33c>

**Est. No. Farm Households in County** computed as [(Population) x (Proportion Rural) x (0.9)] / (6 people per household)

**Groups Interviewed in RA-DS; Farm Households Represented, RA-DS; Sample Av. Asset Wealth, RA-DS; and % Hungry Households** from RA-DS results

Readers may find concise county factsheets

at: [http://en.wikipedia.org/wiki/Kitui\\_County](http://en.wikipedia.org/wiki/Kitui_County),

[http://en.wikipedia.org/wiki/Machakos\\_County](http://en.wikipedia.org/wiki/Machakos_County), [http://en.wikipedia.org/wiki/Makueni\\_County](http://en.wikipedia.org/wiki/Makueni_County)

Kitui is the most remote in terms of distance from Nairobi and also is the most arid.

Tsavo National Park with elephant and other wildlife occupies most of the eastern portion of the County. Maize and beans are the most important staple food crops in all three counties. Cash crops--including cotton, coffee, and fruit--are found in favorable agro-climatic niches. Farmers keep cattle, goats and donkeys in all three counties. Machakos County is adjacent to Nairobi and offers residents greater opportunities for seasonal off-farm employment.

For greater detail, German Technical Cooperation-GTZ

(2007) <http://www2.gtz.de/dokumente/bib/07-1286.pdf> provides a wealth of information on agro-climatic resources, crops, and human population by district for all East Kenya Counties.

## Objectives of Three Surveys

### Rapid Appraisal-Demographic Survey (RA-DS)

The purpose of this survey was to identify groups of households for KSI's subsequent pump marketing campaign. It was essential that the RA-DS identify groups whose members had access to water for irrigation and could potentially use a pump. Groups who failed this criterion were eliminated. The RA-IS questioned group leaders about their members' gender, access to water, assets, risk of hunger, and dominant food and cash crops

### Baseline Buyers Survey (BaseS)

The purpose of this survey is to measure household well being and other household and farm characteristics by finance method shortly after sampled households have purchased a pump.

### End of Project Impact Survey (EOP-IS)

The purpose of this survey is to measure changes in household well being and other personal and farm characteristics by finance method after sampled households have used a pump for 15 to 18 months.

## Population of Interest

The conclusions of the BaseS and EOP-IS will apply to the estimated number of farm households in each County (see Table 1). These include 130,943, 117,023, and 79,098 farm households in Kitui, Makueni and Machakos Counties, respectively. With an average six persons per household, the conclusions will apply to about two million people in the three Counties. Cautiously, one could generalize conclusions to other African locations which share characteristics similar to the surveyed counties.

## Null and Alternative Hypotheses

(1) Null hypothesis for a *two-tailed* test:  $H_0: \mu^j_{2014} = \mu^j_{2016}$ , or equivalently,  $\mu^j_{2016} - \mu^j_{2014} = 0$ , where  $\mu^j_{\text{year}}$  is the population value of  $j$ 'th characteristic in the given year.

If we reject  $H_0$ , we can tentatively accept the alternative hypothesis<sup>1</sup>,  $H_a$ , that  $\mu^j_{2014} \neq \mu^j_{2016}$ .

(2) Null hypothesis for a *one-tailed* test:  $H_0: \mu^j_{2014} \geq \mu^j_{2016}$ , or equivalently,  $\mu^j_{2016} - \mu^j_{2014} < 0$

If we reject  $H_0$ , we accept the alternative hypothesis,  $H_a$ , that  $\mu^j_{2014} < \mu^j_{2016}$ , or equivalently,  $\mu^j_{2016} > \mu^j_{2014}$

If  $j$  denotes wealth of farmers in years 2016 and 2014,  $H_a$  implies there has been growth in wealth over the two years. We state each null hypothesis so that its rejection suggests the acceptance of the alternative hypothesis we are seeking to confirm.

### **RA-DS Sample Means and Standard Deviations for Wealth and Hunger**

As discussed earlier, one of the primary objectives of this study is to measure changes by finance method in household wellbeing including wealth, income, nutrition, health and school enrollment after families use the KSI treadle pumps for 15 to 18 months. This will be accomplished by interviewing a sample of households that have taken up pumps by one of three finance methods in a November 2014-January 2015 BaseS and interviewing a sample of the *same households* again 15-18 months later in the EOP-IS.

The RA-DS provided results on two important household well being measures, namely household wealth and the proportion of households who went hungry sometime during the year (see Table 2). Household wealth equaled the report of a group leader on group members' cattle, goats, bicycles and motorcycles at the time of the survey. Values of the assets were computed by multiplying values per unit times number of units. Reported asset values were consistent among a sample of informants. The hunger index equaled the report of a group leader on the number of member households that skipped meals sometime during the year. No data were collected in the RA-IS on school enrollment, income or general health, but we assume household wealth and hunger are sufficient to estimate minimum required sample sizes by finance treatment.

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<sup>1</sup>“Alternative hypothesis (in the statistical testing of a hypothesis) is the hypothesis to be accepted if the null hypothesis is rejected.”

Dictionary.com Unabridged, Based on the Random House Dictionary, © Random House, Inc. 2014.

<http://dictionary.reference.com/browse/alternative+hypothesis>

Also: “The alternative hypothesis is what we are attempting to demonstrate in an indirect way by the use of our hypothesis test. If the null hypothesis is rejected, then we accept the alternative hypothesis. .... Null hypothesis: ‘x is at most y’ Alternative hypothesis ‘x is greater than y’ ”

<http://statistics.about.com/od/Inferential-Statistics/a/The-Difference-Between-The-Null-Hypothesis-And-Alternative-Hypothesis.htm>

A key assumption of the sample size derivation is that household sample means and standard deviations for wealth and for proportion hungry will remain the same in the RA-DS and in the BaseS.<sup>2</sup> This is reasonable because farmers will have had little time to use the pumps and realize wealth or hunger changes between the May-June RA-DS and the Nov. 2014-Jan. 2015 BaseS. A strength of our approach is that it uses empirical data from the target counties. The data were proofed in the field and post-collection by the enumerators and the principal investigators. We judge the data to be relatively accurate.

Table 2. Sample Means and Standard Deviations for Household Wealth (KSh) and Proportion Hungry Households in 2014 from RA-DS

County	2014 Household Wealth Sample Mean from RA-DS	2014 Household Wealth Sample Standard Deviation from RA-DS	2014 Sample Proportion Hungry Households from RA-DS	2014 Sample Standard Deviation Proportion Hungry Households from RA-DS
Kitui	21,648	12,083	0.7057	0.4557
Makueni	34,683	18,794	0.5102	0.4999
Machakos	34,699	19,372	0.4654	0.4988

As expected, Makueni and Machakos enjoy higher household wealth and lower proportions of hungry households than Kitui. The former counties have more favorable agro-climatic endowments, especially precipitation. Their greater proximity to Nairobi provides greater opportunity for seasonal off-farm employment than for remote Kitui.

The sample standard deviations for proportion hungry households is relatively high compared to the sample proportion because all three Counties contained many groups with 0% or 100% hungry households.

### **Dependent t-test for paired samples: deriving minimum sample size for progress in household wealth**

Statistical theory shows that greater cost and statistical effectiveness is achieved when the *same* observations are interviewed before and after some treatment. The appropriate test when units of

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<sup>2</sup>Substituting means and standard deviations from the RA-DS as random variables assumes that they came from a random sample. Technically the RA-DS came from a selected sample of groups conducting crop agriculture and with access to irrigation water; however, because the sampled groups represented a substantial proportion of all groups in a county meeting these criteria, we assume it can be treated as a random sample of the set.

observation are *tested twice*, once in the BaseS and again in the EOP-IS, is the “dependent t-test for paired samples” described in equation (3) ([http://en.wikipedia.org/wiki/Student's\\_t-test](http://en.wikipedia.org/wiki/Student's_t-test) ; Rice, 2006; Zimmerman, 1997).

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(3)  $t = \frac{\bar{u}_{1j} - \bar{u}_{0j}}{s_D / \sqrt{n}}$  where 0 and 1 denote the survey and j denotes the finance method

$\bar{u}_{1j} - \bar{u}_{0j}$  is the sample mean difference between the BaseS wealth ( $\bar{u}_{0j}$ ) and EOP-IS wealth ( $\bar{u}_{1j}$ ) across households,  $s_D$  is the sample standard deviation of the *differences* in wealth across individuals.  $n$  equals the identical sample size of the BaseS and EOP-IS. We assume that BaseS sample mean wealth for all finance treatments can be represented by May-June 2014 RA-DS sample mean wealth (see Table 2). This is reasonable because households will have had very little time to use the pumps and experience changes in wealth between the two surveys. The program for marketing/advertising the pumps will occur primarily in August-October 2014 and it will take households time to decide whether and how to purchase a pump before using it.

Of course the differences in wealth and other variables between the BaseS and EOP-IS by household are unknown. Some reasonable assumptions are necessary to proceed. We *assume* that by EOP-IS,  $u_{1j} = 1.25u_{0j} + \varepsilon$ , where  $\varepsilon \sim N(0, \sigma^2)$ . In other words we assume a 25% increase in wealth *on average* between the two surveys. Readers should note that this assumed average 25% wealth increase is utilized only to derive minimum sample sizes. The *actual* average wealthy increase will be determined by data from the surveys.

From basic statistical theory,

$$(4) s_D = \sqrt{\frac{\sum(u_{1j} - u_{0j})^2}{n - 1}} = \sqrt{\frac{n \sum(u_{1j} - u_{0j})^2}{(n - 1)n}} = \sqrt{\frac{n}{(n - 1)} \text{Var}(u_{1j} - u_{0j})}$$

$$(5) \text{Var}(u_{1j} - u_{0j}) = \text{Var}(1.25u_{0j} + \varepsilon - u_{0j}) = \text{Var}(0.25u_{0j} + \varepsilon) = \text{Var}(0.25u_{0j}) + \text{Var}(\varepsilon) + 2\text{Cov}(0.25u_{0j}, \varepsilon)$$

Because we assume  $\varepsilon \sim N(0, \sigma^2)$ ,  $\varepsilon$  is independent of  $u_{0j}$ , or  $\text{Cov}(0.25u_{0j}, \varepsilon) = 0$ , which implies

$$(6) \text{Var}(u_{1j} - u_{0j}) = \text{Var}(0.25u_{0j}) + \text{Var}(\varepsilon) = (0.25)^2 \text{Var}(u_{0j}) + \text{Var}(\varepsilon)$$

Since the detailed data about  $u_{1j}$  is unknown, we assume  $\text{Var}(\varepsilon) = \text{Var}(u_{0j})$ . This implies

$$(7) \begin{aligned} \text{Var}(u_{1j} - u_{0j}) &= (0.25)^2 \text{Var}(u_{0j}) + \text{Var}(\varepsilon) \\ &= (0.25)^2 \text{Var}(u_{0j}) + \text{Var}(u_{0j}) \\ &= 1.0625 \text{Var}(u_{0j}) \end{aligned}$$

$$(8) s_D = \sqrt{\frac{1.0625n}{(n-1)} \text{Var}(u_{0j})} = 1.03s_{u_{0j}}$$

As an example,  $s_{u_{0j}}$  for wealth in Kitui County from the RA – DS is KSh12,083 (see Table 2). For purposes of minimum sample size determination, we assume this equality holds for all j.

We reject the null hypothesis when t from (3) is greater than the critical value. The degrees of freedom for the t-statistic is (n-1). There were 131 RA-DS household interviews in Machakos, 63 in Makueni, and 61 in Kitui, which provides critical values for our one-tailed tests:

$$t_{0.05,60} = 1.671 \text{ and } t_{0.10,60} = 1.296 \text{ for Kitui}$$

$$t_{0.05,62} = 1.670 \text{ and } t_{0.10,62} = 1.295 \text{ for Makueni,}$$

$$t_{0.05,130} = 1.655 \text{ and } t_{0.10,130} = 1.287 \text{ for Machakos}$$

To reject the null hypothesis of no progress between BaseS and EOP-IS, we need for alpha = 0.05:

$$(9) t > t_{0.05} \rightarrow n > \left(\frac{t_{0.05} s_D}{\bar{u}_{1j} - \bar{u}_{0j}}\right)^2 = \left(\frac{t_{0.05} * 1.03s_{u_0}}{\bar{u}_{1j} - \bar{u}_{0j}}\right)^2$$

For  $\alpha = 0.10$ , we need:

$$(10) t > t_{0.10} \rightarrow n > \left(\frac{t_{0.10} s_D}{\bar{u}_{1j} - \bar{u}_{0j}}\right)^2 = \left(\frac{t_{0.10} * 1.03s_{u_0}}{\bar{u}_{1j} - \bar{u}_{0j}}\right)^2$$

Solving for n from (9) and (10) generates the minimum required sample sizes by finance method listed in Table 3. These minimum sample sizes will permit detecting improvements in wealth.

Table 3. Minimum Required Sample Sizes of Paired Households within a Finance Method for BaseS and EOP-IS, Based on Household Wealth, One-tailed test.

County	Minimum sample sizes n when $\alpha = 0.05$	Minimum sample sizes when when $\alpha = 0.10$
Kitui	15	9
Makueni	14	9
Machakos	15	9

Because the sample sizes represent three finance methods and three counties, the identical BaseS and EOP-IS total sample sizes equal  $3(15 + 14 + 15) = 132$  for  $\alpha = 0.05$ , and correspondingly 81 for  $\alpha = 0.10$ . These correspond to minimum sample sizes of 44 and 27, respectively, per finance method. These are reasonably low sample sizes for detecting progress in household wealth within a finance method. Of course, paired t-tests could also compare changes in wealth across financing methods.

**McNemar’s Test for Paired Proportions: Deriving minimum sample size to show change in proportion of hungry households from BaseS to EOP-IS**

McNemar’s test is appropriate for comparing changes in paired proportions ([http://en.wikipedia.org/wiki/McNemar's\\_test](http://en.wikipedia.org/wiki/McNemar's_test); McNemar, 1947; Zimmerman, 1997). Application of this test requires some assumptions regarding percentage reduction in hunger over the 18 months separating the BaseS and EOP-IS. The test also requires information on changes in hunger status of individual households. As in the case of wealth, we assume a 25% improvement (reduction) in hunger status by 2016. This assumption is made only to determine minimum sample size. Actual improvement will be revealed by the surveys. We also assume that no household who is *not* suffering from hunger in 2014 will suffer hunger in 2016 after the adoption of pumps. This is reasonable because we expect the pumps will improve and not harm food consumption. As in the case of wealth, we assume that the sample proportion hungry households at BaseS for all finance methods can be represented by the measured sample proportion in the RA-DA (see Table 2).

Let  $p_{0j}$  represent the population proportion of hunger in County X in 2014 for finance method  $j$  and  $p_{1j}$  a fixed target proportion for 2016 in County X.  $\hat{p}_{0j}$  is the *sample* proportion of hunger in County X in 2014 and  $\hat{p}_{1j}$  is a fixed target hunger for 2016 in County X.

Table 4. Contingency Table Required for Application of McNemar’s Test

Item	2016 number of households suffering hunger	2016 number of households not suffering hunger	Row total
2014 number of households suffering hunger	$\hat{p}_{1j} * n$	$(\hat{p}_{0j} - \hat{p}_{1j}) * n$	$\hat{p}_{0j} * n$
2014 number of households not suffering hunger	0	$(1 - \hat{p}_{0j}) * n$	$(1 - \hat{p}_{0j}) * n$
Column total	$\hat{p}_{1j} * n$	$(1 - \hat{p}_{1j}) * n$	$n$

Source: [http://en.wikipedia.org/wiki/McNemar's\\_test](http://en.wikipedia.org/wiki/McNemar's_test)

The null hypothesis is that the adoption of Moneymaker Pumps have no impact on the propensity of suffering hunger within a finance method. Consequently the alternative hypothesis is that the adoption of Moneymaker Pumps changes the propensity of suffering hunger.

$$(11) \chi_m^2 = \frac{[(\hat{p}_{0j} - \hat{p}_{1j}) * n]^2}{(\hat{p}_{0j} - \hat{p}_{1j}) * n} = (\hat{p}_{0j} - \hat{p}_{1j}) * n$$

To reject our null hypothesis, our test statistic  $\chi_m^2$  needs to be greater than critical values  $\chi_{1,\alpha}^2$ , where  $\chi_{1,\alpha}^2$  is the value at significance level  $\alpha$  with 1 degree of freedom. Namely,

$$(12) \chi_m^2 > \chi_{1,\alpha}^2 \rightarrow (\hat{p}_{0j} - \hat{p}_{1j}) * n > \chi_{1,\alpha}^2$$

$$\rightarrow n > \frac{\chi_{1,\alpha}^2}{\hat{p}_{0j} - \hat{p}_{1j}}$$

From the chi-square distribution table,  $\chi_{1,0.05}^2 = 3.841$  and  $\chi_{1,0.10}^2 = 2.706$ . Solving for n generates the minimum sample sizes by finance method displayed in Table 5.

Table 5. Minimum Identical Sample Sizes for BaseS and EOP-IS to Show Change in Hunger within a Finance Method by County and Alpha Level

County ( $\hat{p}_{0j} - \hat{p}_{1j}$ )	Minimum sample size for $\alpha = 0.05$	Minimum sample size for $\alpha = 0.10$
Kitui (0.1764)	22	16
Makueni(0.1275)	31	22
Machakos(0.1163)	34	24

Because the sample sizes represent three finance methods and three counties, the total BaseS and EOP-IS sample equals  $3(22 + 31 + 34) = 261$  for  $\alpha = 0.05$ , and correspondingly 186 for  $\alpha = 0.10$ . These correspond to target minimum sample sizes of 87 and 62, respectively, per finance method. These are affordable sample sizes as discussed later for detecting progress in hunger reduction within a finance method. Of course McNemar's test could also compare changes in hunger *across* financing methods.

Our computations show moderate total sample sizes of 186 to 261 paired households in the BaseS and EOP-IS to detect a statistically significant change in hunger. Because the required sample sizes for detecting changes in hunger exceed the required sample sizes of 81 to 132 for detecting wealth growth, the larger sample sizes of 186 to 261 for hunger will dominate.

The minimum sample sizes derived above are substantially below the 600 budgeted BaseS and EOP-IS household interviews. This is good news because it will permit greater precision in the

research conclusions with above-minimum sample sizes. Furthermore, it may liberate funds for interviewing a control group that did not take up pumps. The control survey will occur during the EOP-IS. Adding a control will enhance the publishability of results and improve KSI's probability of achieving funding for future pump distribution and research.

As a caution, the minimum sample sizes derived above only detect significant differences by finance method in two household well being indices, namely wealth and hunger reduction. Other indices sought in objective (3) such as educational enrollment, general health and income might require larger sample sizes. Also, as discussed in the next section, detecting significant differences in measured related to objectives (1) and (2) of the research might require larger sample sizes than those reported above.

### **Sample Size Requirements for Objectives (1) and (2)**

The preceding sections computed minimum sample sizes for objective (3) of the research, specifically: "Results will statistically reveal the effects of pump acquisition by different financing schemes on household livelihood indices....." Because empirical data were available for household wealth and hunger from the RA-DS, we computed minimum sample sizes to detect improvement in these two livelihood indices.

Objectives (1) and (2) promise: "(1) Results will statistically demonstrate how Mobile Layaway and Rent-to-Own financing schemes affect take-up of MoneyMaker irrigation technology in comparison with each other and to Cash sales. (2) Results will statistically show if the different financing schemes enable higher adoption among women, among poor households, and other groups."

Comparable computation of minimum sample sizes for objective (1) based on empirical sample proportions and standard deviations of purchase by Mobile Layaway and Rent-to-Own are not feasible because neither KSI nor any other organization have measured take up of Money Maker pumps by Mobile Layaway and Rent-to-Own. Previous reports by IFPRI and KSI's in-house reports included only cash sales.

In conclusion, we propose interviewing a sample of paired households in the BaseS and EOP-IS that exceeds the minimums reported above, but are below the 600 budgeted in order to conserve funds for a control group at EOP-IS. *Specifically we recommend sampling 300 paired households in the BaseS and EOP-IS and an additional 100 in the control group in the EOP-IS.* We will target sampling 100 households for each of the three finance treatments in the BaseS and EOP-IS. Observe that our proposed sample size of 300 exceeds the dominant sample size for detecting hunger differences which equaled 261 paired households at  $\alpha = 0.05$ .

We will statistically compare differences in take-up by finance scheme and report p-levels for statistical differences. The take-up proportion for a given finance scheme will be computed as  $n_j/N_j$  where  $n_j$  equals the number of households purchasing a pump by finance scheme  $j$  and  $N_j$

equals the number of households who are in the marketing/advertising clusters for finance method j. Because this is a proportion, McNemar's test will be used.

For objective (3) regarding how different financing schemes enable higher adoption among women and among poor households, we will divide the BaseS sample for each finance method into subsamples of households dominated by women, by men, by a mix of women and men, by poor households and wealthier households. We will calculate  $n_{ij}/N_{ij}$ , where i denotes gender-wealth status and j finance method. Because these are proportions, we will use McNemar's test to compare whether finance method significantly increases take up by women-dominated households and by poor households. We will report p-levels of the statistical conclusions.

### **Summary**

The objective of this document was to compute minimum paired sample sizes for the BaseS and EOP-IS to satisfy research objectives. In conclusion, we recommended sampling 300 paired households in the BaseS and EOP-IS with 100 allocated to each finance method. This is an affordable sample size compared to the maximum budgeted BaseS sample size of 600. We propose a sample of 100 in the supplemental control group at the EOP-IS.

These sample size recommendations assume that KSI will elicit 100 purchases within each of the finance schemes. Incentives are under consideration to ensure the targets are realized for all finance schemes. If these purchase targets are not achieved, the WSU team will still be able to conduct paired t-tests and paired McNemar's tests with lower sample sizes; however, the p-levels of such tests will be lower. Whether the p-levels are satisfactory will be subject to the judgement of users. If purchases by one or more finance schemes are substantially below 100 households, another option would be to attempt to identify more groups and market pumps to these new groups. These decisions should await the sales outcomes.

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**KickStart – Washington State University (WSU) Research Study**  
**Milestone 6: Report on Training & Marketing of Farmers**

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*Mobile Layaway and R2O: Bringing an Innovative Savings Solution to the Rural Poor for Small-Scale Irrigation Pump Purchases*

1 December 2014

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## 1. Promotion and Training of Groups

Training of the groups started at the beginning of August to the 98 groups. These 98 groups had been sampled for the study from the initial set of 256 groups and assigned treatment. The Sales Staff had been trained on the content of each training visit and by treatments (see Milestone 4). Of the 98 groups, 33 were on cash only, 45 were on a combination of cash and mobile lay away while 20 were on Cash and Rent to Own.

Some groups were too large to be trained as a single group and had to be divided into smaller groups. This raised the number of “groups” to 109. The groups were then divided among the Sales Officers such that that Sales Officers were each responsible for 10 to 15 groups based on the cluster areas. The treatments were also distributed among staff where possible. In 2 cases, the staff person only had 2 treatments since that was group distribution within their area of operations

Groups were then contacted and visits were scheduled based on the days that they meet to enhance attendance. Progress and group dynamics were observed along the visits and across the treatments as time progressed. At the time of writing this report, three visits had been made to the groups.

## 2. First groups visits

The first visit provided KickStart with the first opportunity to meet with the entire group membership. This allowed for greater understanding of the group’s dynamics and the actual characteristics of the members including their resources and how they share it.

The expectations from the farmers were high after the rapid appraisal where they were promised the possibilities of future visits. Some farmers thought that the pumps would be provided for free and as a result, attendance was high for a project whose benefits were still not clear to the recipients.

The main challenges encountered during the first meeting were:

- Lack of water for irrigation: During the Random Sample survey when KickStart met with the group leadership, those in attendance who did not understand that the question about water meant water for irrigation and there are those who thought that when they say that they have water, some free pumps will be forthcoming. 16 groups did not have adequate sources of water that could support irrigated farming

- Groups aware of the other financial service: 6 groups had members who know of the existence of the other financial product on offer either having met a KickStart staff who introduced it to them or through family links. KickStart had to explain to these groups that only a particular financial service was available for the group
- Uncooperative groups: This affected 3 groups. These were mainly groups who felt that they would be willing to participate in the study only if the pumps were free. The members did not cooperate with the KickStart Sales Officer and thus the groups had to be dropped from the study.
- Elderly members: 1 group was found to have been comprised of members who are too old to productively participate in the study.

Another challenge during the first visits was that the Eastern Area of Kenya was impacted by a major drought. As a result, cash became difficult to obtain and farmers focused more on the Lay-Away financial service because it required less cash commitment and they would not have a legal requirement to make the next payment after 30 days if they did not have the money.

During the first round of visits the following was achieved:

- 2 customers bought pumps on cash
- 13 registered for Lay Away financial service
- 0 registered for the Rent-to-Own

### **3. Second group visits**

During the second group visit, the staff had better knowledge of the groups and their specific challenges, resulting in better handling and management of the groups. However, overall attendance was down and the members who attended were the committed ones. Those who were hard hit by both drought and lack of cash did not attend. Around the same time, relief agencies started providing free food and other forms of livelihood support. CARITAS and World Vision purchase the MoneyMaker pumps and provided the pumps for free to some group members who were in the study groups in Kitui and Makueni Counties. A large number of water pans and wells dried up and available water was mainly for domestic and livestock use. The drought and the relief agencies impacted the study significantly especially on the Cash and Rent-to-Own treatment groups. Some members of the groups had to leave and go seek alternative means of livelihood while others just did not come to the meetings. Every effort was made to get them to attend the meetings especially through the support of the group leadership. The Lay Away treatment groups fared better when compared to the other treatment groups.

At the end of the second visits, the results were:

- 3 customers bought pumps for cash making a total of 5
- 11 customer registered for Lay away service making a total of 24
- 1 customer registered for rent to own. Total was 1

#### **4. Third group visits**

The challenges that affected the groups during the second visits persisted into the third round of visits. The third visit was in the month of October/November which is the time when school children sat for the grade 8 and form 4 examinations. Children who had not completed payment of their school fees needed to complete the payment before they could sit for the examinations. This need for school fees compounded the challenges the farmers in the study faced. Water scarcity was more severe but farmers were optimistic for the rains to start soon and started to remove soil from their water pans for additional space for rain water harvesting. The relief agencies were more active and more people were attending their meetings. The basic needs of life were the main priorities for members of the group.

The committed members of the groups did attend the meetings and they were very enthusiastic and hopeful. Again we found that the Lay Away service was more popular as people looked at it as an investment and a way to manage the risk of unsteady cash flow. The Cash and Rent-to-Own treatments were not attractive options. Farmers realized that it did not make sense to buy a product that they did not need at the time or to pay a deposit and then pay rent for what they could not use immediately when cash availability is a major problem. Farmers also complained that since the March/April 2014 rains did not do well, the only money they had received from farming during the year was from their October/November 2013 rains.

During the third visit, the following results were realized.

- 2 customers bought pumps on Cash service bring the total to 7
- 50 registered for the Lay away service bring the total to 74
- 1 registered for the Rent to own, bring the total to 2

#### **5. Moving forward**

##### *Opportunities*

- Lay Away has taken up well given the current drought conditions
- The rains have just started and the water pans are finally filling up.

- Farmers are excited by the rains after several months of drought. The rains may provide an opportunity for Cash and Rent-to-Own financial services to pick up.
- The Relief agencies' process of giving out pumps for free may slow down.

### *Challenges*

- Money is very limited due to the prolonged drought. January is also when school fees need to be paid and the members most likely prioritize paying school fees over investing in our pumps.
- Attention to the traditional rain fed crops may slow down uptake of the irrigated crops.

### *Next Steps*

- The drought has slowed down the progress of the study. The research team may increase the project area to the neighboring areas in order to reach greater numbers needed for a more reliable study results.
- The research team is also considering a 4<sup>th</sup> visit to further promote the Cash and Rent-to-Own products during this rainy season.

## 2. Social impacts of the intervention

KickStart focused on developing a suitable Rent-to-Own (R2O) product. A number of different payment and ownership models were tested and after 6 months of trials it was apparent that: (1) farmers were not interested in jointly owning a pump – individual ownership was their clear preference [We should advise Agriworks]; and (2) the repayment period had to be long enough to enable farmers to use the profits generated from the sale of their produce to repay the loan.

During this phase, the primary social impact has been in terms of familiarizing farmers with a repayment model based on mobile phone and M-PESA technology, a method that many farmers were reluctant to adopt as they questioned the security of their money. Similarly, at the outset, KickStart's dealers were also apprehensive as this method meant that they would not be paid directly in cash by the farmers [Does anyone have advice for our Support Team led by Sarah?]. Further reluctance on the part of farmers to take advantage of the Mobile Layaway and R2O payment mechanisms became apparent when farmers failed to enroll in the scheme during the first round of registration as they believed they would receive free pumps during the Random Appraisal Demographic study [Potential Energy cook stoves also reports that freebies distort the market.].

## 3. Implementation lessons

Key lessons learned during this phase of the study included: (1) the failure by many farmers to remit their payments in a timely manner, forced KickStart to develop a system of weekly reminder calls, an initiative which has significantly improved repayment rates [Solar Sisters dropped payment terms due to poor payment history and difficulty in collecting.]; (2) numerous enquiries from farmers prompted KickStart to establish two dedicated customer help lines for the R2O and Mobile Layaway facilities; (3) ring-fencing the various treatment groups in order to minimize the sharing of information between farmers proved extremely challenging and a number of groups had to be dropped as they insisted on receiving a different financing option from the one they had been offered; (4) continued suspicion amongst farmers as to the safety of making payments through M-PESA resulted in many individuals paying cash directly to KickStart's sales staff, who were then burdened with the task of depositing these funds with M-PESA; and (5) some difficulties were encountered in terms of convincing the "Cash Only" groups to participate in the research study as they felt they had little to benefit from taking part – since the pumps were not being distributed free of charge, they argued they could simply purchase one from a dealer without the need to participate in the impact study.

Furthermore, farmer group officials proved unsupportive with regards to following up on members' payments, thereby necessitating that KickStart pursue payments directly through numerous phone calls.

The Mobile Layaway scheme is proving to be an ideal investment method amongst extremely poor, risk averse farmers, who lack the confidence to assume debt through the R2O mechanism.



**KickStart – Washington State University (WSU) Research Study**  
**Milestone 7: Mid-term assessment report**

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*Mobile Layaway and R2O: Bringing an Innovative Savings Solution to the Rural  
Poor for Small-Scale Irrigation Pump Purchases*

28<sup>th</sup> February 2015

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## **1. Buyer baseline survey results**

As previously mentioned in our Milestone 6 report, due to severe drought conditions from early September to mid-November 2014 in the project area, the marketing phase was extended through to the end of December 2014. Consequently, KickStart has been forced to re-schedule the start of the baseline survey to March 2015. This exercise will be completed by mid-May 2015 and the results will be included in the Milestone 8 report.

## **2. Social impacts of the intervention**

Immediately after the launch of this project in July 2013, KickStart focused on developing a suitable Rent-to-Own (R2O) product. A number of different payment and ownership models were tested and after 6 months of trials it was apparent that: (1) farmers were not interested in jointly owning a pump – individual ownership was their clear preference; and (2) the repayment period had to be long enough to enable farmers to use the profits generated from the sale of their produce to repay the loan.

During this phase, the primary social impact has been in terms of familiarizing farmers with a repayment model based on mobile phone and M-PESA technology, a method that many farmers were reluctant to adopt as they questioned the security of their money. Similarly, at the outset, KickStart's dealers were also apprehensive as this method meant that they would not be paid directly in cash by the farmers. Further reluctance on the part of farmers to take advantage of the Mobile Layaway and R2O payment mechanisms became apparent when farmers failed to enroll in the scheme during the first round of registration as they believed they would receive free pumps during the Random Appraisal Demographic study.

Due to the prevailing drought conditions, farmers continued to show greater interest in the Mobile Layaway savings option, on account of the fact that they lacked sufficient money either to make a full cash payment or a substantial down payment on the R2O facility. Importantly, women farmers showed a clear preference for investing gradually in the pumps through the Mobile Layaway option (70% as opposed to 51.5% and 28% sales to women through R2O and cash respectively – please see section 6 below for further details). Since completing their savings program and acquiring the pumps, the economic and social status of these women has significantly improved, enabling them to pay school fees, adequately feed their families and participate to a much greater extent in the decision-making processes within their households and communities.

### **3. Implementation lessons**

Key lessons learned during this phase of the study included: (1) the failure by many farmers to remit their payments in a timely manner, forced KickStart to develop a system of weekly reminder calls, an initiative which has significantly improved repayment rates; (2) numerous enquiries from farmers prompted KickStart to establish two dedicated customer help lines for the R2O and Mobile Layaway facilities; (3) ring-fencing the various treatment groups in order to minimize the sharing of information between farmers proved extremely challenging and a number of groups had to be dropped as they insisted on receiving a different financing option from the one they had been offered; (4) continued suspicion amongst farmers as to the safety of making payments through M-PESA resulted in many individuals paying cash directly to KickStart’s sales staff, who were then burdened with the task of depositing these funds with M-PESA; and (5) some difficulties were encountered in terms of convincing the “Cash Only” groups to participate in the research study as they felt they had little to benefit from taking part – since the pumps were not being distributed free of charge, they argued they could simply purchase one from a dealer without the need to participate in the impact study.

### **4. Cost-effectiveness potential versus competing alternatives**

During the testing, piloting and marketing phases, KickStart, on two separate occasions, was forced to increase the price of the pumps sold through R2O (Hip pump: from 6,500 Kenya Shillings to 7,550 Kenya Shillings/ Max pump: from 13,200 Kenya Shillings to 14,760 Kenya Shillings), in order to offset additional logistical and administrative costs. Originally, it was anticipated that during the first round of registration at least one or two farmers within a group would decide to purchase. However, it soon became apparent that farmers would take considerably longer to reach a decision, requiring a series of marketing visits resulting in higher costs. Furthermore, farmer group officials proved unsupportive with regards to following up on members’ payments, thereby necessitating that KickStart pursue payments directly through numerous phone calls. Despite the price increase, farmers have remained committed to the R2O scheme, demonstrating their appreciation of the value of this payment mechanism.

### **5. Scaling potential of the project**

There is enormous scope to scale-up this project, given the fact that the R2O and Mobile Layaway facilities are specifically designed to assist the poorest rural, smallholder farmers. Interestingly, KickStart has already received numerous expressions of interest from farmers outside of the study area concerning these payment options. The Mobile Layaway scheme is

proving to be an ideal investment method amongst extremely poor, risk averse farmers, who lack the confidence to assume debt through the R2O mechanism.

## **6. Number of direct/ indirect beneficiaries impacted by the project**

Pump sales and beneficiary numbers over the 19 month period July 2013 to January 2015 were as follows:

- Cash sales: 924 pumps sold to 665 men (72%) and 259 women (28%)
- R2O: 167 farmers registered, of whom 81 are men (48.5%) and 86 women (51.5%). Out of the total 167 farmers, 86 have already completed payment
- Mobile Layaway: 92 farmers registered, of whom 28 are men (30%) and **64 women (70%)**
- Number of groups visited during the Random Appraisal Demographic Survey: 256 with an average of 25 farmers per group (total 6,400 farmers)
- Number of farmers engaged during the marketing phase: 3,917
- Number of dealers selling pumps under this project: 9

## **7. Monitoring and evaluation activities and stakeholder feedback**

In addition to the research activities being undertaken by Washington State University, KickStart has developed a number of tools to track the progress of farmers who purchase our pumps, including registration and guarantee forms and an automated payment/ SMS database system.



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## **KickStart – Washington State University (WSU) Research Study Milestone 8: Training and Monitoring Results**

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*Mobile Layaway and R2O: Bringing an Innovative Savings Solution to the Rural  
Poor for Small-Scale Irrigation Pump Purchases*

**31 May 2015**

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## **1. Results of training and marketing activities for Rent-to-Own (R2O) and Mobile Layaway**

The training for both R2O and Mobile Layaway proceeded smoothly. These innovative financial services have attracted considerably more women than the cash treatment. To date, the following results have been achieved:

- 256 groups were targeted for training, all of whom were interviewed during the Rapid Appraisal Demographic Survey conducted in mid 2014
- 98 groups were sampled to participate in the intensive marketing phase of the project, which ran from July to December 2014. Different groups were assigned the cash only treatment, R2O and cash treatment and Mobile Layaway/cash treatment. A total of 3,917 individuals were reached during the training.

As a result of the training the following outputs were achieved as at the end of May 2015:

- Cash sales: 1,023 pumps were sold to 709 men (69%) and 265 women (26%). A further 49 pumps were sold to partner organizations
- R2O: 170 farmers were registered, of whom 84 were men (49%) and 86 were women (51%). Out of the total 170 farmers, 89 have completed payment and are using their pumps
- Mobile Layaway: 113 farmers were registered, of whom 43 were men (38%) and 70 were women (62%).

Following the approval by USAID-DIV in March 2015 to allow KickStart to roll out the Mobile Layaway program in other regions, a further 21 farmers were registered.

The Baseline Survey data collection process began at the end of March 2015 and was completed by May 15. A total of 262 farmers were interviewed out of the original target of 383.

## **2. Monitoring and evaluation activities and stakeholder feedback**

In order to facilitate effective monitoring and evaluation, a series of forms are being used, including: guarantee forms for cash sales, which are filled at the point of sale and delivered by the dealer to KickStart at the end of every month; as well as tailor-made registration forms for both Mobile Layaway and R2O. Since the registration fee and all other subsequent payments are sent to KickStart via Safaricom's M-PESA mobile phone platform, KickStart is able to track payments and remain in contact with each farmer. Furthermore, KickStart's field officers meet with farmers on a regular basis.

As of mid-May 2015, indicators were as follows:

### R20

Status	Number	%	Description
Registered	170	100%	Total registered since July 2013
Completed	89	52%	Fully paid for the pumps
On Track	39	23%	Payment within 30 days
Delinquent	15	9%	Payment between 31 and 60 days
Defaulted	21	12%	Payment period above 60 days
Cancelled	6	4%	Withdrawn from service and pumps collected

### Mobile Layaway

Status	Numbers	%	Description
Registered	113	100%	Total registered
Completed	18	16%	Fully paid and taken pumps home
Paying	95	84%	Have not completed paying

Feedback from farmers has included: they do not want to share pumps in a group as this makes payments more difficult; farmers are requesting the inclusion of agronomy training and the installation of rainwater harvesting technologies; farmers also find it difficult to save in a un-structured way – KickStart is therefore partnering with other agencies such as Hand-in-Hand and Caritas that assist farmers in carrying out table banking, enabling them to make monthly payments from weekly savings.



**KickStart – Washington State University (WSU) Research Study**  
**Milestone 9: Baseline Survey of Pump Buyers**  
**by Three Finance Options and of Non-Buyers:**  
**Process and Results Highlights**

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*Mobile Layaway and R2O: Bringing an Innovative Savings Solution to the Rural Poor for Small-Scale Irrigation Pump Purchases*

1 September 2015

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## **1. Buyer and Non-Buyer Baseline Survey Process and Results**

### Overview and Linkage to Other Research Activities

Following the process and results of a Rapid Appraisal Demographic Survey (RA-DS) implemented in March-June 2014 and the training and marketing activities conducted during the intensive marketing phase of the project from July-December 2014, this Milestone report will detail the implementation and results of the Baseline survey of buyers (BaseB) and of Baseline non-buyers (BaseN) of MoneyMaker irrigation pumps designed and sold by KickStart International (KSI). These surveys were implemented in March-June 2015 and data was analyzed from July-August 2015. A total of 262 farmers were interviewed out of the original target of 383.

As per the project's Revised Milestone Table, the Baseline survey results presented in this report were originally slated for inclusion in the Milestone 7 report, which explained that, at that point, they had not yet been completed due to severe drought conditions that warranted the extension of the marketing phase and pushed back all subsequent project activities.

Research during this phase addressed differences which may exist among three financing methods to purchase small scale irrigation systems; cash purchase (Cash), mobile layaway savings (TKT) and Rent to Own (R2O). An additional component addressed differences between pump buyers and non-buyers. During March-June 2015, Baseline surveys of pump buyers and non-buyers were implemented in three eastern Kenya counties: Machakos, Makueni and Kitui.

The RA-DS covered in the Milestone 5 report identified groups of farmers in the study area who had access to water for irrigation. During the RA-DS, group leaders were also questioned about their members' gender, assets, risk of hunger, dominant food and cash crops and other pertinent information.

Unlike the RA-DS which addressed farm group leaders, the March-June 2015 Baseline surveys questioned individual farm household heads who had either purchased a KSI pump by a specific financial scheme, were in the process of purchasing a pump (layaway) or who had not purchased a pump (non-buyers). The Baseline surveys contained much more detail about access to water, production of food/non-food crops and livestock, and household wellbeing indices. The latter included family health, nutrition, income, wealth and assets, and children's educational enrollment. General farm management information elicited use of credit, land allocation to different crops, irrigation intentions, revenues and costs of rainfed/irrigated crops, labor utilization, and exposure to agricultural education and remoteness from public services. The EOP-IS survey in early 2016 will interview the same people or households questioned in the BaselineB

and BaselineNB surveys. The questions in the Baseline and EOP-IS surveys will be identical. The primary objective of the EOP-IS will be to track impacts of up to 9 to 11 months of pump use, or through one production period, depending on time of access to equipment. The tracking of impacts on household health, nutrition, income, wealth and assets, and children's educational enrollment will be a primary focus. Such paired longitudinal impact comparisons are especially valuable in the development literature.

### Research Methodology and Field Activities

The WSU/KSI team had drafted the general plan for implementing the BaselineB Survey and the BaselineNB Survey, undertaken concurrently, when planning the implementation of this project. At the start of the Baseline survey process, KSI provided information on both cash (C) and R2O sales that occurred after the beginning of 2014 in the three counties of focus and the Research Team (RT) convened and translated the draft survey instruments. By March 3 this task was completed and field testing began on March 4, 2015.

Concurrently, the process for accessing Cash (C) and Rent to Own (R2O) buyers was under development and being readied for implementation. This turned out to be a time consuming and meticulously carried out process. The RT consulted with KSI to develop a list that contained only those individuals who, using cash had purchased pumps up to middle of the fourth quarter of calendar year 2014, in the three target Counties. In addition, the WSU/KSI team removed sales that had been made to organizations that eventually gifted the pumps to farmers.

At this stage, a logistics challenge was confronted. Unlike the buyers who used Mobile Layaway (TKT), who can be tracked through their mobile payments, there were no identified locations associated with C sales; only name and cell phone numbers were available for these buyers. The RT, with the agreement of KSI, built a foundation of geographical hub locations based on GPS readings for individual group meeting sites. These were the locations where the RA-DS identified groups met independently and were closer in proximity to the dwellings of the potential buyers than other options. The RT was able to work from the RA-DS identifiable hub areas to locate and access R2O and C buyers in a rational manner that reduced travel and associated logistical costs.

The team was able to accept these sales as part of our location-based and financial tool-based treatments since each of our three treatments (TKT or C, R2O or C, and C only) included a C purchase option. This created an opportunity to accept both C and R2O sales into our research even though they were not part of the original treatment clusters. In addition, using the geographical hubs the RT was able to draw from *non-buyers* within close proximity to the TKT participants.

The team then began enumeration of TKT clients, followed by C and R2O, in early March. At the beginning of each BaseB interview, the enumerator read:

*The questions we ask you today pertain to your recent decision to purchase a KickStart MoneyMaker small scale irrigation technology (SSI) pump. We would like to discuss with you some characteristics of your family, farming practices and beliefs. We expect that your utilization of the SSI pump will create opportunities for you and your family to produce more, at different times during the year and generate revenue from your efforts. We want to know how the pump will help you, your family and your community. The information collected today will be compared with information that you are willing to share with us 12 to 18 months from now, after you have had the opportunity to utilize irrigation technology for an extended period of time. This survey may take about one and one-half hours to finish. The work is being undertaken by Washington State University (WSU) from the United States of America and KickStart International (KSI) of Kenya with funds from the United States Agency for International Development.*

*My name is \_\_\_\_\_ (Enumerator Name). I work with WSU and KSI and am the person who will visit with you today. I am collecting information related to your recent purchase of Small Scale Irrigation (SSI) pump from KSI. The aim is to generate baseline information to see how use of the SSI affects your ability to provide for your family and improve its livelihood. You are one of the selected households to work with us on this project. We need your feedback to help us serve you better. Please answer all the questions openly. We would like to assure you that your individual responses will not be shared with anyone. If you have any questions about this interview, please ask and we will do our best to answer your questions.*

*Are you willing to participate in this interview? YES NO*

The introductory statement for the BaseN varied slightly, but the consent form was identical:

*The questions we ask you today pertain to your decision to not purchase a KickStart Money Maker pump. We would like to discuss with you some characteristics of your family, farming practices and beliefs. The information collected today will be compared with information that you are willing to share with us 12 to 18 months from now. This survey may take about one hour to finish. The work is being undertaken by Washington State University (WSU) from the United States of America and KickStart International (KSI) of Kenya with funds from the United States Agency for International Development.*

The survey activity continued until all willing participants had been interviewed by late May / early June for each of the three Counties. Data input and validation then began, with the RT working electronically with WSU to ensure the highest quality of work and eliminate any possible

errors or omissions. The team completed their work on the June 12 at which time all materials were released to the WSU Analysis Team who began their work by reviewing the data set.

During the Baseline surveys, the team located each respondent by their GPS coordinates. This will prove to be extremely helpful when the *same* Baseline respondents will be located and interviewed again during the EOP-IS after about 10 months of pump use.

Highlights of Baseline Surveys’ Results

While the detailed numerical results of the completed surveys are available upon request, this section will provide a narrative on the highlights of said results. These include: (1) Results will statistically demonstrate how TKT and R2O financing schemes affect take-up of KSI pumps in comparison with each other and to Cash sales. (2) Results will statistically show if the different financing schemes enable higher adoption among women, among poor households, and other groups. (3) Results will statistically reveal the effects of pump acquisition by different financing schemes [cash purchase, rent to own, and layaway savings] on household livelihood indices, especially on women and poor households. (4) Survey results and literature review will determine viability at scale of each financing mechanism and also how these mechanisms could break down barriers for asset acquisition for rural African farmers more generally.

***How do Mobile Layaway and Rent-to-Own financing schemes affect take-up of KSI pumps in comparison with each other and to Cash sales?***

KSI advertised pumps to different groups of farmers under three mutually exclusive financial options, or experimental treatments: (A) TKT or C, (B) R2O or C, and (C) C only. Observe that none of the treatments provided farm households a direct choice between TKT and R2O as in the “with each other” clause of this deliverable, but (A) and (B) provided a clear choice between one of the “innovative” finance options and cash. Table 3 shows the results dramatically favored TKT over C and modestly R2O over C. A Chi Square test that take up of an innovative finance option was equal to C was rejected at the .00000001 p-level!

**Observed choice between Layaway or Rent to Own versus Cash Purchase in Baseline Buyers Survey, Three Eastern Kenya Counties, March – June, 2015**

<b>Treatment Choice</b>	<b>Number Choosing Layaway or Rent to Own</b>	<b>Number Choosing Cash</b>	<b>Total</b>
Layaway or Cash	67	0	67
Rent to Own or Cash	68	59	127
Totals	135	59	194

Selected results from the Baseline surveys will be used to provide tentative explanation of the results in Table 1. The selected results are a subset of all questions in the BaseB questionnaire available in the Appendix. For interested readers, Appendix Table 1 reports seven descriptive statistics for 71 selected variables over the three finance options, and for all buyers and all non-buyers (WSU Staff, 2015a). The variables were selected because of their relevance to the deliverables.

At the outset two results merit highlighting from Appendix Tables 1 and 3. Relatively little land had been irrigated using the KSI pumps by the March-June 2015 Baseline survey. Specifically, 0.03, 0.34, and 0.41 average ac of food crops had been irrigated by farmers using pumps financed by the TKT, R2O and C options, respectively. Virtually no non-food land was irrigated. Furthermore, only 2.1% of TKT purchasers had used their pump to irrigate *any* land yet, but that 26.8% and 24.7 % of R2O and C purchasers had. Most TKT purchasers were still “laying away” savings and had not received their pump. For this reason, the WSU team has urged KSI to accelerate deliveries of pumps to TKT purchasers before the EOP-IS.

To highlight the gradual progress of irrigation with KSI pumps, TKT, R2O and C pump purchasers were producing 4.14, 3.24, and 4.25 average acres of *rainfed* food crops, respectively during the Baseline. Even R2O and C purchasers, who were more likely to have pumps in hand, were irrigating 10% or less of their total food crop land with a KSI pump. The WSU team expects growing use of the pumps across the TKT treatment groups as equipment becomes available by the EOP-IS; this emphasizes the importance of that survey.

### ***How do different financing schemes enable higher adoption among women, among poor households, and other groups?***

Chi Square tests revealed no significant relationship between gender and choice of innovative finance options versus C. The WSU team had initially hypothesized that women might favor TKT because of lower wealth; however, out of 59 C buyers, 27 were women and 32 were men. Among 135 R2O and TKT buyers, there were 80 women and 55 men. But the p-value for a significant gender relationship was only 0.23. Gender did yield a significant pattern when all buyers (TKT, R2O and C) were contrasted to all non-buyers. Forty-one percent of buyers were female, but 79% of non-buyers were female. These proportions differed at < 0.01 significance level. In another comparison, there was no statistically significant relationship between the choice of treadle pumps and the *less expensive hip pumps by gender*.

There was a highly significant preference for TKT and R2O among households in the bottom 50 percentile of wealth. Among 132 who chose these innovative finance options, 108 were in the

poorest half of households and 27 in the wealthiest half. Sample means indicate that buyers were wealthier, at the 0.01 significance level, than all non-buyers (Appendix Table 2). Buyers' average wealth from livestock, farm equipment, and household items equaled KSh 392, 471 versus KSh 175, 819 for non-buyers. Farming, not wages, contributed to buyers' superior wealth. Buyers earned gross revenue from rainfed food crops, their largest acreage, of KSh 30,647/yr versus only KSh 8,614/yr for non-buyers (p-level < 0.01). Off-farm earnings were statistically equal at KSh 116,102/yr for buyers and KSh 87,022/yr for non-buyers (p > 0.10).

Consistent with investment theory, households who had savings of at least Ksh 15,000, the minimum needed to buy a KSI pump and hoses, were more likely to be buyers (31% versus 16%). The hypothesis that proportions of buyers and non-buyers were equal in making this critical savings threshold was rejected at < 0.01 level.

WSU staff hypothesized that having lost collateral on previous loans might cause buyers to choose cash instead of R20 or TKT. There was no support for this hypothesis because of 194 buyers, only two had ever lost collateral on a loan, one each for Cash and for TKT or Layaway.

***Will pump acquisition and use by different financing schemes [cash purchase, rent to own, and layaway savings] statistically influence household livelihood indices, especially on women and poor household?***

Consequently the question in this deliverable will be addressed in WSU's final report following the EOP-IS. The BaseB and BaseN questionnaires in the Appendices list a large number of questions relating to household income, wealth, hunger, nutrition, sickness, domestic water quality, house quality and educational enrollment of children. These *identical* questions will be asked of the *same* households in the EOP-IS in January-February 2016 after eight to nine months of pump use. This interval includes the planting period associated with the *approximate* March-June "long rains" and October-November "short rains."

Repeating the BaseN after the same interval will check for whether some other variable than pump use might have accounted for changes in household livelihood indices. For example, if the EOP-IS showed equal wellbeing gains by the buyer and non-buyer samples, a confounding variable like better weather at EOP-IS versus the Baseline might be the explanation. This corresponds to the proverb, "A rising tide raises all ships." Scientific credibility demands measuring changes for a control group.

The BaseB and parallel EOP-IS questionnaire contain a large number of questions relating to seasonality of pump use, types of crops irrigated, type of water source. Responses to these

questions will be used to explain changes between the two surveys. The final report will also contain more interpretation on questions relating to women's empowerment in small-scale agriculture and relationship to economic and social benefits of pump use over time.

***Survey results and literature review will determine viability at scale of each financing mechanism and also how these mechanisms could break down barriers for asset acquisition for rural African farmers more generally.***

Comparisons of changes in income and other welfare metrics between the BaseB and corresponding EOP-IS by irrigated cropland acres and irrigated cropland gross revenue will shed light on viability of scale of each financing mechanism.

The authors consulted an extensive literature on agricultural technology adoption in other regions of Kenya and other African counties to attempt to ascertain how different financing mechanism could break down barriers to asset acquisition. Two of the three eastern Kenyan counties in this research were populated by dominantly rural households, all three possessed mainly poor households solely dependent on farming. On the positive side, from 70 to 75 percent of the counties' populations were literate. This shows the potential that farmers could understand to operate and care for new agricultural equipment like human-powered irrigation pumps. The authors believe the KSI-WSU research might be generalized to Kenya's Kwale and Tharaka agro-ecological zones because they are similar to the eastern counties (Kenya Food Security Group, 2015). Truly arid regions such as Turkana, Laikipia and Isiolo are mainly inhabited by pastoralists rather than farmers. This makes them poor candidates for the study's results.

Some factors might discourage Layaway savings elsewhere in Africa. Mobile banking has not been as successful everywhere in Africa as in Kenya. For instance, Somalia's agricultural ventures are discouraged by the political instability of the country. Islamic rules against paying any form of interest on loans could inhibit use of R2O in Arabic countries in North Africa (Savin, 2012). The eastern Kenya results will be difficult to duplicate in Saharan and south African countries that experience extremely arid conditions. The mobile layaway and R2O financing schemes will not overcome a genuine lack of water (Kirui et al., 2013).

Mobile layaway and rent to own financing could be beneficial to women by permitting them to expand their asset base. Women were very active in the farm groups surveyed in the RA-DS. The percent of women ranged from 63 in Makueni to 82 in Kitui (Young et al., 2014).

Based on popular brochure, KickStart International (2015) asserts 93% of women feel empowered after buying the pump. Women empowerment by the Kick Start project has tripled

the number of students attending schools. Additionally, 28% of children in the communities using pumps can attend private schools, an increase from 9%. These exceptional benefits are also attributed to the fact that women control 36% of the household income generated through irrigation. Communities embracing the technology experience a doubling in the income per household.

Literature from other countries reveals that certain variables have a consistent positive effect on financial innovation and agricultural technology adoption. These include higher education, exposure to extension programs which teach farmers how to use the new technologies, and adoption of other financial innovations. These relationships are shown by studies in Kenya and Nigeria (Owuor, 2009; Omonoma, 2010). The age range 21-49 has higher technology adoption rates. KSI's Rent-to-Own and Layaway financial options, as well as Cash Purchase, may facilitate adoption by a broader range of households. In Ethiopia, which shares agro-climatic conditions with Kenya, microfinance credit, access to extension services, and shorter distance to the nearest road and/or market positively influenced adoption of irrigation (Liverpool, 2010; Goshu, 2012). Ethiopia possesses extensive agricultural lands. Malawi has greater availability of water and land which may contribute to its higher adoption of human-powered pumps. Higher share of off-farm income, participation in farmers' self-help groups, and contact with extension services were shown to promote adoption of pumps and similar technology in Madagascar, Tanzania, and Malawi (Moser, 2006; Kabunga, 2011; Mohamed, 2008; Amudavi, 2009). By the EOP-IS when pump purchasers have begun irrigating more land, WSU will conduct regression analyses exploring the relationship of wellbeing gains by financing mechanisms to selected farm, farmer and resource variables. These results will be compared to those described in this section for other regions and countries

### Summary and Conclusions

The title of this research project, "Mobile Layaway and Rent-to-Own: Bringing an Innovative Savings Solution to the Rural Poor for Small-Scale Irrigation Pump Purchases" aptly describes its ultimate purpose. Judged by that title, progress recorded in this Milestone has been a striking success. Farmers' choices in the Baseline Buyers survey dramatically favored Mobile Layaway Savings over Cash Purchases at a .00000001 p-level. R2O was also favored over Cash.

The project also sought to discover the impact of innovative finance on underprivileged groups, especially the poor and women. There was a highly significant preference for layaway and rent to own among households in the bottom 50 percentile of wealth. Among 132 pump buyers who chose these innovative options, 108 were in the poorest half of households. Buyers' average wealth from livestock, farm equipment, and household items equaled KSh 392, 471 versus only KSh 175, 819 for non-buyers. Farming, not wages, contributed to buyers' superior wealth.

On the other hand, the BaselineB survey showed no statistically significant relationship between gender and choice of innovative finance options. Gender did display a significant influence when all buyers (TKT, R2O and C) were contrasted to all non-buyers. Forty-one percent of buyers were female, but 79% of non-buyers were female. There is an important caveat to these results. At the time of the March-June 2015 Baseline, relatively little land had been irrigated using the KSI pumps. As a result, little revenue had been generated by users at that time. Most mobile layaway purchasers were still “laying away” savings and had not received their pump. This accounts for the miniscule amount of land, 0.03 ac, irrigated by layaway purchasers. For this reason, the WSU team has urged KSI to accelerate deliveries of pumps to layaway purchasers before the October onset of the 2015 “short” rainy season. This is crucial for the end of project impact survey if it is to reflect a potentially important benefit from use of the layaway pumps during this period.

The Baseline buyers and non-buyers questionnaires contained a large number of questions relating to household income, wealth, hunger, nutrition, sickness, domestic water quality, house quality and children’s educational enrollment. *Identical* questions will be asked of the *same* households in the end of project impact survey in January-February 2016 after eight to nine months of pump use. This interval will capture the planting *and* harvesting seasons associated with the March-June 2015 “long rains” and October-November 2015 “short rains.” Answers to questions relating to impacts of different financing schemes [cash purchase, rent to own, and layaway savings] on farm family’s income and general wellbeing will appear in WSU’s final report.

The BaseB and parallel EOP-IS questionnaire contained a large number of questions relating to seasonality of pump use, types of crops irrigated, type of water source. Responses to these questions will be used to explain changes between the two surveys. The final report will also contain more interpretation on questions relating to women’s empowerment in small-scale agriculture and relationship to economic and social benefits of pump use over time.

The research team made notable advances, through great effort under difficult conditions, in precisely locating enumerated Baseline households with GPS technology plotted using Earth Point on Google Earth. This effort will save significant amounts of time and money when the same households are interviewed again in the end of project surveys.

WSU’s research attention will now be turned toward the end of project surveys. Because the same questionnaires will be used on the completed Baseline and future end of project surveys, this process will be expedited. The research team expects exceptional results, assuming that external factors do not intervene.

## **2. Training and marketing activities for Rent-to-Own (R2O) and Mobile Layaway**

During this phase of the project, the focus was on the collection of Baseline survey data on pump buyers and of non-buyers, as described in the first section of this Milestone Report. Training and marketing activities around the R2O and Mobile Layaway financing products will not be targeted in the period between the Baseline data collection and the final collection of Endline surveys with these same farmers, so as not to influence the impacts we are interested in measuring for these households by exposing some of them to additional training and information about the three options for purchasing MoneyMaker Pumps.