Filling the Niche—A Synthesis of Financial Inclusion among Smallholder Farmers in Africa, the Case for Kenya

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Abstract

This paper makes a synthesis of empirical studies carried out in parts of Africa, and in Kenya to derive lessons on financial inclusion among smallholder farmers in rural and peri-urban areas. The derived lessons point at a steadily growing expansion of financial services to rural/peri-urban poor traditionally characterised by high idiosyncratic risks and huge information asymmetry. This category of households seems to have made the African continent sustain itself in the midst of financial crisis in 2008/09 when the rest of the world including the Asian tigers and the American capitalists faced serious setbacks in their financial sector growth. During this period, Africa experienced steady growth that started in 2000 at below 3% and peaked at about 4.8% by 2009-2015. The contribution of the transformation of the financial sector experienced in Kenya is one of the reasons for this growth. The paper elucidates the key determinants of access to the reformed financial services by the rural poor, access to targeted training on financial services beyond the formal education, participation of female-headed households in collective frameworks and creditworthiness as exhibited by multiple borrowing points. The impact of such inclusion is exhibited by significant changes in purchasing power of households through income and diversified investment in farm assets. In all these successes, ICT through mobile money transfer played a significant role, as exhibited in studies across the region. Despite the successes, the key challenges include high fungibility of targeted funding, showing a need to provide an array of financial services to the poor including credit for consumption, school fees, medical cover and emergency loans found among the savings and credit cooperatives. Also, the inequality and raising the poorest of the poor is still a challenge, one reason being the instrumental role of ICT through mobile money transfer system which some of the poorest farmers have no access to. Mobile banking services such as M-Shwari product is something that ex-

tension personnel could take as part of their advice to small farmers in accessing short-term loans and as means of savings funds between USD 1 - 100. These kinds of funds are useful in particular in bridging financial gaps along the agribusiness value chains. The funds can be borrowed to transport produce to the market, and make payments in time to enable farmers to capitalise on their input purchases. On participation of smallholder farmers in mobile banking type, and in particular saving and immediate credit service is still limited. This is an area for immediate uptake by all stakeholders including policymakers and the financial sector.

Keywords

Smallholder Farmers, Financial Inclusion, Collective Liability

1. Introduction

Financial inclusion (FI) is often seen as outreach of financial institutions to underserved and unbanked regions of society. This definition is expanded in this synthesis paper to include innovations with potential to change customer engagement riding on ICT advancement. The inclusivity of ICT in the definition provides a means of considering convenience as part of financial inclusion. The convenience includes offering financial products, adding new clients, peer enforcement of contracts, using different mobile money savings, transfer and borrowing modalities among others.

The Trajectory of Agricultural Development in Africa

Africa's growth performance has significantly improved since the start of the 21st century. The growth performance is a pay-off to decades of extensive economic and financial sector reforms. In addition, since 2000 the continent has seen a prolonged commodity boom. Among the drivers of growth, performance is improved capacity for policy research and analysis, and improved policymaking, which have contributed to Africa's rise to become one of the fastest-growing regions of the world. Some of the policy changes related to increased awareness of financial services and inclusion of small farmers and small entrepreneurs to the financial market via micro-loans and Micro-Savings. Africa's medium-term growth prospects, therefore, remain strong at 4.8% in 2013.

Despite all the good growth and performance, sub-Sahara Africa still remains with many challenges. This level of economic performance of 4.8% is far below the Millennium Development Goals (MDG) projected growth rate for the region of 7 percent per annum up to 2015. Poverty reduction is seen as the major challenge in Sub-Sahara Africa, and the number of people living in extreme poverty due to loss of income associated with loss of jobs and remittances and reduction in government investment in social sector is expected to rise.

Today, almost 33 percent of the population in Africa, or close to 200 million

people, are undernourished. The region is susceptible to frequent food crises and famines, easily triggered by even the lightest of droughts, floods, pests, economic downturns or conflicts. In actual fact, Africa is the only continent where hunger is projected to worsen over the next two decades unless some drastic measures are taken.

The 2013 Global Hunger Index (GHI) reported by IFPRI still points at a bleak future for Africa. The data which covers the periods 2008-2012 shows global hunger has improved by one-third, however, the level of hunger still remains "serious" with 890 million people still going hungry, with Africa South of Sahara recording the highest GHI. Social inequality, nutrition, education and social status of women continue to contribute to this. Among alarming countries are those in the horn of Africa.

The burden of vulnerable employment continues to fall on women and youth who remain mainly in the agricultural and informal sectors. Indeed, most of the countries are agriculture-based and agriculture is responsible for a significant share of GDP and employment. The impacts of climate change require proper financial inclusion of the poor to come out of poverty and uplift the agricultural potential.

Further, most of the countries in Africa are facing major challenges in structural reforms to generate adequate growth and development through poverty-reducing innovations for small farmers. High population rates and strong rural-urban migration create even major challenges on labour supply for agriculture. These developments pose a number of socio-economic challenges to countries, including increased pressure for housing, health, education and social protection services. Altogether, these are partly responsible for pervasive ethnicity, systemic corruption, and violent crime among other problems. High income, gender and regional inequalities continue to pose a serious threat in the region. The only way to reduce poverty is by long-term sustained economic growth, which addresses inclusive services to ensure equitable income and wealth distribution, improved access to social services, human rights and political participation. To achieve this, there is a need to enhance efforts in the promotion of financial inclusion considering gender equality and the empowerment of women and the poor of the poor in rural areas.

The HIV/AIDS pandemic also continues to incapacitate and eliminate a large proportion of the productive population in rural areas imposing a heavy social and economic burden to the society. The agricultural sector of African economies continues to register mixed performance due to a multiplicity of factors such as low productivity levels, increase in input costs on account of escalating global oil prices, poor rural infrastructure, dependence on rainfall, changes in global prices for commodities, challenges associated with the governance of land, inadequate sound agricultural policies due to human and financial access constraints.

A report by AfDB (AfDB, 2019) on African Governance Outlook (AGO) em-

phasises the role of financial inclusion and enhancing capacity of enhancing smallholders' awareness of the financial services and governance of the same. The report recognises that knowledge on financial governance is still one of the major challenges for African governments, a factor that leads to corruption, misallocation of resources and continued poverty.

More so, regional trading blocks and non-tariff barriers still discriminate against Africa. Effective participation by Africa in trade negotiations (e.g. in the WTO, ACP-EU) will still require the continent to strengthen requisite skills and institutional capacities at both national and regional levels in broad areas of trade policy development.

Examples of programmes that have and continue being targeted to African institutions are the World Bank accelerated development in Sub-Saharan Africa that launched the Structural Adjustment Programmes (SAP), the New Partnership for African Development (NEPAD), the Comprehensive Africa Agriculture Development Programme (CAADP), the UN's Sustainable Development Goals targeting eradication of extreme poverty.

The above initiatives are indeed a significant milestone, demonstrating a clear political commitment by the African heads of state and governments towards addressing the pervasive food insecurity and poverty in Africa.

The fact is that there exists poor policy analysis during the implementation with various policies, institutional and regulatory bottlenecks hampering the adoption of technologies and investment by other value chain actors. To productivity financial access still remains a cornerstone for food security.

Therefore, the efforts to respond to constraints towards creating an enabling environment for smallholder farmers through among other services, enhancing financial inclusion of the poorest of the poor is key for food security, growth and poverty reduction.

2. Methodology

A case-based synthesis approach from 4 projects from Kenya and other similar countries was made. The case study lessons were then prepared based on key outcomes with summarised sampling and analytical methods per project being provided as part of the case synthesis results as presented below. The cases considered include Zambia, Uganda, Malawi and Kenya. Kenya is however given particular attention due to its unique ICT financing successes.

3. Synthesis Results

3.1. Kenyan Group Based Smallholder Farmers Rural Financing Case

3.1.1. Framing and Approach
The group-based smallholder financing lessons are based on a sample of 400 households, in 2 counties in Kenya namely Kakamega and Nakuru counties. The analytical approach followed a typical farm household decision-making whereby

income can only be realized a short period after harvest, yet expenditures on purchased inputs must be made in cash prior to the harvest. The availability of adequate credit is used to enhance greater purchased inputs and thus higher output performance. Asymmetric information, adverse selection and contract enforcement problems that characterize credit markets in developing countries are exhibited as giving rise to credit rationing and affect optimal gains (Stiglitz & Weiss, 1981). To evaluate the impact of the group credit, the propensity score matching estimation approach was used to capture the marginal impact of group based lending programme.

The assumption is based on the premise that impact of group credit on the economic decision process would be manifested through changes in household food and income generation. The study also recognised a number of models that can be used to assess the impact of on target communities. These include PSM, difference in difference (DD), regression discontinuity design (RDD) and instrumental variables models. However, PSM was used following works by Rosenebaum and Rubin 1989 based on its suitability and robustness in capturing impact with and without credit.

Rosenbaum and Rubin (1983) pioneered propensity score matching followed by many other improvements and applications in works by Dehejia and Webba (1999, 2002), Becker and Ichino (2002) and Caliendo and Kopeinig (2005). They defined propensity score as conditional probability of participation given pre-participation characteristics of the subject. Their argument is based on the fact that since assignment of subjects to participation and control groups in a given programme may not be random, then estimation of the effect of participation may be biased by the existence of confounding factors.

Therefore, they proposed propensity score matching as a way to correct for the estimation of effects of the programme controlling for the existence of these confounding factors based on the idea that the bias is reduced when the comparison is performed using participants and control subjects who are similar as possible. To achieve this, the method summarizes pre-participation (pre-participation) characteristics into a single index known as propensity score, which makes matching feasible. Propensity score is a conditional probability estimator, and any discrete choice model such as logit or probit can be used as they yield similar results (Caliendo & Kopeinig, 2005). The first stage of the PSM is expressed as:

$$p(X) \equiv pr\{D = 1/X\} = E\{D/X\}$$

where $D = (0, 1)$ is a participating variable (in this case borrowing status) and X_i is a vector of pre-participation covariates. Propensity score ensures that matching estimation is done on subjects that are similar as possible for effective comparison. A number studies have utilized the PSM method (Caliendo & Kopeinig, 2005; Dehejia & Wahba, 2002; Diagne et al., 2012; Imbens & Wooldridge, 2009).

The above first step technique involve generating p-scores using individual

observed characteristics (e.g. age, sex, education level, employment status, membership in groups, credit, experience, farm size, and family size) and matching control and treated groups based on the computed propensity score. The PSM technique also gives the difference in outcomes/impacts over the common support weighted by PS distribution of subjects who benefited. The independent variable will be the probability of receiving the treatment and the pre-treatment characteristics will be independent variables (Ouma et al., 2002; Wooldridge et al., 2005)

$$\ln\left[\frac{\exp(x_i)}{1-\exp(x)}\right] = \ln\left[\frac{pr(d_i = 1 \mid X_i = x_i)}{1 - pr(d_i = 1 \mid X_i = x_i)}\right]$$

After generating p-scores, several matching techniques were used to create a matched control and treated groups and adopt the one that gives the best results. This was done by imposing a common support condition and drop cases whose scores were not comparable. After matching the two groups should have similar characteristics. In order to check this similarity two balancing tests through t-test and Hotelling's T-squared test was carried out. The t-test involves examining the mean of each covariate. Hottelling'test is done by re-running logit model and comparing pseudo-R^2 before and after matching. Likelihood ratio was also examined to test the significance of the coefficients.

Bootstrapping was done to get SE for PSM. Assuming that the treated group (d = 1) and non-treated group (d = 0). Based on the composite assumption, to estimate the average treatment effects (ATE) on target groups, the model is specified as given in equation below:

$$\text{ATE} \equiv E\left\{E\left(Y_{1i} - Y_{0i} \mid d_i = 1\right)\right\}$$
$$= E\left\{E\left\{Y_{1i} \mid d_i = 1, p(X_i)\right\} - E\left\{Y_{0i} \mid d_i = 0, p(X_i)\right\} \mid d_i = 1\right\}$$

where Y_{1i} and Y_{0i} are potential outcomes/impacts in the two treatments and no treatment conditions, p are propensity scores for subject i,

$$\Delta\overline{Y}_i = \sum_{j=1}^{T} \omega_j \left(Y_{ji} - \sum_{i=1}^{c} W_{ij}Y_{ij0}\right)$$

$\Delta\overline{Y}$ is the post-intervention effect indicators, $\forall i = 1, \cdots, k$;

Y_{ij0} is the outcome/impact indicator of the ith non-treated matched to the jth treated group;

Y_{ji} is the outcome/impact indicator of the ith non-treated matched to the jth treated group;

T is the total number of treatments;

C is the total number of non-treated households;

ω_j are the sampling weights used to construct the mean impact estimator;

W_{ij} are the weights applied in calculating the average income from matched non-participants.

The PSM method work is based on a number of assumptions. Rosenbaum and Rubin (1983) showed that if exposure to treatment is random within each cell as

defined by individual pre-treatment characteristics X, it was also random within cells defined by the propensity score variable p. The assumption underlying this approach is commonly referred to as conditional independence or strong ignorability. Mathematically as stated by Rosenbaum and Rubin (1983) the assumption states that $(Y_0, Y_1) \perp d|X)$ (the simple $\perp$ means independence) which means that conditional on X_i the outcome Y is independent on treatment assignment $[(Y_0, Y_1) \perp d|p]$ (Lemma 1). In addition, if p is the PS, then, under some conditions, exposure to the treatment and the observed covariates are conditionally independent given the propensity score, $d \perp X|p$ (Lemma 2).

Model Assumptions include

1) Conditional Independence Assumption which states that given a set of observable covariates (X) on the study units, which are not affected by treatment, the potential outcomes/impacts (which in this study are banana production, revenue generated, and period the household utilized credit) are independent of treatment assignment (independent of how the participation decision is made by the household.

2) The assumption of unconfoundedness is very strong, and its plausibility heavily relies on the quality and the amount of information contained in the covariates, X.

Instead of matching directly on X, we match on the predicted probability of using the treatment. This probability is calculated as follows:

$$\Pr\left(\text{use or participation} = 1 \mid X_i\right) = \beta_0 + \beta_i X_{ki} + e_i$$

3) **Common support:** This assumption is a slightly weaker assumption also associated with the treatment effect evaluation is referred to as the overlap or matching (common-support condition) assumption. The common support is the region where the balancing p-scores have positive density for both treatment and comparison/control/counterfactual study units. It recognized that no matches can be formed to estimate the average treatment effects on the treated (ATT) parameter when there is no overlap between the treatment and counterfactual/control groups. The assumption ensures that for each value of X, there are both treated and untreated cases. The assumption is expressed as follows:

$$0 < \Pr\left[d = 1 \mid X\right] < 1$$

This implies that there is an overlap between the treated and control/untreated samples. This implies that the control and treated groups have comparable observed characteristics/pre-treatment effects. Under the two assumptions (CIA and overlap) the average treatment effect on the treated (ATT) can be identified as:

$$E\left(Y_1 - Y_0 \mid d = 1\right) = E\left(E\left(Y_1 - Y_0 \mid d = 1, X\right)\right)$$

This assumption rules out perfect predictability of d given X. That is

$$0 < P\left(d = 1 \mid X\right) < 1$$

3.1.2. Balancing Test

Balancing tests and testing for the plausibility of the Conditional Independence Assumption. The main purpose of the propensity score estimation is to balance the observed distribution of covariates across the groups of adopters and non-adopters. The balancing test is normally required after matching to ascertain whether the differences in the covariates in the two groups in the matched sample have been eliminated, in which case, the matched comparison group can be considered a plausible counterfactual (Ali & Abdulai, 2010).

3.1.3. Estimators Employed

Estimators that were used for matching the subjects in the two groups were (Treated group and the counterfactual nearest-neighbor caliper, kernel (Gausian and Epanechnikov), and radius following the procedures given by Caliendo and Kopeinig (2005), Diagne et al. (2012), Imbens and Wooldridge (2009), Dehejia and Wahba (2002). Matching was implemented using the Stata module Becker and Inchino commands.

3.2. Synthesis Results

Results (Table 1) show that exposure to agricultural seminars, female gender, off-farm engagement, and access to other sources of credit had positive and significant effect on marginal probability of participating in the micro-finance credit programme. On the other hand, the higher the number of older members per household, larger group sizes in terms of membership and location further away from the market significantly reduced the marginal probability of participating. The significance of education is consistent with conventional economic theory on the role of literacy in improving conceptualization of information and making economically viable decisions in financial markets. In support for the role of literacy, our results on exposure to agricultural seminar show similar effects.

Results on female gender indicate immense involvement of women in rural economy as well as the fact that women get more attracted to MFC that peg no tangible credit to lending, reason being that a majority of women in Africa still lack right to property to hold as collateral against credit. Creditworthiness of women in the face of formal financial institutions is diminished prompting a majority to shift their loan applications to group based financial markets, such as MFIs. The positive effects of time spent on off-farm activity can be viewed in the context of access to extra and regular income that complements loan servicing. Results on the number of older members of the household point at the low participation of old people in mandatory group savings. Besides, such households are likely to face labour supply problems, with consequential low incomes to commit to savings.

The negative effects of group sizes are a possible indicator of collective liability problems. As group size becomes large, more difficulties emerge in reinforcing sanctions (Gine & Karlan, 2006). Market distance indicates relative effects of transaction costs, a factor that constraints information access.

Table 1. Logistic regression results on determinants of choice to participate/borrow from Micro-Finance Institutions (MFIs).

Predicted probability of the dependent variable	0.447	N = 401			LR X2		101***
Log likelihood Ratio	225				Pseudo R2		0.283
Dep: if MFI participant							
(Yes = 1, No = 0)	dy/dx	Std Err.	z-test	$p > |z|$	95%	C.L.	X
Age of household head in years	0.002	0.003	0.7	0.483	0.03	0.007	44.15
Formal Education of household head in years	0.023	0.007	3.58	0	0.011	0.036	8.998
If attended seminar (1, 0)	0.209	0.062	3.35	0.001	0.087	0.331	0.249
If head is female (1, 0)	0.161	0.06	2.66	0.008	0.042	0.279	0.641
Hld members below 20 yrs	0.017	0.012	1.4	0.161	0.04	0.007	2.895
Hld members aged 21 - 49 yrs	0.029	0.014	2.06	0.039	0.001	0.056	2.379
Hld members > 50 yrs	0.124	0.038	3.3	0.001	0.19	0.05	0.688
If own title to land (1, 0)	0.008	0.085	0.09	0.927	0.17	0.159	0.845
If received transfers (1, 0)	0.057	0.058	1.1	0.329	0.17	0.057	0.364
Hrs on off-farm activity/daily	0.139	0.024	5.72	0	0.091	0.186	0.968
If borrowed other credit (1, 0)	0.16	0.06	2.68	0.007	0.043	0.277	0.342
No of Members per group	0.003	0.002	1.4	0.161	0.01	0.001	26.89
Distance to market (km)	0.005	0.003	1.71	0.031	0.01	0.001	4.92
AEZ (Nakuru = 1, Kak = 0)	0.065	0.063	1.02	0.306	0.05	0.189	0.504

3.2.1. Impact of MFC on Smallholder Farmer's Productive Performance

The average effect of MFI credit was measured using four matching routines as specified in the methodology section, with results (Table 2) showing that Nearest Neighbour Matching (NNM) matched 180 MFC participants to 71 nonparticipants, with average effect on annual productive incomes of US $641.50 per household. The results were significantly at 1% level. In a household made up of six members as in this survey, it translates to 0.30 additional dollars per person per day, implying that MFC reduced poverty levels by 30%. Radius matching was estimated with a default of 0.005, implying that all the nonparticipants with estimated propensity scores falling within a radius 0.005 from the propensity score of a given participant was matched to that particular participant productive income of US $628.462. Kernel matching and stratified matching results show that all 180 participants matched all the 221 controls, with an average effect on productive income of US $478.30. In both cases, the measurements were significant at 1%, with t-values of 3.64 and 3.74 respectively.

Table 2. Income effects between participants and non-participants on MFI borrowing.

Matching Method	Participants	Participants	(US $)	Std. Err.	z-value
Nearest neighbour	180	71	641.5	167.5	3.83
Radius (0.005)	133	150	628.5	151.4	4.15
Kernel (BW 06)	180	221	478.31	131.5	3.64
Stratified (5 Strata)	180	221	478.31	131.5	3.74

3.2.2. Conclusive Findings on Group Credit via MFI to Small Farmers

Participation in MFI credit has significant gains in productive income with literacy, female gender, communication infrastructure and maintenance of indigenous group structures as key factors for policy intervention. Mobilizing more groups, particularly women groups would go further in improving information asymmetry and resolving collateral problems.

4. ICT Money Transfer for Smallholder Farmers Financing

This is based on the study objectives and the background studies identified in the following tentative ICT-based projects for detailed case study analysis in the respective countries:

✓ Benin—Sonhgai Center & Resimao;

✓ Ghana—TradeNet & MAPRONET;

✓ Uganda—WOUGNET & BROSDI;

✓ Kenya—KACE & DrumNet;

✓ Malawi—MACE & FNSJ Taskforce;

✓ Madagascar—MLMI & PPRR.

1) Benin

Songhai Center is a non-governmental organization (NGO) devoted to promoting agricultural entrepreneurship among farmers. Farmers, assisted by Songhai, are able to search for information to improve crop yields, optimize the use of fertilizers, and find the best prices for their produce. Songhai has also established a network of telecentres in some towns in Benin where farmers can access agricultural information. These centres also serve other clients and partners of Songai Center. **Resimao** is a regional market information network with a branch in Benin. With the support of the CTA, the Network disseminates price information through its database and internet site in rural and urban markets. The information disseminated covers all the agricultural products including cattle and the meat products.

2) Ghana

TradeNet allows traders and producers from anywhere in the world to find each other online or via mobile phones and connect to do business. It also runs market information shops from where farmers and buyers can obtain information on commodities of interest. Its goal is to raise revenues of small-scale farmers and traders by allowing them to find trading partners and carry out commodity exchange at low cost. TradeNet also provides free customizable websites

to any group that seeks an online presence and easy integration with the mobile networks.

MAPRONET (Market Access Promotion Network) MAPRONET was formed in 2001 by agricultural producer groups and local and international NGOs. It aims at improving market access for farmers and enabling them to meet the requirements of local and international markets.

3) Uganda

WOUGNET (Women of Uganda Network) Provides agricultural information to women farmers downloaded from WorldSpace receiver, which the center acquired through collaboration between the Department of Meteorology and WOUGNET. Inside the center, the receiver is connected to a computer, which enables it receiver to receive data from WorldSpace. The software has two components, which include the audio and multimedia. The information is disseminated through mobile phones using SMS including agricultural market information.

BROSDI uses mobile phone SMS to disseminate agricultural information to farmers with the aim of improving rural farmers' livelihoods and food security through engaging the government and the civil society in knowledge sharing and information management using ICT methods. It also uses internet website, audio cassettes, telephone calls, newsletters, brochures, and information sharing forums and trade fairs to disseminate information to farmers/community. It also facilitates farmer access to rural/financial services—improvements in access, reach and flexibility through ICTs.

4) Kenya

DrumNet provides market access, extension and financial services to smallholder farmers. It is a project of Pride Africa (an NGO). Its goal is to provide small-scale farmers with efficient and sophisticated information needed to meet market requirements and access better markets. The project has support centers that cater for clients who require financial, market and technical information in order to make more profitable transactions.

KACE (Kenya Agricultural Commodity Exchange) is a private sector firm set up in 1997. It links farmers to input and output markets through provision of timely data and information. It collects, processes, and stores market information on commodity prices, transportation costs, etc and uses the information to link farmers to buyers through matching offers and bids. KACE operates marketing information points (information kiosks) where farmers get market information on notice boards. KACE also uses mobile phones, Internet and radio services to disseminate market information to farmers. One such initiatives is the *Soko Hewani* program where offers and bids are verified and radio program staff link buyers with respective sellers of various commodities (Okelo J, J 2012)

5) Malawi: MACE (Malawi Agricultural Commodity Exchange) provides commodity neutral agricultural marketing information to farmers. It uses various media including use of mobile phones, marketing information centers or kiosks. The major objectives of MACE are to a) facilitate linkages between sellers

and buyers, exporters and importers of agricultural commodities; b) empower farmers with relevant ad timely market information and intelligence to enhance their bargaining power and competitiveness in the market place; c) provide a transparent and competitive price discovery mechanism through the operation of the exchange trading floor; and d) harness and apply the power of ICTs as a strategic tool for rural value addition and empowerment. FNSJ Taskforce (Food and Nutrition Security Joint Task Force) is a project based in Lilongwe. It supplies weekly market information on crops and livestock from all parts of Malawi through internet and bulletins. The information is also transmitted to government and non-governmental organizations that work with farmers. The aim of the project is to provide timely and accurate market information to farmers in order to enhance their decision-making.

6) Madagascar: MLMI (The Last Mile Initiative) is a global USAID initiative aimed to bring the benefits of the information age to rural populations by extending telecommunications infrastructure and access to the remote locations. Its strategy combines modern technological solutions and effective business models to extend connectivity (internet and telephone) from existing networks to isolated areas. Partnerships with the private sector enable efficient, affordable service costs. Community information centers are being created where local citizens can access telephone, photocopy, facsimile and the Internet. Additionally, the centers organize public workshops and sessions on topics, such as the organizational and institutional development of local NGO and associations, development of the sales networks between the local farmers and consumers, and communications to improve quality of the health services.

## 4.1. Sampling Process for Households

A stratified random sampling technique was used in survey. In all the six countries a total of 2040 households were sampled with each country covering a minimum sample of 340 households. The study used both key informant and focus group discussions to obtain information needed in for subsequent households.

The adoption studies undertaken in each country under this objective was employed in identifying three categories of factors that condition the use of ICT-based market information services by smallholder farmers namely:

✓ Those that are related to the ICT-based project and/or ICT-based service itself;

✓ Personal characteristics of the individual actor that determine their response behaviour;

✓ Institutional factors that also influence capability of actors to respond (e.g., market conditions, organization of smallholder farmers, etc).

4.2. Key Results: Who Are Likely to Uses ICT Money Transfer among Small Farmers

The results in Table 3 and Figure 1 are those for the Kenyan case capturing
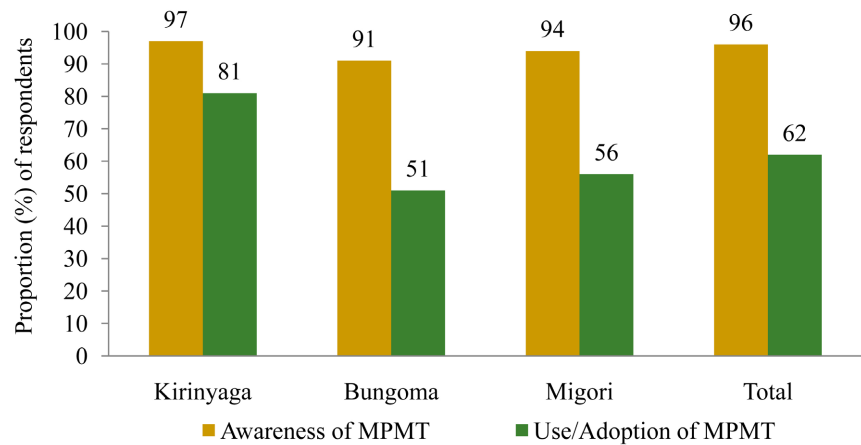
Figure 1. Evaluation of awareness and Adoption of Mobile Money Transfer System in Kenya among Smallholder Farmers (Source: Kirui et al., 2013).

Table 3. Determinants of use of mobile payment methods /transactions among smallholder farmers.

Dependent variable = Use of MPMT	Logit Reg.		Marginal Effects	
	Coefficients	p-value	Coefficients	p-value
Gender (dummy)	0.54	0.041	0.12	0.036
Age (years)	0.03	0.118	0.06	0.118
Education (years of formal education)	0.19	0	0.05	0
Distance to MPMT agent (km)	−0.31	0.001	−0.09	0.001
Distance to nearest bank (km)	0.51	0.009	0.02	0.005
Household size	−0.09	0.159	−0.02	0.149
Years of experience in farming (years)	−0.03	0.064	−0.01	0.064
Distance to agric extension agent (km)	−0.01	0.642	−0.03	0.642
Group membership (dummy)	0.71	0.007	0.16	0.003
Natural log of current value of assets	0.11	0.028	0.09	0.022
Natural log of household income	0.24	0.005	0.06	0.002
Region of Survey	1.22	0.435	1.08	0.476
Constant	−1.13	0		

Source: Kirui et al., 2013.

various regions in Kenya. The figure shows awareness of use of the mobile money transfer using mobile money transfer systems. Overall, the results from the figure show over 90% of the smallholder respondents are aware of the existence of the services, but out of that about 60% use the services.

Further analysis on the same project using same methodology as with the MFI project above, was undertaken to establish key determinants for use or adoption of mobile money transfer system among the smallholder farmers in question,

with results (Table 3) showing that male unlike their female counterparts are more likely to use the mobile based ICT system in transacting in agriculture. On the Other hand, distance to the nearest Mobile Transaction MMT agent has a negative influence on the likelihood of using the mobile services. The further away farmers are from the agent the less likely they are to use the services. Interestingly distance to the nearest bank was positively and significantly related to the likelihood of use of the services. These findings indicate that the mobile services have a great potential to reduce the exclusion of farmers from the banking services.

4.3. Impact of Use of ICT Based Financing on Smallholder Agriculture

On the comparison front between users and non-users of mobile money transfer system, results on Table 4 show that there is a significant difference in input use between those using the services compared with those who don't. The methodologies used are also similar to that of the project on micro-finance borrowing above, with non-parametric measurements namely Nearest Neighbours matching, Radius Matching, stratified Matching and Kernel matching returning significant impact of mobile transaction system on overall value of input use of between US \$42 for non-participants (non-users) to US \$224 for participants (users). Consequently, there is also a significant difference in commercialization between users and non-users, with a difference of over 37%.

4.4. Key Conclusive Outcomes from This Project

▶ Use of m-banking services has a significant effect on:
○ Level of household commercialization—by 37%;
○ Household per-capita income—by K US \$224;
○ Household per-capita input use—by US \$42.

Table 4. Impact of use of mobile money transfer system among smallholder farmers in Kenya.

Matching Algorithm	Outcome Variables	Effect on treated	*t*-value
NNM	Commercialization	0.378**	2.27
	Per-capita input use	3379.69*	1.83
	Per-capita income	17,727.62***	3.36
Kernel	Commercialization	0.377***	2.91
	Per-capita input use	3323.11**	1.99
	Per-capita income	17,720.61***	3.19
Radius Matching	Commercialization	0.377***	3.24
	Per-capita input use	3355.22*	1.88
	Per-capita income	17,724.21***	3.03

Source: Kirui et al., 2013 outputs.

5. USAID Rural Financing Case Study in Zambia, Malawi and Tanzania

The USAID rural financing model looked used three countries and three mobile money transfer systems in reaching out to rural agriculture. The three models used are the Zoona money transfer system in Zambia formerly the MTZL, the SmartMoney mobile money transfer system in Tanzania and the Opportunity international modality of Malawi. The research questions considered here were as follows:

- Whether mobile financing reduce transaction costs and delays in making farming and agribusiness production decisions;
- Whether mobile banking finance enhance small farmers and agribusinesses increase in sales and income;
- Whether mobile financing enhance farmers access to use of inputs, business services and enable farmers access even more financial products;
- Whether mobile financing enhances credit worthiness of farmers in the face of other financial providers.

5.1. Methodology

The approach used involved person to person transfer analysis referred to as (P2P), business to customer transfer analysis (B2C), Customer to Business money transfer modality (C2B) and finally Government to person (G2P) money transfer modality.

5.2. Tanzania Zoona Mobile Financing Model

Mobile Transactions Zambia Limited (MTZL)—now called Zoona—was founded by brothers Brad and Brett Magrath in 2008. From the beginning, Zoona aimed to provide easy, quick, and safe transactional services for the unbanked in the agricultural sector. Zoona focuses on building reliable, cash-in/out networks and facilitating B2C and B2B payments. They provide technical assistance to client businesses and design tailored, end-to-end solutions that meet their specific needs. On a monthly basis, the Zoona platform supports 50,000 transactions valued at $3.5 million and reaches over 60,000 people. With the support of USAID's PROFIT project, Zoona designed and piloted a cashless payment system for small-scale cotton farmers that supply Dunavant Zambia Ltd. Originally the payments were paid to m-wallets, but because of illiteracy and financial illiteracy constraints they decided that an e-voucher platform—which are used like pre-paid debit cards—was more viable to implement than an m-wallet platform. The twin objectives of the PROFIT grant to Zoona were to foster innovation in agriculture value chains and to reduce the cost of transactions with thousands of farmers. Zoona was built with a focus on the rural unbanked and addressed the barriers to financial inclusion for the farmers. In particular, they worked without grower schemes to develop MIS software, microfinance solutions for payments/repayments, solutions for rural remittances, e-voucher payments, and

savings mechanisms for agricultural inputs linked to farmer cash flows on several tranches of funding totalling $280,000, as well as targeted technical assistance on the regulatory framework.

Several improvements have resulted from the integration of mobile money into the value chain. Most notably, there is increased information for the agribusinesses about farmers. This allows agribusinesses to impose greater accountability in their system and make evidence-based decisions on whether to work with a given farmer. It is also important to agribusinesses to keep farmers inside an out grower scheme and to prevent side-selling. Agribusinesses can use the information Zoona's service provides to reward farmers who have a strong record of performance and avoid working with farmers who consistently underperform or try to cheat the system. Farmers value the increased security of their e-voucher payments. Paper vouchers are more easily lost or damaged than a phone, and they cannot be replaced. Zoona also negotiates with local retailers to provide discounts (typically 2 - 10 percent, depending on products) to participating e-voucher farmers. In addition, farmers build their financial identity when storing value, in order to invest in productive assets like inputs, which can increase their future access to credit.

Input suppliers (and other retailers) increase business opportunities, carry less cash risk and have improved recordkeeping. Input dealers can also use this increased transparency to improve their relationship with wholesale suppliers via the new Zoona supply chain management platform, which strengthens vertical linkages in the value chain.

5.3. SMART Money in Zambia

SmartMoney is a third-party provider, founded by Michael Spencer in 2010, that has developed a proprietary mobile money service for lead firm agribusinesses to use to initiate cash-free transactions with smallholder farmers. Farmers often receive the majority of their income from lead firm buyers in only one or two transactions throughout the season. SmartMoney allows farmers to store cash in their mobile wallet and spend it throughout the year. This informal savings mechanism increases their financial security and encourages longer-term planning for investments and emergencies. Lead firms, often large buyers, establish a SmartMoney account and use mobile money to transfer working capital to their intermediary buyers.

SmartMoney is currently partnered with six cotton ginners in Tanzania representing 50% of all cotton production. In Uganda, they are partnered with the Ministry of Industry, Trade & Cooperatives to introduce SmartMoney to their 13,000 cooperatives throughout the country. The ministry has identified a small pilot team that will be working with SmartMoney local staff to travel around the country registering 3250 pilot participants with 20 cooperatives and SAACOs involved in coffee, maize, fish, fruit and dairy. These intermediary buyers in turn buy crops from farmers and pay with mobile money transfer into farmer's m-wallets. The lead firm agribusiness manages the operational aspects of the
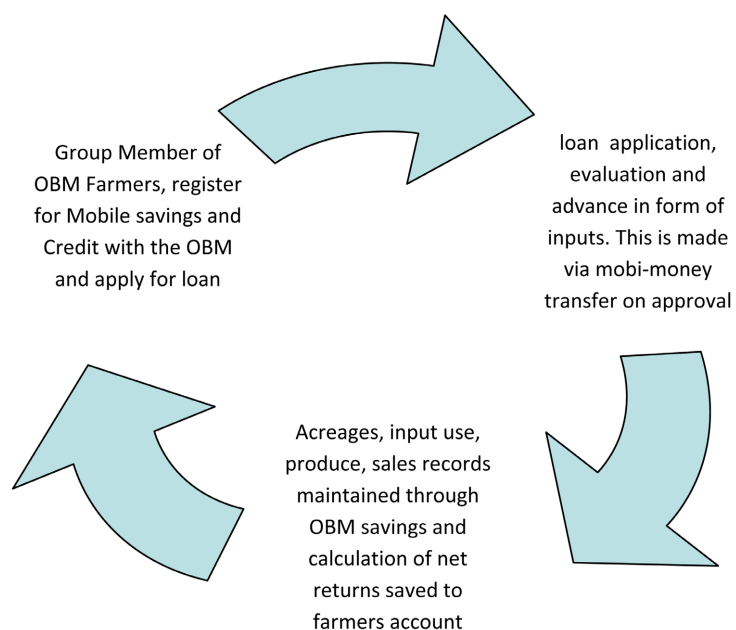
SmartMoney system. They also register m-wallet accounts for the farmers as well as the intermediaries and provide training on the user interface and functionality of the SmartMoney wallet.

A key aspect of the model is that SmartMoney itself reduces its own operational expenses by leaving it to the lead firm to manage the back-office tasks as well as registering and providing training for new accounts. As such, this is less of a vendor/client model and more of a partnership model that presents the lead firm with the option to become an equity owner of SmartMoney. Employees from the agribusiness partners—as well as the independent intermediary/buyers—already work in the villages and are trusted by the local population. Another key aspect is that SmartMoney provides training of trainers to its partners. They in turn train their employees and intermediary buyers, each of whom must be trusted individuals at the village level. These individuals provide SmartMoney training to farmers as well as the village cash agents. By contrast, in the vendor/client Zoona model, agents are trained directly by Zoona.

5.4. Opportunity Bank Malawi (OBM) Model

The Malawi opportunity provides agricultural loans to farmer groups as either cash or in kind inputs. Loans that are in kind are inform of inputs and are done through extension service providers (ESPs) synonymous to market ked extension approach used by Syngenta Foundation initiatives in Kenya. This is because they provide extension services in addition to contracting farmers through input credit and then farmers' output returns are deducted to cover input credit. The input credit is facilitated by collecting individual farmers' data (plot areas crop produce etc) using mobile devices as well as customer relationships tool that cross references loan repayment histories, and then the ESP is responsible for collecting loans repayment from farmers.

Group Member of OBM Farmers, register for Mobile savings and Credit with the OBM and apply for loan

loan application, evaluation and advance in form of inputs. This is made via mobi-money transfer on approval

Acreages, input use, produce, sales records maintained through OBM savings and calculation of net returns saved to farmers account

Each farmer has an OBM savings account and at the time of sale, the ESP calculates the net balance due to the farmer after loan is deducted. Meanwhile the farmer can conveniently view their loan balance levels using OBM mobile ban saving account codes.

5.5. Key Messages from the Tanzania, Zambia and Malawi Small Farmers Financing Models

The lessons learned from Zoona, SmartMoney and OBM reveal increased security and transparency throughout the value chain. Transaction and other histories provide data that can reveal the creditworthiness of farmers. Documented and transparent transaction histories reduce side-selling by contract farmers. Finally, reduced costs increase income and opportunities for farmers and agribusinesses, thereby making value chains more efficient and effective.

6. Overall Conclusion

The key determinants of access to the reformed financial services by the rural poor include access to targeted training on financial services beyond the formal education, participation of female-headed households in collective frameworks and creditworthiness as exhibited by multiple borrowing points. The impact of such inclusion is exhibited by significant changes in purchasing power of households through income and diversified investment in farm assets. Nonetheless, the key challenges still being faced in this include high fungibility of targeted funding, showing a need to provide an array of financial services to the poor including credit for consumption, school fees, medical cover and emergency loans found among the savings and credit cooperatives. Also, the inequality and raising the poorest of the poor is still a challenge. Because of the instrumental role of ICT through mobile MPESA, MKESHO and the likes being a major instrument for financial inclusion of the poor. The newly introduced M-Shwari product is something that extension personnel should take as part of their advice to small farmers in accessing short-term loans and as means of savings funds between US $1 and US $10.

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Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

References

AfDB (2019). *Africa's 2019 Economic Outlook*. Africa.com.
https://www.africa.com/afdb-report-africas-2019-economic-outlook

Ali, A., & Abdulai, A. (2010). The Adoption of Genetically Modified Cotton and Poverty Reduction in Pakistan. *Journal of Agricultural Economics, 61,* 175-192. https://doi.org/10.1111/j.1477-9552.2009.00227.x

Becker, S. O., & Ichino, A. (2002). Estimation of Average Participation Effects Based on Propensity Scores. *The Stata Journal, 2,* 358-377. https://doi.org/10.1177/1536867X0200200403

Caliendo, M., & Kopeinig, S. (2005). *Some Practical Guidance for the Implementation of Propensity Score Matching.* Discussion Paper No. 1588, DIW Berlin Department of Public Economics. Königin-Luise-Str. 5, 14195. Forschungsinstitut zur Zukunft der Arbeit Institute for the Study of Labor. https://doi.org/10.2139/ssrn.721907

Dehejia, R. H., & Wahba, S. (1999). Causal Effects in Non-Experimental Studies: Re-Evaluating the Evaluation of Training Programs. *Journal of the American Statistical Association, 94,* 1053-1062. https://doi.org/10.1080/01621459.1999.10473858

Dehejia, R. H., & Wehba, S. (2002). Propensity Score-Matching Methods for Non-Experimental Causal Studies. *The Review of Economics and Statistics, 84,* 151-161. https://doi.org/10.1162/003465302317331982

Diagne, A., Bastin, G., & Coron, J.-M. (2012). Lyapunov Exponential Stability of 1-D Linear Hyperbolic Systems of Balance Laws. *Automatica, 48,* 109-114. https://doi.org/10.1016/j.automatica.2011.09.030

Gine, X., & Karlan, S. D. (2006). *Group versus Individual Liability. A Field Experiment in the Philippines.* Discussion Paper, World Institute for Development Economics. https://doi.org/10.1596/1813-9450-4008

Imbens, G. W., & Wooldridge, J. M. (2009). Recent Developments in the Econometrics of Program Evaluation. *Journal of Economic Literature, 47,* 5-86. https://doi.org/10.1257/jel.47.1.5

Kirui, O. K., Okello, J. J., Nyikal, R. A., & Njiraini, G. W. (2013). Impact of Mobile Phone-Based Money Transfer Services in Agriculture: Evidence from Kenya. *Quarterly Journal of International Agriculture, 52,* 141-162.

Ouma, A. S. (2002). *Financial Sector Dualism: Determining Attributes for Small and Micro Enterprises in Urban Kenya. A Theoretical and Empirical Approach Based on Case Studies in Nairobi and Kisumu.* Published PhD Thesis, University of Cologne.

Rosenbaum, P., & Rubin, D. (1983). The Central Role of the Propensity Score in Observational Studies for Causal Effects. *Biometrika, 70,* 41-50.

Stiglitz, J., & Weiss, A. (1981). Credit Rationing in Markets with Imperfect Information. *American Economic Review, 71,* 393-410.

Wooldridge, J. M., Wadud, M., & Lye, J. (2005). *Introductory Econometrics: Asia Pacific Edition with Online Study Tools.*