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Addressing the Challenges of Extension and Advisory Services in Uganda: The Grameen Foundation's Community Knowledge Worker Program

Daniel McCole
Michigan State University

Michael J. Culbertson
University of Illinois, Urbana-Champaign

Murari Suvedi
Michigan State University

See next page for additional authors

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Abstract

Diffusion of agricultural knowledge is vital to food security and capacity building in the developing world. Many developing world farmers still do not have access to extension and advisory services (EAS), and poor agricultural practices still exist. Diffusion of agricultural knowledge could lead to improved productivity, higher obtained prices, and increased incomes, but it is made more difficult in the developing world by poor infrastructure, high illiteracy rates, and too few extension agents. The rapid spread of mobile phones throughout the developing world has sparked many EAS programs that incorporate mobile technologies. Although they offer great potential for knowledge diffusion, research has not yet identified strong positive impacts of mobile technology-based interventions. The Grameen Foundation's Community Knowledge Worker (CKW) program provides model farmers in Ugandan communities with training and smartphones that are linked to a database with actionable agricultural information. The model farmers (CKWs) interact with their neighbors to share the information in the database. This relatively inexpensive program differs from other EAS initiatives by using a large number of lightly trained "extension agents" and mobile technology that provides those agents with easy-to-access information they share with and help interpret for the farmers in their communities. The program also incorporates ongoing data collection via the smartphones, allowing for a two-way exchange of information and enabling constant monitoring. Two recent studies have shown this program to have positive impacts. An ongoing randomized control trial promises to offer a comprehensive impact assessment

Keywords

agricultural extension and advisory services, international development, Uganda, information and communication technology (ICT), knowledge diffusion

Erratum

A correction has been issued for this article. The DOI of the article was incorrect as published. The correct DOI is: 10.5191/jiaee.2014.20101. Link to Erratum: <https://doi.org/10.4148/2831-5960.1473>

Authors

Daniel McCole, Michael J. Culbertson, Murari Suvedi, and Paul E. McNamara

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Daniel McCole

Michigan State University
East Lansing, MI

Michael J. Culbertson

University of Illinois, Urbana–Champaign
Champaign, IL

Murari Suvedi

Michigan State University
East Lansing, MI

Paul E. McNamara

University of Illinois, Urbana–Champaign
Urbana, IL

Abstract

Diffusion of agricultural knowledge is vital to food security and capacity building in the developing world. Many developing world farmers still do not have access to extension and advisory services (EAS), and poor agricultural practices still exist. Diffusion of agricultural knowledge could lead to improved productivity, higher obtained prices, and increased incomes, but it is made more difficult in the developing world by poor infrastructure, high illiteracy rates, and too few extension agents. The rapid spread of mobile phones throughout the developing world has sparked many EAS programs that incorporate mobile technologies. Although they offer great potential for knowledge diffusion, research has not yet identified strong positive impacts of mobile technology-based interventions. The Grameen Foundation's Community Knowledge Worker (CKW) program provides model farmers in Ugandan communities with training and smartphones that are linked to a database with actionable agricultural information. The model farmers (CKWs) interact with their neighbors to share the information in the database. This relatively inexpensive program differs from other EAS initiatives by using a large number of lightly trained "extension agents" and mobile technology that provides those agents with easy-to-access information they share with and help interpret for the farmers in their communities. The program also incorporates ongoing data collection via the smartphones, allowing for a two-way exchange of information and enabling constant monitoring. Two recent studies have shown this program to have positive impacts. An ongoing randomized control trial promises to offer a comprehensive impact assessment.

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Introduction

The important role of agricultural extension and advisory services in building capacity among farmers in the developing world is widely known. Throughout Uganda, like in many places, access to and diffusion of agricultural knowledge is critical to improving food security, reducing poverty, and developing sustainable agriculture. Uganda is a country of almost 35 million people, and about 19.3 million (56% of the population) are members of farming households (Uganda Bureau of Statistics, 2011). As a landlocked country, Uganda produces almost all of its own food, and most of its agricultural production is for domestic use (Gollin & Rogerson, 2010). Rural households in Uganda are very poor with a poverty rate (34.2%) almost triple that of urban households (Uganda Bureau of Statistics, 2006).

Most of Uganda's agricultural production occurs on smallholder plots (Uganda Bureau of Statistics, 2003) on which the majority of farmers implement traditional practices that provide low yields. According to a survey by the Uganda Bureau of Statistics (2007), only 1% of agricultural plots used chemical fertilizers, and 6.3% were planted with improved seeds. According to a USAID report on Uganda's rural economy (2008), agronomic best practices such as mulching, proper plant spacing, weeding, and pruning are not widely used in Uganda, and intercropping for higher yields is not properly understood. The report concludes that the "inability to manage pests and disease, together with poor post-harvest handling, often result in substantial crop losses" (USAID, 2008, p. 12). Better diffusion of agricultural knowledge would likely lead to improved yields thereby improving food security and reducing poverty.

As with many developing countries, agricultural extension and advisory services (EAS) in Uganda have traditionally not reached a large portion of the farming population. Poor transportation infrastructure

makes travel to remote villages difficult for extension agents, and many government EAS agencies face organizational challenges that limit their reach. Since 2001, Uganda's agricultural extension and advisory services have been implemented by the National Agricultural Advisory Services (NAADS). Unfortunately, NAADS has faced many difficulties including mismanagement of public funds, embezzlement, and policy uncertainty (Naluwairo, 2011). As a result, there is a very high ratio of farmers-to-extension worker in Uganda (Ministry of Agriculture, Animal Industry and Fisheries, 2009). According to the 2008 National Service Delivery Survey, for example, only 14% of all farming households had interacted with an extension worker in the 12 months preceding the survey (Uganda Bureau of Statistics, 2008).

In addition to the poor coverage of extension agents, the diffusion of knowledge among Ugandan farmers is hampered by a high rate of illiteracy that makes the dissemination of written material a less effective option for EAS. The illiteracy rate among Ugandan farmers has been reported to be as low as 31% (Uganda Census of Agriculture, 2011) and as high as greater than 50% (Naluwairo, 2011). Due to the challenges presented by the high illiteracy rate, and without the resources for a large network of field-based extension agents, EAS providers in Uganda and many other countries have looked to information and communications technologies (ICTs) to help facilitate the diffusion of agricultural knowledge. Although ICTs include hardware and software associated with personal computers, fixed-line telephones, televisions, VCR/DVD players, digital cameras, etc., in areas of high poverty and poor infrastructure, the use of ICTs in agricultural knowledge diffusion has typically been limited to radio and, more recently, mobile phones.

For many years, agricultural information has been disseminated via rural radio initiatives, and some studies have shown support for radio's ability to

communicate effectively some agricultural information (e.g., Nazari & Hazbullah, 2010; Svensson & Yanagizawa, 2009). However, radio has several limitations including poor signals, lack of reach to certain areas, one way communication, lack of electricity and financial means needed to consistently operate a radio, and inappropriate programming due to poor communication between farmers, advisors, and researchers (Nakabugu, 2001). Uganda has long used radio broadcasts to disseminate agricultural information (e.g., Radio Uganda); yet, poor agricultural practices persist.

Previous Use of Mobile Phones in Extension

In recent years, much attention in the agricultural EAS field has focused on the potential of mobile phones. Few technologies have experienced as rapid and pervasive adoption as mobile phones, and because mobile communication infrastructure does not require a large and expensive network of fixed wires, the developing world has driven much of this growth (Word Bank, 2012). Although the use of mobile phones has great potential in agricultural EAS and many such programs have been implemented throughout the developing world, impact studies of these mobile phone EAS programs have generally only shown either small impacts or no impact at all.

In a quasi-experimental study on the impact of mobile phones on grain prices in Niger, Aker (2008) found some support that mobile phones increased price dispersion in markets that are more remote and have lower road quality. Fafchamps and Minten (2012) conducted a randomized control trial in 100 Indian villages of an agricultural market and weather service that used mobile phones. Although the researchers found some evidence in the treatment groups of improved practices in a few areas, such as spatial arbitrage and crop grading, the effect sizes in these were small. More importantly,

no statistically significant changes were observed in areas targeted by the program such as price received by farmers, crop value added, crop losses resulting from rainstorms, and the likelihood of changing crop varieties and cultivation practices.

In another quasi-experimental study, Muto and Yamano (2009) found that in Ugandan regions that had recently experienced expansion in mobile phone coverage, there was an increase in the sales of banana, but not maize. The researchers in this study concluded that mobile phones seem to increase market participation of farmers in remote areas who grow perishable crops. In another study, Futch and MacIntosh (2009) found no effect of price information on average producer price in a randomized experiment in Rwanda. Other studies that have been unable to identify a positive impact or change in behavior as a result of mobile phone interventions include Camacho and Conover (2010), Cole and Hunt (2010), and Mitra, Mookherjee, Torero, and Visaria (2012). Although the literature on mobile phone-based agricultural programs has yet to show strong impact, many EAS providers recognize that the educational use of mobile phones is in its infancy and offers significant potential for inexpensive knowledge diffusion (Aker, 2010; Jensen, 2007), especially with the advent of smartphones, which dramatically enhance the communication capabilities of mobile phones.

Purpose

A review of the programs evaluated in the studies mentioned above reveals three possible reasons for the weak impact of agricultural EAS programs that use mobile technology. First, most mobile phone interventions rely on one-way, top down communication, which has been identified as a weakness of radio-based EAS programs. Second, many of the EAS programs that use mobile phones include text messages, which are appropriate only for literate farmers. Third, EAS programs

that use mobile phones attempt to reach directly the farmer or someone in the farmer's household, rather than reaching someone who can help the farmer interpret the information from the mobile phone. An agricultural EAS program that addresses these three potential weaknesses might more effectively incorporate mobile phones into agricultural knowledge diffusion. The purpose of this article is to describe the Community Knowledge Worker program, an agricultural EAS program in Uganda that uses a unique extension model to address many of the challenges and weaknesses of other EAS programs, including issues of illiteracy; limited resources for government EAS provision; poor communication between farmers, advisors, and researchers; and lack of hands-on assistance and interpretation of agricultural information sent via ICTs.

Community Knowledge Worker Program

The Grameen Foundation was created in 1997 with the mission "to enable the poor, especially the poorest, to create a world without poverty," relying on the microfinance philosophy of the Grameen Bank (Grameen Foundation, n.d., para. 5). Recently, the foundation created an innovative agricultural extension program in Uganda to help disseminate much needed agricultural information to the most impoverished farmers. Traditional agricultural extension uses a relatively small number of highly trained extension agents who try to reach a large number of farmers. The Grameen Foundation's Community Knowledge Worker (CKW) program reverses the traditional extension model by using a large number of lightly trained, but respected, local farmers (CKWs) to access up-to-date and actionable agricultural information via a smartphone. These CKWs then act as liaisons between their community members and the agricultural information in the database. The database includes: agricultural best practices, weather forecasts, market information and prices, an input supplier directory, and

detailed farming information on a wide variety of crops and animals.

Although the use of smartphones is essential to the CKW program, it is secondary to the CKWs themselves, who use the phones to search for needed agricultural information in the database and interpret the information for their neighbors. This immediate access to information allows for the recruitment of less educated "extension agents," and because CKWs are vested members of the communities they serve, they often take an active role in diagnosing their neighbors' farming challenges and encouraging the adoption of recommended farming practices.

Most EAS programs that have used mobile phones to disseminate agricultural information rely on farmers having access to a mobile phone. While the penetration of mobile phones in rural areas is high, it is not complete. Moreover, farmers receiving agricultural information directly may not accurately understand what is being communicated. The Grameen program addresses both of these problems, as only the CKW needs to have access to the smartphone, and they can provide their neighbors with hands-on interpretation of the information accessed from the database.

The use of community members allows the program to reach the most-rural "last kilometer" villages and allows for important agricultural information to reach a larger number of farmers at a relatively low cost. Moreover, the operational costs of the program stay relatively constant even in the most remote villages (Paavo-Krepp, 2012). Another advantage of the CKW program over other mobile phone EAS programs is a two-way exchange of information between farmers and development organizations. The CKW smartphones include software for collecting data from farmers. When the CKWs register a new farmer, they collect basic information, including the size of their plots, their top crops and animals, their primary EAS topics of interest, and poverty indicators. This information facilitates

monitoring of the program. Moreover, when CKWs encounter local remedies (e.g., to common plant diseases), they can submit this information to Grameen. After a vetting process by agricultural researchers, this local knowledge is added to the CKW database for wider distribution. CKWs also act as survey enumerators, collecting information on agricultural conditions for other development organizations that seek to

understand emerging agricultural problems in order to inform their own programming. For example, CKWs surveyed farmers in one region to track the spread of baby chicken blight (see Fig. 1). The ability for CKWs to collect information is also the key to the program's sustainability; Grameen uses the revenues from this service to defray the operational costs of the CKW program.



Figure 1. Heat map of baby chicken blight in Uganda.

Program Partners

The Grameen CKW program depends on partner organizations in a number of different areas. To help fund the initial development and test the concept of the CKW program, the Grameen Foundation received financial support from the Bill and Melinda Gates Foundation. When Grameen expands the CKW program to new regions, it does so in consort with regional partners that share the start-up and operational costs of the new roll-out. In return, these partners dictate where the program expansion will take place to ensure their service areas benefit from the CKW program. The quality of the agricultural database is a vital component of the program, as improved

agricultural performance depends on accurate, up-to-date, empirical data. As of May 2013, ten different partner organizations provide agricultural information for the database, and a panel of agricultural experts reviews this information.

A number of private sector partners provide technological support for the CKW program. MTN Uganda provides the technology infrastructure over which all CKW applications work. Google donated dozens of Android phones and a thousand solar phone chargers. Salesforce.com donated a number of licenses for its software, which serves as an interface for the program's administrative and survey

database. Atlassian provided the collaboration and project management software that Grameen uses to streamline its operations. These product donations have been vital to Grameen's ability to manage the start-up and operational costs of the CKW program.

CKW Equipment

The CKW mobile platform includes three apps: one for searching the agricultural database, one for conducting surveys, and one for communication with program staff in Kampala. The agricultural database is programmed into the phone's app allowing it to be accessed even in areas with no network coverage. When offline, database searches and survey responses are cached and once the phone comes within range of cell service, the CKW can update the database and submit any collected data to the central server.

Since grid-based electricity is not common in rural areas, CKWs use a solar power system to charge the phones. Upon completion of their training, CKWs must make a deposit of 10,000 Ugandan Shillings (UGX), which is slightly less than US\$4, for their equipment package, which includes the phone, a solar charger, a weighing scale, and a measuring band used for livestock girth measurements (to estimate the weight and health for the purposes of nutrition and pharmaceutical dosing). They also agree to have 20,000 UGX withheld from their pay each month for the next two years as part of a rent-to-own program. This arrangement is consistent with Grameen's philosophy to help provide micro-credit to impoverished people throughout the world, and it is important to Grameen that CKWs are invested in their own success. Moreover, Grameen feels that the CKWs are more likely to provide better care for their equipment if they have ownership in it. A monthly airtime allowance is provided to the CKWs for their programmatic and personal use, which CKWs may supplement with airtime they purchase themselves.

CKW Recruitment and Training

Areas are selected to receive the CKW program in cooperation with partner organizations. Grameen only expands the CKW program when it has found a partner to share the costs of the expansion, so the specific communities that receive the program are based on the partner organization's interests, rather than as part of an overall strategy by Grameen. Once an area has been selected, the CKW recruitment process begins. Typically, one CKW covers a single parish (5-10km and 500-700 households), though two CKWs are sometimes selected for larger parishes. CKWs must be farmers, permanent residents of the community, cannot have full-time employment outside the farm, and must be able to read and write in English and speak the local language. Additionally, Grameen aims for half of all CKWs to be women. The recruitment process begins with stakeholder meetings with local officials, farmer cooperative organization leaders, and local technical experts. During these meetings the recruitment team explains the program and the CKW selection process. At a later community meeting, Grameen representatives again describe the CKW program and the desired qualities of CKWs (e.g., trustworthy, leadership skills, and enthusiastic about trying new things), and solicit nominations by the community members present. As candidates are nominated, they undergo a public vetting process, in which their English proficiency and the other qualifying characteristics are checked. All present community members later vote for the nominee they want to be their community's CKW.

CKWs are generally trained in cohorts of up to 50 (2 classes of about 25). During training, CKWs are provided with room and board and receive a travel allowance. Training lasts about 4 days (10-12 hours per day), and is conducted in English. Training begins with the program philosophy and background, a program value proposition, and expectations of the

program. The second module describes how to use the smartphone. The third module introduces the CKW platform (search, farmer registration, etc.), and includes role-playing exercises to practice picking out key words from farmer narratives. Next, CKWs receive training on survey methodology, including survey ethics. Finally, the general training concludes with support functions. At any time during the training, candidates have the option of backing out; otherwise, they sign a commitment to participate upon completion of training. About two in 50 candidates do not complete the training. Refresher training occurs periodically, particularly when there are new partner needs or training is needed for a new survey.

CKW Monitoring and Compensation

Even though CKWs are recruited as volunteers, Grameen provides monthly performance-based financial incentives. Each month, CKWs are expected to register 15 new farmers and complete 48 searches of the agricultural database for farmers. The CKW platform automatically records all searches of the agricultural database, as well as the GPS coordinates where the search, survey, or farmer registration occurred, and these records are used to pro-rate the incentives based on performance. To help manage the performance-based evaluation system, Grameen has developed a dashboard that continuously tracks any number of variables that are programmed into the dashboard. A version of this dashboard can also be customized and provided for a fee to other organizations interested in tracking the data Grameen has collected.

In addition to the pay they earn by performing their expected duties, CKWs are encouraged to earn extra money by using their solar chargers to re-charge their neighbors' mobile phones for a fee. Other benefits include having access to their smartphones and solar charging stations for their personal use. Many CKWs power small electrical devices for their houses, such as lights and radios. Although more

difficult to quantify, CKWs also benefit financially by improving their farming practices based on the information in the agricultural database. Nontangible benefits include the intrinsic reward of knowing they are helping to improve the lives of their fellow community members, the increased knowledge they obtain, and enhanced status in the community. For example, many CKWs have reported that their neighbors have bestowed titles of respect upon them, such as "doctor."

Program Sustainability

One of the most challenging obstacles to extension initiatives is sustaining programs over time, especially after initial grant funds have been exhausted. The Grameen Foundation views the sustainability of the CKW program from two perspectives: the sustainability of the CKWs, and the sustainability of the program itself. Regarding the CKWs, Grameen has been developing and piloting several ideas that could potentially incent CKWs to continue to be a resource for the farmers in their communities, while still earning income that does not rely on Grameen and its partners. Most of the ideas include transitioning the CKWs into something Grameen is tentatively calling a "Village Enterprise Service Provider," which is a generic term for any of a number of specialized activities that CKWs would carryout in service of the farmers in their village while earning outside income. These activities include acting as a weighing specialist for harvested crops, organizer of bulked village crops (to obtain a greater price), quality assurance specialist for cash crops, agricultural input agent, and mobile money agent. Additionally, Grameen has been engaging with NAADS, which is exploring adopting the CKW model (in some way) for its extension services, allowing some CKWs to act as hybrid extension agents who continue to provide one-on-one, hands-on extension services while also providing more proactive services

that benefit groups of farmers, such as farmer trainings, demonstration plots, and forming farmer groups. It is unclear what effect such a change in roles would have on a CKW's current responsibility of information dissemination, but over time, it could be that basic information dissemination may become less important than when a CKW is first introduced to a community.

Regarding the sustainability of the program itself, Grameen built some form of sustainability into the initial development of the program when it developed an open data kit surveying app. By training CKWs on such topics as survey gathering procedures and survey ethics, and requiring ongoing survey gathering as part of the CKWs responsibilities, the Grameen Foundation, in addition to having a growing network of extension workers, has also developed a network of enumerators. Grameen uses this network, equipped with its custom-developed mobile survey applications to gather data for research, extension, commercial, and development organizations on a variety of topics, including agricultural practices, livestock numbers, family health, poverty, and education. This service allows client organizations to gather important data more effectively and cheaper than they could on their own. Also because the CKWs are often asked to collect data in their communities, they have local knowledge of the survey area and can therefore collect the data more efficiently, something important in a country such as Uganda where finding homes in rural areas can be difficult. Moreover, survey respondents are reportedly less suspicious of enumerators who are from their community. In addition to these customized surveys, many organizations are interested in the data Grameen CKWs are already collecting as part of their ongoing responsibilities, and have paid Grameen to develop customized dashboards that allow them to track (on an ongoing basis) specific data that Grameen collects.

The revenues that Grameen earns through its data collection services and dashboard development help to supplement the operational costs associated with the CKW program. As of June of 2013, less than four years after it started, the CKW program was 57% sustainable. In addition to helping the program remain sustainable, the opportunity to collect surveys represents yet another possible source of income for CKWs, as they are paid for their work collecting data outside the requirements of their regular duties. Time will tell whether Grameen's data collection services will be able to compete in that market, and whether there will be enough demand for the data the organization collects to fund the program once it is no longer funded by outside organizations.

Future Initiatives

In select areas, Grameen has piloted a program in which CKWs measure farmers' plot sizes by walking the perimeter of farm plots with their phone, using its GPS function to calculate the size of the plot. As of the summer of 2013, the accuracy of the measurements is not perfect (margin of error of about 15%), however, there is hope that new phones being adopted in the Fall of 2013 will perform this function more accurately. One obvious reason to perform this function is to gather objective data on farmer plot sizes. Another is because some of the recommendations that CKWs provide to farmers are tied to their plot size. A third reason for providing this service is to provide better collateral information to lenders and insurers. In the past, farmers have over-borrowed in part because they either exaggerated the size of their land or double-counted their land (for example a farmer may have one acre of land on which he grows banana, and coffee, but may claim to have an acre for each). Over-borrowing is bad for farmers and also bad for the sustainability of a micro-financing environment. If lenders and insurers are willing to accept the margin of measurement

error for the land measurements, Grameen will continue to develop this initiative.

Grameen is also working on a new tool that is based on the Endiisa computer tool recently developed at Makerere University to help farmers formulate livestock diets that yield maximum production at the least possible price. Endiisa means “feeding” in Lugandan, and Grameen is developing an app based on the computer tool that selects the correct amounts of competitively priced feed ingredients to satisfy the nutrient requirements of a specific type of animal at a particular stage of development.

Another new app Grameen is developing focuses on soil fertility. The app will allow CKWs to help farmers make well-informed business decisions about their farms based on the soil available to them. The app will provide prompts about various observable conditions of the soil (color, texture, apparent moisture levels, condition of plants being grown, etc.). Based on the answers to these prompts, the app will provide a recommendation about the best crops for that soil, and information on how to grow and manage each crop (e.g., type and amount of fertilizer to use, where to obtain inputs, etc.). The app will also include market information about the recommended crops (current price ranges, where to sell, etc.) to help to farmer make informed decisions about his or her agricultural mix.

Grameen is currently considering different mobile money solutions, many of which would involve the CKW program. One example involves combining mobile money with mobile financing to provide farmers with credit to buy agricultural inputs. Another initiative would help farmers access credit to manage their annual cash flow. Currently school fees are due around harvest time and many farmers are forced to sell their crops when the market is flooded and prices are at their lowest. One initiative is to have CKWs teach proper storage techniques and take photos of stored

crops that would act as collateral on loans that could be used to pay for school fees, and repaid when the farmer sells the goods once prices have risen again.

Program Evaluation and Impacts

Both Grameen and its funders place great importance on monitoring and evaluation. The ability to monitor the CKW program was built in from the beginning by asking the CKWs to collect basic data on the farmers they contact and provide services for. In addition to the data collected by the CKWs, Grameen has the ability to track CKW activity via the customized dashboard it developed. Not only is this information used to evaluate the CKWs, it is also used to better understand the reach of the program. As of June 2013, Grameen had 1,139 CKWs in 39 districts, who had conducted 1,144,771 information searches for farmers in their communities. Repeat users have accounted for 26.71% of the CKW interactions. Additionally, CKWs have completed 69,603 survey interviews for Grameen.

Despite the effective reach in many parts of the country, Grameen and its partners wish to know if the program is having a meaningful impact on the lives of the farmers with whom it interacts. To answer that question, Grameen has partnered with independent outside reviewers to implement a three-phase evaluation of the program: data mining of Grameen’s significant base of program administrative data, a quasi-experimental impact study, and a randomized control trial in communities where the program has been recently introduced as a planned expansion.

A team of researchers led by a private sector contractor conducted the data mining effort, which involved detailed analysis of over 650,000 search records, as well as interviews and focus groups with farmers, CKWs, and Grameen staff. The study showed evidence consistent with established patterns for diffusion of innovation (Rogers, 1962), with early adopters driving program use. If the pattern

of diffusion holds over time, there could at some future point be wide adoption of new agricultural practices. Additionally, the study revealed a number of interesting findings including: both the poorest and least poor of the registered farmers accounted for the highest usage of CKW services; information on crops (29%), market prices (25%), and livestock (22%) comprised 76% of all searches; and female CKWs are more successful in meeting with female farmers, while male CKWs are more successful at cultivating deeper relationships with farmers (more repeat meetings). The study also examined CKW performance and found that the median number of searches a CKW conducted met the monthly target, with half of CKWs performing beyond incentivized levels, and in many cases much beyond the financial incentives. A few districts had more CKW meetings than predicted by a regression model. An examination of these districts showed that they tended to have: strong partner involvement, more peer group meetings, and experienced field officers who created an expectation of quality by monitoring CKW performance, holding CKWs accountable, and replacing poor performers.

The second evaluation phase of the CKW program used difference-in-difference methodology to examine the causal effects of the CKW program in a single Ugandan district on farmers' knowledge, attitudes, practices, and outcomes about two years after the introduction of the program (Van Campenhout, 2012). Results from this study suggest significant positive impact of the presence of CKWs on farmer knowledge about farming practices and market prices. The presence of CKWs had no impact on the use of newspapers and radio for price information. There was, however, a significant drop in farmers' use of SMS-based (text message) price information sources, but an increase in reliance on family and neighbors for information. With regard to practices, more farmers in CKW areas switched away from low-risk, low-

return crops such as groundnuts, millet, and cassava toward higher risk/reward crops such as maize, beans, and coffee. Additionally, farmers in CKW areas reported using better farming practices such as recommended crop spacing and the use of manure as fertilizer for crops. As for outcomes, the study found that the presence of CKWs accompanied a 34 percentage-point increase in farmers' access to extension services. The study did not show any impact on productivity, possibly because changes in productivity take more time to surface than an outcome such as access to extension services. The study did show, however, that farmers in CKW areas received a significantly higher price for maize.

For the third evaluation phase of the CKW program, Grameen has partnered with Modernizing Extension and Advisory Services (MEAS) to conduct a cluster-randomized control trial (RCT) in communities into which the program was expanded in late 2012. For this expansion, Grameen's roll-out partner was the East Africa Dairy Development (EADD), which establishes and supports the development of dairy farmer associations (hubs) that offer training, milk bulking, and other dairy business services. For this RCT, 12 dairy hubs in the region near Masaka served as the units of randomization. Hubs were randomly assigned to one of three treatment conditions: The first condition consists of EADD dairy hub services alone, and serves as a comparison group for the presence of CKWs. The second condition consists of EADD dairy hub services with the addition of CKWs who serve all farmers regardless of whether they have dairy cattle. The third condition is intended to determine the extent to which the effects of the CKW program can be enhanced by increasing access to needed supplies. In this condition, in addition to CKWs, EADD will help each hub to establish an agro-vet shop that will give dairy farmers greater access to dairy-related inputs.

The survey used for the RCT consisted of over 140 questions, plus a series of repeated items for each crop and animal the farmer has, covering (a) demographics; (b) household characteristics, poverty, and finance; (c) food security and health; (d) agricultural production; (e) agricultural practices; (f) CKW key messages; (g) risk adversity; (h) diffusion of knowledge; (i) household decisions; and (j) extension and advisory services. The survey was administered to a random sample of 1,200 households (100 in each hub) as a baseline in August 2012, and will be administered after one year and then again every six months for up to three years or until pre-established impacts are observed.

Summary

The Grameen Foundation's CKW program is an innovative approach to inexpensively supplement existing EAS efforts in a way that reaches the most rural villages and the farmers who are in the greatest need of EAS. Unlike most EAS programs that use ICT, the program uses the latest ICT (smartphones) not as the main focus of the intervention, but rather merely as a key tool used by a large number of lightly trained extension workers. By doing so, the program addresses some of the greatest challenges facing traditional extension programs (e.g., large extension worker-to-farmer ratios and illiteracy) and ICT programs (e.g., access to technology and one way communication that can be misinterpreted).

More importantly, the Grameen Foundation has wisely placed significant emphasis on monitoring and evaluation to inform program management decisions and to ensure the program is having the impacts it was created to have. Because data collection is a crucial component of the CKW program, Grameen has a tremendous amount of data on rural Ugandan farmers, something quite rare for Africa, which will inform international development efforts for many years. Over time, the amount of data

will continue to grow, the ongoing RCT will provide further insights, and the program's promise will likely attract future researchers. Ultimately, the program could not only have a significant positive impact on the lives of Ugandan farmers, but if the model proves to be an effective and sustainable one, people in need of extension and advisory services throughout the world might benefit as well.

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