Introduction

In the summer of 2008, Grameen Foundation received a call from the Gates Foundation inviting us to come over from our Seattle offices for a white-boarding session. The goal was to learn from our efforts using technology to reduce poverty and to brainstorm about how mobile phones could be employed to improve the delivery of agricultural services to poor farmers. Our hypothesis was that farmers could use mobile phones to create dynamic two-way feedback loops between the communities they lived in and the organizations providing services to those communities. We stipulated that these feedback loops would enable farmers to articulate their needs directly to agricultural organizations in the public and private sectors. These feedback channels would help bridge the research-extension divide, fostering an ongoing dialogue between farmers and organizations working in agricultural development.

About Grameen Foundation
Grameen Foundation is a global nonprofit organization that helps the world's poorest people achieve their full potential by providing access to essential financial services and information on health and agriculture that can transform their lives. Founded in 1997, it delivers solutions that respond to the needs of the poor, as well as tools that help poverty-focused organizations become more effective. It focuses on initiatives that can achieve widespread impact and uses an open-source approach that makes it easy for other organizations to adopt them broadly. Nobel Laureate Dr. Muhammad Yunus, founder of Grameen Bank and the Grameen family of companies, is an inaugural member of its Board of Directors, and now serves as director emeritus.

Box 1. Grameen Foundation

In the collaborative sessions that ensued, we discussed how mobile technology might be deployed to address "last-mile" challenges in agricultural extension, including high agent-to-farmer ratios, the difficulty of providing regular outreach in remote areas, and the high-cost, low accountability nature of the traditional one-way training and visit model. We hypothesized that mobile technology could dramatically increase the viability of reaching remote, off-the-grid communities, improve the cost-effectiveness of interacting with farmers regularly, and provide a channel for much needed feedback, allowing farmers not only access to accurate, up-to-date information but also a channel to articulate their challenges and priorities. Speaking with other agricultural extension practitioners, our staff, and partners on the ground, we evaluated what type of model would best facilitate farmer voice. Ensuring farmer participation and promoting a two-way interchange with farmers became fundamental principles of the model that emerged.

At the time we began these discussions, we had been working in the mobile-for-development space for six years. In 2002, we had launched Village Phone in Uganda, a business-in-a-box in which micro-entrepreneurs offered calls and SMS for a fee to those who didn't own a phone or have airtime. We had sold our stake in the Village Phone joint venture in 2006 after it was established as a profitable business line of a major telecom company, MTN. We were also developing five SMS-based information services in agriculture, health, and markets in collaboration with Google and MTN in Uganda. Through this work, we had seen that mobile technology had huge potential to be leveraged as a tool in international development. We were also getting our first glimpse of the importance of thinking about what types of individuals could serve as effective intermediaries to help make mobile phone-based information services discoverable, usable, and relevant. We understood from these early experiences in Uganda that the technology was the easy part; ensuring that the technology would actually be used, and that its use would lead to beneficial outcomes for poor farmers, posed a greater challenge.

Specifically, we grappled with how to increase the accessibility of agricultural extension, improve extension service quality, and make the entities serving farmers more responsive to their needs and more accountable for results.

With these goals in mind, we developed the Community Knowledge Worker (CKW) concept, in which a network of village-level farmer intermediaries would be equipped with mobile phones and would use these phones to facilitate the flow of information between farming communities and research organizations, government extension agencies, buyers, NGOs, and other groups working with farmers. The CKW, we hypothesized, would be critical to the functioning of this feedback loop. As members of farming communities, the CKW would help introduce farmers to mobile information services, teach them how to use the services, contextualize information, and ensure that the information was accessible—even if the farmers weren't literate, couldn't speak English, or didn't have a phone or airtime. The CKWs would play an equally important role in gathering data on farmers' needs and transmitting that information to agricultural organizations. To complete the two-way feedback loop, we would also have to develop partnerships with the actors providing services to farmers. Finally, we recognized that we would need to develop a business model to incentivize the CKWs to provide services over time. Given the focus on monitoring and evaluation in the development sector, we hypothesized that we could sell data collection services to a range of entities. Offsetting the costs of providing extension services, the revenue could then be used to remunerate the CKWs.

The Community Knowledge Worker Model

Years of research have documented the benefits of using an inclusive approach to extension in which farmers are active participants in designing, delivering, and critiquing extension. Using insights from this research we established a channel for farmer voice, recruited farmers to extend information, and facilitated linkages between farming communities and agricultural organizations. Not surprisingly, collective learning emerged as a fundamental component of the model, with a multitude of actors use the CKW channel to communicate with farmers and learn from these interactions to address farmer needs.

As seen in *Image 1*, the CKW theory of change articulates this learning cycle. The cycle begins by engaging communities to select a farmer who will serve as the village change agent, occupying the center of the model. Next, the CKW collects baseline data to better understand farmers, including their adoption of sound agricultural practices. This data then informs how information services are developed
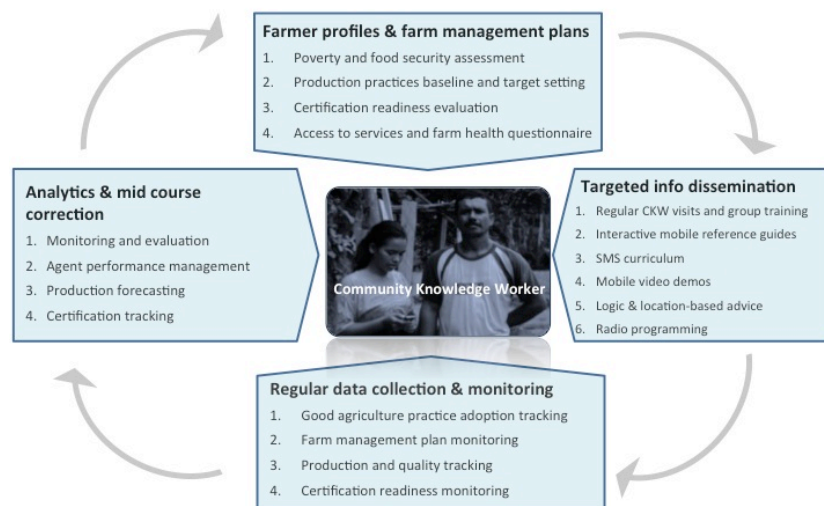

Farmer profiles & farm management plans
1. Poverty and food security assessment
2. Production practices baseline and target setting
3. Certification readiness evaluation
4. Access to services and farm health questionnaire

Targeted info dissemination
1. Regular CKW visits and group training
2. Interactive mobile reference guides
3. SMS curriculum
4. Mobile video demos
5. Logic & location-based advice
6. Radio programming

Community Knowledge Worker

Analytics & mid course correction
1. Monitoring and evaluation
2. Agent performance management
3. Production forecasting
4. Certification tracking

Regular data collection & monitoring
1. Good agriculture practice adoption tracking
2. Farm management plan monitoring
3. Production and quality tracking
4. Certification readiness monitoring

Image 1. CKW Learning Cycle

and targeted to farmers. On-going monitoring and evaluation efforts are used to track farmers' feedback on service value and to monitor how farmer behavior changes. Finally, farmer feedback is analyzed to design and deliver new and improved services.

The Evolution of the CKW Model: from pilot to expansion

Validating the model

After developing the CKW concept, the next step was to test the model's potential to deliver value to poor farming communities in Uganda. We embarked on an intensive six-month pilot in which we recruited 40 CKWs in two distinct cultural, linguistic, and agro-ecological zones. Each month we prototyped a new information or data collection service with the CKWs and farmers. We innovated rapidly, co-designing and deploying the services with the CKWs. On a monthly basis, we solicited feedback from farmers, CKWs, and partners concerning the value and relevance of the information services, the usability of the technology, and the utility of the data. During this period, we had fast iteration cycles in which we tested rough concepts as opposed to robust products, trialed multiple mobile devices and channels, and relied heavily on the qualitative feedback from CKWs, with whom we remained in constant contact. We responded quickly to feedback. For example, we eliminated basic phones and SMS-based data collection when we realized that smartphones' utility and value far outstripped that of basic phones once we factored in the cost of SMS data transmission. We experimented broadly, relying not only on the feedback we gathered from farmers but also on our own observations as to farmers' usage of different mobile channels and their demand for different information topics.

It was a period of intensive learning. Initially, we harbored our fair share of doubts. In our first training we focused on helping CKWs learn how to use a mobile phone. Some CKWs had never owned a phone; other older CKWs could barely read the screen because they didn't have reading glasses. The CKWs' hands were weathered by working in the field, meaning that they, in their own words, had "big thumbs" that made the error rate typing on tiny keyboards high. Despite fears that because many CKWs could barely send a text message, they would never master the phones' more complex functionality, the CKWs quickly proved us wrong.

Early in the pilot, we hosted a group of leaders and donors in the field and invited CKWs to discuss their experiences. As we began the discussion, the visitors took out their cameras and started taking pictures; the CKWs, in response, took out their phones and began taking photos of the visitors. At this point, it had already become evident how comfortable the CKWs had become with their phones; for example, many had downloaded additional applications, one regularly filmed church services for the sick and elderly, and another bought a projector that he connected to his phone to create a village movie hall. The CKWs had independently adapted the technology to create additional value. Watching the CKWs and the visitors filming each other was an ironic reminder of our innate ability to learn and our natural tendency to innovate.

In addition to initial doubts about the CKWs' ability to master new technology, we wondered whether farmers would find the information useful, whether they'd trust CKWs, and whether the data CKWs collected would be accurate enough to convince organizations to pay for data collection. Within the short pilot, each doubt was refuted. For example, working with Uganda's National Agricultural Research Organization (NARO) and IITA (Institute for International Tropical Agriculture), we tested a diagnostic survey that enabled CKWs to help farmers identify which banana disease they had present on their plantation and use that diagnosis to teach farmers

how to control the disease. Farmers found the diagnostic surveys and disease control information so useful that CKWs had to travel outside their sub-counties to meet farmer demand. Over a period of two months, 38 CKWs collected 2,991 geo-tagged surveys with disease photos—compared to 120 surveys that had been gathered by research organizations up to that point. Survey analysis and on-site follow up visits by scientists confirmed that CKWs had achieved an accuracy rate of over 95 percent in their survey diagnosis.

Despite our initial doubts, these encouraging results boosted our confidence about the model's fundamentals. Due to the pilot's iterative nature and small scale, we had the ability to be highly responsive to farmer feedback delivered via the model. As we moved to scale the program, we had to make major shifts to formalize the feedback loops the CKW model enabled. Although it was much more difficult to capture and act on that feedback at scale, we continued to use the feedback captured to adapt program design, and, with time, we internalized the learning to make modifications to deepen the value farmers received.

Scaling the Model
During the scale-up of the program in Uganda, we realized a number of achievements that further validated the CKW approach. For example, over four years we deployed 1,300 CKWs who generated more than 1.5 million interactions with farming households, proving the ability to scale and setting us apart from the many ICT for development pilot projects in the sector. We developed a robust set of mobile tools, delivered over multiple channels, that we offered to development partners. We responded to farmer information demands by building out our content base, eventually covering 58 farming enterprises (*i.e.*, crops, livestock) and providing market prices at more granular levels than other providers. In addition, a wide range of industry clients commissioned CKW data collection. There was also substantial demand for services by extension organizations and farmers. In total, over for a four-year scale up period, we generated $1,108,085 in earned revenue through our CKW extension and data collection services.

Most importantly, we saw positive indications that CKW services could effectively influence farmers' adoption of good agricultural practices and improve their price realization. The International Food Policy Research Institute conducted an evaluation of CKW services, finding a 17% increase in farmer knowledge of best practices, a 22% increase in price realization in maize, and a 34% increase in access to extension services. In partnership with Palantir Technologies[1], we also performed internal analyses of dairy farmers served by CKWs under the East African Dairy Development initiative; we found a positive correlation between farmers' adoption of best practices and usage of CKW services. Additionally, Innovations for Poverty Action (IPA) carried out its own evaluation of the quality of CKW data collection services and found that CKW services were equal to those of IPA-trained enumerators in 78 percent of evaluation criteria.

The Challenges of Scaling-Up and Implications for Learning
Although these results were encouraging, we realized that we were receiving feedback that suggested new opportunities to deepen the model's value. Equipping village level intermediaries

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[1]Palantir Technologies builds software products that enable organizations to solve their hardest data problems and overcome their most complex operational challenges. To achieve this, they build platforms for integrating, managing, and securing data on top of which they layer applications for fully interactive human-driven, machine-assisted analysis. Grameen Foundation has been partnering with Palantir Technologies under their Philanthropy Engineering initiative since 2011.

with mobile devices *did* create dynamic two-way feedback loops, but we found less-than-anticipated gains in accountability and improvements in our partners' service delivery. Internally, we acted on this feedback to improve our information services and to refine the CKW operating model. However, we did not make more substantial modifications to deliver greater value to farmers and partners as quickly as we hoped. This was in part because the necessary changes required substantial shifts in our strategy, and in part because we did not initially have the all the pieces in place to link insights to action. We also recognized that in some cases we were not listening to what the feedback was telling us.

With time, we gained insights on what changes we needed to make to ensure that we were learning from our efforts and maximizing the value we were delivering. As the quantity and sources of data increased, we needed to invest in more powerful analytic tools—and more skilled data analysts—to sort through the data and extract meaning. We needed to simplify the data and make it more accessible through automation and visualization and we needed to ensure it was embedded in our own processes, as well as those of our partners, so that we could act upon it. We also needed to shift our approach to working with partners from providing turnkey solutions to embedding the technology and the CKW network within their businesses. In addition, we needed to adjust our operational model and organizational structure to promote greater responsiveness to farmer needs and increased accountability to our partners and donors. The feedback and results we saw during the initial scale-up period also made it clear it was time to go back to our strategy and evaluate the impact we were delivering, how we could maximize it, and the importance of measuring and proving our impact as a precursor to scaling and sustaining the model. We used the lessons from our successes and failures during the scale-up period to improve our accountability for results, refine our strategy, modify our approach in Uganda, and design initiatives in new geographies.

Expanding the Model
Expanding the model to new geographies provided a number of opportunities to adapt and improve our model. The agility offered by again being in pilot mode, without aggressive sustainability and scale targets, allowed us to test new service components. In Kenya, Grameen Foundation worked with Farm Concern International and SMEP, a local microfinance institution, to adapt the CKW model to deliver an e-Warehouse solution designed to mitigate smallholders' dependence on seasonal cash flows, which force farmers to sell when prices are lowest. E-Warehouse is a virtual warehouse receipt-lending and bulk-buying platform that enables farmers to use their stored grain as loan collateral while assisting them to maintain the quality of their stored grain at the farm, group, or village level. Farmer groups are also able to bulk and sell their grain through the e-Warehouse solution, which provides payment processing to individual farmers via mobile money or directly into farmer bank accounts. CKWs register farmers in the system before the season begins and then provide training on good agricultural practices, post-harvest handling, and localized storage techniques throughout the growing season to increase productivity. Following these practices reduces the risks of harvest spoilage that deter lenders from providing financing to farmers. CKWs also provide information and education on loan products. At harvest time, CKWs visit registered farmers and complete a harvest survey which determines the loan amount that individual farmers are eligible to receive—equal to 50% of the their crop value at current market prices. These loans smooth out farmers' incomes, allowing the farmers to hold grain until they can fetch higher prices.

In Latin America, we have used learning from what worked and didn't work in the original CKW program in Uganda, to deliver three solutions that leverage the CKW model and mobile tools. In our Cafeteros Connectados (Connected Coffee Farmers) program, we rolled out a network of CKWs with a targeted mandate to drive productivity increases, promote Fairtrade and Starbucks' CAFÉ Practices certification, and improve quality. Partnering with Starbucks and coffee producer cooperatives in Colombia and Guatemala, we profile cooperative members and then use the needs surfaced during profiling to help producers develop farm management plans. These plans help farmers get on track for certification schemes and identify ways that farmers may adopt better practices to boost productivity. In addition to targeting producers and assisting cooperatives to deliver more effective technical assistance, Cafeteros Connectados aims to deliver value up the value chain by increasing the visibility of coffee production levels, quality, and certification compliance among buyers, exporters, and other key market players.

In Colombia, we also work with a horticulture association, Al Sur, which sells 75 different crops to six grocery store chains, each of which has its own quality standards and packaging requirements. On a daily basis, the association consolidates orders for each crop from the grocery stores and sends the orders to their farmers. There is frequently a mismatch between supply and demand, and produce that does not meet quality standards is rejected. As a result, farmers miss the opportunity to sell more of their crops and lose revenue on the rejected produce. The association performs the ordering, fulfillment, and reconciliation manually using pen and paper, white boards, and by calling farmer leaders who then call farmers in their network to fill the orders. Given these inefficiencies, it takes farmers weeks to get paid. It's also difficult for the association to expand its farmer base because it doesn't have a clear picture of fluctuations in supply and demand for each crop or knowledge about the individual farmers who supply produce. To address these challenges, Grameen Foundation worked with farmers and the association to design a mobile sourcing solution. Working closely with association staff, we digitized sourcing processes and equipped farmer group leaders with mobile devices. Farmer leaders now use the mobile device to view and fulfill orders, track farmer contributions by crop and grocery store chain, reference quality requirements, and order packaging materials.

Finally, we work with a government partner in Colombian, MANA, which focuses on improving food-security and nutrition for over 25,000 of the poorest households in the region. In this case, the intermediaries are managed by government contractors and provide inputs and training on how to establish backyard gardens and how to improve household nutrition. The intermediaries use mobile devices to register households, track the delivery of inputs, log trainings, and provide information on agricultural techniques and nutrition practices. They also use mobile phones to monitor food security and track household food consumption. The government uses the system to manage the performance of its contractors and their intermediaries, evaluate which interventions are delivering the most value, link program recipients to other government programs, and monitor how household nutrition is changing over time.

Leveraging Mobile Phones to Enable Feedback Loops

Our experience with the CKW program has demonstrated that mobile phones provide a highly appropriate and effective tool for reaching more farmers at the last mile with far greater frequency than possible via traditional extension methods. The mobile channel has also enabled us to capture farmer feedback on regular basis. In the CKW program, we used the mobile phone to engage communities in providing feedback via three primary channels: i) mobile surveys, ii) a

real-time two-way feedback application called Pulse, and iii) a field force management application that enables Grameen Foundation and partner organizations to track field agent performance. In addition, we conducted analyses on usage statistics of information services including a mobile reference guide called CKW Search, SMS campaigns, and our farmer call center. These feedback channels and tools are outlined in *Box 2*.

Tool Description	Purpose	Data Collected	Frequency
Mobile Surveys			
Industry surveys	Understand farmer needs/ demands	Policy topics; e.g. access to services, farmer needs	On-demand
Farmer registration	Create a system for tracking farmer demand and behavior	Poverty, gender, agriculture enterprises, food security	Ongoing
Partner surveys	Monitor changes in impact indicators	Change in knowledge, attitude, practice	Baseline, endline
Adoption survey	Track changes in farmer knowledge, attitude, practice	Adoption of practices & use of CKW services	Annual
Farmer satisfaction survey	Gage program quality	Satisfaction with program and CKW service delivery	Annual
Farmer group participation survey	Track CKW outreach	Farmer participation & topics	Weekly
"Pulse"			
Two-way real-time data messaging channel linked to ticketing system	Answer CKW and farmer questions on agronomic and program topics	Payment and performance	Ongoing
		Program feedback	
		Content requests	
		Complaints	
		Technical issues	
Field Force Management			
Mobile "jobs" split activities into distinct tasks to be completed with specific farmers	Program and coordinate field activities	Task list and instructions	Monthly
Real-time target setting and tracking on phone/web portal	Set and track field targets and target field support	Performance targets	Monthly

Box 2. Tools for enabling feedback loops

Farmer registration is one of our most important tools for capturing feedback and has been administered by CKWs to the over 200,000[2] farmers we reach today in Uganda—an achievement which would have been cost-prohibitive using most other channels. The registration form asks questions designed to assess the probability that a household is below international and national poverty lines using Grameen Foundation's Progress Out of Poverty (PPI) tool and to evaluate food security. It also captures basic farm characteristics, such as farm size and primary enterprises, and details about individual farmers, such as gender and age. Capturing this data allows for market segmentation and needs assessment oriented toward different groups such as the very poor or women-headed households. As a result, the farmers we serve are visible as individuals with specific needs. This is a substantial and important development, as the rural poor are too often regarded as a single, generic market even though they may constitute 80% of a developing country's population.

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[2] We actually have over 300,000 farmers registered in the system. Based on our challenges using unique identifiers (more on this later), we are undergoing a data cleaning exercise to delete suspect and duplicate records. However, we expect to have reached 200,000 farming households based on calculations and analyses of CKW outreach.

We also use mobile forms to conduct annual farmer surveys, using feedback from these surveys to prioritize the development of content, design new services, and to address pain points in the field. In addition, we collect farmer adoption surveys on good agricultural practices for the extension partners with whom we deploy CKWs. These surveys enable our partners to track behavior change and assess and improve the effectiveness of their extension efforts. Finally, we historically conducted monitoring and needs assessment surveys on topics like water resource management for industry clients like the World Bank[3]. Clients used the information to evaluate their programs, scope interventions, inform policy, and develop new services.

In addition to collecting data, we also use the mobile channel to solicit direct feedback from farmers on service quality. We have created a two-way, real-time data channel called Pulse that lets CKWs send in questions, comments, and challenges. This channel provides farmers with a voice to share their perceptions of the program. At any point, farmers and CKWs can submit a comment through Pulse or by calling our farmer call center. Dedicated customer service agents and call center operators address feedback from Pulse and use a ticketing system to direct each query to the relevant Grameen Foundation team member so that they can be resolved, documented, communicated back to the CKW, and closed. As illustrated in *Box 3,* farmers have provided various types of feedback via Pulse, for example, suggesting topics

Box 3. Feedback from CKWs illustrating farmer demand

they'd like covered in the information services (*e.g.*, bee-keeping), pointing out where the information provided was insufficient (*e.g.*, disease control in plantain crops), and offering ideas for new products and services (*e.g.*, a directory of agrochemicals on sale from the local banana company). CKWs have also used the channel to raise challenges with operational issues such as phone repairs and payments. These qualitative channels are critical sources of feedback as they enable us to have a dialogue with farmers in real-time on a regular basis. Frequently this qualitative feedback has been easier for staff to digest and act on then the survey data we collect. We've also shared this qualitative feedback with our research and extension partners, and then fed new content from those partners back out to farmers.

In addition, we have leveraged mobile technology to support and promote accountability among the dispersed networks of field agents and staff serving farmers in remote areas. Often agents themselves are disconnected from the organizations they work with; agents frequently are not accountable or recognized for the work they do, have few channels for communicating with their organizations, and receive little guidance on how to perform their work. Recognizing

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[3] We have decided to discontinue these services in line with our insight that we needed to narrow our focus and prioritize impact over revenue generation.

mobile technology's potential to remedy these challenges, Grameen Foundation created a separate unit that focuses exclusively on developing mobile applications for social business clients. The product suite, called TaroWorks, includes a mobile field force application that allows organizations to remotely task agent work and set and track performance goals. Agents use the mobile application to view and track targets while field supervisors use a web portal to set, assign, and monitor agent projects. Today we use this application to create a series of jobs with sub-tasks that CKWs need to carry out with specific farmers, whose identities are logged into the system and shown with pre-populated data fields (such as farmer names and IDs). We are able to track the overall performance of different agent groups and individual CKWs and our partners can see performance hotspots at a glance via dashboards. Using this capability, we are better equipped to track challenges in the field, monitor which intermediaries need support, and identify opportunities for improving field force accountability.

Box 4. Dashboard illustrating agent outreach to farmers

As these examples demonstrate, mobile technology can be incorporated into program design not only to accomplish direct objectives—such as training farmers and collecting crop data—but also to make systems more transparent. Mobile devices provide a mechanism for communities (and individuals) to evaluate the services they receive and to provide qualitative feedback. Mobile devices also make it easier to monitor and support field agents, providing more consistent guidance while promoting accountability by tracking extension outreach and quality.

Building mobile feedback loops to support collective learning
Use the two-way capability of the mobile channel to create dialogue with end-users. It can be tempting to focus on only information dissemination or data collection, but once the channel has been established there's substantial value in ensuring two-way information flows. This two-way capability is essential in facilitating inclusive feedback and participatory learning
Leverage the basic phones already in the hands of users *and* deploy smart phones with intermediaries to balance the reach of basic phones with the rich feedback and content that smart phones enable
Track and analyze mobile services usage to gain additional insights into demand and interest that users may not state outright

Box 5. Learning on how to leverage the mobile channel to enable feedback loops

Leveraging Networks of Local Change Agents to Enable Feedback Loops

Scaling the CKW program, we learned that while the mobile channel is an excellent mechanism for capturing feedback from farmers, it also plays an important function in delivering value back to communities. One element that promotes this value exchange is the use of village change agents. From our work with Google SMS, we learned that mobile solutions are rarely sufficient to create responsive and effective feedback loops that lead to learning and improved results. Enlisting a local intermediary is an essential ingredient; *Image 2* shows a CKW in Colombia.

A critical element of the CKW approach is the CKWs' relationship to the communities they serve. The CKW's role as a trusted representative of the community not only ensures that feedback loops are as close to the end-user as possible, but also that farmers will have confidence in the system—both receiving assistance and providing valuable feedback. An intermediary increases accessibility for those who aren't literate, who don't own a phone, or who are less comfortable with technology. By living in the communities in which they work, CKWs are also accessible to farmers in their own settings, whether

Image 2. CKW serving coffee farmer

at the market, in the field, or at a social gathering. These quotidian interactions encourage on-going dialogue and avoid the power dynamics that an outsider introduces.

Image 3. CKW recruitment efforts

The selection of CKWs is arduous, as illustrated in *Image 3*. After soliciting lists of eligible candidates from our partners, our teams go village by village to select the CKWs with the participation of the individual communities. We publicize the nomination process on radio stations and in other social forums (such as churches and mosques) and solicit wide community participation. In the selection meetings, we share our learning on what makes a CKW effective and then provide the initial list of partner-nominated candidates. We then encourage the communities to debate who would make the best CKW.

To ensure that a CKW will be effective we encourage communities to select someone who is trusted by the community, has a deep commitment to community service, has some leadership experience, is a permanent resident and a farmer, is literate in English, and has the time and mobility to visit farmers. These criteria have been developed through years of observing which CKWs tended to be successful in the program. Some demographic groups are less likely to be eligible for the CKW position or, if eligible, to stick with it. These groups include recent graduates (who often drop out of the program when they receive full time job offers or move to other locales), the elderly (who are less mobile), and women and the poorest (who are less likely to be literate in English and have less time available because of other household requirements).

While these criteria were developed to maximize program effectiveness, we recognize that they may exclude certain already-marginalized groups and might further exacerbate power dynamics by bestowing influence on individuals who already enjoy more resources. To mitigate these risks, we monitor the percentage of poor and poorest who access the services, set targets for the participation of women as CKWs, and speak to the importance of using the services for community gain during CKW selection and training. While political interests and power dynamics do surface, our facilitators remind the communities of the criteria, and communities usually select CKWs who serve with success and receive high farmer satisfaction ratings.

Given the high costs associated with soliciting community input at the selection stage, we tried to cut out community participation in later iterations of the model. However, we reverted back to our original approach as we learned that participatory selection plays an important role in

validating the CKW's position. A community's trust in the CKW—and long-term participation in the feedback process—depends on meaningful involvement in the selection process.

This trusted relationship between the CKW and the community touches almost all elements of the CKW's work. It also creates a social contract in which the community expects the CKW to deliver value in return for receiving its trust. To maintain the delicate balance between the CKW and the community, the mobile channel should be used bilaterally: not just to gather data on farmers but to provide useful information back to them. Communities also expect us (and our partner organizations) to be responsive to the feedback they raise. Sharing useful new information on, for example, New Castle disease in chickens, after a farmer has requested it, deepens the trust between the CKW and the community. A CKW's prominence in a community also serves as an incentive in sustaining the two-way flow of information. CKWs receive social prominence through selection and their ongoing visibility in the community; this provides motivation for them to serve their community and reach the community's poorest members.

Applying the model to new geographies, we saw that these core principles—creating a trusted relationship between a CKW and the community, and involving the community in the selection process—hold across cultures, continents, crops, and languages. However, fostering a trusted relationship between a CKW and the community needs to adapt to fit local cultural norms. For example in Cote D'Ivoire[4], it was less acceptable for a female farmer to deliver information to male farmers. There, we worked with local stakeholders to develop the concept of a "couple CKW," as seen in *Image 4*, in which the husband and wife would work together to serve their community.

Image 4. "Couple CKW" in Cote D'Ivoire

The CKWs also serve as important agents in the learning system, identifying new ways of interacting with their communities and adapting the mobile services to deliver value. That active role in interpreting the program's value at the village level creates a bridge between the communities, Grameen Foundation, and our partners. The CKW reduces the divide between the service provider and the beneficiary, promoting a greater sense of ownership for program results in the community in which the CKW lives. CKWs not only bring feedback loops within reach of farmers but also make it more likely that farmers trust the information exchanged and, in turn, more likely that farmers act on the information. *Box 6* outlines these findings.

Leveraging trusted change agents at the last mile to enable feedback
Leverage existing village level networks to ensure agents are accessible on an ongoing basis
Involve the community in the selection of agents to ensure that the community will trust the agent and provide candid feedback an outsider might not be able to capture
Select agents who have a commitment to serving their communities and use incentive schemes that tap into and reward this intrinsic motivation by showcasing CKW contributions to their communities

Box 6. Learning on leveraging trusted change agents to enable feedback loops

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[4] In Cote D'Ivoire, we recruited 150 CKWs but ultimately did not deploy the network due to shifts in the political landscape in the cocoa sector.

Using Data to Drive Insight and Learning

Examples of data analyses enabled through the CKW channel in Uganda

Employing mobile devices opens up tremendous opportunity to analyze data to inform learning and improve service delivery. In the case of the CKW model, our farmer registration system enabled us to analyze farmer behavior at scale to glean insights on farmers and how to improve the services we offered. Once a farmer is registered in the system, we can track farmer demand for mobile information services by monitoring which types of users access which topics and at what frequency. Each time a farmer interacts with a CKW, either by asking a question about farming or completing a survey for a partner or client, the farmer ID is logged. Analyzing usage data against farmer registration data has enabled us to identify trends and tailor services more effectively for different types of farmers. This ability to observe behavior by monitoring usage trends is a powerful mechanism for

Image 5. Heatmap of baby chicken blight developed by Palantir Technologies by analyzing CKW Search queries on the disease

understanding demand. For example, we observed that 60% of queries in the first year were related to pest and disease management, market prices, or weather. This data helped us realize that the on-demand channel works particularly well for dynamic information that changes regularly and for responding to a challenge or threat on the farm. However, it was less effective at changing behavior on other good agricultural practices, as farmers were less likely to proactively ask about those topics. In those cases, sending information directly to farmers on their own phones was a better tactic to build awareness and drive behavioral changes. Based on this insight, we used targeted SMS campaigns and CKW led farmer group meetings to promote greater adoption of practices such as post-harvest handling. Monitoring farmer queries can also be used to develop early warning insights, as illustrated in *Image 5*, which shows how disease queries were used to identify disease outbreaks.
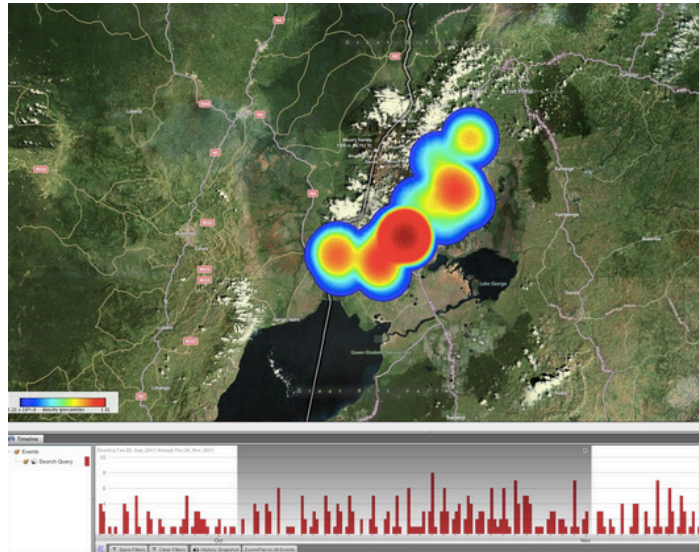
We also correlated usage analyses against CKW performance data to better understand how CKW characteristics such as age and gender impact outreach. We observed that CKWs who were effective at disseminating information were not always as strong at collecting data. For example, more elderly and female CKWs were likely to be lower performers when it came to data collection because of the time commitment and travel it required, but were quite effective at disseminating information—particularly in reaching more disadvantaged users, such as female-headed households. Despite their strength as educators, these CKWs were penalized in the performance management system. Using this information, we created a tiered CKW structure in which those who were high performers in data collection—and presumably had time and ability to travel to survey locations—were assigned more surveys and paid more for the additional work. This structure provided a role for CKWs who might not be able to collect as much data but who were champions in providing information to disadvantaged farmers.

Challenges with data and its analysis

During program scale-up, we encountered challenges that led us to learn more about what metrics to employ and, more crucially, how to visualize, automate and embed data analyses in organizations to promote learning and change. Because the mobile channel generates and makes it easy to collect large quantities of data, data analysis can become unmanageable if there is not an accompanying investment in analytic capacity on a human and technological level. The sheer quantity of data we collected and number of data sources, including over 1.5 million logged program interactions, initially made it difficult to store and analyze the data. Storing that much data in the cloud was costly and required exporting it from local servers to data analysis tools, which often took hours; exports frequently timed out requiring our analysts to start again. In addition, correlating data from multiple different sources to identify trends required specialized software. It also meant that there were many more possible analyses that could be run and more potential for "noise." Although this was not a problem in itself, it required greater staff expertise to design appropriate analyses to derive meaning from the data.

We also struggled to develop a reliable unique identifier for individual farmers and households that farmers were able to remember. It is essential to have a unique identifier to track farmer interactions with CKW services, which then provides insights on behavior, demand, and pain points. In some countries where we work, national ID systems are available and farmers know their numbers; in many other countries (including Uganda), national ID systems either do not exist or if they do, many individuals do not have IDs or cannot remember their numbers. We considered using farmer phone numbers but we saw that over 50% of our farmers didn't own a phone; those who did would often change SIM cards to take advantage of carrier deals. This problem was specifically challenging because CKWs need to register and interact with farmers offline and may not connect with the system for days, meaning that it was not possible for us to auto-generate an ID without significant investment in the mobile application.

To address this challenge, we developed an ID system in which CKWs provided farmers with a physical card with a unique ID that they could reference when using CKW services. CKWs were instructed to provide these cards to farmers at the time of registration. However, a number of challenges quickly arose. It was difficult and costly to ensure CKWs maintained a stock of ID cards, and when farmers would lose their card or forget their IDs, CKWs would sometimes register the farmer in the system again. The ID issue was also problematic when farmers addressed CKWs in a group setting where it was time-consuming to register a new farmer and disruptive to enter each individual farmer's ID. As a result, CKWs would sometimes use one farmer's ID to answer all questions in the group. Overall, the ID system was burdensome for CKWs and farmers alike, leading to duplicate registrations and misattributed searches. The result was "dirty" data that required significant cleaning and quality control investment by staff and created challenges when trying to correlate the usage of CKW services with changes in farmer behavior. As a result, despite our wealth of data, we weren't able to extract enough meaningful indicators of program impact and communicate them to key decision makers.

Partially related to challenges associated with extracting meaning from the data, the CKW program in the early years emphasized activities, outreach, and financial indicators, which tended to be significantly easier to automate and visualize, over metrics that were more closely tied to value, like changes in adoption of specific good agriculture practices, productivity gains, or improved prices. Not surprisingly then, we focused the automation of our analytics on outreach and output indicators, such as the total number of surveys completed, what

percentage of our users lived below $2.25/day, and how many farming households CKWs had reached. While these statistics were useful in telling us whether or not we were achieving operational and equity goals, they did not tell the full story on the impact we were delivering.

We did include two metrics in our electronic dashboard in Uganda that were more closely tied to the value the system was delivering: farmer adoption rates and repeat usage. In an annual adoption survey, CKWs ask farmers to report if they have adopted one or more practices they learned about through CKWs over the past year. Our adoption surveys have consistently shown farmers reporting around 70% adoption rates. [5] The repeat usage rate is calculated automatically via the technology platform, measuring if a farmer asks a CKW more than one question per quarter. Our repeat usage rates range between 20-25% per quarter. Both of these statistics are encouraging, especially in agricultural extension, where a farmer often sees an extension agent no more than once a year and often not at all.

However, we still struggled to use these indicators to inform program modifications. In the case of annual adoption surveys, the breadth of topics we covered made it difficult to derive meaning from the adoption statistic. Largely in response to farmer demand, we provide a broad set of information services and have partnerships that span multiple value chains, subsistence crops, and livestock. With over 1,000 best practices spanning the 58 enterprises we cover, it was difficult to track changes in adoption or productivity for specific practices and crops. The blanket adoption statistic we regularly reviewed did not capture which practices were delivering the most value to farmers, or how those adoptions affected farmer livelihood. In order to take action to deepen value, we needed more specific information. At the partner level, we did measure adoption statistics specific to the value chain or intervention in which the partner worked via baseline and endline surveys conducted by CKWs. However, this more meaningful adoption indicator was not reviewed at management levels. Further, due to the challenges of analyzing disparate data sources and challenges with farmer IDs, it was difficult to effectively correlate farmer usage of CKW services against changes in farmer behavior.

Examples and lessons on how to conduct data analysis to drive value
Based on these lessons, we have made adjustments that allow our partners and us to measure value in a way that wasn't possible before. From our initial experiences working with the data collected via the CKW program, we have learned how to design data collection, data analyses, and reporting to drive learning and deliver value. For partners to act on the collected data, they require a handful of simple but specific indicators that quantify the impact their programs are delivering. They also need data analytics that are delivered in real-time, within their decision processes, in easy-to-digest visual graphics that allow them to easily extract meaning. Understanding what data our partners were already collecting and how that data fit into their business processes and decision structures enabled us to co-design dashboards and reports. Using that information, we configured our technology platform to run automated analytics and visualize key indicators in dashboards that are directly accessible to our partners. For example, we developed an automated food security scoring tool using Freedom From Hunger's methodology. The system automatically provides a score for each household, and that score is then visible at aggregate and household levels through a web portal as seen in *Image 6*. Designing reports that map to specific points in iterative decision cycles that staff can reference

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[5] Data validators back-check a percentage of those surveys to assess if there is statistically significant difference between the adoption reported to a CKW versus that reported to an external verifier.

on a regular basis is another way to promote data use. These findings highlight the importance of training partner staff on how to create and use data analytics.

In Colombia, for example, we work in partnership with the Government of Antioquia. Prior to the partnership, the Government's food security program, MANA, collected data on all of its participants yet only analyzed data on 10% of households due to the costs associated with digitizing paper forms and performing analysis manually. It would often take six months to a year to answer a particular question given the time it took to collect, send, digitize, and analyze data. Today, the program has access to data on all the households it serves in real-time and uses automated reports to improve programming and operational efficiency. For example, analyzing surveys and
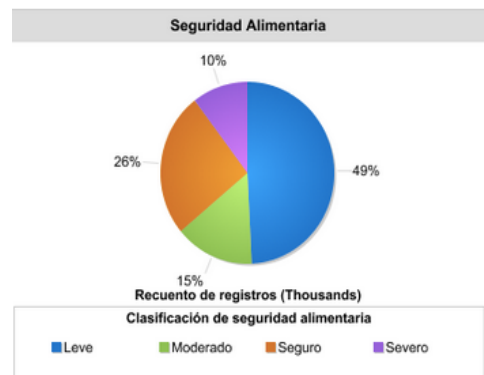

Image 6. Food security analytics

matching them to government databases and food security scores, revealed that some of the families included in the program were neither poor nor food insecure. In these cases, the government has used the data to require that operators include only those families that meet program criteria. Data analysis also brought attention to the fact that the chickens being provided to households to serve as a source of on-going protein (by egg consumption) were being consumed within a few weeks of delivery. In response, the program no longer include chickens as part of the backyard garden kit, focusing instead on inputs that have proven more effective in driving positive nutritional outcomes. The program also tracks its field agents' outreach by the food security level of program beneficiaries to assess which agents are most successful—and which struggle most—in helping households become food secure. The government program could only take this kind of ownership over the information once staff members had direct access to the data. This experience has illustrated that learning gleaned from data can only be used to improve service delivery to poor communities if it is accessible.

In the case of the m-Sourcing program in Colombia, the data that is collected is now automated and aggregated in reports by grocery store client, farmer cooperative, farmer, and product, thereby substantially reducing the time it takes to pay farmers. Previously, a full-time staff position was dedicated to manually generating reports from paper receipts that were issued daily and had to be collected from each farmer cooperative. Today, this task has been eliminated. The data has also allowed the association to track when stores reject produce, in order to identify which farmers and cooperatives require more support to reduce future losses. With this new visibility into its operations, Al Sur has learned where farmers face challenges, has tracked demand and supply fluctuations over time, and has developed plans to expand its business to new stores and additional crops using this information.

Embedding Feedback Loops and Analytics for Results

Why feedback didn't always lead to improved results
Although we co-designed CKW deployments with partners in the scale-up period in Uganda to accelerate the success of their interventions, after the initial design was complete, Grameen Foundation did the vast majority of the "heavy lifting" to get a CKW project running. We offered a turnkey solution in which we recruited, trained, supported, and monitored the CKWs, we input

partner surveys and content into the system, and we performed all data analysis ourselves. Although partners were very active in providing inputs and designing content and surveys, they usually didn't have direct access to the technology platform and were multiple steps removed from the CKWs in the field. This meant that the CKW services were never embedded in a partner's infrastructure and partners ultimately didn't take ownership of the CKW services. While partners usually perceived value in the services CKWs provided, they weren't always able to pinpoint that value; they felt little ownership for the results and did little to adapt the services to drive additional value. As a result, the feedback the system generated was less apparent to partners, making it less likely that they would learn from the feedback.

In addition, the learning the CKW program generated was often divorced from the partner's decision-making and operational infrastructure. During the initial scale-up, we would present findings from data analyses to partner management in quarterly steering committee meetings that covered multiple agenda items. We would spend a short time reviewing findings and move on. Often the staff responsible for the areas highlighted in the data analyses were not in the room or, when they were, they were skeptical of the results and saw the data as a threat introduced by an outsider, rather a tool they could use themselves to improve program results. Ultimately, the majority of the feedback coming in through the model was going to Grameen Foundation rather than to the partner and was therefore disconnected from the day-to-day decisions and actions of partner staff. This lack of ability to present where a partner's intervention was succeeding and failing made it difficult to prove the full value of the model.

Linking learning to action by embedding feedback loops in a partner's systems
Based on this experience, we recognized the importance of not only designing services with the partner but also embedding the technology and the last-mile, mobile-enabled agent network within a partner's infrastructure. By embedding the model components in partner systems, we promote both ownership of the feedback loops and greater accountability for using information exchange to drive results. This shift towards embedding solutions within the core business of our partners, whether public or private, demands that we, at Grameen Foundation, be more flexible and agile in our approach so that partners can adapt the technology and methodology to fit their own needs. We have had to modify our technology to make it more modular and standardized so that it can be configured to meet the specific needs of a particular partner. This also holds true for our approach to leveraging agent networks. The basic fundamentals of the trusted intermediary remain the same, but the specific tasks that an agent performs or who that agent is within a partner's ecosystem, varies. For example, in our mobile sourcing program, an agent's primary role is still to facilitate two-way information flows; however, agents have shifted their focus to connecting farmers to markets, as opposed to delivering extension advice.

To embed effectively, we involve the partners in program design, deployment, and support, identifying key staff members who will own and operate the technology and field agent components. Partner staff are not only involved in designing services but also trained on CKW methodology and how to be tech system administrators. They learn how to build mobile surveys, create and run reports, and input content for information services. Similarly, although we offer standard tools for the value chains we work in, we help partners to digitize the forms and content they are already using. Partner field agents, which previously did not receive CKW kits, are now not only equipped with mobile devices but also use the mobile phone to perform their existing work. If a partner chooses to deploy additional village level agents, those agents are recruited, trained, monitored and supported by the partner field staff.
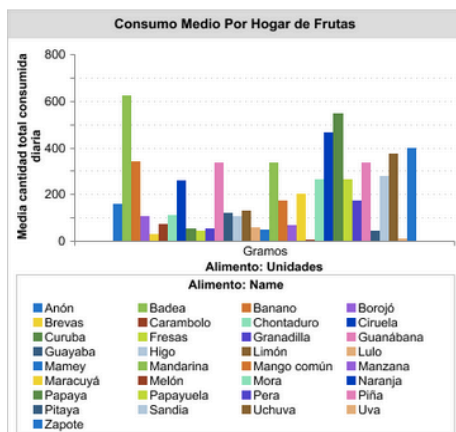
Image 7. Automated report showing household food consumption

Because the services are embedded in the partner's systems, partner staff are better situated to internalize and act on the learning generated by the CKW approach. For example, partner staff have identified ways to use the services to drive additional value that Grameen Foundation would not have otherwise proposed, illustrating the type of adaptation and adoption that is needed to sustain services on a long-term basis. For example, partner staff on the MANA food security program realized they could use the system to automate the calculation of household consumption of key nutrients, saving them considerable time and enabling them to easily identify in which nutrients families are deficient, as illustrated in *Image 7*. By analyzing the system's data, MANA staff also realized that 50% of children under six in their program were not benefiting from the government's infant feeding program, which provides milk and fortified biscuits to malnourished children. MANA now uses that data to enroll eligible households that had previously been excluded.

Cultivating a Learning Culture

In addition to developing feedback loops, we realized that we would also need to promote a learning culture to ensure that we were constantly attuned to where we were succeeding and failing as an organization. Proving our assumptions and getting the operational model right would be critical during the pilot and initial scale-up and would require active learning and mid-course correction. Due to its pilot nature, learning was an innate component of the original CKW pilot and it emerged dynamically and organically as we tested different approaches. Listening, and responding, to farmer needs became more difficult as we scaled. By examining the points at which we fell short in internalizing our learning and acting on it, we have been able to glean insights around how to enable collective learning. In this section we explore why we initially fell short in internalizing feedback and what adjustments we've made to increase our accountability and responsiveness to farmers, donors, partners, and other stakeholders. We will also outline how we've used that learning to modify our strategy to deepen the value we deliver.

Obstacles to internalizing and acting on feedback generated from the CKW model
In the case of mobile information services, which were relatively easy and low cost for us to develop, we were able to quickly pivot to respond to farmer feedback. In other cases, we did not always directly address the needs that farmers articulated. For example, one of the pain points CKWs raised was the time it took to get phones repaired. We hadn't developed an effective system for tracking broken phones and repair times, it was not a metric that was highly visible to our management team or partners, and responsibility for the issues resolution sat across multiple functional groups (including technology, account management, and network and training units). It has also been difficult to respond to farmer requests to address obstacles at the sector level, for example access to inputs or finance, that prevented farmers from acting on the information they received via the program because of the lag time associated with making strategy pivots and the additional resources needed to do so.

Another challenge was that our initial hypotheses around the business model did not play out. While there was demand for data collection services and we saw a greater willingness to pay for embedding CKW services in existing extension efforts than we anticipated, it was still not sufficient to sustain the overall CKW program. We had made commitments to reach 60% sustainability by the close of the grant cycle and hit revenue targets as key milestones, which meant that we dedicated much of our energy and focus toward trying to figure out how to fill the revenue gap when our original assumptions fell short. It also meant that our learning culture was particularly sensitive to the financial health of the program, sometimes to the detriment of evaluating the program's impact metrics and the value generated for farmers and partners. Because of our persistent optimism in believing we could achieve these targets—and because we did not have strong internal monitoring structures—we did not communicate as transparently as we could have as signals began to indicate that we might fall short of revenue targets. In many ways, we jumped directly from a promising pilot to scaling a sustainable business without fully understanding what the value drivers would be for the latter.

Similarly, the demands of scaling the agent network meant that our operations and account management teams struggled to respond to feedback from farmers, CKWs, and partners as they grappled with expanding the CKW network while maintaining and supporting existing CKWs. With so much of our focus on scaling and achieving what proved to be unrealistic revenue targets, and without strong measurement systems in place with clear protocols for addressing and resolving feedback, it was more difficult to identify challenges in the field, hear grievances from partners, and track whether they had been addressed and resolved.

How our learning led us to shift strategy
In response to our own learning, as well a feedback from farmers, partners, and our donor, we modified our strategy to drive more value. These modifications include addressing farmers' needs more holistically by bundling access to information with access to finance and markets; targeting and more deeply contextualizing solutions for specific value chains; more deeply embedding the model with long-term business owners; and differentiating between sustainability and commercial viability.

Although some of our extension partners provided access to markets and inputs, the extent to which our partners offered farmers an integrated solution was inconsistent and, when available, often disconnected from the services CKWs delivered. As a result, farmers told us that there were a number of obstacles that prevented them from acting on the information services CKWs delivered. They lacked access to finance, and the recommended inputs were not always available locally or affordably, and were often of questionable quality. Farmers' incentive to act on the information was also diminished when there was not a guaranteed market that rewarded them for investing in practices that would deliver higher productivity or improved quality.

Today, our strategy aims to address these challenges by bundling mobile-enabled information services and CKW facilitated technical assistance with access to finance and inputs and outputs markets. Pairing extension information with other agricultural services makes it more likely that farmers have the incentives and resources to manage their subsistence crops more productively and operate their farming businesses in a more profitable way. We work with long-term business owners in the public and private sector to deliver these integrated solutions within the contexts in which farmers transact. The early feedback we're receiving shows higher value for

both farmers and the organizations serving them, as well as a much tighter and responsive feedback loop between the two.

In designing solutions, we also learned that we needed to focus our efforts to more effectively drive behavior change. We have adopted a much more targeted approach to designing and delivering information services for the specific value chains and enterprises of our farmers and partners. Today, we utilize multiple channels to transmit information on a regular basis to farmers, including via SMS campaigns that are timed to a specific cropping calendar, CKW-facilitated farmer group meetings, mobile interactive guides, and videos. (We also continue to offer information on-demand via CKW Search and the call center.) In Uganda, these insights were reflected as modifications to the CKW program. For example, the program now targets adoption via SMS campaigns and CKW-facilitated farmer group discussions delivered regularly to farmers in specific value chains like coffee, banana, and maize.

Cafeteros Connectados in Colombia and Guatemala is another example of how a more focused approach enables tighter and more responsive feedback loops between value chain players and farmers. The program's baseline includes a full battery of good agricultural practices for coffee, socio-demographic information, food security

Nucleo	Registros	Beneficio	Conservación de suelos	Manejo de sombra	MIPE	Control de malezas
LA MANGA	Bajo	Medio	Bajo	Medio	Medio	Alto
ROMERAL	Bajo	Medio	Medio	Bajo	Medio	Alto
YARUMAL	Bajo	Medio	Bajo	Alto	Medio	Alto
MORRON	Bajo	Medio	Bajo	Bajo	Bajo	Alto
LA BELLA AGUADA	Bajo	Medio	Bajo	Bajo	Alto	Alto
LA VIBORA	Medio	Medio	Bajo	Bajo	Medio	Alto
LA MANGA	Medio	Medio	Medio	Bajo	Alto	Alto
EL TOSTADO	Bajo	Medio	Bajo	Medio	Medio	Alto
SAN ANTONIO	Bajo	Medio	Bajo	Medio	Medio	Alto
LOS ANIMES	Bajo	Medio	Bajo	Medio	Medio	Alto
PUEBLO RICO	Bajo	Medio	Bajo	Medio	Medio	Alto
PARTIDAS DE MORELIA	Medio	Bajo	Bajo	Medio	Medio	Alto
LA IRACALA	Medio	Medio	Bajo	Bajo	Alto	Alto
AGUACATES	Bajo	Medio	Bajo	Bajo	Bajo	Alto
LA CLARA	Medio	Medio	Bajo	Bajo	Medio	Alto
CASA GRANDE	Bajo	Medio	Bajo	Medio	Medio	Alto

Image 8. Farm management plan report illustrating farmer adherence with good agriculture practices

indicators, farmer attitude questions, and farm characteristics such as size, coffee variety, and the previous season's production information. This expanded, detailed baseline captures adoption levels of specific agronomic practices and adherence to certification standards, allowing coffee cooperatives to evaluate where the greatest opportunities are for improving productivity (for example, in soil management and nursery establishment) and to drive faster certification to open up opportunities for farmers to sell to higher-paying markets. The more comprehensive baseline has also enabled producer organizations to identify which farmers are most likely to respond positively to interventions through attitude segmentation and analysis on the economic viability of coffee farming at the household level.

We also see through Cafeteros Connectados how involving farmers in setting and tracking targets helps promote farmer accountability for learning. The CKW meets with farmers on a bimonthly basis to discuss their progress on farm management plans. Farmers set their own targets in the plans, giving them more ownership and accountability for using the information to improve outcomes on their farms. Showing the farmers how they benchmark against other farmers has proven to be an important motivator for behavioral change and has helped farmers learn how they can improve their own practices. Similarly, CKWs regularly facilitate trainings. They use a tablet to show more in-depth, curriculum-based information, including videos and other multimedia presentations, mapped to the cropping calendar. These modifications have driven faster learning for farmers, producer organizations, and other value chain players.

Through a partnership with Opportunity Bank in Uganda, we are testing the value of delivering bundled financial and extension services. The bank uses CKWs to collect "know your client" data to identify credit-ready farmers. Under this partnership, the delivery of financial services is paired with agronomic information delivered by CKWs to maximize the farmer's return on investment and to reduce the bank's default risk. We are also strengthening our partnership with the Government of Uganda with the aim of embedding the model within the national extension agency for long-term sustainability, rather than pursuing a commercial model.

E-Warehouse is another example of how farmer demand for access to financial services and markets changed the way we deliver the CKW model. By providing extension and financial services in tandem, we were able to generate more value for the farmer and provide opportunities for commercial players such as banks and buyers to offer services to farmers where they had before been unwilling. Although the pilot included only 90 farmers in the loan and/or bulk buying services, the results have been encouraging; farmers who held grain through the program received over 50% higher prices.

How we used learning to modify our operations and promote a learning culture
We have also modified our approach to cultivate a responsive learning culture and to increase our accountability by investing in analytics and M&E capacity; systematizing our tracking of key impact metrics and elevating their regular review; phasing learning objectives over time and multiple grant cycles; having honest, data/evidence based conversations with donors about the time needed to achieve results (especially related to program sustainability); and institutionalizing learning capture and knowledge sharing. Through a collaborative dialogue with our donor, we have shifted course to focus on validating the model's impact and prioritizing the delivery of high quality extension, rather than generating revenue. Critically, we are no longer pursuing a commercial model to attain sustainability. This has given us both the space and the mandate to fine-tune our operational model and quantify the value we are delivering.

We have adjusted our approach in Uganda to promote more rapid learning cycles and greater accountability. For example, we found that we sometimes didn't listen to or act on feedback from CKWs and farmers because accountability for problem resolution was spread across multiple functional areas. To address this accountability gap, we reorganized the management team into two primary areas that include service delivery and account management. Consolidating responsibility with a single manager for service delivery and for partner account management has led to improved coordination and accountability for resolving field issues such as equipment maintenance while also improving responsiveness to partner concerns. In addition, we are currently hiring a seasoned M&E expert in Uganda and contracting an M&E firm to help us design a system that can analyze data from various sources to better evaluate impact results. We are also partnering with Palantir Technologies to analyze our existing data and to build automated dashboards that can pull data from disparate sources, including farmer registrations, mobile surveys, and SMS and call center logs, so that we can understand whether the CKW program as a whole is driving behavior change. These analyses also enable us to assess which services deliver the greatest value and are most effective in changing specific behaviors.

We have also institutionalized channels for learning that map to our organizational culture to make pathways for action more visible. Our staff bring experience from multiple domains, including finance, technology, and international development, and we borrow methodologies from across these domains to understand our clients and listen to our users. A drive toward

innovation permeates Grameen Foundation's organizational culture. This organizational affinity for innovation has influenced how we learn from our clients, including poor farmers served by the CKW program. Gathering user insights and requirements directly from our clients—using human centered design principles, prototyping tools and services, and frequent iteration in line with lean methodology—are all standard approaches we use to cultivate insights that drive innovation. Similarly, our learning culture incorporates tools from the private sector, such as balanced scorecards and key performance indicators, alongside more traditional development tools, such as results frameworks, that link back to our theory of change. Program teams conduct annual and multi-year strategic planning and collective visioning sessions. These teams then assess progress against targets and evaluate results in weekly management meetings and quarterly off-sites. We have also introduced mechanisms for better measuring and tracking key indicators that roll up to senior leadership review, for example through quarterly program reviews and an organization-wide balanced scorecard that tracks operational and impact indicators that is shared with our Board. This collective process of setting and tracking goals provides a forum for organizational learning and promotes accountability at multiple levels.

Learning from the original CKW program delivered insights that enabled us to pivot in Uganda and innovate to drive additional value in new programs. Our learning continues to deepen as we expand our initiatives. This expansion brings a new challenge of ensuring that learning is being shared between geographically diverse teams; we are just beginning to address this by promoting more structured knowledge exchange to institutionalize learning. For example, we recently created a mAgriculture Council comprised of leaders running our country programs where we discuss challenges and insights. We also have a knowledge exchange initiative in which we send out monthly communication on program learning as well as providing webinar spotlights on particular programs that allow teams to share their insights. We have found that having a local champion in each office who works as part of a larger knowledge exchange group has helped drive participation; conversely, we have seen that without senior level buy-in and support of the initiative, attendance suffers. These lessons, summarized in *Box 6*, reflect how we have evolved to promote a responsive, learning-oriented organizational culture.

Lessons on Enabling Collective Learning
Phase the development, testing, scaling and commercialization of new innovations to ensure there is sufficient time to refine the operating model, prove the innovation's impact, and articulate and quantify the value proposition before introducing aggressive revenue targets. Include business model innovation and rigorous business assumption testing during pilot and scale-up stages to distinguish between those innovations that may be commercially viable and those that can be sustained via government funding
Develop shared ownership for results among stakeholders, including implementers, communities, and donors, and at different levels of an organization, to help promote open and honest dialogue about results, challenges, and failures. Position feedback channels as a tool for improving outcomes for those who are responsible for driving results
Align incentives and build accountability structures that elevate the visibility of impact and value indicators to tighten the link between feedback and course correction
Package learning in language that resonates with stakeholders and organizational culture
Co-design, with stakeholders, indicators that measure operational health and end-user impact, and invest in the capacity to automate and visualize analytics to derive meaning and promote action

Box 6. Lessons on enabling collective learning

Conclusion: Insights on Enabling Collective Learning

In piloting, scaling, and expanding the CKW model, we created a two-way dynamic feedback loop between farmers and the organizations serving them. This feedback loop presented

tremendous opportunity for enabling sector-wide learning. Sometimes, however, we missed the chance to fully deliver on that potential. With time, our experience scaling and adapting the CKW model generated insights that has led us to not only deliver on this potential, but also has guided us toward becoming a more responsive and accountable organization.

We've seen that the use of mobile devices within last-mile agent networks promotes participatory, iterative, real-time dialogue between development stakeholders and farmers, a fundamental component in enabling a collective learning process. However, establishing feedback loops alone is rarely enough to spur action or ensure accountability for the information exchanged. In our experience, it was critical to build analytic capacity to derive meaning from feedback and to develop the institutional systems and incentives to ensure that learning leads to action. In particular, we needed to elevate the visibility of and accountability for value indicators to tighten the link between feedback and course correction. It was also important to create sufficient runway to prove program value and impact as well as rigorously test the potential for commercial viability before introducing aggressive revenue targets. Sharing overall CKW program accountability amongst leadership and across the team created an atmosphere in which failure was something that was both owned at the highest level by the organization and was a part of the learning process. Similarly, with our partners, it was important to position CKW feedback as a learning tool rather than an auditing mechanism.

Another key take-away was designing our operational structure to insulate our field and services team from the pressure of achieving sustainability so that they could focus on listening to farmers and shifting course as needed. Capturing and communicating learning in a language that resonated with our organizational culture—in our case, tying it closely to innovation and "private sector speak"—made it more likely that we would internalize and act on insights. We had to invest in our analytical capacity and prioritize rigorous M&E. Developing automated analytics was one of the highest return investments to drive learning internally and with partners. Embedding analyses within the decision-making process of those who were responsible for resolving challenges and driving results was also a key factor in ensuring data is used to improve results. Similarly, embedding feedback loops and analytics within partner organizations led to greater ownership of the services and promoted accountability for using the information gleaned from CKWs to respond to farmer needs and to improve service delivery.

Undoubtedly, collective learning requires bidirectional feedback channels. In our case, building these channels to facilitate dialogue with farmers was the easy part. It was through multiple cycles of learning and, admittedly, some failure along the way, that we gained insights on how to develop the organizational capacity needed to consistently derive meaning from the feedback channels we created and to ensure that the unique insights that the CKW model enabled translated into improved services for farmers.