Appropriating Technology for Ultra Poor Women – Smartphone Apps for Agricultural Improvement

Trickle Up Program

Introduction

Providing access to "just in time" information on crop choice, planting technique, care, harvest and marketing of produce is one of the key challenges in improving livelihood of rural ultra poor women and their households. In 2019 Trickle Up, an NGO dedicated to enhancing the economic and social inclusion of ultra poor women, completed the pilot stage of partnership with Tata Communications to address these challenges through mobile technology. To support the agricultural activities of ultra-poor households, Trickle Up developed mobile based applications which were uploaded on smartphones provided to 1000 women participating in its programs in Odisha and Jharkhand, in partnership with the Odisha Livelihood Mission (OLM) and Jharkhand State Livelihood Promotion Society (JSLPS).

This case study outlines key learnings from this project, drawing on data from internal monitoring and external evaluation. Results show that custom apps significantly facilitated adoption of improved agricultural practices and complemented the work of frontline staff in conveying training messages. This included supporting scientific cultivation practices, informed decision making around crop choice and adoption of newer farming techniques, as well as positive follow-up action enabled through access to smartphones.
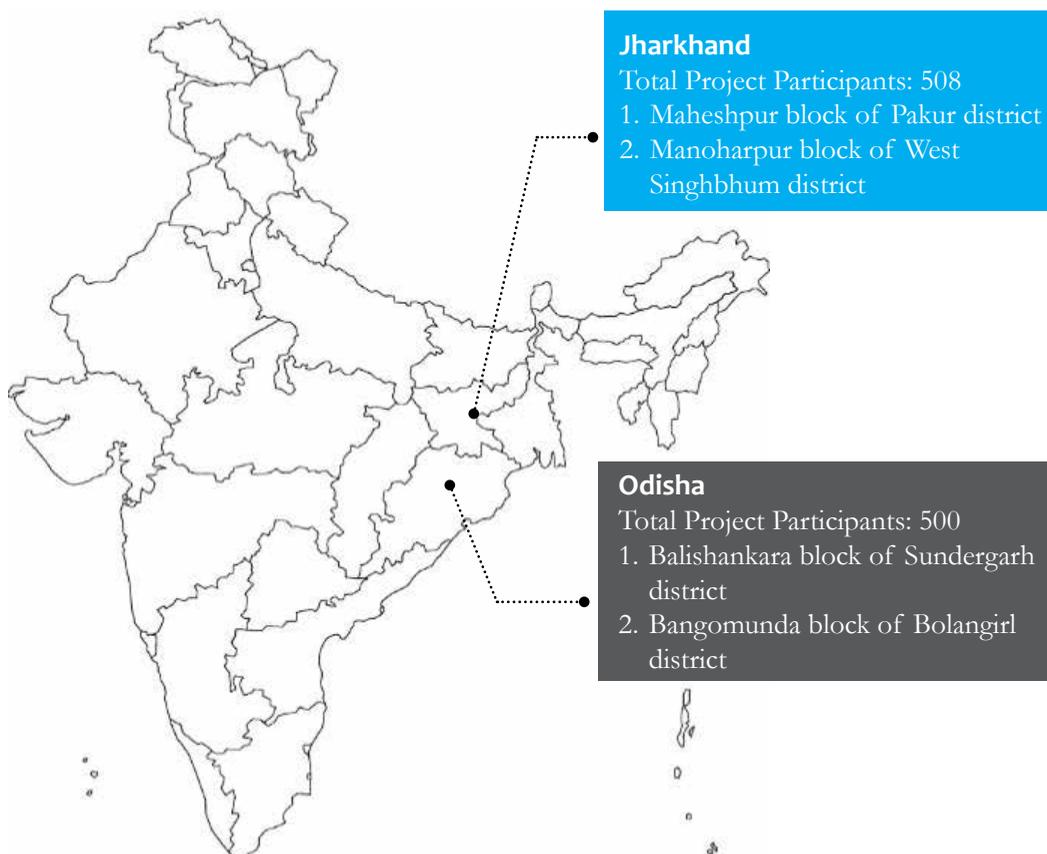
The case study explains how app design was understood and adopted by community members with no literacy and no prior experience with smartphones and how support was provided to address differing capacities. It also discusses broader issues of ownership and usage from a gender perspective. Lastly, some key considerations are addressed for scaling up, especially the comparative utility of providing individual participants with mobile devices versus shared group devices.

Project Context

Trickle Up's programs are designed to reach and benefit ultra poor women and their households. This segment of the population has very few assets and depended on sporadic and unreliable income sources. 75 percent of the project participants were primarily reliant on daily wages or migrant labour. They were often subject to multiple exclusionary factors, and left out of or are unable to fully benefit from mainstream government programs. For this reason, Trickle Up has partnered with two state agencies of the National Rural Livelihoods Mission (NRLM), from Odisha and Jharkhand, to implement and test scalable models for strengthening ultra poor households' livelihoods and effectively integrating them into NRLM and other government schemes.

The livelihood component of the project is based on the Graduation Approach, which is specifically designed for ultra poor households to create a sustainable pathway out of poverty. The elements of the program include livelihood planning and training, seed capital grants (of INR 3000) for investment in productive activities, integration into Self Help Groups (SHGs) to promote social and financial inclusion, and regular coaching by Community Resource Person (CRPs) to reinforce training messages and help participants and their households solve problems and link to services.

Since 2007, Trickle Up has been successfully using and adopting the Graduation Approach in Jharkhand, Odisha and West Bengal. The project lasts for 36 months, during which time the participants are supported to achieve a number of "graduation" criteria which indicate their ability to sustainably move out of poverty, including SHG participation, livelihoods diversification, income generation, savings, food security, and access to entitlements.

Jharkhand
Total Project Participants: 508
1. Maheshpur block of Pakur district
2. Manoharpur block of West Singhbhum district

Odisha
Total Project Participants: 500
1. Balishankara block of Sundergarh district
2. Bangomunda block of Bolangirl district

Picture 1: Pilot project implementation areas

Rationale for Technology Component

To support its programs, Trickle Up has developed "Package of Practices" (PoP) outlining the steps required to develop a portfolio of livelihood activities. These provide basic information about the required inputs and steps for growing a range of crops and managing livestock rearing activities, using pictures and fairly simple text that can be understood by front line workers. However, despite intensive training and follow-up by coaches, monitoring of the program indicated that one of the main reasons for poor outcomes was lack of full adherence to the PoP. Problems included using inappropriate quantities or types of inputs, errors in timing of transplanting, and problems with disease control such as inadequate spacing of plants.

The large majority of program participants were primarily reliant on daily labour and had little experience in cultivation of their crops, particularly higher value crops like vegetables. Furthermore, given limited education and literacy levels, most participants struggled with training sessions and were not able to effectively record information for future use. For this reason, use of the "just in time" training method that can provide information when needed, has obvious advantages. Graduation program field staff (coaches) visit on a weekly or biweekly basis, but even this creates potential gaps that can result in lowered productivity if a critical step has been missed or a problem emerges.

Most participants also tend to be reliant on field staff for support with calculations required for the planning and management of their activities. The provision of timely accessible information to support agricultural activities was amplified as Trickle Up's programs moved from a model in which the front line coaches were relatively well educated, to one in which they came from the target communities, as part of scaling within government livelihood programs.

ICT Component and PoP Application

The technology component of the project was three fold:
1. Provision of a smartphone for the ultra poor women program participants and training in its use and care;

2. The development of a custom "Package of Practices" application to support cultivation, including management of associated basic finance;

3. Access to other apps,text and voice based information to support livelihood development and linkage to entitlements.

To support planning, the PoP apps provide step-by-step instructions and automated calculations of the quantity and type of inputs required for preparing and planting nursery beds, ploughing, preparing growing beds and transplanting seedlings, weeding, fertilizing, pest control and other required care. Once commenced, an automated calendar provides reminders for each step in the cultivation process.

Picture 2: Sample screenshots

A series of visual cues, largely consisting of photos and voiceovers provide detailed guidance, and participants can check off each step as they complete it. The app enables participants to enter expenses related to each step, amount of produce harvested, income received from sales and amount consumed, thereby creating an assessment of overall profits and helping suggest future investment decisions.

Instructions were first developed for cultivating chili peppers, tomatoes, brinjal, bitter gourd, and green beans, followed by lady fingers, spinach, potatoes, onions, eggplant, long beans, pumpkin, mushrooms and green pumpkin. The choice of vegetables was updated by the staff depending on their seasonality and popularity, PoPs for more crops are now under development. The app was developed iteratively, with new crops and functions added over time, based on monitoring of use and user feedback.

Effectiveness of the PoP Apps

Usage of the PoP App was high - eighteen months into the program, 80 percent of participants were using the PoP app to support cultivation. It was also being appreciated by both participants and field staff. As per an evaluation by KPMG, 77 percent of the participants reported that the use of the PoP application has improved the agricultural yield and livelihood conditions, and almost all said that they planned to continue using the phones to support their livelihoods.

As anticipated, the apps facilitated "just in time" information, and the participants articulated the value of this. This is what Kuntala (Balisankara, Odisha) told the evaluators,

> *'Last year, I bought one kilogram of seeds and with the help of the PoP, I could produce 250 kg of onions from it. Imagine the kind of profit I was able to make! The regular trainings are also very helpful, but what happens with the PoP is that it is like a regular reference. Now that I know how to use my phone, I can refer to PoP whenever and wherever I am stuck. I do not have to wait for anyone to come and help me solve my problem. Being a single parent, this is extremely time saving for me.'*

Participants also claimed that the detailed instructions and step by step processes embedded in the PoP helped them bring in discipline to their cultivation practices. Subodhini (Pakur, Jharkhand) explained,

'Earlier we used to sow the seeds anyhow. Most of the crops either died from disease or pest infestation or because they were sown too close together and could not grow properly. It seemed like we would always remain poor…. With the help of the PoP, I now know details like how much distance I should keep between seeds and how to save them from pests. Naturally the quality of the produce has improved drastically. Even if one plant gets infected, the others don't get infected by it because of the distance we now maintain. We eat well now.'

Having this information in a non-written form was noted by Subodhini and many other participants as one of the big advantages,

'None of us are so educated, and most of us are not comfortable with Hindi or any other language. The PoP app speaks our language. That makes it much easier for all of us to follow instructions.'

Field staff also reinforced the importance of both the PoP app and simply having access to communication technology, in bringing about these changes. As noted by Snehalata, a Smart Sakhi, in Pakur, Jharkhand,

'When I started teaching the women how to use the PoP application for disciplined farming, it helped them produce better from the same piece of land, where they were unable to make any profit earlier. Being able to see how to take the measurements and follow the instructions in such detail every time they need it, and being able to reach out to me whenever they need help, has been the biggest advantage for them.'

Furthermore, the field staff and managers used the information entered by participants on the steps they had taken in the PoP and produced calculations to determine which participants needed more support.

Participants and field staff reported that they particularly valued PoP app support for new cultivation techniques, and this sometimes provided a comparative advantage. For example, Bhagyabati, in Odisha, used the PoP app to switch to organic fertilizer and pesticides (the app promoted organic agriculture, as per OLM guidelines), enabling her to reduce costs and attract customers. Her training also enabled her to educate her customers on the benefits of organic agriculture.

Participants also reported that they were able to make more informed decisions on the crop choice. The addition of the modules on financial management were particularly beneficial in this regard. Prior to the project, most participants with some agricultural land primarily cultivated paddy and maize – high investment crops with long cycles. The PoP app helped reinforce the value of replacing or diversifying into shorter cycle vegetable crops with

higher market value. Participants' ability to record input costs and income supported this shift by providing a record of performance.

The PoP app helped empower women in family decision-making. In some households, men supported women's leadership when shown electronic evidence of increased profit.

Addressing Literacy and Numeracy Constraints

Literacy rates among the ultra poor women tend to be low, two thirds of Trickle Up's participants in Jharkhand lacked functional literacy. This situation presents both opportunities and challenges: mobile technology offers a particularly important opportunity to meet the information needs of people who are not able to access or record written information, however, illiteracy also limits their ability to fully take advantage of technology.

The challenge, therefore, was to design an app and training module that would be useful for people without literacy, still enabling extra functionality for those with some literacy, or with literate support networks. Design features were added to help low literacy users such as making key information image with instructional visual cues and step-by-step voice over. Recordings of program participants were used to make language and dialect intelligible and familiar, with content recorded in Hindi, Bengali, Oriya, Ho, Santhal and English (for staff review). Videos were initially integrated into the content, but later abandoned due to their data size. The next stage of development will involve animation to visually demonstrate PoP steps without the heavy storage demands of video.

The apps were also designed to mirror existing usage by people with limited literacy and numeracy who understand money, but never learned to add and subtract on paper. For example, the money manager part of the app helped people to count and record income and expenditure by enabling users to swipe images of different denominations of rupee notes. This proved to be extremely useful for women who had never previously had a means to record transactions and calculate overall profitability.

Electronic images of the sticks used by farmers to measure land were used for calculating land size. Together with images of different types of land, this facilitated calculations of required inputs and expected profit for each type of crop.

Despite these features, the women still needed to be able to make sense of the information provided through the apps, including in numerical form. Participants were provided with training to recognize simple numbers, but their ability to internalize these messages varied widely. Locally recruited resource people were crucial in providing support, as discussed below. The apps also included some text for support staff and participants with emerging literacy, all accompanied by voice-overs.

Furthermore, a number of apps were added to the phones that did require literacy, particularly apps to link to government services. For example, 43 percent women linked

their mobile phone numbers to their bank accounts. This enabled them to receive text message notifications from their banks, and so even though most could not read them, they knew when to seek help from a staff member or other trusted literate acquaintance. While literacy was clearly an impediment to engagement, the women were generally able to still benefit from text-based applications and information.

Designing for First Time Smartphone Users

The project had to address the lack of participants' prior experience with smartphones (only 2 percent had previously even had access to an analogue phone). Despite initial apprehension by some participants towards even holding the phones, engagement and enthusiasm proved high. Shortly after an initial training, many women were using the phones to take and share photos, and were exploring other applications. Within 6 months, all participants were using the phones to make calls and 82 percent were able to take photos or videos.

Nevertheless, there were significant differences in the uptake and capacity. Many participants who were slower to learn drew support from family members, especially children. However, peer support among quick learners in the SHGs was more effective and reliable. This was institutionalized 8 months into the program with "Smart Sakhis", many of whom were recruited from among the participant women who had demonstrated success with the phones and apps to help others. Smart Sakhis were almost all literate and committed to supporting a group of 25 peers in exchange for a modest stipend of INR 1500 per month.

They were provided training and mentoring from the field staff and effectively complemented, and sometimes replaced, the work of CRPs. Most Smart Sakhis took great pride in their work and developed significant leadership skills, including basic livelihoods development coaching. Their basic literacy and access to, and comfort with the phones enabled them to participate in online PoP training and easily communicate with technical staff through messaging apps. This made them effective field coaches who were able to support participants in decisions about crop choice and cultivation. They also provided important regular feedback on the PoP app, enabling iterative improvements in design. Towards the end of the project some Smart Sakhis articulated aspirations to train for professional coaching roles in new project sites.

One of the main predictors of success was age: there was a significant negative correlation between the age of users and the ability to understand basic concepts and effectively use the PoP app. Two percent of women who received smartphones and training were found not to be using them, even after provision of support, and expressed little interest in doing so. These were women over the age of 45, and their phones were reallocated to younger participants. The Smart Sakhi model also helped support such older women, but one of the key learnings was that the program is more effective with women aged 18-35. In the next

stage of the project, older women who meet the selection criteria (of being ultra poor) will still be integrated, but the technology component will be mediated through the support of youth within their households.

A gradualist and sequential approach to training was also deemed important. The training commenced with the basics of smartphone use and care. Initially the project staff, who feared that phones would be damaged or sold off before their value was apparent, debated whether participants should be allowed to keep the phones immediately after the first training. However, it was determined that the benefits of rising confidence in use outweighed these risks. After the initial training, the participants had 3-4 months to learn basic functions and build their confidence and comfort before receiving training on the PoP app. Their use of the PoP app was then supported by coaches, and later Smart Sakhis. Given the sequential nature of the PoP apps themselves, they also had time to get used to negotiating each step as needed. Eighteen months after receiving their phones, 87 percent of the participants could use the smartphones and the PoP application easily (and 85 percent could help others). At this point, trainings started to focus on helping the participants to use the internet and increase their access to more complex applications such as YouTube to search for information relevant to their livelihoods.

Smartphone Usage to Support Agricultural Development Beyond the PoP App

Participants were also encouraged to use their phones to contact field staff. Most participants did this, and reported that greater and quicker access to field staff was a major advantage. Participants also used their phones to take pictures of their crops and send them to coaches for advice.

Field staff used the questions and concerns shared by the participants through messages and photos to assess their training needs and to schedule and prioritize visits. Early in the project, tobacco caterpillars attacked the tomato crops in Bangamunda block in Odisha. Participants risked catastrophic losses on leased land. Affected participants immediately alerted their CRPs by smartphone. The CRPs sent photos of the damaged crops to a group chat of their peers, including OLM staff, to seek advice. Experts quickly identified the correct organic pesticide, and using the electronic network, greatly minimized crop loss. The availability of the phones in the hands of participants greatly speeded up the identification of and solution to the problem, and averted a disaster. Push notifications used by staff to share information from block officers were delivered by text, but in the next stage audio and video links will also be shared.

Participants were supported to register their mobile numbers with government departments such as Jharkhand's Department of Horticulture, which sent them mobile alerts on the availability of varieties of seed that the department was distributing in weekly markets. In Odisha, 77 percent of participants received grants of INR 1000 each to develop nutrition gardens, through linkage to an online scheme. Expanded connectivity also afforded greater

access to government services and support by enabling participants and field staff to obtain crucial information about who was or was not receiving entitlements. It enabled them to make direct contact with relevant authorities, without expensive and time consuming travel, when schemes were not implemented as mandated.

Lastly, participants used their phones to reduce costs and improve marketing, including calling wholesalers to get market prices, and arranging for goods for sale or purchase and delivery. This reduced their own need to travel, saving time and money. They also used the weather forecasting app, Kishan Suvidha.

Addressing Connectivity and Electricity Supply Limitations

Trickle Up's programs generally target remote communities where ultra poverty tends to be concentrated and connectivity is often limited. This creates challenges for large data use activities such as application updates. Smart Sakhis and field staff addressed this by identifying high connectivity locations to perform batch updates for all participant phones in their area. This was effective in the pilot, but poses problems for scaling. In the second stage, Trickle Up is partnering with mobile network providers to expand connectivity and provide pro-poor data and voice calling plans.

Electricity supply also proved to be a challenge. Seventy percent of the households did not have their own electricity connection, making phone charging uncertain, particularly during peak seasons when the grid was only intermittently available. The project had planned for solar chargers for those without an adequate electricity supply. However, these were not enough, as the reliability of the grid had been underestimated. The staff responded by mapping electricity needs to create solar charging hubs in locations with acute electricity supply problems. In the next phase of the project, solar chargers will be distributed to program participants in a ratio of 1:2. Participants will be encouraged to build enterprises to provide for the charging needs of the increasingly connected communities.

Hardware and Maintenance Issues

Phone damage and malfunction is inevitable. During the project, 70 phones had to be replaced, suggesting the need for more durable hardware with the ability to withstand the fluctuating electricity supply, high temperatures, and difficult conditions that characterize remote villages. Late in the project, the participants were willing and able to pay for repairs, so Smart Sakhis supported repair drives to bring nearby repairers to villages at fair prices. In the next phase, Trickle Up plans to expand the training of future participants or their family members to repair and maintain mobile phones and create local mobile repair hubs that can contribute to household livelihoods, while meeting the growing mobile needs of their communities.

Smartphone Ownership, Usage and Potential Negative Effects

In addition to direct project related livelihoods benefits, participants were pleased by the way their phones connected them to their near ones in distant villages. Many also reported having increased self- confidence simply from possessing phones which is currently a status symbol in their villages. Such improvements in social standing, integration, and social belonging are important objectives when working with ultra poor households. There was even evidence that the provision of smartphones was a significant motivator for many ultra poor women, who due to their socio-economic status often require significant encouragement to join. This was explained by a CRP who became a Smart Sakhi after the introduction of the phones,

> *'After I was chosen as Community Resource Person, one of my first tasks was to get the participants in my village to form a Self Help Group. But the participants were extremely apprehensive. They were scared that if they took loans and were unable to repay it, they might even end up getting jailed! It took us a lot of time to convince them to join Self Help Groups, and regular meetings to start happening. When I was chosen as a Smart Sakhi, the situation became much better. None of us had ever even dreamt of owning a mobile phone, let alone smartphones that operate on touch! The feeling of owning a smartphone completely changed the attitude of the project participants. Not only did they become more regular to the meetings, but they were happier to do so, knowing that they needed to be consistent to keep being a part of the program.'*

However, as with all changes that can affect social dynamics, the provision of smartphones and training did lead to some backlash. In fact, in one village, the participants' husbands initially barred them from collecting the phones. Eventually, after the project staff was able to convince them of the benefits to their households, they agreed to the plan, but it required significant engagement and counselling through household level visits. Based on a survey of 400 participants, majority of the women (approximately 60 percent) did manage to maintain primary control over the phones, with the rest still maintaining access. But this needed to be reinforced through frequent coaching visits, and still up to 20 husbands restricted their wives' usage and some took away the phones when they migrated.

This survey suggests that participants were using the smartphones regularly and for a multitude of reasons. On an average the participants were using the PoP app for 15 minutes a day. They also reported spending approximately three hours on entertainment and media. The latter included watching the news and videos to help them with their livelihood activities (the breakdown of this time use was not sufficiently disaggregated in the evaluation). The latter result is of concern, given the addictive nature of online content such as games, especially for new users, while noting the limited entertainment options that exist in remote communities. The participants' stated appreciation of the phones as an entertainment device.

Furthermore, 70 percent reported buying extra data to support their phone usage beyond the basic plan needed for the PoP and other supported apps, which indicates the value they place on it. However, this should not necessarily be seen as positive if it is displacing other important expenditures. It will be important to study this issue in more depth in the next phase, including acquiring more details on how the phones are used by other household members and for what purposes.

Exploring Alternate Models for Cost-effectiveness

Considerable costs are incurred to provide one phone per household at scale (approximately INR 6000 per phone plus INR 500 for SIM cards and screen guards). Therefore, it is important to consider the cost-effectiveness of this model compared to providing a smaller number of phones to be shared among a group of participants (in a SHG) or to be used primarily by field staff (such as Smart Sakhis) to support participants. This latter model was already partly explored, by default, during the pilot project period. After the first iteration of the apps were developed, Trickle Up uploaded them on the phones of the CRP working with ultra poor women in other locations. The CRPs were trained by using a function that can project images from phones on the walls to support training of small groups. Given coaches already had been provided with smartphones to support their monitoring activities, no additional costs were incurred.

Furthermore, towards the end of the program, the Smart Sakhis trained 2500 additional women from their communities on cultivation techniques using the PoP application. The Smart Sakhis, who were not agricultural experts, had themselves been trained through use of the PoP app. While passing on information to other women, they referred to the apps and also passed the phones around, so that small groups of women interested in the same crops could see the images and hear the voice overs. Some participants also showed their neighbors and relatives how to use the PoP app and lent their phones so they could also use them to start new crops.

However, this model also has significant limitations compared with each participant having direct access to the apps and smartphones. Apart from not having access to instructions for crop development at the exact time when each step needs to be taken, it also meant that the data entry by participants is complicated. Monitoring systems used by field staff can address this to an extent, but this reduces active participation and ownership of the data collection process by program participants themselves, which are important skills to develop. This can also require coaches to spend more time entering the data rather than spending time supporting and analysing it in collaboration with the participants. The app could be adjusted to be used in a group setting to enable women enter data under their own profile when they have access to a shared phone, however, the staff assumes that unavailability of the phones at their convenience would limit its usage. As smartphone ownership spreads, this issue may become less important, as the apps can be uploaded on the households' own phones. However, even with rapid expansion, phone ownership among ultra poor households remains low, and some type of subsidy is likely to be required

for the foreseeable future. Therefore, in the second stage of the project Trickle Up plans to assess the cost-effectiveness of different models in which phones with the custom apps are provided to each participant, provided to small groups of participants, or are just provided to community-based field staff.

Conclusions and Way Forward

The pilot project demonstrated that smartphones with custom apps have significant potential for enhancing the effectiveness of programs that promote agricultural productivity among ultra poor women, even when, or particularly when, they have low levels of literacy and technological experience. The PoP apps complement and support the work of front line staff by assisting them in training and mentoring women in livelihood development, providing truly just-in-time information, enhancing discipline related to cultivation, facilitating troubleshooting and contributing to informed decision-making about crop choice. This support appears to be of particular value when the frontline staff themselves are from the target communities, and hence also have limited education levels.

The pilot demonstrated the importance of continually using feedback from staff and participants to refine the app to make it more user friendly and reflect their content needs, and also to adopt implementation mechanisms to meet the varying capacities and learning speeds of participants. There was also significant value in using the provision of smartphones to link to other digital services that support agricultural and general livelihood development, as well as simply enabling voice connectivity to the staff and others. However, it is also important to monitor usage of new technology and experiment with varying models for cost-effectiveness. In partnership with Tata Communications, Trickle Up will further explore these factors in the second phase of the program, incorporating 1000 new participants in Odisha and Jharkhand, plus exploring expansion to Bihar.