

## **Development Calling: The Use of Mobile Phones in Agriculture Development in Uganda**

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### **abstract:**

This study examined the diffusion and perceived impact of agricultural-based mobile phone use among small- to medium-size limited-resource farm holders in Kamuli District, Uganda, where 42% of farm households now have a mobile phone. Interviews were conducted with 110 small- to medium-size farm holders – 56 men and 54 women. Respondents were chosen according to farm group (n=91) or non-farm group (n=19) membership status. Results showed more than half of the farmers were using their mobile phones for coordination for access to agricultural inputs, getting market information, monitoring financial transactions and agriculture emergency situations. Slightly less than half were consulting with experts via mobile phones. Men tended to adopt mobile phones earlier than women and those with more education were more likely to use SMS (short message service) text features. Women were less likely to use the calculator function, perhaps due to a lack of numerical literacy training. Those who were members of agricultural groups were more likely to use their mobile phones for a variety of purposes. The study identified a number of unique uses being made of mobile phones, including taking photos of agricultural demonstrations, using the loudspeaker function to permit a group of farmers to consult with an expert, recording group members pledging when they will repay loans, and storing data such as the date hens should start laying eggs. Diffusion of mobile phones is now in a “take-off” stage with rapid adoption. However, universal adoption would depend on both need and benefits.

**keywords:** *[agriculture, diffusion, ICTs, ICTD, mobile telephony, rural development, Uganda]*

## **Introduction**

The diffusion of mobile phones into rural areas represents one of the most profound changes in rural Uganda and many other developing countries in the past decade (GSM, 2008). Farmers, agricultural processors, and marketers have transitioned from a culture in which there was virtually no telephone service of any kind to one in which mobile phones are now widely utilized among farmers and at rural markets. Thus far, little is known regarding the utility of the mobile phone for the livelihoods of those within resource-constrained environments. The objective of this study was to establish baseline data on the agricultural-based uses of mobile phones among resource-constrained small- to medium-size farmers in Kamuli District, Uganda.

Mobile phone adoption has been rapid in the developing world. In Uganda the number of subscribers has increased from 776,200 to over 8.5 million in the past five years (Uganda Communications Commission, 2008).

Researchers (Hudson, 2006; Jagun, Heeks, & Whalley, 2007) have speculated that information and communication technologies (ICTs) can aid greatly in rural development and poverty reduction within developing countries due to an increase in local people's ability to obtain information for sound decision-making. Hudson (2006) outlines the use of telecommunications in development under four overarching categories: (1) *efficiency*, ratio of output to cost (e.g., gathering information to improve agriculture yields); (2) *effectiveness*, increased quality of products, services, and organizational functions; (3) *equity*, distribution of development benefits to all areas; and (4) *reach*, the ability to communicate regardless of time or geographic boundaries (p. 12).

Small to medium-size enterprises (SMEs), businesses with five or fewer employees, are vital to developing economies in that "any gains in stability, productivity, and profitability are of utmost importance to the livelihoods of the households involved" (Donner, 2006, p. 4). For SMEs, access to information through the use of ICTs is critical to economic growth, especially in resource-constrained environments (Donner, 2008).

The effect of market information on market performance and rural farmer welfare is relevant to understanding the value of ICTs. Determining how ICTs are used by the agriculture, forestry and fisheries sectors of developing countries, such as Uganda, is of utmost importance to upgrade market performance (Jensen, 2007). In the Kamuli District, Uganda, approximately 42 percent (%) of 306 rural farming households were found to own a mobile phone (CSRL, 2009). This is according to research conducted on behalf of Volunteer Efforts for Development Concerns (VEDCO), Makerere University, and Iowa State University, College of Agriculture and Life Sciences, Center for Sustainable Rural Livelihoods (CSRL), which have been working in joint efforts since 2004 (CSRL, 2008).

The Kamuli District of Uganda faces development barriers stemming from an overall lack of infrastructure, diseases such as malaria and HIV/AIDS, and food insecurity. In addition to developing a baseline on mobile phone usage, this study aimed to understand whether these barriers could be overcome and whether the mobile phone enhanced the effectiveness of farmer groups working with VEDCO, a local non-governmental organization established to promote food security through agricultural development. According to Blau and Scott (1962) there are three organizational communication functions in which the mobile phone can play a role: (1) provision of information needed to solve problems, (2) coordination of information designed to make the organization more efficient in carrying out its work, and (3) group solidarity through support information that solves group problems and supports the organization itself.

Given the increasing ownership of mobile phones in the Kamuli District, this study identified how mobile phones are being or may be used to facilitate access to information, such as market information, especially for buying and selling, enabling efficient coordination during agricultural emergencies, and enhancing the administration of agricultural-based development activities among small- to medium-size farm holders.

## Methods

In order to understand the local use of mobile phones, semi-structured in-depth interviews were conducted with 110 small to medium-size farm holders residing in six parishes of the Kamuli District, Uganda. A nearly equal number of men ( $n=56$ ) and women ( $n=54$ ) were interviewed in June and July 2009. Respondents also were chosen according to farm ( $n=91$ ) or non-farm group ( $n=19$ ) membership status to uncover the impacts, if any, of farm group affiliation on the presence of productive agricultural-based uses of the mobile phone. All interviews were conducted through an interpreter conversant in both the local Luganda dialect and the English language. This research project received Iowa State University Institutional Review Board approval and consent from participants was obtained prior to the interview.

By using a snowball sampling technique, access was gained to non-farm group interviewees not working directly with VEDCO. Initial interviews were conducted with mobile phone owners identified in a 2008 study (CSRL, 2009). Interviewees were asked to provide the names of individuals they believed to have agriculture-based experience with mobile telephony.

Interviews were guided by an interview questionnaire that was designed to secure information about:

- a) Socio-economic data, including individual and household characteristics (i.e., gender, age, education level, occupation, family size)
- b) Livelihood descriptors, including individual and household livelihood characteristics (i.e., social networks, engagement in business, farm-group membership status)
- c) Individual and household use of mobile telephony for productive agricultural-based purposes
- d) Perceived value/impact of productive agricultural-based uses of mobile phone for livelihoods

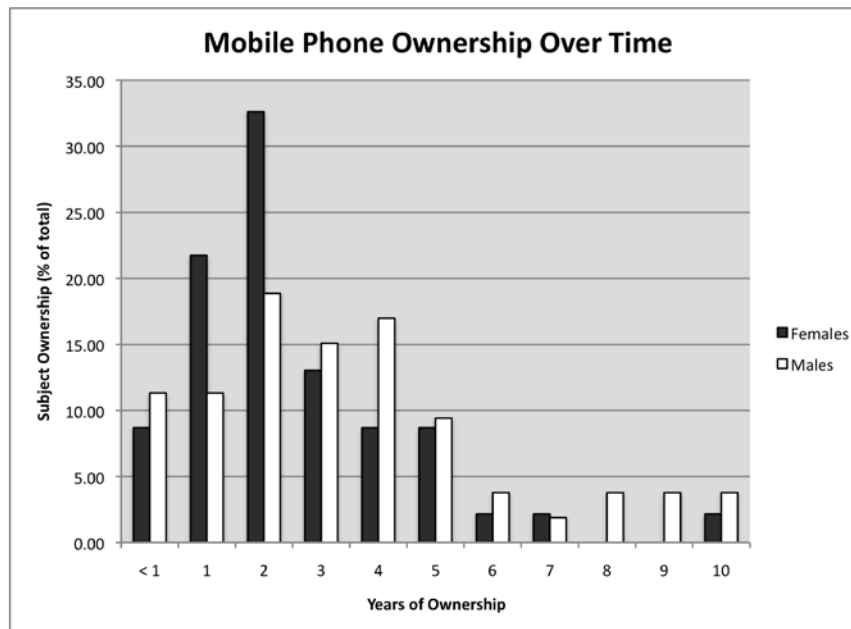
All responses from interviews were coded to reveal recurring themes using thematic analysis. Thematic analysis, as defined by Boyatzis (1998), identifies themes from qualitative data that “at minimum describe and organize the possible observations and at maximum interpret aspects of the phenomenon” (p. 4).

## Results and Discussion

Results shed light on demographic information, usage of mobile phone functionality, gender differences, and the effect of farm group affiliation.

### Ownership time frame

Mobile phone ownership (in years) among women ( $M = 2.6$  years,  $SD = 1.9$ ) is more recent than among men ( $M = 3.5$  years,  $SD = 2.5$ ),  $t(99) = -2.032$ ,  $p = 0.04$ . Until recently, mostly men were using mobile phones. Over half of the women (63%) have adopted the mobile phone since 2007 (see Figure 1).

**Figure 1. Mobile Phone Ownership by Gender**

Specific factors that have led to the recent adoption of mobile phones among women are unclear. According to the Food and Agriculture Organization of the United Nations (FAO), rural women constitute the majority of the world's poorest due to low levels of education, illiteracy, and lack of assets such as credit, agriculture extension training, and agricultural inputs (fao.org, 2009, pp. 6-7). The differences between men and women could be due to socio-economic factors. Diffusion theory states that individuals who are higher in socio-economic status are able to adopt innovations much more quickly than those with lower levels of education and fewer assets (Rogers, 2003, p. 288). From this study, the average level of education for women and men was primary school level 7. A one-way analysis of variance (ANOVA) was conducted to evaluate the relationship between level of education completed and length of time owning the mobile phone under the assumption that those who are higher in education level would have adopted the mobile phone earlier. The ANOVA indicated that education level was not significant in impacting earlier adoption of the mobile phone,  $F(2/97) = .694$ ,  $p > .05$ . Since education level does not significantly impact the time of mobile phone adoption, other social factors may be causing women to adopt the mobile phone later than males.

### **Voice versus SMS**

Approximately one-fourth of the respondents (27.3%) use both voice-based phone conversations and short message service (SMS). Males were more likely to use SMS than females (16% vs. 11%).

Regardless of farm group membership, male and female use of SMS focused on two categories: (1) greetings with family and friends and (2) agricultural consultation which included coordination for farm group meetings and access to agricultural inputs as well as market information from local businessmen and farm group members. Respondents did not indicate receiving or accessing market information from organizations, such as Foodnet, that distribute SMS market updates. Male use of SMS

was greater for agricultural consultation ( $n=11$ ) than females ( $n=4$ ). However, females ( $n=8$ ) were similar to males ( $n=7$ ) in their use of SMS to communicate with family and friends. Total respondents that utilize SMS ( $n=30$ ) indicated the use of SMS only when low on mobile phone credit; the primary means for communication was through the mobile phone voice-based application.

The limited use of SMS is likely a consequence of high illiteracy rates in the rural population of this study. Male and female SMS rates may reflect the differences in literacy levels. Those using SMS were found to have higher levels of schooling ( $M = 8.7$  years of schooling,  $SD = 2.27$ ) than individuals not using SMS ( $M = 6.6$  years of schooling,  $SD = 2.87$ ),  $t(109) = -3.584$ ,  $p = 0.001$ ). These results suggest that applications of mobile phones for development purposes should emphasize voice-based communication and user interfaces that can be used by those with low literacy. In addition, incorporating functional literacy and mobile phone training, in particular SMS training, into agriculture training sessions is recommended. Functional literacy is defined as the combination of “teaching, reading, writing and numeracy with the teaching of livelihood skills or the ability to engage in all those activities in which literacy is required for effective functioning of his/her group and community” (Baryayebwa, 2004, p.15). By providing functional literacy training, individuals will be better equipped to utilize the mobile phone for a greater spectrum of productive uses.

Individuals who are illiterate can ask others who are literate in the community to interpret SMS messages. However, if the information is private, an individual may be hesitant to ask for help (Chipchase, 2009). Issues relating to privacy of SMS messages were also documented among literate respondents in this study. For example, a farmer indicated that he has decided to not send and has encouraged others to not send him SMS messages because he fears that while charging his mobile phone in the city, individuals will read his messages.

## Recurring use themes

Five recurring themes were identified for agricultural-based mobile phone use. Regardless of gender or farm-group membership status, use focused on: (1) coordination for access to agricultural inputs, (2) consultation with expert advice, (3) attainment of market information, (4) agriculture emergency security, and (5) monitoring of financial transactions. Overall, small to medium-size farm holders involved in a farm group were likely to use the mobile phone for more agricultural-based purposes ( $M = 3.18$  out of 5 uses,  $SD = 1.27$ ) than non-farm group members ( $M = 2.57$  out of 5 uses,  $SD = 1.20$ ),  $t(107) = -1.995$ ,  $p < 0.05$ . This finding suggests that farm group membership is associated with knowledge transfer.

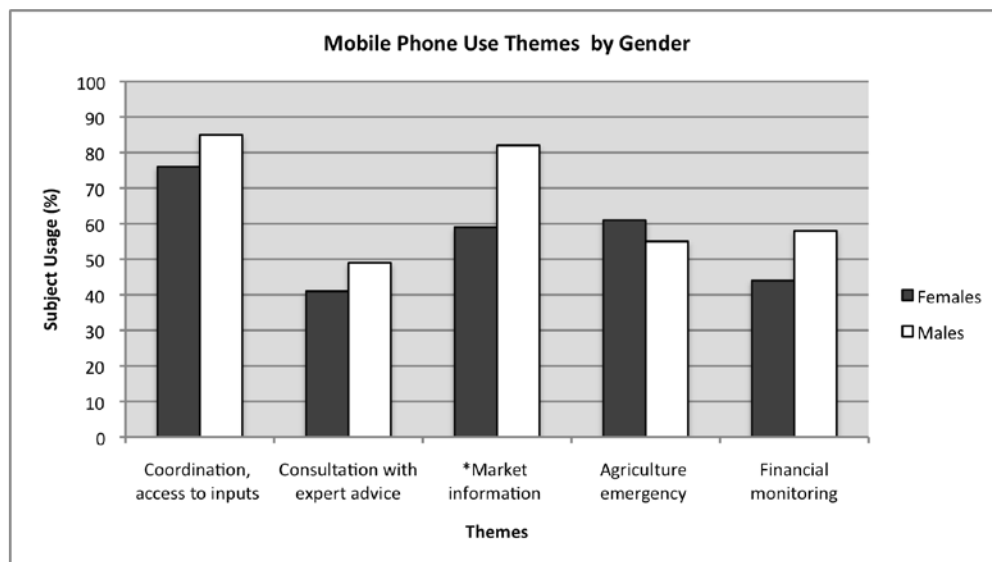
The majority of the respondents (82%) used mobile phones to coordinate meetings including agricultural trainings and to gain access to agricultural inputs including seeds, livestock, pesticides, etc. from local seed dealers, nongovernmental organizations (NGOs), and community members. Respondents indicated that mobile phones provided monetary savings over what would normally have been spent on travel. For example, in the past an individual would have paid to travel to a seed dealer only to find that all seeds had been sold. Now, farmers are able to call ahead and coordinate a meeting time, determine price and availability. Respondents also reported using the mobile phone to coordinate farm group meetings. In particular, respondents commented

that they no longer missed meetings or trainings because they were always available through the mobile phone. For example, a respondent indicated that he could continue to work in the field without worry of missing out on opportunities.

Members of a farm group were significantly more likely to use the mobile phone for agricultural consultation with expert advice than non-farm group members ( $X^2(1, N=110) = 7.055$   $p < 0.01$ ). Approximately 51% of farm group members indicated using the mobile phone for consultation, while only 19% of non-farm group members did. This finding indicates that being in a farm group allows for greater access to expert advice through the mobile phone. There was no significant difference between females and males in the use of the voice-based application of the mobile phone for consultation with experts.

Respondents (74.5%) also reported the use of the mobile phone to gain market pricing prior to negotiations and travel so as not to buy or sell at a loss. Males used the mobile phone for market information more than females (see Figure 2,  $X^2(1, N=110) = 6.68$   $p < 0.01$ ).

**Figure 2. Mobile Phone Use Themes by Gender**



\* significant at  $p < 0.05$

FAO reports that women are responsible for between 60 and 90% of total food production (2006, p. 8). Generally, women are responsible for cultivating and marketing of food crops produced for household consumption and men are responsible for commercial or export-driven crops in sub-Saharan Africa (Koehler, 1999, p. 293). During interviews, many women commented on the need for access to markets and requested to learn how to coordinate with others to sell produce in bulk. It is thus essential to train women on how to: (1) access and compare markets for sound decision-making and (2) how to coordinate with others in the area to combine resources. First, it is important to train individuals how to identify proper market prices for the local market. Second, and more complex, it may be advantageous to develop a mobile phone application that can match buyers and sellers beyond the local market through coordination of local farmers'

contact with bulk buyers, coordination of collection of multiple farmers' produce for selling in bulk and coordination of transportation of bulk produce.

According to the FAO, due to women's lack of assets, there are high economic costs such as wasted human capital and low labor productivity. Increasing women's assets will directly influence the attainment of family food necessities and financing for child development (fao.org, 2009, pp 6-8). An increased ability for rural farmers, especially women, to coordinate resources and increase access to markets through the mobile phone has the potential to provide support to small and medium-size farm holders' livelihoods.

Nearly 58% of both males and females utilize mobile phones for agriculture emergency security. Respondents reported agriculture emergency security as the ability to call a veterinarian and agricultural-based NGOs, including VEDCO and The National Agricultural Advisory Services (NAADS) for livestock and crop emergencies. One of the most frequently observed agriculture emergency security functions of the mobile phone was the ability to contact a veterinarian to treat sick livestock. By being able to call a veterinarian for assistance instead of travelling to consult, money and time that would have been spent on travel is saved. The ability for the veterinarian to be called rather than consulted face-to-face results in earlier detection and treatment of illness in livestock. Female respondents reported contacting veterinarians for livestock assistance on a regular basis. For example, a female respondent noted that since she began consulting with the veterinarian via the mobile phone she has been able to save money that would have been spent on travel and has been able to keep her pigs healthier and able to breed due to early detection and timely treatment of illness. Agriculture emergency is the only mobile phone use in which the percentage of women is greater than the percentage of men (see Figure 2). According to the International Fund for Agriculture Development (IFAD), Ugandan women are likely to "sell surplus from their own plots, chickens and pigs" (ifad.org, 2000). Since women can sell these assets for profit, it is clear why a substantial portion of women (61%) would utilize the mobile phone for agriculture emergency security of these resources.

Financial monitoring included consulting with lenders on availability and guidelines of microfinance loans, reminding farm group members to repay loans accountable to the group as a whole, and monitoring of domestic and business remittances. Regardless of gender or farm group membership status, approximately 51% of the total respondents indicated using the mobile phone regularly for financial monitoring. In particular, comments from interviewees focused on the ability for the mobile phone to increase knowledge of and access to microfinance loans.

In sum, regardless of gender or farm group membership status, there is opportunity for governmental and nongovernmental agencies to strengthen the use of the mobile phone for consultation with expert advice. The ability to communicate without travel will save both the rural farmer and the development agency from incurring travel costs. Using Hudson's framework (2006) that outlines the utility of telecommunications in development, there is opportunity to utilize the mobile phone to increase efficiency in distributing agricultural trainings, increase effectiveness in operations and achieving desired outcomes through remote diagnosis and consultation, as well as providing the ability to increase monetary gains of the rural population by training farmers, in particular women, on how to access markets and sell in bulk to larger, more profitable markets.

## Recurring impact themes

Interviews also revealed the perceived impact of agricultural-based mobile phone use on farmers' livelihoods. Impacts stated by the farmers focused on: (1) transportation efficiency, (2) benefits of agriculture emergency security, (3) increase in contacts and opportunities, (4) increase in market access, and (5) increase in efficiency resulting in greater output. Farm group members and non-farm group members did not differ in perception of impact of the mobile phone. However, males (62%), unlike females (43%), perceived transportation efficiency ( $X^2(1, N=109) = 4.04, p < 0.05$ ) to be a primary beneficial impact of the mobile phone. Also, males (66%), more than females (44%), felt the mobile phone increased contacts and opportunities ( $X^2(1, N=109) = 4.06, p < 0.05$ ). The fact that males associate benefits of the mobile phone with transportation efficiency and an increase in contacts provides further indication as to why females have adopted the mobile phone later than males. According to Rogers (2003), earlier adopters of innovations have higher levels of social participation, travel widely and are exposed to ideas and opportunities beyond their local social system (pp. 287-292). Traditionally, women in Uganda are less mobile than their male counterparts due to social norms that dictate their responsibility in household tasks such as childbearing, cooking and cleaning (worldbank.org, 2008). Since women have less contact with outside sources of information they are potentially less likely to be early adopters of new innovations.

## Unique use themes

Understanding unique uses of the mobile phone is important as it shows how the technology has been adapted to respondents' needs and suggests applications that may be useful to others. According to diffusion theory, re-invention allows for an innovation to fit more appropriately with local contexts. Innovations that can be re-invented to fit changing needs are more sustainable (Rogers, 2003, pp. 183-185).

Mobile phone uses that were unique to the local context of this study were discovered (see Table 1). Some of the unique uses included: (1) use of the calculator to figure proper market pricing, (2) use of the loudspeaker function for group meetings with NGOs, (3) storage of agricultural-based information in the calendar of the mobile phone, (4) voice recording of agricultural-based lessons, and (5) use of the camera phone for educational purposes.

Males used the calculator function of the mobile phone to know proper market prices more than females (68% vs. 37%). Nearly half of the female respondents (46%) indicated an inability to use the calculator. Over half of the male respondents (53%) used the loudspeaker while a small proportion of females (17%) do. Few females (17%) use the mobile phone to store agricultural-based information compared to males (53%). Female participants did not comment on the use of a voice recorder or camera phone while 10% of men use voice recording and 4% use the camera for educational purposes. Overall, more males (73%) than females (50%) were found to have at least 1 unique mobile phone use ( $X^2(1, N=109) = 5.94, p = 0.01$ ).

The loudspeaker function of the mobile phone is utilized in order to promote transparency in the group. For example, respondents reported the use of the loudspeaker to contact VEDCO with concerns on repayment of loans accountable to the group as a whole and requests for agricultural inputs such as seeds and livestock. During farm group



meetings, the mobile phone would be placed in the center of the group so that each member of the group could hear and participate in the consultation.

**Table 1.** Unique uses of mobile phones among small to medium-size female (n=54) and male (n=56) farm holders

Calculator (Information advantage)	Loudspeaker (Group solidarity)	Storage of information (Knowledge transfer)	Voice recording (Knowledge transfer and group solidarity)	Use of camera on phone (Knowledge transfer)
Use calculator: Male: 68% Female: 37%	Use loud speaker Male: 53% Female:17%	Information storage Male: 53% Female:17%	Voice recording: Male: 10% Female: 0%	Use of camera: Male: 4% Female: 0%
Do not know how to use calculator: Male: 16% Female: 46%	Uses loud speaker to communicate with VEDCO to clarify agriculture methods  "Everyone can hear the lesson first-hand"	Storage of current farm group debt and debt relief training from VEDCO (in text messaging folder)	Records VEDCO trainings to review again	Takes photos of examples of good agricultural techniques during VEDCO trainings to review again
		Storage of notes on VEDCO trainings (in reminder folder)	Records phone conversations when VEDCO provides remote diagnosis for group	
Uses calculator to know proper price before selling to the market. "I no longer feel cheated."	Uses loudspeaker to communicate with loan officer to encourage group and individual accountability.	Storage of daily market price in order to sell at a higher price (in calendar)	Records fellow group members stating when they will pay back loans to promote accountability	
		Storage of names of appropriate drugs to treat livestock (in calendar)		
Uses calculator to calculate body mass index for health monitoring	Uses loudspeaker when a member is absent to include individual in decision making	Storage of age of hens and expected date when will start laying eggs (in calendar)		
		Storage of planting and expected harvesting dates (in calendar)		
	Uses loudspeaker to communicate with bulk buyer.  "No one feels cheated, we all know the proper price."			

While males were found to have more unique mobile phone uses than females, many females were very ingenious in the storage of critical information in their mobile phone. For example, one female respondent indicated storing daily market prices of goods she sold in the local and surrounding markets. By doing so, she commented that she was now getting the proper price and no longer felt cheated because she could choose the market with the best price or store her goods until the market price rose. Another female respondent indicated storing the date a veterinarian visits and recommendations such as when her hens should start laying eggs. If her hens did not lay eggs by this date, she knew that she needed to contact the veterinarian for assistance. Both respondents indicated that the storage of agricultural-based information freed them from a guess-based approach in decision-making, and they were now more informed and confident in their decisions.

While not very common, voice recording and camera functions of the mobile phone were used. These functions were mainly utilized to capture VEDCO agricultural training sessions for later reference. In order to maintain contractual agreements within the group, one individual noted recording fellow group members stating when they anticipated paying back their portion of the group loan. If the group member did not pay their portion back on the date specified, the recording would be played aloud to subject the individual to public embarrassment.

According to diffusion theory, individuals depend heavily on their near peers' experience with an innovation to shape their use of the innovation (Rogers, 2003). Just as the mobile phone hardware was adopted in the diffusion process, so will the evolving unique uses of the mobile phone. Once productive uses are identified, development practitioners and farm group members should encourage teaching the new use identified in order to continually spur the development of productive uses of the mobile phone.

## Conclusions

Mobile phones have diffused rapidly into the rural countryside of Uganda in the past five years, providing new opportunities for communicating information that will be helpful to limited-resource farmers and small agricultural businesses. Diffusion of innovations research shows that early adopters of new technologies tend to be more educated, more connected, and more able to take risks. The current "snapshot" of the situation does indeed find that being male, having education, and being part of a group increases the use of mobile phones. That does not mean that mobile phones will not move to other segments of the population. In fact, this study documents the rather recent adoption and use of mobile phones by women, suggesting that they are the next group to take advantage of this technology. However, there is no guarantee that mobile phones will be adopted by a large majority of farmers. That depends on future costs and benefits.

This study found that farmers who were members of farmer groups were more likely to use mobile phones for a variety of uses. There may be several explanations for this. One is that being part of a group means a farmer has more access to new information about agriculture as well as new information about how to use mobile phones. When new relevant agricultural information arrives, it would be expected that farmers would use mobile phones to spread the word about it. Group membership in and of itself also increases the need for use of mobile phones to coordinate group activities, and to support

one another. Thus, there is a synergy between farmer groups and effective mobile phone use. In contrast, farmers who are social isolates, and who have little access to new agricultural technologies, would have much less use for a mobile phone.

A total of 110 farmers in Kamuli District, Uganda, were interviewed in June and July 2009 – 56 men and 54 women. Five specific areas of mobile phone use were examined. They are: (1) coordination, access to inputs; (2) consultation with experts; (3) market information; (4) agricultural emergencies; and (5) financial monitoring. Except for consultation with experts, which was a function used by less than half, at least a majority used mobile phones for the other four purposes. This indicates a fairly broad use of mobile phones for a number of different agricultural purposes. Women lagged behind men slightly in these uses except for agricultural emergencies, where they led slightly. Since women often care for livestock, they use the mobile phone to call veterinarians when animals become sick. These results indicate that mobile phones are used for a variety of purposes, and thus training and opportunities for future use should focus well beyond single uses such as getting market information. Farmers strongly believe that these devices are saving them money by avoiding wasted travel, seeking veterinarian advice by phone first, coordinating time working in the fields or at meetings, and recording key information such as agreements on loan repayments.

During the interviews, farmers also were asked about unique uses they made of mobile phones. Results suggest that there are a number of creative uses being made of these devices as farmers re-invent them for their own purposes. Examples include use of the mobile phone camera to document training or use of its loudspeaker function to permit a group of farmers to consult with an expert. This suggests that those who want to train farmers in mobile phone use should constantly document these unique uses and then incorporate them into training.

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