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# Mobile phones and rural livelihoods: An exploration of mobile phone diffusion, uses, and perceived impacts of uses among small- to medium-size farm holders in Kamuli District, Uganda

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**Mobile phones and rural livelihoods: An exploration of mobile phone diffusion, uses, and perceived impacts of uses among small- to medium-size farm holders in Kamuli District, Uganda**

by

**Brandie Lee Martin**

A thesis submitted to the graduate faculty  
in partial fulfillment of the requirements for the degree of

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Ames, Iowa

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**TABLE OF CONTENTS**

LIST OF TABLES	iv
LIST OF FIGURES	v
ABSTRACT	vi
CHAPTER 1. INTRODUCTION AND STATEMENT OF THE PROBLEM	1
Study Purpose	5
CHAPTER 2. LITERATURE REVIEW AND THEORETICAL FRAMEWORK	7
ICTD Perspective	7
The Diffusion of Innovations	11
Impacts of Mobile Phone Uses	15
Organizational Communication and Group Performance	19
Gender Differences in Diffusion and Use of Mobile Phones	23
Research Questions	25
CHAPTER 3. METHODOLOGY	26
Study Design	26
Purposive and Snowball Sampling	27
Qualitative Data Gathering: Semi-structured In-depth Interviews	30
The Interview Questionnaire	32
Operational Definition of Variables	33
Data Analysis	37
CHAPTER 4. RESULTS AND DISCUSSION	39
Agricultural-based Uses of Mobile Phones	39
Adoption of Mobile Phones and Uses	44

Re-invention of Mobile Phone Uses	50
Perceived Impacts of Mobile Phone Uses	56
Organizational and Gender Influence on Adoption, Use, and Perceived Impacts of Mobile Phones	61
CHAPTER 5. IMPLICATIONS OF THE FINDINGS AND CONCLUSIONS	69
Limitations of the Study and Suggestions for Future Research	78
REFERENCES	80
APPENDIX A. LETTER OF INTRODUCTION	86
APPENDIX B. INTERVIEW QUESTIONNAIRE	87
APPENDIX C. LIST OF AGRICULTURAL-BASED USES OF MOBILE PHONES BASED OFF OF RESEARCH LITERATURE	89
APPENDIX D. INTERVIEW RESPONSES FOR: (1) REASONS FOR MOBILE PHONE ADOPTION, (2) MOBILE PHONE USES, AND (3) PERCEIVED IMPACTS OF MOBILE PHONE USES	90
ACKNOWLEDGEMENTS	97

**LIST OF TABLES**

Table 1	Agricultural-based use themes, frequencies, and illustrative examples	41
Table 2	Frequency of initial use categories that influenced mobile phone adoption	49
Table 3	Unique use themes, frequencies, and illustrative examples	53
Table 4	Percentages of farm and non-farm group members utilizing agricultural-based use themes	64
Table 5	Percentages of RDEs and CNHWs, chairpersons, and members of farm groups utilizing agricultural-based use themes	65
Table 6	Percentages of males and females utilizing agricultural-based use themes	66

**LIST OF FIGURES**

Figure 1	Innovation attributes leading to adoption and possible re-invention	13
Figure 2	Breakdown of individual length of time owning mobile phone	45
Figure 3	Breakdown of time owning mobile phone by membership status	61
Figure 4	Breakdown of time owning mobile phone by gender	62

## ABSTRACT

This study examined the diffusion, use, and perceived impacts of agricultural-based mobile phone uses among small- to medium-size farm holders in Kamuli District, Uganda. Interviews were conducted with 110 farmers – 56 men and 54 women. Respondents were chosen according to farm group (n=90) or non-farm group (n=20) membership status. Results showed more than half of the farmers were using mobile phones to coordinate access to agricultural inputs, obtain market information, and to monitor agriculture emergency situations and financial transactions. Slightly less than half were consulting with experts via mobile phones. Members of farm groups were more likely to use mobile phones for agricultural-based purposes, especially consulting with experts. Women were less likely than men to access market information through the mobile phone. Overall, men tended to adopt mobile phones earlier than women and were more likely to have a unique mobile phone use. Unique uses included taking photos of agricultural demonstrations, using the loudspeaker function for group consultation, recording group members pledging repayment of loans, and storing data such as market trends in the mobile phone calendar. The current “snapshot” of the situation does indeed find that being part of a farm group and being male is associated with mobile phone use.

**Keywords:** diffusion, mobile phones, ICTD, agriculture development

## CHAPTER 1

### INTRODUCTION AND STATEMENT OF THE PROBLEM

According to the Global System for Mobile Communications, there are more than 2.5 billion mobile phone subscribers all over the world. It is projected that by 2010, mobile phones will cover 90 percent of the planet (GSM, 2008). This suggests that the developed and the developing worlds are becoming more and more connected into a global network. As mobile phone use becomes more prevalent especially within the developing world, it is pertinent to ask: Is the mobile phone a viable tool for economic growth and a facilitator of sustainable livelihoods among those engaged in agricultural-based livelihood activities?

Small- to medium-size enterprises (SMEs), businesses with five or fewer employees, are a vital component of developing economies so that “any gains in stability, productivity, and profitability are of utmost importance to the livelihoods of the households involved” (Donner, 2006, p. 4). To these sectors, access to information through the use of information and communication technologies (ICTs) is critical to economic growth, especially in resource-constrained environments (Donner, 2008). As such, the role these technologies can play in poverty alleviation and the improvement of the human condition has been the subject of considerable study.

In particular, researchers are concerned with understanding the local use of ICTs according to different information and communication needs and the adaptability of these technologies to social, economic and cultural practices

(Michiels & Van Crowder, 2001). As ICTs, including mobile telephony, continue to evolve and be adopted at a fast rate, their contributions —and their drawbacks, if any—must be continuously assessed (Food and Agriculture Organization of the United Nations [FAO], 2003).

The benefits accruing from the widespread adoption of information technologies in rural communities have been documented. It has been argued that mobile telephony in developing countries has increased people's knowledge of market information, specifically for buying and selling; improved the coordination of transportation especially during emergencies; and enhanced the administration of international activities (Saunders, Warford, & Wellenius, 1994).

Researchers stress the importance of understanding peoples' livelihoods including the motivations behind adoption and perceived relative advantage derived from ICTs in order to understand the impact of these technologies in developing countries (Michiels & Van Crowder, 2001; Kaba, Diallo, Plaisent, Bernard, & N'Da, 2006). This study aims to further this research goal. The diffusion of innovations approach outlined by Rogers (2003) will expand understanding of reasons for adoption, usage patterns, and communication objectives that are and can be met by the mobile phone in a developing country.

The effect of information on market performance and welfare is relevant to the debate over the value of ICTs in economic development. The international donor community has rallied efforts toward "bridging the digital divide" between the "haves" and the "have-nots" to help maximize the impact of ICTs on the millennium development goals outlined by the United Nations (*infoDev*, 2010).

Determining how ICTs are being used to advance market performance of the agriculture sector in low-income countries is of utmost importance (Jensen, 2007). This is especially important in a country like Uganda that faces tremendous challenges.

According to the Food and Agriculture Organization of the United Nations, Uganda depends heavily on subsistence farming. About 85 percent of its rural population derive income directly or indirectly from agriculture (FAO, 2009). The gross domestic product per capita in Uganda is approximately 400 dollars (United Nations [UN], 2010). In addition, Uganda is also ranked 156 out of 179 countries in the United Nations' Human Development Index, indicating that life expectancy, education, purchasing power and income are extremely low (UNDP, 2008).

Uganda, and the continent of which it is a part, face unique challenges that tax the government structure and other development agencies that come to their assistance. Diseases such as malaria and HIV/AIDS continue to ravage the continent. Extreme poverty and food insecurity are hindering growth. According to the World Bank (2008a), Uganda has a population of approximately 30 million and has an HIV prevalence rate of 5.4 percent among individuals between the ages of 15 to 49. Thirty-one percent of the population lives below the poverty line, and 45 percent of children under the age of five are malnourished (World Bank, 2008a).

Within Uganda, the number of mobile phone subscribers has increased from 776,200 to over 8.5 million in the past five years (UCC, 2008). This rapid

growth can be attributed, in part, to a 1996 Uganda Communications Commission (UCC) telecommunications policy that outlined objectives to provide universal access particularly in rural, underserved areas (UCC, 2005, p.21) In order to promote universal access, the telecommunications sector was opened for private investment. As a result of increased competition, mobile telecommunications service providers including Celtel and MTN Uganda Limited were established resulting in increased construction of mobile telecommunications towers, particularly in rural areas (UCC, 2005, p. 22).

According to a report on behalf of the Grameen Bank, in the last two years mobile phone handsets have declined in price to approximately 40,000 Uganda shillings (approximately 19 dollars) (Burrell, 2008). Rural mobile phone users pay an additional 500 Uganda shillings (approximately 24 cents) every three to four days to charge the mobile phone's battery at a battery-charging kiosk in the local city center (D. Masinde, personal communication, April 19, 2010). In order to further promote accessibility of the rural poor to mobile telecommunications, mobile phone services have been provided through a pre-pay model in which a scratch card can be purchased in varying price increments to load onto the mobile phone as mobile phone credits (Burrell, 2008, p.12). In addition, receivers of mobile phone calls are not charged thus increasing cost savings for at least one party involved (Donner, 2005). Given the rapid growth and increased access to mobile telecommunications, particularly among the rural poor, the question appears: How can the fullest potential of this resource be utilized to support sustainable livelihoods?

The Kamuli District of Uganda has an approximate population of 700,000 with a land area of approximately 1,700 square miles (UDS, 2006). The Kamuli District is considered to be among the poorest in the country due to a high level of dependence on agriculture (UDS, 2006). Over half of the land is used by small- to medium-size farm holders for cultivating cassava, sweet potatoes, groundnuts, beans, bananas, rice, cotton, coffee, and soy beans (UDS, 2006). Given these facts, understanding the local use of mobile phones in the Kamuli District can provide information pertinent to the goal of increasing agricultural productivity and rural incomes. It is therefore important to ask the rural population: What are the agricultural-based uses of mobile phones? How, when, and why are agricultural-based uses of the mobile phone adopted? How have mobile phone uses been altered to fit the needs of the user? Furthermore, what is the value of agricultural-based uses of the mobile phone to individual adopters?

### **Study Purpose**

The aim of this study is to understand the origin and evolution of agricultural-based uses of mobile phones and the impact of these uses on sustainable livelihoods activities in developing countries. Another aspect of this study is to further the understanding of the communication needs of those involved in agricultural activities that are instrumental in establishing sustainable livelihoods in developing countries. Using a qualitative approach through in-depth interviews, this study sought to discover agricultural-based uses of mobile phones including where the use came from, how the use has been adapted to fit

local needs, and how the use is being diffused throughout one rural area of a developing country, namely the Kamuli District of Uganda.

The findings of this study are expected to provide deeper insights into the utility of mobile phone adoption and to further examine the function of mobile phones in the development and growth of SMEs within a developing country. By targeting small- to medium-size farm holders and farm groups, the relationship between ICTs and economic development will be further explored within a sector that can be considered to be the backbone of a nation. Furthermore, the application of the mobile phone as a tool for development will be further understood as it relates to the needs of the individuals operating SMEs within a developing country.

The results of this study can be useful to national and international initiatives focusing on the role of ICTs for development. New applications and techniques that will tap the fullest potential of mobile phones in developing regions of the world may be identified. A local focus brings a unique perspective that will provide greater nuances to people's understanding of the implications of mobile communication technologies to assist in the achievement of development initiatives.

## **CHAPTER 2**

### **LITERATURE REVIEW AND THEORETICAL FRAMEWORK**

This chapter discusses previous literature on the subject of information and communication technologies, namely mobile phones, as tools that assist development initiatives. Next, this chapter explains the diffusion of innovations process and factors that impact adoption and use of innovations. This chapter also explores previous literature on the impacts of adoption of mobile phones and discusses the influences of organizational membership and gender on use of the mobile phone within resource-constrained environments. This chapter concludes with a listing of the research questions.

#### **ICTD Perspective**

Researchers studying information and communication technologies and development (ICTD) argue that information and communication technologies (ICTs) can greatly aid in rural development and poverty reduction (Saunders, Warford & Wellenius, 1994; Hudson, 2006; Donner, 2008). In developing countries, between 30-80 percent of the poor depend partially or entirely on small- to medium-size enterprises (SMEs) for their livelihood (Vanderschueren, Wegelin, & Wekwete, 1996, p. 33). Given that the majority of SMEs in developing countries are agriculture-based and that ICTs are fast becoming ubiquitous in many parts of the world, further research on the productive uses of mobile phones by small- to medium-size enterprises including farmers, farm groups and the organizations that serve them will expand understanding of how mobile phones can be used to support sustainable livelihoods. The agricultural sector is

critically important in any developing economy and no less so in Uganda where 80 percent of the workforce is involved in agricultural enterprises (CIA, 2009).

The current study examines agricultural-based uses of mobile phones in Kamuli District, Uganda, to support the development of sustainable livelihoods.

Scoones (1998) offers five factors that influence the sustainability of livelihoods: “(1) the creation of working days and employment; (2) poverty reduction; (3) overall well-being and use of capabilities; (4) livelihood adaptation, vulnerability and resilience (the ability to cope and recover from stresses and shocks); and (5) natural resource base sustainability (the ability to maintain productivity without depleting natural resources)” (pp. 5-6). Development scholars and planners (Hammond, 2001; McNamara, 2003) agree that the poor need economic opportunities, education, and healthy environments to achieve these goals. Researchers (McNamara, 2003; Donner 2008) argue that ICTs may help achieve these objectives in their role as *complementary* tools for development. Indeed, McNamara (2003) further cautions that ICTs have the ability to *enable* change, not necessarily *create* change. That is, ICTs are not goals in and of themselves.

Past investigations of the perceived attributes of mobile phones within developing countries focus on their ability to encourage efficient and informed action to lead to greater productivity over current practice (Saunders, Warford & Wellenius, 1994; Hudson, 2006). According to Albu and Scott (2001), mobile telephony can be an asset for development by enabling the rural poor to respond more efficiently to external economic opportunities or threats. Mobiles phones

can empower the rural poor to lobby for and demand a higher priority for themselves through an increase in access to information which can assist in sound decision-making (McNamara, 2003).

According to Donner (2008), mobile telephony can serve as a development tool to the extent that it accelerates, complicates, and interacts with the process of economic development in general. Because communication within and between institutions responsible for making livelihood decisions is substantially enhanced, those who are served by these institutions benefit by the improvement of local capacities enabled by the acquisition and exchange of information (FAO, 2003).

The availability, quality, and cost of communication are important factors to consider in the enhancement of commerce and trade. In developing countries, commerce often is conducted at a slow pace, mainly through face-to-face contacts, and business transactions are often done through intermediaries (Jagun, Heeks, & Whalley, 2007). Rural residents, who comprise a substantial majority of the world's poorest, expend substantial amounts of valuable resources such as time and money to facilitate communication with family, trading partners, health providers, and other suppliers of economic necessities (McNamara, 2003). Instead of travelling to communicate, ICTs, especially mobile phones, offer faster and cheaper means for interaction.

Rowan-Campbell and Tandon (2009) identified the use of mobile phones to increase economic opportunities among farmers and traders through allowing them to access buyers who were not previously accessible due to boundaries

imposed by traditional social network linkages and geographic constraints. The connected rural community, according to Rowan-Campbell and Tandon, provides benefits of not only connecting the farmer to a greater network of buyers and consumers but also providing the ability to lobby for more resources by being connected to decision and policy makers (2009, p. 2).

Field research has indicated that benefits derived from telecommunications are related to distance and density, so that benefits are proportionally greater in rural areas where the presence of telecommunications is low and where alternative forms for communication are expensive and/or time consuming (Hansen, Cleavelly, Wadsworth, Bailey, & Bakewell, 1990). Hansen et al. (1990) found that the benefits of telecommunications are reduced for extremely rural areas, possibly due to their lack of general infrastructure, indicating that mobile phones have more value in rural areas with some level of development. The cooperation of development-based organizations and rural stakeholders may help rural areas identify the context, resources, and strategies for development-based ICT use.

According to McNamara (2003), the key to realizing the potential of ICTs for development is in understanding the interdependent factors (both local and global) that impact their ability to advance development goals. According to Scoones (1998), understanding formal and informal institutional and organizational processes allows for the identification of opportunities and barriers to development of sustainable livelihoods (p.12). The framework underscores the importance of understanding the use of ICTs according to local context and

needs. Researchers (Chambers and Conway, 1992; Richardson, 2006) recommend placing emphasis on stakeholders' views and primary livelihood assets to determine how ICTs can be utilized to take advantage of opportunities and to cushion people from economic stresses and shocks. Understanding the formal and informal processes will uncover the conditions that promote the diffusion of mobile phones and agricultural-based uses of mobile phones.

### **The Diffusion of Innovations**

Diffusion, as defined by Rogers (2003), is the process by which “ (1) an *innovation* is (2) *communicated* through certain *channels* (3) *over time* (4) among the members of a *social system*” (p. 11). Innovations are seen as extending beyond new technologies to include new skills and ideas. Diffusion of such innovations occurs within a social system. The social structure of the system can impede or facilitate the diffusion of an innovation (Rogers, 2003, p. 25).

Like all technological devices, mobile phones may have a differential impact on peoples and societies. According to Tichenor, Donohue and Olien (1970) any member of the community that is higher in socio-economic status, in particular, education level, will more likely receive information first and will therefore be benefited the most by the application of new technologies. This phenomenon leads to a knowledge gap between the “haves” and the “have-nots” within a community. Like most early adopters of most innovations, initial adopters gain advantage over those who are late adopters, but especially over those who are unable to adopt (Rogers, 2003).

Understanding the perceived attributes of an innovation to the individual such as:

*Observability* or the degree to which the outcomes of an innovation are viewable by individuals, *trialability* or the ability to experiment with an innovation prior to adoption, *relative advantage* or the degree to which an innovation is perceived as being better than the practice it supersedes, *compatibility* or consistency with existing values and needs, and *complexity* or the degree of difficulty in understanding use all influence the likelihood for adoption and shape the use of an innovation (Rogers, 2003, pp.15-16).

According to Rogers, relative advantage is often the most important factor that impacts adoption. “The greater the perceived relative advantage of an innovation, the more rapid its rate of adoption will be” (Rogers, 2003, p.15).

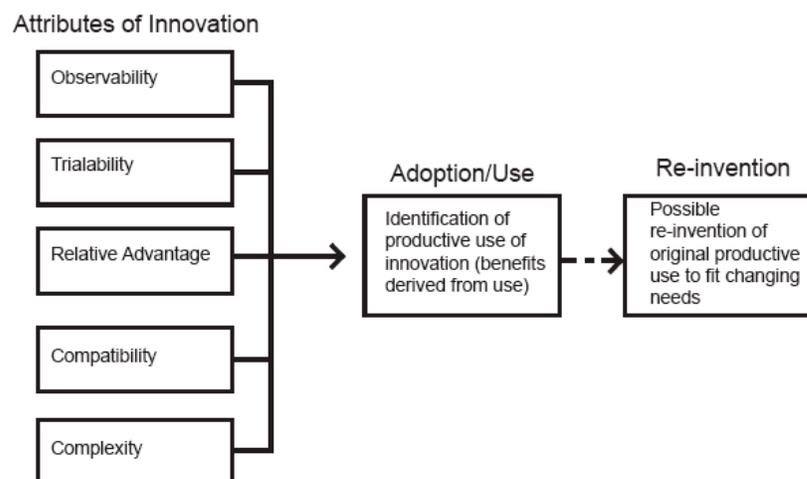
Early diffusion research understood adoption as the exact copying or imitation of how the innovation had been used by an early adopter (Rogers, 2003, p. 180). However, understanding the re-invention, or the degree to which an innovation is altered, sheds light on ways in which the original innovation may be adapted to add value for adopters. Re-invention occurs in order for an innovation to be more appropriate in solving a wide range of users’ problems by allowing the innovation to fit more appropriately with local and/or changing needs (Rogers, 2003, p.185).

The re-invention of the use of the mobile phone in Rwanda, as reported by Donner (2005), is specific to local context and needs. Donner found that Rwandans had uncovered a way to maximize the benefits of mobile telephony while minimizing the costs through a technique referred to as “beeping.” Beeping occurs when an individual places a call to a mobile subscriber and hangs up before the call is answered. The beep from the missed call is used to indicate

pre-negotiated messages and is a free application to both sender and receiver. For example, a dairy merchant in Rwanda receives a beep from his suppliers when they want to tell him that he should not send his truck because there is no milk to be picked up. This unique application has demonstrated the mobile phone's ability to be a viable tool to those in resource-constrained environments (Donner, 2005).

How and why an innovation is adopted and especially the unique re-invention of an innovation to fit the changing local needs of the individual harkens to its productive and sustainable characteristics (Rogers, 2003, pp. 180-187). Understanding the perceived attributes and especially the perceived relative advantage, compatibility and re-invention of an innovation to fit local circumstances is particularly important in understanding reasons for adoption and use of an innovation (Rogers, 2003). This framework is diagrammed in Figure 1.

Figure 1. Innovation attributes leading to adoption and possible re-invention (adapted from Rogers, 2003)



According to a 2006 study of the reasons for adoption of the mobile phone within the developing country of Guinea, located in West Africa, local perceptions, motivations, and social variables directly influenced the adoption and use of mobile phones (Kaba, Diallo, Plaisent, Bernard, & N'Da, 2006). In this study, three factors were found to have a direct impact on shaping the reasons for adoption and use of a mobile phone. They are (1) *mobility* allowed through the mobile phone, or the ability to be on the move while carrying out tasks; (2) *familiarity*, or the degree of intimacy between users of mobile phones; and (3) *social influences*, or the social pressure to imitate the same mobile phone uses as those found most commonly among members of their society (Kaba et al., 2006, p. 5). According to Rogers (2003), potential adopters desire to know the degree to which a new innovation will provide a relative advantage above their current practice. Thus, social exchanges concerning relative advantage and other innovation attributes between adopters and potential adopters are critical in the diffusion process (p. 233).

Rogers (2003) argues that at the heart of the diffusion process is modeling and imitation by potential adopters due to the viewing of near peers' experiences with an innovation (pp. 330-331). The social construction of technology, as defined by Rogers (2003), is the process by which people give meaning to a new technology by talking about it with each other (p. 256). Individuals rely on a subjective evaluation of an innovation that is conveyed to them from other individuals, in most cases opinion leaders, who are similar to them but that are

usually higher in socio-economic status, innovativeness, and are connected to a broader heterogeneous network (Rogers, 2003, p. 27).

The study of the adoption of agricultural technologies and practices introduced by Volunteer Efforts for Development Concerns (VEDCO), a non-governmental organization established to promote food security through agricultural development in Uganda, concluded that social networks facilitated the adoption of innovations by providing a platform for knowledge sharing, experimentation and risk mitigation (Mazur & Onzere, 2009, p. 120). While social networks were utilized to exchange information on farming practices distributed through VEDCO, a majority of farmers interviewed reported experimenting and modifying practices to suit their unique situation and sharing the results of their experiments with others, thus enabling mutual learning and status transformation due to possession of valuable knowledge and skills (Mazur & Onzere, 2009, pp. 128-130). Individuals identified as having more access to information and continuous training were found to serve a central role in farmer networks. The ability of ICTs, in particular mobile telephony, to produce, store, and transmit information makes them a potential tool to aid in the diffusion of agriculture strategies resulting in increased social and economic development (Hudson, 2006).

### **Impacts of Mobile Phone Uses**

Diffusion theory emphasizes understanding the *consequences* or impact of the adoption of an innovation (Rogers, 2003, p. 436). Understanding the

perceived impact of mobile phones will help uncover reasons for adoption, sustained use, and re-invention of uses to deal with a greater spectrum of needs.

Hudson (2006) outlines the overall impact of the adoption of telecommunications within resource-constrained environments under four overarching categories: (1) *efficiency*, ratio of output to cost (e.g., gathering info on soil/weather 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).

Some researchers have attempted to summarize the benefits of telecommunications for various activities. Research has expanded the efficient and productive uses of the mobile phone to include: (1) obtaining information advantage for sound decision-making (e.g., dissemination and retrieval of market information, especially for buying and selling); (2) coordination function (e.g., efficient coordination of transportation, especially during emergencies); and (3) networking and social capital (e.g., agricultural specialists and veterinarians can readily exchange information to improve crop yields and livestock production) (Saunders, Warford & Wellenius, 1994; Hudson, 1997).

In an effort to understand the use of mobile phones to expand social networks and opportunities, Jagun, Heeks and Whalley (2007) analyzed Nigeria's *aso oke*, a key cloth-weaving industry, because of its well-developed supply chain in which intermediaries (or "middlemen") play an important role and tend to siphon most of the profits. The main reason: the absence of direct

communication between weavers and buyers. Through in-depth face-to-face interviews, Jagun et al. (2007) found that the mobile phone allowed weavers to search for job opportunities and permitted buyers to have direct contact with weavers. Buyers also used the phone to commission credible intermediaries to inspect the work on their behalf, saving travel cost. In this case, time saved resulted in a faster turn-around of orders. Buyers who wished to inspect the design and quality of products called ahead so weavers could prepare for their visit. Mobile phones also were instrumental in strengthening the heterogeneous network of weavers who were able to accept and distribute more and/or larger orders and allocate job opportunities to other weavers within and outside their traditional network.

The impacts of an innovation tend to vary per individual and social system (Rogers, 2003, p.442). According to Leung and Wei (2000), the uses of mobile phones are linked to different demographic characteristics. Individuals engaged in business are more likely to use the mobile phone for productive purposes such as obtaining information for sound decision-making rather than solely for social reasons. Within the study, mobility and immediate access were perceived as unique advantages provided by the mobile phone. The relative advantage of mobility, immediacy, and instrumentality of the mobile phone versus previous techniques were observed as the strongest predictors of mobile phone adoption and use (Leung & Wei, 2000, p. 316).

In an initiative in Bangladesh, the Grameen Bank leased village pay phones (VPPs)—mobile phones that can be used by the general public for a

nominal fee—to women members. Program planners wanted to determine to what extent VPPs contributed toward improving the welfare of the poor, especially women. An evaluation study conducted by Bayes, von Braun and Akhter (1999) on the Grameen Bank initiative found phone conversations focusing on economic information constituted a substantial portion of all phone calls. According to the report, out of the 356 mobile phone users surveyed, approximately 46 percent of all phone calls were made to receive or send economic information. For example, a woman who had traditionally sold eggs to an intermediary began using the mobile phone to check the price of eggs before the intermediary would offer her a price. By obtaining an information advantage, the woman was able to barter with the intermediary and receive a higher price for her products (Bayes et al., 1999).

Burrell (2008), studying the impact of mobile phones in Uganda, expanded mobile telecommunication attributes of *efficiency*, *effectiveness*, *equity*, and *reach* within resource-constrained environments. Burrell uncovered nine reasons for adoption and use to aid in supporting sustainable livelihoods, some of which are unique to the study. They are: “ (1) emergency coordination; (2) organization of domestic remittances between family members living in different parts of the country; (3) reduction in transportation and transaction costs in trade (e.g., coordinating trade by phoning other farmers and traders to discuss produce marketability and market prices); (4) monitoring transactions and security enhancement (e.g., people who sent money through intermediaries used the phone to inform recipients and confirm arrival); (5) reduction of downtime (e.g., a

taxi driver could be contacted *during* transportation and thus was able to receive increased requests for services and increased income); (6) ability to increase networking and building of social capital; (7) consultation, ability to keep people in touch with expert advice (e.g., an HIV+ woman was able to phone doctors to receive reassurances and instruction when she fell ill); (8) coordination function through text messaging (e.g., local counselors were notified to attend a training session); and (9) the ability for data storage (e.g., a boat operator used his address book to keep track of debts)” (pp.16-17).

### **Organizational Communication and Group Performance**

Understanding the role of organizations to encourage adoption and use of mobile phones will uncover opportunities and barriers to the development of productive uses of mobile phones. In addition to understanding the role of organizations to encourage the diffusion process, this study aims to understand the application of mobile phones to enhance the effectiveness of organizations, in particular those that are agricultural-based, in order to uncover the role of mobile phones as complementary tools for development.

Blau and Scott (1962) document 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.

To Blau and Scott's (1962) list of organizational communication functions that can be enhanced by mobile phones, Hudson (2006) adds the ability to enhance efficiency at all levels of development-based organizations through the example of a health care system. In this domain, the benefits of using mobile phones include the: "(1) provision of information through consultation, remote diagnosis and information sharing; (2) coordination of emergency assistance, monitoring and training; and (3) group support through administration (e.g., ordering supplies and accessing patient medical records)" (p.47).

The application of ICTs, especially auditory technologies like the mobile phone, are particularly beneficial to strengthen group support in rural areas, which typically have low literacy rates and suffer from a shortage of teachers and educational facilities. An example in which the auditory function of the mobile phone has been adapted to strengthen group solidarity is through mobile phone conferencing. According to a report on behalf of The Forum for Agricultural Research in Africa (FARA) on the Busoga Rural Open Source & Development Initiative (BROSDI) in their work with the agricultural program, Collecting and Exchange of Local Agricultural Content (CELAC) in Uganda, farm groups are utilizing the loudspeaker function of the mobile phone to include all members in conferences with local agriculture experts to clarify agricultural techniques sent through short message service (SMS) or taught during extension services. By doing so, everyone in the group is able to express their individual concerns, thus promoting transparency and democracy (FARA, 2009).

A 2008 study on individuals working within agricultural-based enterprises in India assessed the relative advantage of mobile phones on the productivity of small-scale farmers and farm groups (Mittal, Gandhi, & Tripathi, 2009, p. 22). Focus groups and in-depth interviews were conducted involving individuals from many facets of agricultural-based enterprises, including farmers, fisherman, traders, and non-profit organizations. Out of the 200 people interviewed, 160 were small-scale farmers. The underlying objectives of the study were to determine the information needs of small-scale farmers and to explore the role of mobile phones in responding to the identified information needs resulting in possible productivity gains.

One of the farm groups Mittal et al. (2009) examined was the Indian Farmers Fertilizers Cooperatives Limited (IFFCO), which utilizes the mobile phone to disseminate agricultural information through a service called IKSL (IFFCO Kisan Sanchar Limited). Under this scheme, farmers must purchase a special SIM card to receive free voice-mails containing agricultural information as well as access to a helpline service for a nominal fee. The interviewees reported that subscribing to the IKSL service reduced crop losses and improved yields. For example, a farmer indicated he was able to protect his harvest due to timely weather information. The farmer also made use of recommended planting and disease control techniques, a far cry from his “guess-based” approach to farming before adopting the mobile phone. He credited these practices to a 25 percent increase in his annual revenues (Mittal et al., 2009).

A 2007 study of the relationship between animal health workers and farmers in two districts in Kenya documented the use of the mobile phone in the identification and management of livestock diseases and increased coordination for greater attendance and participation in organization meetings (FARM-Africa, 2007). Farmers indicated that mobile phones reduced their transportation costs because they enabled greater access to information and group support (FARM-Africa, 2007). Because referrals could be conducted by phone, community animal health workers, animal health assistants and veterinary surgeons also appreciated the savings in transportation costs. They were able to stay in contact with and form new relationships with a larger number of farmers; hence, they were able to render more services, and the sales of drugs increased, resulting in an increase in their profits (FARM-Africa, 2007).

The adoption of the mobile phone by dairy farmers in rural Uganda further supports the role of the mobile phone in providing information advantage and coordination in order to make operations more efficient. Karamagi and Nalumansi (2009) report that many dairy farmers in the Bugerere district in central Uganda would have to drive approximately 75 miles to the main market in the capital, Kampala. Blindly searching for buyers at the market often left the farmers with thousands of liters of unsold milk that would inevitably spoil and become worthless. However, after the adoption of mobile phones in 2005, the members of the Bugerere Dairy Cooperative Society, an organization representing 170 members, changed their marketing strategies and livelihoods after working with the Farmers Information Communication Management (FICOM) project

(Karamagi & Nalumansi, 2009, p.3). As a result of FICOM's training, farmers were introduced to the use of the mobile phone as a business and marketing tool. Farmers were taught to begin using the phone to connect to FoodNet, an East and central African initiative, which supplies up-to-date price information for agricultural commodities as well as providing contact details for interested buyers via SMS. By obtaining an informational advantage on market prices for milk and the location of interested buyers, the dairy farmers were able to coordinate before expending time and money in travel resulting in a decrease of spoiled milk and an increase in profits.

### **Gender Differences in Diffusion and Use of Mobile Phones**

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). 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, 2009, pp. 6-7). If any, differences in mobile phone adoption and use between men and women may be due to socio-economic factors.

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 (World Bank, 2008b). Since women have less contact with outside sources of information, they are potentially less likely to be early adopters of new innovations.

### **Research Questions**

Scholars argue that mobile phones improve the productivity of individuals and organizations within resource-constrained environments due to increased *efficiency, effectiveness, equity, and reach* (Saunders, Warford & Wellenius, 1994; Hudson, 2006; Burrell, 2008). This study aims at better understanding the construction of such productive agricultural-based uses of the mobile phone to support sustainable livelihood strategies.

This study's focus is four-fold: (1) acquire a thorough understanding of the uses of mobile phones for agricultural-based purposes by small- to medium-size farmers in Kamuli District, Uganda, and how these uses are shared with others in the diffusion process; (2) identify the reasons for adoption, value of adoption, and re-invention of uses of mobile phones pertaining to the local context; (3) identify the perceived impacts of mobile phone adoption and use; and (4) identify the influence, if any, of farm group membership and gender on adoption practices, use of mobile phones, including re-invented uses, and perceived impacts of mobile phone uses. The overall objective is to understand the local utility of mobile phones and to determine local opportunities and barriers to the development of productive use of mobile phones. Qualitative data were analyzed to answer the following research questions:

**RQ1:** What are the agricultural-based uses of the mobile phone?

**RQ2:** When was the mobile phone adopted? In terms of innovation attributes, what determined adoption of the mobile phone? (Figure 1, adapted from Rogers (2003))

**RQ3:** How have mobile phone applications been altered to fit the needs of the user?

**RQ4:** What is the perceived impact of agricultural-based uses of the mobile phone to individual adopters?

**RQ5:** How has organizational membership and gender affected adoption practices, use of mobile phones, including re-invented uses, and perceived impacts of mobile phone uses? (What are the conditions that make the application successful? What are the conditions that make the application less successful?)

## **CHAPTER 3**

### **METHODOLOGY**

This study aims to acquire a thorough understanding of the uses of mobile phones for agricultural purposes by small- to medium-size farmers in Kamuli District, Uganda. This study's focus is four-fold: (1) acquire a thorough understanding of the uses of mobile phones for agricultural-based purposes by small- to medium-size farmers in Kamuli District, Uganda, and how these uses are shared with others in the diffusion process; (2) identify the reasons for adoption, value of adoption, and re-invention of uses of mobile phones pertaining to the local context; (3) identify the perceived impacts of mobile phone adoption and use; and (4) identify the influence, if any, of farm group membership and gender on adoption practices, use of mobile phones, and perceived impact of mobile phone uses. The overall objective is to draw from the findings local opportunities and barriers to the development and productive use of mobile phones within resource-constrained environments.

#### **Study Design**

To gather data for this study, qualitative interviews were conducted. As noted by Lofland (1971), qualitative research methods are effective in describing a given social issue through the words and experiences of those directly involved. Lofland describes qualitative studies as attempts to uncover the characteristics of a social phenomenon, the causes of such social phenomenon, and its consequences. Qualitative studies are distinctive in terms of the questions they ask:

What kinds of things are going on here? What are the forms of this phenomenon? What variations do we find in this phenomenon? That is, qualitative analysis is addressed to the task of delineating forms, kinds and types of social phenomena; of documenting in loving detail the things that exist (p. 13).

Lindlof (1995) sees qualitative investigators as researchers trying to “get inside the action” (p. xi). Human subjects are observed and respected, and are the source from which researchers learn (Lindlof, 1995). The qualitative approach allows researchers to relinquish control over the study through their use of rigidly defined questions to one that enables them to adapt their particular nature and context to the action of the observed. In this approach, “flexibility and an openness to the fully participatory nature of social life open unexpected paths of questioning and discovery and allows for observation of communicative performances and practices that are informed by local cultural and ideological significance” (Lindlof, 1995, pp. 63-65). While this study started out qualitative in nature, upon analysis of the results there was enough data collected to form categories and make quantitative analysis possible.

### **Purposive and Snowball Sampling**

This study will examine small- to medium-size farmers residing in Kamuli District, Uganda that own a mobile phone. This study did not assess non-adopters of the mobile phone. To arrive at the sample, purposive and snowball sampling techniques were utilized. Purposive sampling is “a nonrandom sampling technique in which the researcher solicits persons with specific characteristics to participate in a research study” (Johnson & Christensen, 2008, p. 239). According to Vogt (1999), snowball sampling is a technique in which

participants are identified through another participant who provides the researcher the name of another possible participant, who in turn provides the name of another, and so on. Atkinson and Flint (2001) indicate that snowball sampling enables researchers to obtain respondents “where they are few in number or where some degree of trust is required to initiate contact. Under these circumstances, techniques of ‘chain referral’ may imbue the researcher with characteristics associated with being an insider or group member and this can aid entry to settings where conventional approaches find difficult to succeed” (Atkinson & Flint, 2001, p. 2). Atkinson and Flint (2001) recommend asking for numerous referrals from each participant to minimize the bias inherent in the snowball sampling technique.

#### *Arriving at the sample*

Volunteer Efforts for Development Concerns (VEDCO), Makerere University and the Iowa State University College of Agriculture and Life Sciences Center for Sustainable Rural Livelihoods (CSRL), have been working in joint effort since 2004 in Kamuli District, Uganda, to “support collaborative training and development activities that strengthen the capabilities of rural people and their institutions in developing countries to: improve agriculture and natural resource management practices; build assets; diversify income sources; and achieve food security, nutrition and health” (CSRL, 2008). One way in which VEDCO tries to achieve these goals in rural Uganda is through encouraging the development of farm groups and training community leaders, namely rural development extensionists (RDEs) and community nutrition and health workers (CNHWs).

VEDCO provides support through training of RDEs, who are taught agricultural techniques including farm planning and management, livestock management, post harvest handling, farm business including marketing skills, and lobbying and advocacy, among others. VEDCO also trains CNHWs, who are taught nutrition and health extension as well as assessment, community management of malnutrition in children, nutrition and nutritional management in the context of HIV/AIDS, and crop and livestock production, among others (Mazur, Sseguya, Masinde, Bbemba, & Babirye, 2006). RDEs and CNHWs are instructed to train members of farmers' groups and the broader community in the agricultural and health-related techniques taught to them by VEDCO (Mazur et al., 2006). Since RDEs and CNHWs are rural farmers and members of VEDCO farm groups, they were asked to participate in interviews.

Previous research on behalf of VEDCO, Makerere University, and CSRL determined that roughly 42 percent of 306 rural farming households working with VEDCO in the Kamuli District own a mobile phone (CSRL, 2009). A list of these individuals was provided by VEDCO. All VEDCO farm group members were identified from this list. Interviews with members of these farm groups, which also included RDEs and CNHWs, were conducted first. Not all eligible people on the list were contacted. Through assistance from VEDCO, deliberate efforts were made to reach individuals evenly spread throughout the Kamuli District. For the snowball sampling, VEDCO farm group interviewees were asked to provide the names of two farmers who were (1) not associated with VEDCO and (2) use the mobile phone for agricultural-based purposes. Once these non-farm group

members were identified and interviewed, they too were asked to provide the names of others that fulfilled the criteria. In instances when a potential interviewee could not to be reached, the next possible interviewee closest in proximity was chosen.

### **Qualitative Data Gathering: Semi-structured In-depth Interviews**

Semi-structured in-depth interviews were conducted to uncover personal accounts and experiences regarding mobile phone use. Marshall and Rossman (1989) further clarify qualitative interview methods as:

Typically, qualitative in-depth interviews are much more like conversations than formal, structured interviews. The researcher explores a few general topics to help uncover the participant's meaning perspective, but otherwise respects how the participant frames and structures the responses (p.82).

Semi-structured in-depth interviews, sometimes referred to as qualitative or semi-structured life world interviews, are further outlined by Kvale and Brinkmann (2008) as serving to discover the lived world of the subject in order to understand a described phenomenon (p. 124). Semi-structured in-depth interviews are guided by a predetermined theme and questions; however, flexibility in the order or form of questions is encouraged to reveal deeper insight into respondents' experiences (Kvale & Brinkmann, 2008).

Semi-structured in-depth interviews were conducted individually with 110 small- to medium-size farm holders residing in Kamuli District, Uganda from June to July 2009. A nearly equal number of men (n=56) and women (n=54) were interviewed.

Agriculture is the main occupation of women in Uganda with 90 percent of all rural women working in agriculture compared to 53 percent of rural men (FAO, 2006, p.18). As was indicated in a 2006 report of women and agriculture in developing countries on behalf of the Food and Agriculture Organization (FAO), women are responsible for between 60 and 90 percent of total food production in their respective countries (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 such as cotton in sub-Saharan Africa (Koehler, 1999, p. 293). By striving to represent an even number of males and females, it was hoped that the results of this study could compare differences between sexes.

Out of the 110 small- to medium-size farm holders interviewed, 90 were members of a VEDCO farm group and 20 were not members of a VEDCO farm group. Of the 90 VEDCO farm group members, 19 were either a RDE or CNHW. Interviews with the non-farm group members were conducted in order to reveal the impact, if any, of farm group affiliation on mobile phone adoption, use, and perceived impact.

All Interviews were conducted through an interpreter conversant in both the local dialect and the English language. In cases in which the translation was unclear, there was a pause so that the researcher and the interpreter could discuss and clarify the response, and agree on the final English translation, which was then recorded on paper. This research project received Iowa State

University Institutional Review Board approval, and consent from participants was obtained prior to the interview.

Due to high levels of illiteracy in Uganda, respondents were read a letter of introduction in the local language that described the aim of the study, the possible benefits of the research to rural livelihoods, the voluntary nature of participation, the confidentiality of their responses, and their right to refuse to answer any questions or leave the interview at any time (Appendix A). During the introduction, participants were encouraged to ask questions throughout the interview. Only after they gave their approval to participate did the interview begin.

### **The Interview Questionnaire**

The interview questionnaire included questions designed to secure information about:

- a) Individual and household characteristics (i.e., gender, age, education level, and occupation)
- b) Livelihood descriptors (i.e., social networks, engagement in business, farm group membership status, when the mobile phone was adopted)
- c) Individual and household use of mobile telephony for agricultural-based purposes
- d) How uses were learned and if the individual has taught others
- e) Perceived value/impact of productive agricultural-based uses of mobile phone for livelihoods

See Appendix B for the complete interview questionnaire used to help guide interviews with small-to medium-size farmers.

### **Operational Definition of Variables**

Respondents were first asked about agricultural-based uses of the mobile phone (**RQ1**). Based on previous studies, agricultural-based uses of mobile phones were categorized into the following five groups (adapted from Hudson, 2006; Burrell, 2008):

1. Coordinating access to agricultural inputs (e.g. coordinating meetings including agricultural trainings, contacting agriculture extension agents, local dealers, etc. to gain access to seeds, plant cuttings, livestock, and monetary loans.)
2. Accessing market information (e.g., calling market centers or family/friends in other market areas to be informed of market price in that area);
3. Contacting help for agriculture emergency assistance (e.g., contacting a veterinarian when livestock are ill or contacting an agriculture extension agent when crops are disease or pest-stricken)
4. Monitoring of financial transactions (e.g., contacting businessmen or non-governmental organizations for loans, coordinating payment of loans, monitoring financial transactions sent through an intermediary)
5. Consulting with experts regarding agriculture productivity (e.g., consultation with non-governmental and governmental agriculture extension agents including Volunteer Efforts for Development Concerns (VEDCO) and The National Agricultural Advisory Services (NAADS) for advice on appropriate planting, maintaining, and harvesting practices)

Specific agricultural-based uses were coded as either present or not present for each of the five categories. In order to help prompt respondents, a guiding list of agricultural-based uses from the research literature was used (see Appendix C). When individuals presented a unique agricultural-based use of the mobile phone, questions were asked in order to further understand the unique use. Discussion of unique uses of the mobile phone can be found in RQ3.

**RQ2:** The length of time owning a mobile phone was coded as a continuous variable in years. Eleven individuals did not report time of mobile phone adoption. Attributes relating to *observability*, *trialability*, *relative advantage*, *compatibility*, and *complexity* of the mobile phone to individual users were sought (adapted from Rogers, 2003). While all five factors impact the likelihood for adoption, Rogers argues that relative advantage, or the perceived increase in utility above current practice, is often the most important factor that impacts adoption (2003, p.15). Because of the importance of relative advantage, specific attention was given to this item when farmers were asked why they originally adopted the mobile phone. Specific responses were recorded and used to form a list of recurring relative advantage themes.

**RQ3:** Re-invention of mobile phone use was uncovered by asking respondents to indicate a new use that they have begun utilizing the mobile phone for. Uses that were defined as re-invention were uses that were developed after adoption of the mobile phone and were not used at the onset of mobile phone adoption but were developed over time in order to solve a problem or respond to a need. Unique uses were identified in the research literature and

were used to help identify unique uses in this study. Unique uses included the following (adapted from Burrell, 2008; FARA, 2009; Mittal, Gandhi, & Tripathi, 2009):

1. Storing agricultural-based information in the mobile phone (e.g., storing market prices in the mobile phone calendar);
2. Using the loudspeaker function of the mobile phone for group conferencing;
3. Receiving market prices through SMS

While a list of unique uses from the research literature was created as an initial guide, it was hoped that through the qualitative interview process, new unique uses would appear from the local context. Specific responses were recorded and used to form a list of recurring unique use themes. While there was enough overlap in many of the unique uses to create themes, there were a few responses that were very unique. Individual responses of unique uses were coded either present or not in order to uncover the impact, if any, of gender and farm group membership status on re-invention of mobile phone use for unique purposes. Discussion of impact of farm group membership and gender can be found in RQ5.

**RQ4:** Individuals were asked what they perceived to be the greatest impacts of the adoption of agricultural-based uses of the mobile phone on their livelihoods. Hudson's (2006) outline of the overall impacts of telecommunications on *efficiency, effectiveness, equity, and reach* was used to help categorize individual adopters' perceived impacts of agricultural-based mobile phone uses on their livelihoods. Since data was not gathered on the level of access to

resources before mobile phone adoption, the impact of *equity* as defined by Hudson (2006) as the increase in access to resources within rural or underserved areas could not be examined. Responses were categorized as follows (adapted from Saunders, Warford & Wellenius, 1994; Hudson, 2006; Burrell, 2008):

1. *Efficiency*- Increased coordination (e.g., efficient coordination of transportation, especially during emergencies, ability to coordinate for access to agricultural inputs, reduction in transportation and transaction costs in trade);
2. *Effectiveness*- Increased productivity through access to resources (e.g., dissemination and retrieval of market information, especially for buying and selling, obtaining agriculture advice resulting in improved crop yields and livestock production, knowledge and access to agricultural inputs such as seeds, plant cuttings, livestock, and loans);
3. *Reach*- Increased networking and building of social capital (e.g., increase in access to agricultural specialists and veterinarians, increase in access to economic opportunities, especially access to markets and job opportunities)

**RQ5:** The possible influence of both group membership and gender on mobile phone adoption, use, and perceived impacts of mobile phone uses was investigated. In addition, variation of agricultural-based uses among members of farm groups was examined. Those who were members of VEDCO farm groups, including rural development extensionists (RDEs) and community nutrition and health workers (CNHWs), were classified as farm group members. Each participant's gender was also coded.

## **Data Analysis**

Thematic analysis, as defined by Boyatzis (1998), involves the identification of themes from qualitative data that “at minimum describe and organize the possible observations and at maximum interpret aspects of the phenomenon” (p. 4). These themes can be at a manifest or latent level. Thematic analysis was employed to answer the research questions.

Notes from in-depth interviews were compiled into a word processing document for analysis and referral. Notes were used to create a data set that included responses from each participant. Detailed notes were taken to ensure representation of responses as well as any ideas or key words that were unique from other responses. See Appendix D for the complete coding of interview responses that fit into the five agricultural-based use themes for mobile phone uses, reasons for mobile phone adoption, and the perceived impacts of mobile phone uses relating to Hudson’s 2006 framework of the impacts of telecommunication on efficiency, effectiveness, and reach.

This study made use of both descriptive and inferential statistics to answer the five research questions. To respond to RQ1, the frequency distributions of agricultural-based mobile phone uses by categories were analyzed. To answer RQ2, the frequency distribution of length of time owning mobile phones was analyzed as well as frequencies for attributes of the mobile phone that led to adoption. In order to represent the re-invention of mobile phone uses posed in RQ3, unique uses were categorized into themes and frequencies of unique uses were analyzed. Frequencies of perceived mobile phone impact themes were

analyzed to answer RQ4 and independent samples t-tests and chi-square tests were used to analyze the impact of organizational membership and gender on length of time owning mobile phones, presence of agricultural-based uses, and perceived impacts of mobile phone use on livelihoods posed in RQ5.

Since the sample is relatively small (n=110) and has included a purposive sample of rural farmers in the Kamuli District, Uganda, this data cannot be generalized to the wider population of rural residents in other developing countries. One respondent was unable to complete the interview process due to health-related issues. For questions not answered by this respondent, a sample size of 109 was used during analysis. Due to the qualitative nature of the research methods, the responses to the interview questions may be unique to this study. It is hoped, however, that through inferential statistics the impacts of gender and organizational membership will reveal opportunities and barriers to the development of productive uses of mobile phones in rural Uganda.

## CHAPTER 4

### RESULTS AND DISCUSSION

This study aims to understand the agricultural-based uses of mobile phones by small- to medium-size farmers in Kamuli District, Uganda. It aims to: (1) acquire a thorough understanding of the uses of mobile phones for agricultural-based purposes by small- to medium-size farmers in Kamuli District, Uganda, and how these uses are shared with others in the diffusion process; (2) identify the reasons for adoption, value of adoption, and re-invention of uses of mobile phones pertaining to the local context; (3) identify the perceived impacts of mobile phone adoption and use; and (4) identify the influence, if any, of farm group membership and gender on adoption practices, use of mobile phones, and perceived impacts of mobile phone uses. The total sample for this study is 110 small- to medium-size farmers from Kamuli District, Uganda. Out of the 110 respondents, 90 are farm group members and 20 are not members of farm groups. The total sample is nearly evenly split between men (n=56) and women (n=54).

#### **Agricultural-based Uses of Mobile Phones**

The current agricultural-based uses of mobile phones reported during interviews were sorted into five use themes uncovered in previous research on the use of telephony in resource-constrained environments (Hudson, 2006; Burrell, 2008). Regardless of farm-group membership status or gender, the following themes were used as a guide to categorize responses: (1) coordinating access to agricultural inputs including agriculture education, (2) accessing market

information, (3) agriculture emergency assistance, (4) monitoring of financial transactions, and (5) consulting with expert advice. An overall list of uses identified in this study that fit into these five agricultural-based use themes is provided in Appendix D. Table 1 provides a distribution of the overall frequencies and illustrative examples of agricultural-based uses for each of the five themes.

Table 1. Agricultural-based use themes, frequencies, and illustrative examples

Coordinating access to agricultural inputs	Accessing market information	Agriculture emergency assistance	Monitoring of financial transactions	Consulting with expert advice
Use coordination function: 80%	Use market function: 70%	Use agriculture emergency function: 57.3%	Use financial function: 50.9%	Use consultation function: 44.5%
Total number of uses: 191	Total number of uses: 95	Total number of uses: 91	Total number of uses: 87	Total number of uses: 80
Calls local dealers in seeds and livestock to know quality/availability	Calls local businessmen to know local market prices	Calls veterinarian to treat sick cows, goats, hens, and pigs.	Calls friends, family, and local businessmen for financial loans	Calls VEDCO for general agricultural maintenance questions
Calls agriculture dealers in Kampala for improved chicken breeds	Calls VEDCO to be informed of local market prices	Calls District Agriculture Office for assistance with pest or disease-stricken crops and livestock	Calls VEDCO to gain access to microfinance group loans	Calls VEDCO for updates about weather for timely planting
Calls farm group members to know about new livestock breeds and availability in the local area	Calls individuals in Kampala to get market pricing	Calls VEDCO for assistance with pests affecting crops <i>"My banana plants had banana bacteria wilt, I called VEDCO and service providers came to help me deal with the disease"</i>	Calls VEDCO to know of conditions of loan and repayment scheme	Calls VEDCO or Community Nutrition Health Workers (CNHWs) for health advice for children
Calls farm group members and local porters for help with agricultural maintenance	<i>"I call Kampala in order get the fair market price for charcoal so as to not have a financial loss"</i>	Calls VEDCO to ask for assistance with sick livestock	Calls farm group members to remind of obligations to repay loans	Calls VEDCO or Rural Development Extensionists (RDEs) for advice on proper planting (i.e. spacing, depth, etc), maintaining, and harvesting.
Calls farm group members and VEDCO to coordinate meetings and agricultural trainings			Calls to coordinate payment of loans <i>"I call VEDCO and the businessmen that I owe money and inform them to stop by and collect money"</i>	
Calls VEDCO to obtain seeds, livestock, and plantings (cassava, potato, banana, orange trees)	Calls local business people to negotiate price for bulk produce, picking up produce, and transporting for sale in Kampala		Calls intermediaries that are carrying financial payments to monitor delivery of funds	Calls farm group members to clarify agricultural trainings from VEDCO

The majority of the respondents, 80 percent, used mobile phones for coordinating access to agricultural inputs including agricultural trainings and seeds, livestock, pesticides, etc. from local seed dealers, governmental and non-governmental agriculture extension agents, and community members. 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, the farmer is able to call ahead and determine availability, coordinate a meeting time and agree on a price before expending time, energy, and money on travel.

The second most frequently cited agricultural-based use of the mobile phone, indicated by 70 percent of respondents, was for accessing market information. Accessing market information included using the mobile phone to contact local farmer associations and buyers, buyers for markets in other cities, and friends or family members in other areas that have access to different markets.

Use of the mobile phone for agriculture emergency assistance included contacting a veterinarian or agriculture extension agent when livestock are ill or when crops are disease or pest-stricken. Approximately 57 percent of the respondents indicated some level of use for this purpose. One of the most frequently observed agriculture emergency assistance 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, time and money that would have been spent on travel is saved. The ability for the veterinarian to be called rather than consulted face-to-face was reported to result

in earlier detection and treatment of illness in livestock due to quickened communication.

The use of the mobile phone for monitoring of financial transactions was mentioned by nearly 50 percent of the respondents. Monitoring of financial transactions included consulting with lenders on availability and guidelines of financial loans, reminding farm group members to repay loans accountable to the group as a whole, and monitoring of domestic and business remittances. In particular, comments from interviewees focused on the ability for the mobile phone to increase knowledge of and access to microfinance loans from VEDCO.

Approximately 45 percent of individuals interviewed cited at least one use of the mobile phone for consulting with expert advice from entities such as non-governmental and governmental agriculture extension agents, namely Volunteer Efforts for Development Concerns (VEDCO) and The National Agricultural Advisory Services (NAADS). Consultation with expert advice included using the mobile phone for information on livestock and crop maintenance, including advice on appropriate seed and livestock varieties, timely planting relating to weather predictions, and advice on proper planting and harvesting techniques. Specifically, individuals who were members of a VEDCO farm group indicated using the mobile phone to clarify agricultural methods learned during VEDCO training sessions.

The findings reveal that the most frequent category of agricultural-based mobile phone uses relate to coordination to gain access to agricultural inputs. Total uses of the mobile phone for market information, agriculture emergency

assistance, financial monitoring, and consultation with agriculture experts were nearly equal (see Table 1). According to Donner (2006), 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” (p. 4). In this study, coordinating access to agricultural inputs was found to be the leading agricultural-based use for the mobile phone due perhaps to the direct impact access to inputs has on livelihood stability, productivity, and profitability.

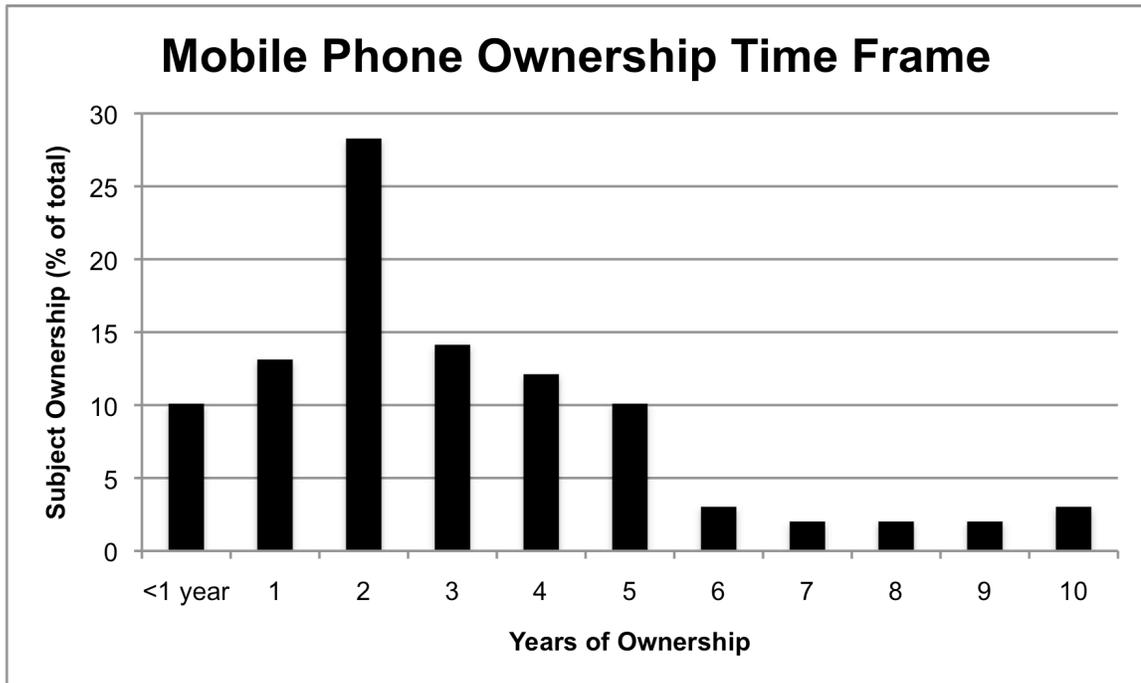
### **Adoption of Mobile Phones and Uses**

Diffusion theory may further explain why coordinating access to agricultural inputs is the most frequently cited agricultural-based mobile phone use. One of the main arguments of diffusion theory is that individuals are more likely to adopt an innovation if it provides a relative advantage over current practice and especially if the individual can see others gaining advantage from adoption (Rogers, 2003). It can be argued that the ability of individuals to see others in the community utilizing the mobile phone to coordinate access to inputs directly impacts their likelihood to use the mobile phone in the same manner.

More than half of the respondents, 51 percent, have adopted the mobile phone within the last two years. Another 37 percent have owned mobile phones for three to five years, while 12 percent have owned for six to ten years. Diffusion theory states that an innovation will first be adopted by a small number of people and, if the innovation provides a relative advantage, more and more people will

adopt resulting in critical mass (Rogers, 2003). Figure 2 provides a distribution of length of time owning a mobile phone.

Figure 2. Distribution of individual length of time owning mobile phone



Individuals who are higher in socio-economic status or are leaders in the community are likely to be earlier adopters of innovations (Rogers, 2003). As for the community and farm group leaders trained through VEDCO, diffusion theory would speculate that rural development extensionists (RDEs) and community and nutrition health workers (CNHWs) would own the mobile phone longer than other members of VEDCO farm groups. In this study, 19 VEDCO RDEs and CNHWs were interviewed. While it was speculated that RDEs and CNHWs would be earlier adopters due to their position as community leaders and as part of their role as liaisons between VEDCO and farm group members, farm group members who were not RDEs or CNHWs were found to have owned the mobile phone

longer with a median length of time owning of three years compared to the median one-year length of time owning for VEDCO RDEs and CNHWs. This finding suggests that leadership status may not directly impact time of mobile phone adoption.

Observability, or the degree to which the outcomes of an innovation are viewable by individuals, is an important factor in the adoption process (Rogers, 2003). Over half of the respondents, 58 percent, indicated that viewing mobile phone-owning family and friends encouraged mobile phone adoption. Twenty percent of respondents attributed VEDCO staff and farm group members with their adoption of the mobile phone as a means to enhance communication effectiveness. Business colleagues and buyers in markets influenced 17 percent of respondents to adopt the mobile phone, viewing the mobile phone as a tool that enhances commerce and trade. The remaining five percent claimed to be self-taught. Only five individuals directly noted the impact of trialability, the ability to experiment with someone else's mobile phone or a public phone, to influence adoption.

Questions regarding relative advantage, or the perceived positive impacts of adoption, were specifically asked during interviews in order to uncover reasons for initial mobile phone adoption. Aspects of relative advantage that led to mobile phone adoption in this study were maintenance of kinship and family networks and for agricultural-based purposes including the ability to access financial information and the ability to consult and coordinate meetings with agriculture extension agents or farm group members. An overall list of responses identified

in this study that fit into these relative advantage themes is provided in Appendix D.

Sixty-three percent of respondents indicated that the ability to strengthen ties with family and friends was one of the main reasons for adoption. An example of strengthening ties with family and friends included the ability to monitor family members who were ill without having to travel. For example, numerous respondents indicated that a family member was ill in another area of the Kamuli District; by having the mobile phone, they felt more at ease knowing that they could check up on their family member and be contacted at any time if the family member's situation turned worse. Another example of the importance of the mobile phone for familial ties is through the adoption of the mobile phone by parents whose children are in boarding schools. Because the parents now own a mobile phone, they can be contacted if their child becomes ill, if school fees are due, and, in some cases, can be contacted to sell agricultural products for school lunch programs.

Nearly half of the respondents, 48 percent, indicated the ability to access financial information as a perceived advantage that influenced mobile phone adoption. For example, respondents indicated that their adoption of the mobile phone was influenced by seeing their near peers make economic gains from selling to larger markets as well as their increase in transportation savings due to increased coordination with local buyers before travelling. Respondents also mentioned the ability of the mobile phone to increase their likelihood of being aware of job opportunities. For example, a local builder reported receiving phone

calls that commissioned him to build a shelter and to show up at a certain location on a certain date. According to respondents, without the mobile phone, they are much less likely to be contacted in time and would miss out on these economic opportunities.

Forty-seven percent of individuals indicated adoption of the mobile phone as a means to strengthen contact with agriculture extension agents such as VEDCO and NAADS and farm group members. For example, individuals mentioned that the mobile phone allowed for increased agricultural consultation with VEDCO. Through the adoption of the mobile phone, farm group members felt they would increase their ability to contact VEDCO and farm group members with agricultural-based questions and would have greater ability to coordinate farm group meetings. Through increased consultation and coordination over the mobile phone, farm group members felt they would be able to gain advice and coordinate meetings without costly and time-consuming travel.

Overall, 24 percent of respondents indicated adoption and initial use solely for kinship maintenance. More females, 35 percent, than males, 13 percent, have adopted the mobile phone solely for kinship maintenance. In total, 39 percent of respondents attributed both kinship maintenance and agricultural-based purposes with adoption. Females (46 percent) were slightly more likely than males (33 percent) to adopt the mobile phone for both kinship maintenance and agricultural-based purposes. On the whole, adoption and initial use exclusively for agricultural-based purposes was indicated by the remaining 37 percent of

respondents. More males (55 percent) than females (19 percent) were found to adopt the mobile phone solely for agricultural-based purposes.

Overall, these findings suggest that mobile phones are being adopted for agricultural-based purposes that provide perceived positive impacts on access to market information, increasing job opportunities, gaining agriculture advice, and saving valuable time and money through increased consultation and coordination. Table 2 provides the frequencies for individuals who adopted for: (1) solely kinship maintenance, (2) kinship maintenance and agricultural-based purposes, and (3) solely agricultural-based purposes.

Table 2. Frequency of initial use categories that influenced mobile phone adoption

Initial Use	Females		Males		Total Respondents	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Kinship maintenance (only)	19	35.2	7	12.7	26	23.9
Kinship maintenance and Agricultural-based purposes	25	46.3	18	32.7	43	39.4
Agricultural-based purposes (only)	10	18.5	30	54.6	40	36.7
	54	100.0	55	100.0	109	100.0

Compatibility and complexity, or the degree to which an innovation fits within the socio-cultural framework and the perceived difficulty of use, are directly related to its likelihood for adoption and use (Rogers, 2003, pp. 240-241). An interesting finding of the impact of compatibility and complexity of the mobile phone was the presence of low numbers of short message service (SMS) use. Approximately one-fourth of the respondents (27.5 percent) indicated using both

voice-based phone conversations and SMS. Since this is a “snapshot” of the early stages of the diffusion process, the initial needs of mobile phone users may solely be for voice-based communication. As length of time and experience with the mobile phone continues to grow, the SMS application may become more compatible with the needs of the user. At the time of this study, the mean length of time owning the mobile phone for those who utilize SMS ( $M = 3.7$  years,  $SD = 2.7$ ) was higher than the length of time owning the mobile phone for individuals who do not utilize SMS ( $M = 2.8$  years,  $SD = 2.0$ ); however, the difference was not statistically significant,  $t(96) = -1.82$ ,  $p = 0.07$ . In addition, a certain level of functional literacy and familiarity with the SMS mobile phone application may increase likelihood of operation. Out of the 30 respondents who utilize SMS, 10 respondents indicated the use of SMS only when low on mobile phone credit; the primary means for communication was still through the initial mobile phone use at adoption: voice.

### **Re-invention of Mobile Phone Uses**

Understanding the re-invention of mobile phone uses is important as it shows how the use of a technology has grown to fulfill respondents' needs. 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). Re-invented uses were classified as uses that were not utilized at the onset of adoption, but were added as familiarity with the mobile phone device and mobile phone applications grew.

Initial uses of the mobile phone directly reflect the perceived relative advantages that led to adoption, including kinship maintenance, financial monitoring, and consultation and coordination with agriculture extension agents and farm group members. While the mobile phone was initially used for these purposes, the re-invented uses identified from responses indicate the development of a broader spectrum of agricultural-based uses of the mobile phone to fulfill a wider range of needs.

In particular, individuals mentioned learning the following uses from businessmen, community members, family, VEDCO, and VEDCO farm group members after adoption: (1) accessing larger markets such as those in Kampala or Jinja, (2) contacting veterinarians for general livestock maintenance and consultation during emergencies, (3) contacting governmental and non-governmental organizations, such as NAADS and VEDCO, as well as agriculture dealers for access to agricultural inputs including seeds and livestock, and (4) coordinating repayment of individual and farm group loans. In addition, the mean number of mobile phone uses per person at the time of adoption was 1.66, which increased to 4.92 over time. This finding supports the claim that, over time, mobile phone uses are being re-invented in order to deal with a greater spectrum of needs.

Understanding unique uses of the mobile phone allows for the identification of unique applications that may be useful to others. Mobile phone uses that were considered unique were discovered (see Table 3). In this study, unique uses were uses that were not used at the onset of mobile phone adoption

but were added to deal with a particular need, did not fit easily into the five agricultural-based mobile phone use themes, and were atypical in nature. Unique uses of mobile phones were also identified by referencing previous research literature. Examples of unique uses included (adapted from Burrell, 2008; FARA, 2009; Mittal, Gandhi, & Tripathi, 2009): (1) storing agricultural-based information in the mobile phone (e.g., storing market prices in the mobile phone calendar); (2) using the loudspeaker function of the mobile phone for group conferencing; and (3) receiving market prices through SMS.

Unique uses found in this study included: (1) use of the calculator to figure proper market pricing, (2) use of the loudspeaker function for group meetings, (3) storage of agricultural-based information, (4) voice recording of agricultural-based lessons, and (5) use of the camera phone for educational purposes. None of the respondents indicated utilizing these unique uses at the onset of mobile phone adoption, indicating they were added later. The frequency and illustrative examples for the unique use themes can be found in Table 3.

Table 3. Unique use themes, percentages, and illustrative examples

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  <i>"Everyone can hear the lesson first-hand"</i>	Storage of VEDCO loan repayment training (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 <i>before</i> selling to the market. <i>"I no longer feel cheated."</i>	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	
Uses calculator to calculate body mass index for health monitoring		Storage of names of appropriate drugs to treat livestock (in calendar)		
	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.  <i>"No one feels cheated, we all know the proper price."</i>			

Approximately 68 percent of males and 37 percent of females used the calculator function of the mobile phone to calculate proper market prices. However, 46 percent of females indicated not understanding how to use the calculator function compared to 16 percent of males. A unique example of the use of the calculator includes a VEDCO-based community and nutrition health worker (CNHW) who reported using the calculator function of the mobile phone to calculate body mass index.

The loudspeaker function of the mobile phone was utilized for remote conferencing with VEDCO, group communication with loan officers on status of loans, and to include absent farm group members when decisions must be made during meetings. When the loudspeaker function is needed, the mobile phone is placed in the center of the group so that all members may participate in the conversation. In total, 53 percent of men and 17 percent of women utilized the loudspeaker function.

According to one respondent, utilization of the loudspeaker function of the mobile phone for agricultural-based purposes was due to training by VEDCO and VEDCO farm group members. In order to promote group transparency and increase communication effectiveness between VEDCO and VEDCO farm group members, the loudspeaker function of the mobile phone was incorporated into remote consultations.

Past research has found that mobile phones are used to store important information (Burrell, 2008, pp. 16-17). In the current study, 53 percent of men and 17 percent of women were found to store information in their mobile phone.

Farm group loan repayment, VEDCO loan repayment training and notes on VEDCO agriculture development trainings were stored in short message service (SMS) folders. Daily market prices, names of appropriate veterinary drugs, approximate dates when hens should start laying eggs, as well as timely planting and harvesting dates are examples of types of information individual respondents indicated storing in the mobile phone calendar.

Taught by other VEDCO-trained CNHWs after mobile phone adoption, a female CNHW indicated financial impacts from storing local market prices in her mobile phone calendar in order to visualize local market trends. By doing so, she indicated knowing when to store her produce in order to sell later when prices would rise.

While not very common, voice recording and camera functions of the mobile phone were also used. These functions were mainly utilized to capture VEDCO agriculture training sessions for later reference or to capture agricultural-based or health-related problems for consultation with VEDCO. For example, a VEDCO CNHW indicated utilizing the voice recording function of the mobile phone to record the health status of individuals he serves as a CNHW. By doing so, the respondent noted an increase in the frequency of correct diagnosis of individuals since the information could be shared with VEDCO officials in a timely and effective manner.

In order to maintain contractual agreements within the farm group, one individual reported 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 accountability during farm group meetings. According to the respondent, viewing local community members recording important information, such as agricultural advice, gave him the idea to utilize the voice recording function to promote group accountability in the repayment of loans. The small number of individuals utilizing the voice recording and camera functions may be due to the fact that mobile phones with these functions are expensive or less accessible.

### **Perceived Impacts of Mobile Phone Uses**

Diffusion theory emphasizes understanding the perceived impacts of adoption of an innovation in order to recognize factors that impact sustained use and the development of unique uses to deal with a greater spectrum of needs (Rogers, 2003, p. 436). Respondents were asked what they perceived to be the greatest impact of mobile phone use for their livelihoods. The responses have been categorized in relation to Hudson's 2006 framework of the impacts of telecommunication on social and economic activities. Impacts include: (1) *efficiency*, ratio of output to cost; (2) *effectiveness*, increased productivity through access to resources; and (3) *reach*, the ability to communicate regardless of time or geographic boundaries (p. 12). A complete list of responses on perceived impacts in relation to Hudson's 2006 framework can be seen in Appendix D.

Responses that were categorized as efficiency focused primarily on increased coordination for access to agricultural inputs and selling of outputs. In most cases, impacts of the mobile phone on levels of efficiency referenced the

ability for increased coordination resulting in financial savings. Numerous farmers indicated using the mobile phone to call ahead and coordinate a meeting time instead of travelling and guessing that someone may be at a particular location. By coordinating meetings, farmers are able to continue working in the field instead of wasting valuable time looking for individuals. For example, numerous farmers indicated utilizing the mobile phone to negotiate market price and to coordinate buyers to travel to them to buy and transport goods to the market. Not only were the farmers saving travel costs from no longer meeting with buyers face-to-face but were also saving the cost of transporting the produce to markets in which there was no guarantee of a buyer. The overall ability to decrease transportation costs through increased coordination was reported by approximately 52 percent of the respondents.

Slightly over half of the respondents indicated impacts on effectiveness, or increased productivity, due to improved access to agricultural resources. Agricultural-based advice as well as access to agricultural inputs such as labor, seeds, plant cuttings, livestock, and loans from VEDCO or NAADS, consultation with veterinarians, and increased access to market information were mentioned as agricultural resources that impacted productivity.

Another aspect of increased effectiveness of agricultural methods was the ability for emergency coordination. Nearly 21 percent of respondents indicated the impact of the mobile phones during agriculture emergencies. For example, numerous respondents indicated consulting with veterinarians when their pigs fell ill. By doing so, the respondents felt that their pigs were diagnosed, treated, and

regained health quicker than before adoption of the mobile phone. As a result of continual consultation with veterinarians and agricultural-based experts, numerous respondents indicated an increase in the overall health of their livestock resulting in greater likelihood for successful breeding.

Increases in reach, indicated by nearly 55 percent of respondents, included the ability to gain access to agricultural experts, including agricultural development-based organizations and veterinarians, and fellow VEDCO farm group members. Benefits such as improved crop yields and livestock production were attributed to the ability to consult with agricultural experts and coordinate agricultural training sessions. Remote agricultural consultation (e.g. proper spacing of banana plantings, timely planting advice due to weather patterns, etc.), awareness of agricultural trainings or meetings, and notification of the availability of agricultural-based loans were the most frequently cited impacts of reach. Impacts of reach also included access to information for sound decision-making. Respondents indicated use of the mobile phone to increase access to job opportunities outside of their local area and to gain access to buyers from larger, more distant markets. For example, numerous respondents indicated no longer feeling cheated in the local market because they were able to call VEDCO or multiple buyers to compare market prices before bartering.

There are two levels of overall impacts of the mobile phone. Since the mobile phone adopters in this study are at the early part of the diffusion process, the majority of impacts from this study are located at the first level of impact. At this level, the core agricultural-based activities of the rural farmer have remained

the same as before mobile phone adoption; however, the individual is now utilizing the mobile phone to assist those activities. Diffusion theory states that an individual is more likely to adopt an innovation if it fits with existing values and needs (Rogers, 2003, p. 240). It is then likely that initial use of the mobile phone will be for improving operations already being conducted. For example, a rural farmer who used to walk house to house to remind farm group members of meetings now uses the mobile phone. Another example is a farmer who previously communicated with local market buyers face-to-face but now uses the mobile phone to barter with the same individuals before travelling to the market. At this level of impact, operations have essentially remained the same. However, the mobile phone has been utilized to increase primarily efficiency of operations, or for coordination to decrease transportation costs.

At the second level of impact, the impacts have been transformative. Transformative impacts include changes of the core activities of the rural farmer to include new opportunities that have emerged from the use of the mobile phone. For instance, a farmer indicated that after adoption of the mobile phone she received the phone number of a businessman in Kampala from a local acquaintance. After contacting the businessman she was encouraged to grow beans, as they were more likely to sell for a profit in the markets in Kampala. Taking this advice, she began growing and selling her bean harvest to the businessman in Kampala. After she received a profit and built trust with the businessman, she encouraged other local farmers to come together and sell in bulk.

Another example of the transformative nature of the mobile phone is a farmer who was engaged in buying and selling maize in bulk locally and, after adopting the mobile phone, began selling in bulk to larger markets for a better price. While selling the maize in the local market, he exchanged mobile phone numbers with a bulk buyer from a larger city, Jinja. After adoption of the mobile phone, he indicated being able to not only improve the coordination of buying and transporting the maize locally, but has been able to keep in contact and sell the maize directly to buyers in Jinja at a much higher price than the local market.

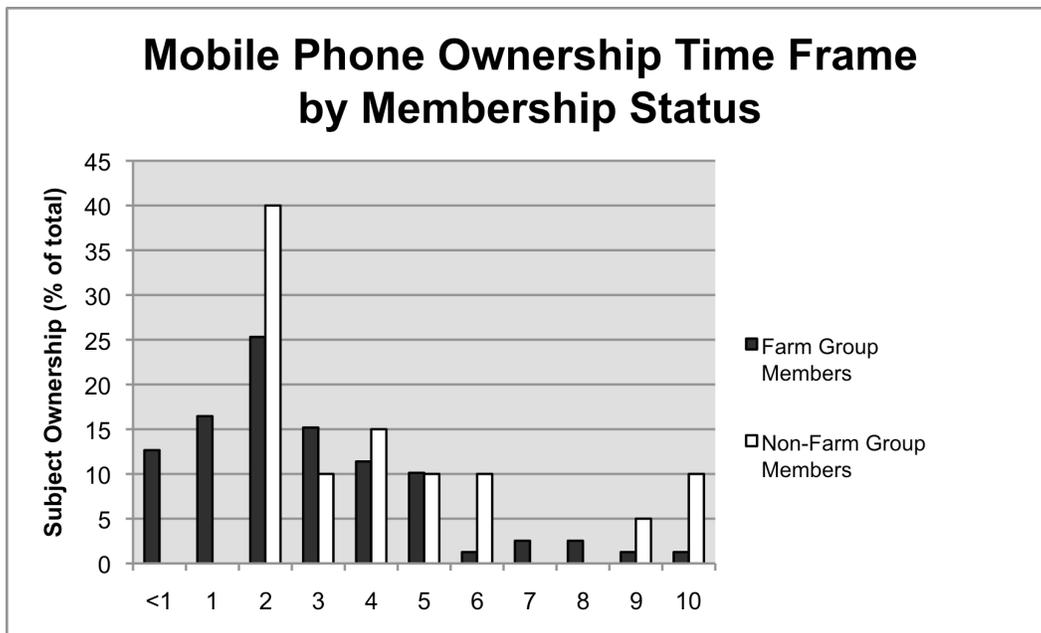
As with the adoption of any innovation, there will be negative impacts. The only negative impact mentioned directly during interviews was the high cost to utilize the mobile phone. While nearly all respondents indicated that buying the mobile phone handset, mobile phone minutes on pre-paid phone cards, and battery charging fees were expensive, they nearly always countered with a statement that the cost of transportation was much more expensive than the operating costs of the mobile phone and that they knew they were saving money by not travelling. While the mobile phone is expensive, it seems the respondents feel that the positive impacts of mobile phone use outweigh the cost.

## Organizational and Gender Influence on Adoption, Use, and Perceived Impacts of Mobile Phones

### *Differences in adoption*

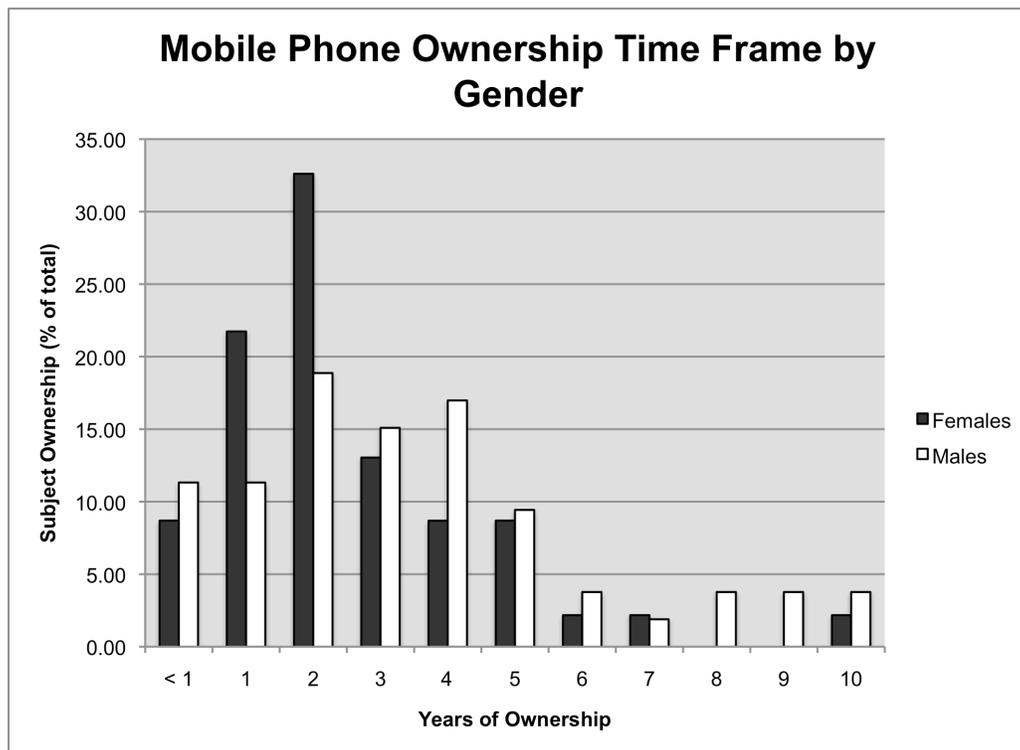
An analysis of the time of adoption of the mobile phone revealed differences between organizational status and gender. Mobile phone ownership (in years) among farm group members ( $M = 2.8$  years,  $SD = 2.11$ ) is more recent than among non-farm group members ( $M = 4.2$  years,  $SD = 2.7$ ),  $t(97) = 2.47$ ,  $p = 0.015$ . Approximately 54 percent of farm group members have adopted the mobile phone within the last two years while 50 percent of non-farm group members adopted the mobile phone two to three years ago. There were no non-farm group members who indicated adoption of the mobile phone within one year or less. Figure 3 provides a distribution of time owning mobile phone in relation to organizational membership.

Figure 3. Distribution of time owning mobile phone by membership status



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 percent, have adopted the mobile phone since 2007 (see Figure 4).

Figure 4. Distribution of time owning mobile phone 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, 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, regardless of farm group membership status, 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. In order to conduct an ANOVA, levels of education were grouped into three categories as follows: (1) 0 to 4 years of schooling, (2) 5 to 7 years of schooling, and (3) 8 to 13 years of schooling. The mean length of time owning was 2.75 years for individuals with 0 to 4 years of schooling, 2.84 years for 5 to 7 years of schooling, and 3.37 for 8 to 13 years of schooling. While length of time owning increases with higher levels of schooling, 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 the cause.

#### *Differences in mobile phone uses*

While farm group members have adopted the mobile phone more recently than non-farm group members, overall, farm group members were more likely to use the mobile phone for more of the five agricultural-based use categories, including: (1) coordinating access to agricultural inputs, (2) accessing market information, (3) agriculture emergency assistance, (4) monitoring of financial

transactions, and (5) consulting with expert agriculture advice ( $M = 3.18$  out of 5 uses,  $SD = 1.28$ ) than non-farm group members ( $M = 2.45$  out of 5 uses,  $SD = 1.09$ ),  $t(107) = -2.353$ ,  $p = 0.02$ . This finding suggests that farm group membership is associated with more use of mobile phones for knowledge transfer regarding agriculture. Table 4 provides a distribution of percentages of farm and non-farm group members utilizing the five agricultural-based use themes.

Table 4. Percentages of farm and non-farm group members utilizing agricultural-based use themes

	Farm group members	Non-farm group members
<b>Agricultural-based use themes</b>		
Coordinating access to agricultural inputs	86.5	55.0
Accessing market information	69.6	75.0
Agriculture emergency assistance	57.3	60.0
Monitoring of financial transactions	53.9	40.0
Consulting with expert agriculture advice	62.9	15.0

In particular, members of farm groups were significantly more likely to use the mobile phone for agricultural consultation with expert advice than non-farm group members ( $\chi^2(1, N=109) = 8.88$ ,  $p < 0.01$ ). Approximately 63 percent of farm group members indicated using the mobile phone for consultation, while only 15 percent 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.

Rural Development Extensionists (RDEs) and Community Nutrition and Health Workers (CNHWs) were found to utilize agricultural-based uses of mobile phones the most in farm groups with an average of 3.72 out of the 5 agricultural-based use themes. Chairpersons, or leaders of individual farm groups, were

found to utilize, on average, 3.42 out of the 5 agricultural-based use themes. All other members of farm groups were found to utilize, on average, 2.95 out of the 5 agricultural-based use themes. Since the means for RDEs, CNHWs, and chairpersons of farm groups were similar, they were combined in order to compare agricultural-based mobile phone uses between group leaders and group members. Farm group leaders (i.e. RDEs, CNHWs, and chairpersons) were found to have more agricultural-based mobile phone uses ( $M = 3.68$  out of 5 uses,  $SD = 1.14$ ) than members that were not leaders ( $M = 2.95$  out of 5 uses,  $SD = 1.28$ ),  $t(87) = 2.664$ ,  $p = 0.009$ . This finding indicates that individuals that are farm group leaders are more likely to utilize mobile phone applications in all five agricultural-based use themes. Table 5 provides a distribution of percentages of RDEs and CNHWs, chairpersons, and members of farm groups utilizing the five agricultural-based use themes.

Table 5. Percentages of RDEs and CNHWs, chairpersons, and members of farm groups utilizing agricultural-based use themes

Agricultural-based use themes	Position in VEDCO farm group					
	Rural Development Extensionist (RDE) or Community Nutrition Health Worker (CNHW) (n=18)		Chairperson (n=13)		Member (n=58)	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Coordinating access to agricultural inputs	17	94.4	11	84.6	49	84.5
Accessing market information	14	77.7	12	92.3	36	62.1
Agriculture emergency security	12	66.6	8	61.5	31	53.4
Monitoring of financial transactions	13	72.2	9	69.2	26	44.8
Consulting with expert advice	11	61.1	7	53.8	28	48.3

Overall, males and females did not differ in agricultural-based uses of the mobile phone under the five agricultural-based use themes. However, while 70 percent of total respondents indicated using the mobile phone to gain market pricing prior to negotiations and travel so as not to buy or sell at a loss, males (82 percent) were found to utilize the mobile phone for market information more than females (60 percent) ( $X^2(1, N=109) = 6.68$   $p = 0.01$ ) (See Table 6). This finding may be representative of the fact that, generally, women are responsible for cultivating and marketing food crops produced for household consumption and men are responsible for commercial or export-driven crops in sub-Saharan Africa (Koehler, 1999, p. 293). Table 6 provides a distribution of percentages of males and females utilizing the five agricultural-based use themes.

Table 6. Percentages of males and females utilizing agricultural-based use themes

	Males	Females
<b>Agricultural-based use themes</b>		
Coordinating access to agricultural inputs	85.4	75.9
Accessing market information	81.8	59.2
Agriculture emergency assistance	54.5	61.1
Monitoring of financial transactions	58.1	44.4
Consulting with expert agriculture advice	49.0	40.7

#### *Re-invented uses of the mobile phone*

While more non-farm group members (80 percent) than farm group members (57 percent) had at least one unique use, farm group membership status was not found to influence the presence of unique uses for the mobile phone ( $X^2(1, N=109) = 3.552$ ,  $p = 0.06$ ). On the other hand, more males (73 percent) than females (50 percent) were found to have at least one unique

mobile phone use ( $X^2(1, N=109) = 5.94, p = 0.01$ ). Differences between males and females can be seen in Table 3.

*Perceived impacts of mobile phone uses*

In total, perceived impacts of mobile phone uses including: (1) transportation and operational efficiency through coordination; (2) benefits in agriculture effectiveness due to greater access to resources; and (3) increase in contacts and opportunities due to the ability to reach and be reached by agricultural specialists, veterinarians, and individuals offering financial opportunities did not differ among non-farm group ( $M = 1.58$  out of 3 perceived impacts,  $SD = 0.88$ ) and farm group members ( $M = 1.48$  out of 3 perceived impacts  $SD = 0.77$ ),  $t(87) = .539, p = 0.591$ ).

Males (62 percent), unlike females (43 percent), perceived transportation and operational efficiency ( $X^2(1, N= 109) = 4.04, p < 0.05$ ) to be a primary beneficial impact of the mobile phone. Also, males (66 percent), more than females (44 percent), felt the mobile phone increased their ability to reach new contacts and opportunities ( $X^2(1, N= 109) = 4.06, p < 0.05$ ). The finding that males associate the benefits of mobile phones with transportation and operational efficiency and an increase in contacts and opportunities could be due to the fact that males are more mobile than females. 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 (World Bank, 2008b). Since women may travel less frequently and perhaps not as far as their male counterparts, they may be less likely to view

increased transportation efficiency and contacts as a beneficial impact of the mobile phone.

## CHAPTER 5

### IMPLICATIONS OF THE FINDINGS AND CONCLUSIONS

This study sought to understand the uses of mobile phones for agricultural-based purposes by small- to medium-size farmers in Kamuli District, Uganda, and how these uses are shared with others in the diffusion process. Another aspect of the study was to identify the reasons for adoption, value of adoption, and re-invention of uses of mobile phones pertaining to the local context. In addition, this study sought to understand the perceived impacts of mobile phone adoption and the influence, if any, of farm group membership and gender on adoption practices, use of mobile phones, and perceived impacts of mobile phone uses. To do so, in-depth interviews were conducted with 110 small- to medium-size farmers from Kamuli District, Uganda. Out of the 110 respondents, 90 were farm group members and 20 were not members of farm groups. The sample was nearly evenly split between men (n=56) and women (n=54) in order to better reveal differences between genders.

Using Hudson's (2006) and Burrell's (2008) five recurring mobile phone use themes as a guide to categorize the agricultural-based uses of mobile phones in this study proved very useful. Overall, agricultural-based uses of the mobile phone in this study were for coordinating access to agricultural inputs, attainment of market information, agriculture emergency assistance, monitoring of financial transactions, and consulting with expert advice. 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. In particular, an overwhelming majority of respondents indicated use of the mobile phone for coordinating access to agricultural inputs and market information. The information and communication technologies for development (ICTD) perspective states that mobile telephony can serve as a development tool in that it allows for increased communication with institutions responsible for livelihood development (Donner, 2008). Since the majority of respondents utilize the mobile phone to communicate with those that offer agricultural inputs and markets, it is clear that small-to medium-size farm holders are utilizing mobile telephony for development initiatives. Overall, these results indicate that mobile phones are used for a variety of purposes and are, in particular, being used to access resources and economic opportunities.

This study also found that farmers who were members of farm groups were more likely to use mobile phones for certain agricultural-based uses. There may be several explanations for this. One possible reason is that being part of a farm group means a farmer has more access to new information about agriculture as well as new information about agricultural-based uses of mobile phones. When new relevant agricultural information arrives, it would be expected that farm group members would use mobile phones to spread the word about it. Additionally, farm group members were more likely than non-farm group members to use the mobile phone for consultation with expert advice indicating that being in a farm group and owning a mobile phone provides a direct pathway to expert advice.

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. Effective use of the mobile phone for organizational communication functions include provision of information through consultation, coordination of emergency assistance, and group support through access to agricultural inputs (Blau and Scott, 1962; Hudson 2006). In the case of agricultural-based mobile phone uses in this study, it is clear that organizational membership increases likelihood of use. In contrast, farmers who are social isolates, and who have little access to new agricultural information, would have much fewer agricultural-based uses for mobile phones.

Differences in use across genders were found. Women lagged behind men slightly in uses except for agricultural emergencies, where they led slightly. 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. According to the International Fund for Agriculture Development (IFAD), Ugandan women are likely to “sell surplus from their own plots, chickens and pigs” (IFAD, 2000). Since women can sell these assets for profit, it is clear why a substantial portion of the women in this study would utilize the mobile phone for agriculture emergency assistance with these resources.

Females were less likely than males to utilize the mobile phone to access market information. 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. Thus, it may be beneficial to train women on how to utilize the mobile phone 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.

Diffusion theory speculates that those who are higher in socio-economic status and who are leaders in a community will be earlier adopters of innovations (Rogers, 2003). In this study, education and leadership levels were not found to impact time of adoption.

Factors such as observability, trialability, relative advantage, complexity and compatibility of a technology have been shown to impact the likelihood for adoption (Rogers, 2003). Over half of the respondents, 58 percent, indicated observing family and friends as a leading factor that influenced adoption. Other sources that played a role in influencing adoption were VEDCO staff and VEDCO farm group members as well as business colleagues. Rogers (2003) argues that technologies are more likely to be adopted if they are first experimented with.

However, in this study only a very small number of individuals said trialability influenced adoption. This finding suggests that mobile phones are being adopted without an emphasis on experimentation and that observability of others utilizing mobile phones may have a strong impact on adoption. This finding supports Rogers' (2003) claim that individuals depend on their near peers' experiences with a technology to influence adoption. In fact, members of farm groups were, on average, later adopters of the mobile phone than non-farm group members. This may be due to two reasons. The first reason could be that many of the non-farm group members operate businesses that put themselves in contact with others outside of the local community. Rogers (2003) further argues that those with greater heterogeneous network ties are more likely to adopt innovations at an earlier rate due to the likelihood of being exposed to new ideas. The second reason could be that farm group members, as a social system, are just now beginning the diffusion process whereas non-farm group members could be further along. However, there is no guarantee that mobile phones will be adopted by a large majority of farmers. That depends on future costs and benefits.

Women were later adopters than their male counterparts. 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. While it is difficult to predict specific factors that impact adoption, this study suggests that the mobile phone is a technology that can cross social and economic boundaries.

According to Rogers (2003), the primary reason for adoption is the perceived relative advantage that the innovation will provide above current practice. This study supports Rogers' (2003) argument that initial use of a technology will directly reflect the perceived relative advantage that led to adoption. Agricultural-based mobile phone uses mentioned that led to adoption focused on the ability to access market information, job opportunities, and to consult and coordinate with agriculture extension agents or farm group members. These findings suggest that the mobile phone is not only being adopted in order to maintain kinship networks but also to gain access to financial information and agricultural advice. The mobile phone is not only adopted for social reasons but is viewed as a tool that will allow the farmer to respond more efficiently to external economic opportunities or threats. This finding supports the ICTD perspective that mobile phones are tools that encourage efficient and informed action to lead to greater productivity (Saunders, Warford & Wellenius, 1994; Hudson, 2006).

The complexity and compatibility of a technology to the local context directly impacts the use of a technology. Overall, use of short message service (SMS) was low indicating an opportunity for development of this skill set. Education level was found to increase likelihood for using the mobile phone's SMS function. This finding could be due to the fact that use of SMS requires a certain level of functional literacy. These results suggest that development planners who wish to utilize SMS-based mobile phone applications should incorporate 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.

Over time, agricultural-based uses for the mobile phone increased. This finding suggests that the mobile phone will be adopted for a few key purposes but that uses will be re-invented to fit changing needs. In addition, understanding these productive re-invented uses of mobile phones locally will uncover applications that take advantage of opportunities and allow individuals to better prepare for economic stresses and shocks (Chambers & Conway, 1992; Richardson, 2006).

Unique uses of the mobile phone to respond to specific local needs were identified in this study. While there were no differences in the presence of unique mobile phone uses in relation to farm group membership status, numerous farm group members attributed VEDCO with learning unique uses. The benefit for farm group members is clear; not only are they utilizing the mobile phone for more agricultural-based uses, but are receiving training on unique uses from VEDCO.

According to diffusion theory, individuals depend heavily on their near peers' experience with an innovation to shape their use of the innovation (Rogers, 2003). Males, more than females, were found to have at least one unique mobile phone use. Just as the mobile phone hardware was adopted in the diffusion process, so will the evolving unique uses of the mobile phone. Since females have adopted more recently than males, they may be at an earlier stage of use and are likely to develop unique uses as experience with mobile phones grows. 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 and spread of productive uses of the mobile phone.

In her analysis of the perceived impacts of mobile phone uses, Hudson (2006) outlined the impacts of telecommunications to increase efficiency, effectiveness, and reach. The perceived impacts of mobile phone uses in this study were found to fit well into Hudson's perceived impacts categories. For example, farmers strongly believe that the positive impacts of these devices are increases in efficiency through money savings by avoiding wasted travel, increases in effectiveness due to access to improved agricultural resources, and increases in the ability to reach information such as market prices, agriculture advice, and financial opportunities. Overall, there were no differences in perceived impacts of mobile phone uses in relation to farm group membership status. Males, unlike females, view transportation efficiency and increased ability to reach new contacts and opportunities to be major impacts of the mobile

phone. This finding suggests that females are less mobile than their male counterparts and are thus less exposed to new individuals and opportunities.

In his criteria for the establishment of sustainable livelihoods, Scoones (1998) considers five factors that influence sustainability: (1) creation of working days and employment, (2) poverty reduction, (3) overall well-being and use of capabilities, (4) the ability to cope and recover from stresses and shocks, and (5) natural resource base sustainability. While it is difficult to predict the direct impact of mobile phone use on sustainability of livelihoods, the perceived impacts of mobile phone uses in this study may provide a glimpse. For example, the creation of working days and employment can be attributed to the impact of the mobile phone to gain access to job opportunities. Poverty reduction can be attributed to saving money by using the mobile phone to communicate instead of travel and can also be seen in the perceived impacts of access to agricultural inputs for greater output. While only a portion of Scoones' (1998) definition of the ability to recover from stresses and shocks, the ability to be proactive and reach out to agricultural specialists and veterinarians for necessary agricultural inputs and advice during agricultural stresses was mentioned to provide a greater sense of well-being. Also, the perceived impacts of contact with agricultural specialists and veterinarians for regular consultation and during emergencies results in increased productivity with natural resources.

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.

Overall, this study shows differences in time of mobile phone adoption, use, and perceived impacts of mobile phones in relation to farm group membership status and gender. The current “snapshot” of the situation does indeed find that being part of a farm group, being male, and having education are associated with the uses for mobile phones.

The findings of this type of research may be useful for development planners wishing to utilize mobile phones in their operations. Drawing from these findings, development planners should provide specialized training in order to promote the productive use of mobile phones. The value of implementing mobile phone training into development activities lies in its ability to assist in increasing the effectiveness, efficiency, and reach of operations resulting in the beneficial impacts of time and money savings within resource-constrained environments.

#### **Limitations of the Study and Suggestions for Future Research**

This study has a number of limitations. First, the sample was purposive. All farm group members were chosen because they were members of VEDCO farm groups that were known to use the mobile phone in the Kamuli District, Uganda. As such, the generalization of the findings to other resource-constrained environments comes under question. This limitation also implies that the operations of VEDCO may be influencing agricultural-based uses of mobile phones and that these results cannot be generalized to other areas or other farm groups.

Second, the sample size for this study is quite small. Another issue with the sample size is that many more farm group members were interviewed than

non-farm group members. Increasing the sample size of non-farm group members may produce different results. Another weakness is that the snowball sample of non-farm group members may not be typical of other non-farm group members in the area.

Third, since literacy and numeracy tests were not administered, the relationship between, for example, SMS use and levels of literacy in relation to years of schooling is just assumed. A complete analysis of level of education including an analysis of skill sets in literacy and numeracy may produce clearer understanding of reasons why certain functions of the mobile phone are used or not.

Future research should be conducted on how adoption, use, and perceived impacts of uses change over time in the diffusion process. A longitudinal look at trends and changes will be helpful in predicting potential consequences of adoption. Also, including concrete economic impacts of mobile phone uses over time measured in monetary terms may give a greater understanding of the potential for mobile phones to be tools that aid in economic development. This type of evaluation will be able to provide further understanding of the utility of the mobile phone within resource-constrained environments.

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## **APPENDIX A**

### **LETTER OF INTRODUCTION**

(Specific wording may change to fit appropriate communication between different social status of respective communicators as determined by the knowledge and expertise of a skilled local translator.)

I am Brandie Martin, a graduate student at Iowa State University in the United States and am working with Volunteer Efforts for Development Concerns (VEDCO) and Iowa State University on identifying productive agricultural uses of mobile phones in Kamuli District, Uganda. You are being invited to participate in this interview because of your possible experience in using mobile phones for productive agricultural purposes. This research is being conducted to understand your agricultural-based uses of a mobile phone.

This is a research study. Please take your time in deciding if you would like to participate. Please feel free to ask questions at any time. If you choose to take part in this interview, there will be no direct benefit to you. You will not be at physical or psychological risk and should experience no discomforts resulting from the research procedure. It is hoped that the information gained in this study will further the understanding of the productive uses of the mobile phone among those whose livelihoods are dependent on agricultural-based activities. The information from this interview is important in helping VEDCO and other organizations identify the potential use of mobile phones for productive agricultural purposes.

Participation in this interview is completely voluntary and you may refuse to participate or leave the study at any time. If you decide to not participate in the study or leave the study early, it will not result in any penalty or loss of benefits to which you are otherwise entitled. The interview will take about one hour. The interview will be based on a series of questions related to the identification of productive agricultural uses of the mobile phone. You may skip any question or topic that you do not wish to answer or that may make you feel uncomfortable.

Records identifying participants will be kept confidential. To ensure confidentiality, your name will be removed from the data collected. Only the researchers in this study will have access to study records. These records will be kept in a password-protected computer. Whatever you say will be confidential and if results from this study are published, your identity will remain anonymous.

You are encouraged to ask questions at any time during this study.

## APPENDIX B

### INTERVIEW QUESTIONNAIRE

Guiding questions for interviews with small- to medium-size farmers in Kamuli District, Uganda

#### Part 1: Introduction and Personal Background

1. How old are you? Record gender.
2. Where do you live?
3. Are you a member of a farm group? Are you involved in an agricultural-based enterprise?
4. Do you have your own agricultural business? What do you regularly do regarding this business?

#### Part 2: Mobile Phone Access, Use, and Impact

1. Do you own a mobile phone?
2. Why did you get a mobile phone?
3. If you do not own a mobile phone, do you use a mobile phone at a mobile phone kiosk?
4. How often do you use a mobile phone?
5. What do you use the mobile phone for?
  - a. *Prompt:* Do you use the mobile phone to gain agricultural information?
  - b. *Prompt:* Have you ever used the mobile phone during an emergency? What type of emergency?
6. Do you use the voice application, text messaging (sms), and/or the Internet application on your mobile phone?
7. How often do you use these applications?
8. Which application do you use most often? Why and for what purpose?
9. Are there other purposes for which you use your mobile phone?
10. What has been the impact of the mobile phone on your livelihood?
  - a. *Prompt:* Are you more informed on business information such as market prices for crops/livestock?
  - b. *Prompt:* Have you gained information through the mobile phone that has aided you in raising crops and/or livestock?
  - c. *Prompt:* Has this application improved your productivity? If so, how?

#### Part 3: Information Needs

1. What kind of information do you ask for and/or receive over the mobile phone?
2. What types of agriculture information do you need the most?

**Part 4: Mobile Phone Network and Building Heterogeneous Networks**

1. If you do use the mobile phone to gain agricultural information, how and whom do you contact to for agricultural information?
  - a. *Prompt:* Do you use sms/text messaging, voice application, etc?
2. Where did you learn about this agricultural-based use for the mobile phone?
3. Have you taught anyone else this agricultural-based use for the mobile phone?
4. Do you use the mobile phone to speak with someone outside of your kinship network/family? If so, who and for what reason? How often?
5. Do you use the mobile phone to contact any organization for agricultural advice? If so, whom do you get in touch with? How often and for what reason?

**Part 5: Mobile phone use for farm group solidarity**

1. Do you use the mobile phone for farm group coordination for meetings? How?
2. Have you ever used the mobile phone to contact another farm group member or organization leader for farm assistance? How, How often and for what reason?
  - a. *Prompt:* Have you received remote diagnosis for farm problems?
  - b. *Prompt:* Have you used the mobile phone to clarify methods learned at farm group meetings?

**APPENDIX C****LIST OF AGRICULTURAL-BASED USES OF MOBILE PHONES BASED OFF  
OF RESEARCH LITERATURE**

(adapted from Hudson, 2006; Burrell, 2008)

1. Lobbying for more resources including new cropping, livestock, or production alternatives
2. Coordination of training, travel, etc.
3. Agricultural problem-solving
4. Market information or negotiation
5. Group support/ solidarity
6. Agricultural credit – obtaining/ payments/ rules, etc.
7. Weather information – forecast, trends, rainfall, etc.
8. Recruit farm laborer
9. Storage of agricultural information in phone

**APPENDIX D****INTERVIEW RESPONSES FOR: (1) REASONS FOR MOBILE PHONE ADOPTION, (2) MOBILE PHONE USES, AND (3) PERCEIVED IMPACTS OF MOBILE PHONE USES****1. Why did you get a mobile phone? (Relative advantage)**

- a. To communicate with family and friends:
  - i. To ease communication with family and friends (e.g., to communicate with children in boarding school or family members that are ill in other areas)
  - ii. To ease communication with family during medical emergencies
- b. Farm group communication and coordination:
  - i. To be in contact with VEDCO farm group members in order to ease communication and mobilization
  - ii. Individual is a leader in Volunteer Efforts for Development Concerns (VEDCO) farm group or in sub-county or Uganda National Agricultural Advisory Service (NAADS) and needs to be able to be contacted by others for information and assistance.
- c. Access to service providers:
  - i. To ease communication with service providers (i.e., VEDCO or NAADS) for remote diagnosis, assistance, and knowledge of meetings, workshops and loan opportunities
  - ii. To coordinate with individuals who provide agriculture services such as spraying pesticides, operating an ox plow, etc.
  - iii. To gain assistance from a veterinarian
- d. Financial purposes:
  - i. To communicate with family to gain market information for other areas
  - ii. To communicate with buyers to sell their agricultural products
  - iii. To buy from others to collect agricultural products to resell in bulk
  - iv. To always be reached for business transactions (owns a business)
  - v. To increase timeliness of business operations while decreasing travel expenses
  - vi. To gain access to job opportunities (e.g., a builder is called by his boss to let him know he is commissioned to build and to show up at a specific location on a specific date and time).
- e. Emergency security
  - i. To contact police during emergencies

## 2a. What do you use the mobile phone for? (Agricultural-based uses)

Number of separate individuals that indicated each use is provided.

### a. Coordinating access to agricultural inputs (total n=191):

- i. To coordinate farm group meetings with VEDCO farm group members, RDEs, and CNHWs (n=62)
- ii. To receive information on meetings and workshops offered by VEDCO (n=30)
- iii. To receive information on meetings and workshops offered by NAADS (n=10)
- iv. To coordinate meetings with other local businessmen (n=2)
- v. To coordinate veterinarian training sessions (n=1)
- vi. To contact VEDCO for seeds, plantings, and livestock availability (n=17)
- vii. To contact VEDCO farm group members for seeds, plantings, and livestock availability (n=11)
- viii. To contact RDEs for seeds, plantings, and livestock availability (n=6)
- ix. To contact the NAADS for seeds, plantings, and livestock availability (n=3)
- x. To contact Namasagali Farmers' Association (NFA) for seeds, plantings, and livestock availability (n=1)
- xi. To contact local dealers for seeds, plantings, and livestock availability (n=9)
- xii. To contact dealers in Kampala for improved chicken breeds (n=2)
- xiii. To contact family members for seeds, plantings, and livestock availability (n=4)
- xiv. To hire farm labor for planting, weeding/maintenance, and harvesting (n=17)
- xv. To contact VEDCO farm group members to recruit for work in the garden (n=1)
- xvi. To hire ox plow for timely planting (n=6)
- xvii. To coordinate with an artificial inseminator for livestock breeding (n=2)
- xviii. To offer ox plow services to others in the community (n=2)
- xix. To coordinate transportation to Jinja to buy seeds at The Jinja Agricultural Show (n=1)
- xx. To coordinate a boda boda driver to go to town to gather agricultural inputs (n=4)

### b. Market information (total n=96):

- xxi. To contact VEDCO for local buyers and sellers (n=4)
- xxii. To contact VEDCO farm group members to be matched with a buyer or seller (n=7)
- xxiii. To contact RDEs for market pricing (n=1)

- xxiv. To contact local buyers and sellers (n=36)
- xxv. To contact business people to come, buy, and pick up agricultural products (n=16)
- xxvi. To contact local farmers to buy agricultural products, pick up, and take to Jinja and Kampala to sell in bulk (n=15)
- xxvii. To contact business people that buy in bulk (n=6)
- xxviii. To contact NFA for market prices (n=1)
- xxix. To contact individuals in Kampala to retrieve market prices from market board (n=1)
- xxx. To hire transportation for transport of agricultural products to market (n=2)
- xxxi. To contact local businessmen to coordinate transportation of goods to be sold in local shop owned by individual (n=2)
- xxxii. To coordinate selling maize in bulk to NAADS (n=2)
- xxxiii. To coordinate selling rice in bulk to local shops (n=1)
- xxxiv. To coordinate selling pigs to other districts (n=1)
- xxxv. To coordinate buying chickens in bulk from Jinja to sell in local shop (n=1)

**c. Agriculture emergency assistance (total n=91):**

- i. To contact VEDCO for emergency crop and livestock maintenance (pests and diseases) (n=18)
- ii. To contact VEDCO farm group members for emergency crop and livestock maintenance (pests and diseases) (n=5)
- iii. To contact District Agriculture Office for emergency crop and livestock maintenance (pests and diseases) (n=2)
- iv. To contact veterinarian for emergency treatment of livestock (n=66)

**d. Financial purposes (n=89):**

- i. To gain loans from VEDCO (n=19)
- ii. To gain loans from VEDCO farm group members (n=2)
- iii. To gain loans from NAADS (n=2)
- iv. To gain loans from PRIDE in Buwenge (n=1)
- v. To gain loans from FINCA (n=2)
- vi. To gain loans from local businessmen (n=9)
- vii. To gain loans from local banks (n=4)
- viii. To gain loans from family members (n=4)
- ix. To gain loans from friends (n=6)
- x. To consult with VEDCO farm group members on terms and status of group loans (n=1)
- xi. To contact and consult with VEDCO on terms and status of group loans (n=2)
- xii. To receive calls from VEDCO on terms and status of group loans (n=5)
- xiii. To coordinate picking up loans from VEDCO (n=3)
- xiv. To coordinate payments of group loans to VEDCO (n=16)

- xv. To coordinate payment of loans to businessmen (n=4)
- xvi. To coordinate others to pay money owed to them (n=5)
- xvii. To contact schools to know if there is a need for agricultural products for school lunch program (n=2)
- xviii. To contact VEDCO to know of job opportunities in a timely manner (n=1)
- xix. To receive calls informing of job opportunities for building construction work (n=1)

**e. Agricultural consultation (n=80):**

- xx. To coordinate when VEDCO will visit their farm group (n=2)
- xxi. To carry out agriculture development counseling of the farm group with VEDCO (n=3)
- xxii. To consult with VEDCO and VEDCO farm group members including RDEs and CNHWs on general crop and livestock maintenance questions (n=18)
- xxiii. To consult with VEDCO on how to handle pests affecting crops (n=5)
- xxiv. To consult with organizations other than VEDCO (i.e., NAADS, District Agriculture Office) on general crop and livestock maintenance questions (n=2)
- xxv. To contact local farmers for advice on how to deal with pests affecting crops (n=4)
- xxvi. To consult with VEDCO on weather patterns and appropriate agriculture procedures (n=10)
- xxvii. To consult with VEDCO farm group members on weather patterns and appropriate agriculture procedures (n=11)
- xxviii. To receive call from VEDCO informing them it is time to plant (n=7)
- xxix. To clarify VEDCO trainings with VEDCO farm group members (n=3)
- xxx. To clarify agricultural methods learned during VEDCO farm group meetings with VEDCO farm group members (n=2)
- xxxi. To be informed by VEDCO of new livestock breeds (n=7)
- xxxii. To contact VEDCO farm group CNHW to be informed of improved crop varieties that should be planted (n=6)

**2b. What do you use the mobile phone for? (Non-agricultural-based uses)**

**a. Uses relating to family and friends (total n=95):**

- xxxvi. To maintain ties with family and friends (n=69)
- xxxvii. To communicate with family especially during emergencies (n=11)
- xxxviii. To inform others of death in family or community (n=2)
- xxxix. To communicate with school on payment of school fees (n=3)

- xl. To communicate with boarding school and children at boarding school (n=10)

**b. Uses that did not fit into categories (total n=7)**

- i. To inform individuals in local market that the Uganda Department of Revenue will be coming to check and improve the weighing scales (n=1)
- ii. To ask community members to help fix broken brew machine for making local beer (n=1)
- iii. To communicate with District Medical Officer (n=1)
- iv. To provide religious guidance to community members (n=1)
- v. To let others use mobile phone for a small fee (n=2)
- vi. To send money as airtime to friends and family (n=1)

**3. What has been the impact of the mobile phone on your livelihood?**

**a. Efficiency:**

- i. Ability to decrease transportation cost through increased coordination results in increased financial savings
- ii. Ability to increase communication with children at boarding school without travel costs
- iii. Ability to increase time management through using the mobile phone calendar and clock for increased work in the garden and increased buying and selling in a timely manner
- iv. Ability to use the mobile phone calendar allows for timely planting
- v. Ability to multi-task allows for increased work in the garden while being able to be contacted for opportunities
- vi. Ability to coordinate multiple farmers so that they can now sell in bulk to larger markets
- vii. Ability to call and coordinate local and non-local business people to come to them and buy agricultural products increases selling in a timely manner
- viii. Ability to increase coordination by no longer guessing where individuals are located saves time and money
- ix. Ability to contact someone far away without incurring transportation costs
- x. Ability to save money by not travelling and can put money saved back into paying for seeds and pesticides
- xi. Ability to have meetings with individuals in Jinja over the phone instead of spending money to travel to consult face-to-face
- xii. Ability to call someone in Kampala to pick up supplies and bring them back

**b. Effectiveness:**

- i. Ability to contact a veterinarian in case of livestock emergencies

- ii. Ability to contact agricultural-based development organizations (i.e., VEDCO or NAADS) for emergency agricultural needs
- iii. Ability to contact other VEDCO farm group members or VEDCO staff to review agriculture procedures or solve agriculture issues
- iv. Ability to use the phone has increased agriculture outputs through increased access to agriculture inputs
- v. Ability to know proper price of agricultural products before going to market makes the individual feel they are no longer “cheated”
- vi. Ability to gain information much more quickly (general)
- vii. Ability to call for agriculture help decreases uncertainty (includes hiring an ox plow, farm labor, etc.)
- viii. Ability to contact VEDCO farm group members for agricultural-based questions and can coordinate meetings
- ix. Ability to monitor livestock at night due to use of mobile phone flashlight function
- x. Ability to work at night due to use of mobile phone flashlight function
- xi. Ability to help others solve problems (e.g., Individual serves as CNHW or RDE or serves another role in community and can easily consult expert advice)
- xii. Ability to communicate with family during emergencies
- xiii. Ability to contact health clinics in case of emergency for family, self, and others and by doing so the individual feels they can get back to work quicker

**c. Reach:**

- i. Ability to gain remote agriculture consultation with agricultural-based development organizations (i.e., VEDCO or NAADS) on issues such as banana plant spacing, timely planting, weather patterns, etc.
- ii. Ability to gain access to expert advice
- iii. Ability to gain access to agriculture inputs
- iv. Ability to call people that own land and organize rental agreement to farm it
- v. Ability to use the mobile phone to be notified of VEDCO meeting dates and storing these dates in the mobile phone calendar increases participation
- vi. Ability to contact and be contacted increases likelihood of knowing about VEDCO meetings, workshops, and loan availability
- vii. Ability to contact multiple markets and compare before bartering

- viii. Ability to contact others for financial needs including gaining access to loans
- ix. Ability to call VEDCO to know of job opportunities in a timely manner
- xxxiii. Ability to gain knowledge of markets (especially more distant markets)
- xxxiv. Ability to receive job opportunities for building
- xxxv. Ability to be contacted for job opportunities at all times reduces worries about getting enough income for family
- xxxvi. Ability to maintain ties with others living outside of local area

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