

**Mobile Phone Use in Ugandan Aquaculture: Farmer Experiences and Aspirations**

by

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## **ABSTRACT**

Aquaculture, being largely non-traditional in Uganda, is challenged by inadequate information and technical assistance to guide farmers. Farmers in Uganda have accumulated enough experience in growing crops and livestock farming, but they have little information on raising fish. Mobile phones could improve aquaculture productivity by increasing access to technical guidance, extension services, product assembly, input coordination, and price discovery for small-scale fish farmers. However, little is known about the potential impact of mobile phone use on aquaculture learning and conveying needs and interests of fish farmers in Uganda. The objectives of this study were (1) to review the literature on the use of mobile phones in agricultural development, (2) to assess mobile phones as a source of information for fish farmers in Uganda and (3) to examine the reported experiences and perception of mobile phone use among fish farmers in Uganda. Five focused group discussions with fish farmers were conducted in five districts of Uganda in the months of May, June, and July 2014. The main findings reveal that fish farmers mainly use their mobile phones to access technical guidance from intermediary farmers, obtain market information, accomplish mobile banking and receiving, contact family members and make plans for procurement of fish farming inputs. Factors influencing mobile phone use included lack of electricity, poor network coverage, high calling credit and maintenance costs, lack of awareness and promotion. On the other hand, information regarding stocking and harvesting, feeding management, pond construction and management, disease

management, water quality management, broodstock management and market prices were most needed by fish farmers.

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### **List of Abbreviations**

AMSDP	Agri-Marketing Systems Development Programme
ASARECA	Association for strengthening Agricultural Research in Eastern and Central Africa
CKWs	Community Knowledge Workers
FAO	Food and Agriculture Organization
FGIs	Focused Group Interviews
GDP	Gross Domestic Product
GPS	Global Positioning Systems
ICT	Information and Communication Technologies
KARDC	Aquaculture Research and Development Centre, Kajjansi
MAAIF	Ministry of Agriculture, Animal Industries and Fisheries
MMT	mobile phone-based money transfer
NaFIRRI	National Fisheries Resources Research Institute
NEPAD	New Partnership for Africa's Development
NGOs	Non-Governmental Organizations
UIA	Union of International Associations
UNID	United Nations Industrial Development
USAID	United States Agency for International Development

## **Chapter 1**

### **Introduction**

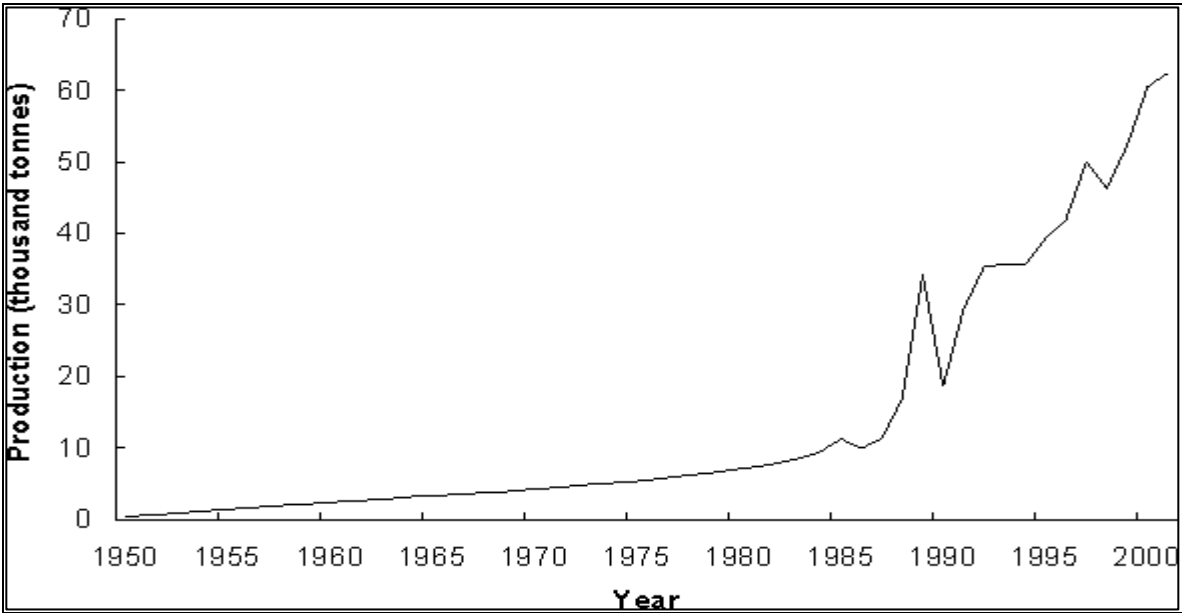
Globally, an estimated 840 million people lack adequate access to food and about 25% of these people live in sub-Saharan Africa (FAO, 2002). As the population increases and added pressure is put on natural resources, more and more people become food insecure; lacking access to adequate amounts of safe and nutritious food for normal growth and development, and an active and healthy life (Pretty, 1999). Sub-Saharan Africa is characterized by moderate agricultural productivity, widespread economic stagnation, persistent political instability, increasing environmental damage, and severe poverty (Pretty et al., 2003). Nonetheless aquaculture has a role to play in reducing food insecurity. Unlike Asia, Africa has little aquacultural tradition and has been affected by a number of external problems that have prevented proper fish pond management and development despite investment (FAO 2001).

Aquaculture is expanding rapidly throughout the world and has a high potential for the provision of valuable protein in less developed countries (Little & Edwards, 2003). It is one of the fastest growing food-producing sectors and an important contributor to national economic development, global food supply and food security (Subasinghe, 2003). Aquaculture offers a key entry point to reach millions of poor people in Africa, improve nutrition and health of families, alleviate poverty, and become an active agent of economic development and social change (Bene and Hecks, 2005).

Aquaculture is one important source of animal protein supply for human consumption (Bailey et al., 1996). Fish culture can be a competitively priced source of protein (FAO, 1983). Sustainable aquaculture technologies can supplement the decreasing wild fish supply (READI, 2001), and fish farming provides a low cost and readily available strategy to increase food

production using less land per caput and less water without further damage to the environment (Pretty et al., 2003). Fish is an important source of proteins for many African people, providing around 18% of animal protein intake (ASARECA, 2012), and many African countries benefit from aquaculture in terms of meeting the increasing demand for dietary protein. Improving aquacultural productivity increases food availability (FAO, 2005).

Aquaculture is one way to bridge the gap between sustainable fisheries and increased fish demand (Nutreco, 2012). Aquaculture can make a unique contribution to providing essential nutrition by producing large quantities of lower-cost, protein rich food (READI, 2001). In addition, Aquaculture can generate food of high value, especially for the vulnerable groups such as pregnant and lactating women, infants and pre-school children (Coche, 1998). It also provides a good source of essential micronutrients and can play a role in the prevention of many human diseases (Williams and Poh-Sze, 2003).



**Figure 1: Evolution of the total aquaculture production in the sub-Saharan Africa region (Fishstat, 2001)**

## **1.1 Aquaculture in sub-Saharan Africa**

In sub-Saharan Africa, small-scale fish farming is a recent enterprise. Aquaculture in many of sub-Saharan Africa started in the early 1950s under the motivation of different colonial administrations, apart from Madagascar where traditional water management for aquaculture began in the 18<sup>th</sup> century (FAO, 2004). The Food and Agriculture Organization of the United Nations (FAO) initiated a number of experimental stations and model farms in the early 1970s. New programs were developed based on the plans of community management, participatory research and development and farmer field schools, mainly to publicize fish farming (FAO, 2004).

Aquaculture development has been driven by social and economic intentions, such as food and nutritional security, providing household income and employment in fish production, and international trade (MAAIF, 2004). About nine million people worldwide are employed in aquaculture, which offers some with supplementary income during lean seasons (FAO, 2003).

Aganyira (2005) reported that aquaculture's potential for meeting nutritional needs and providing employment and income opportunities for producers has attracted significant attention from researchers and policy makers in both industrialized and non-industrialized nations. Significant funds and efforts have been invested in aquaculture in sub-Saharan African countries over the past four decades (SARNISA, 2011). Although the potential of aquaculture for income, employment and food supply has been widely recognized and often promoted, the actual results in terms of aquaculture development are not keeping pace with the projected expectations (NEPAD, 2008).

Sub-Saharan African aquaculture continues to contribute less towards the total fish production in the whole world, and this has frustrated the attempts of international development

agencies, governments and private sector investors alike. Aquaculture in sub-Saharan Africa supplies around 3% of fish production. Contribution to total fisheries production varies from country to country (NEPAD, 2008).

FAO (2006) reported that the Asia Pacific contributes 21.9% of the global aquaculture production, China 69.6% and the other 8.5% from the rest of the world. Sub-Saharan Africa contributes only about 0.2% of the remaining 8.5%. Depending on specific aquaculture systems promoted, shortages of information and technologies, markets have been constrained to the development of the sector (SARNISA, 2011). Results have been particularly disappointing in sub-Saharan Africa.

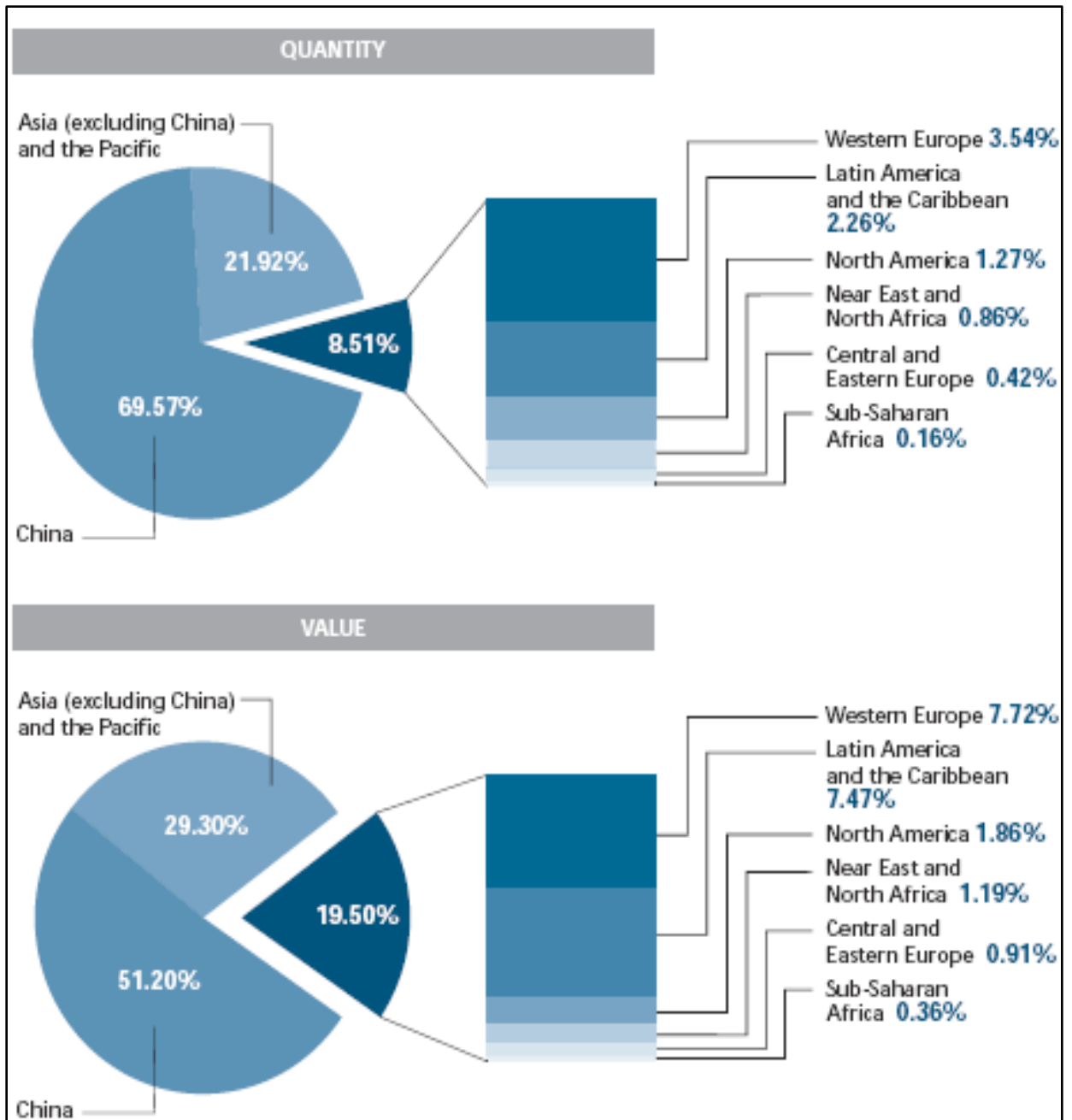


Figure 2: Aquaculture production by regional grouping in 2004 (FAO, 2006)

## **1.2 Aquaculture development in Uganda**

Aquaculture in Uganda is a non-traditional activity that was introduced by the colonial authorities, subsequently the Kajjansi Fish Experimental Station (FAO, 2005). Aquaculture in Uganda was started in 1931, and an experimental station was set up in 1953 at Kajjansi, now in Wakiso District, within the Lake Victoria Basin (Balarin, 1985). The experimental station was responsible for conducting research in aquaculture and training extension workers and farmers, as well as production and supply of fish fry (fingerlings) to farmers.

By 1967, about 11,000 ponds, mostly producing fish for subsistence with estimated annual production of 800-900 tons, had been established throughout the country (FAO, 2005). Because the governments, both colonial and post-colonial, were concerned with people's welfare and nutrition, the focus on aquaculture development in its early years was to improve nutrition and food security among the rural communities. Fish ponds in the country are mainly concentrated around areas with favorable land and water conditions for fish farming. For example, the western region, which is far from the major lakes such as Lake Victoria and Lake Kyoga, has 46% of the ponds; the northern region, with mainly the Nile river, has 24.4%; the eastern region, much of which surrounds lake Kyoga, has 17.4%; and the central region, surrounding Lake Victoria, has only 12.2% of the ponds (KARDC, n.d).

Aquaculture in Uganda has benefited from efforts of the government and various international development agencies, such as Food and Agriculture Organization (FAO), United States Agency for International Development (USAID), United Nations Industrial Development, Oregon State University and Auburn University. These efforts have increasingly promoted aquaculture technology within the context of integrated agriculture, and have begun addressing



socio-cultural and economic factors that have in the past stalled aquaculture development in the country (FAO, 2010; Auburn University, 1999).

Aquaculture production has increased tremendously in the past decade, from less than 50,000 tonnes in the year 2008 to over 95,000 tonnes in 2010 (Figure 3), with African catfish (*Clarius gariepinus*) accounting for two-thirds of the production (FAO, 2012). Aquaculture contributes about 2.8% of the national GDP, and has attracted interest and investment from both the private sector and public institutions in the country (UIA, 2005).

Two key species are cultured in Uganda for commercial purposes and contribute over 90% of the total aquaculture production in the country; Nile tilapia and African catfish that has now surpassed Nile tilapia (Dickson, 2011). Realizing this potential will require new ways of linking farmers to information and markets.

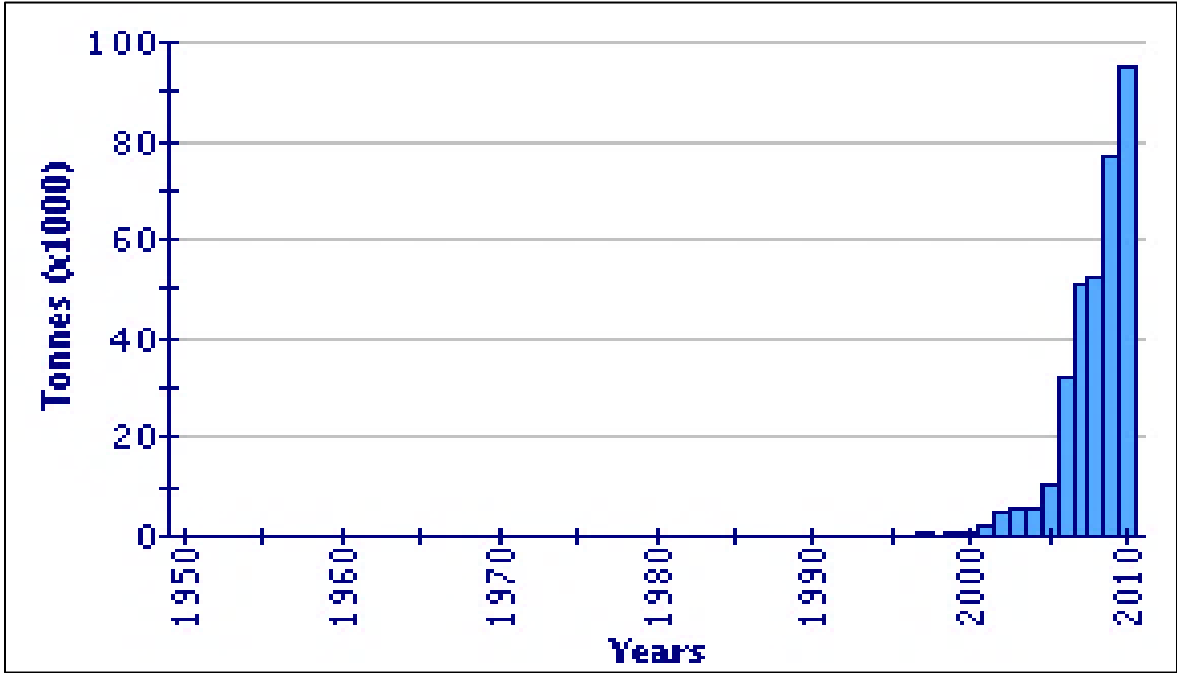


Figure 3: Aquaculture production in Uganda since 1950 (FAO, 2012)

### **1.3 Information technology**

In aquaculture, education and access to knowledge is critical, and are the tools that enable farmers to acquire and use information (Evenson et al., 1999). Advances in information and communication technologies (ICTs) have created many possibilities. ICTs have had a significant positive impact on sustainable development and poverty alleviation (Torero and Braun, 2006). Extension services can now help disseminate information about production systems, quantity and quality of inputs, and timely use (Mittal, 2012).

The World Development Report emphasized that agricultural extension plays an important role in agricultural development and in promoting sustainable, inclusive and pro-poor economic development (World Bank, 2007). However, recent stagnation in public investments and the breakdown of extension services has led to large gaps between potential yields and actual productivity. Weak extension services and poor access to information have hindered the transfer of technology at the farm level (Mittal, 2012).

Today, information and communication technology (ICT) and mobile-enabled services act as instruments to augment and help disseminate agricultural information to farmers (Mittal et al., 2010). Improved communication and information access are directly related to social and economic development (World Bank, 1995).

Mobile phones seem to influence the commercialization of farm products, as a result of easy accessibility of both market and agricultural information by farmers. They have provided new approaches to farmers to make tentative decisions much more easily than before (Ilahiane, 2007). The availability of mobile phones can lead to greater social cohesion and improved social relationships (Chhachhar and Hassan, 2013). Mobile phone based social-networking in developing countries shows the growing importance of this aspect (Kwaku & Kweku, 2006).

Mobile phones, as devices for improving the efficiency of agriculture markets, promoting investment, and contributing to empowerment, are therefore becoming increasingly important to agro-based entrepreneurs. Between 1996 and 2003, a developing country with an average of 10 or more mobile phones per 100 people would have enjoyed per capita Gross Domestic Product growth of 0.59% higher than an otherwise identical country with a mobile phone density of less than 10 phones per 100 people (Röller and Waverman, 2001).

#### **1.4 The problem**

Aquaculture productivity in Uganda is limited, not from technical or genetic barriers, but from lack of compliance with known and standard methods for producing fish in earthen ponds and cages. Most small-scale fish farmers in Africa have limited access to reliable information about new and improved methods of farming. Most farmers do not attend agricultural fairs (where they exist), and aquaculture extension workers do not reach every farmer. In addition, extension workers who visit the farmers often give them discrepant information, leaving farmers confused (Mwangi, 2008). Thus, farmers recline back to their traditional knowledge, experience and guesswork to make decisions for day-to-day activities, which has proved to be ineffective in managing a non-traditional enterprise like aquaculture.

Access to appropriate information, inputs, and technical support are significant determinants of agricultural productivity. A study from Nigeria found that farmers need to have access to agricultural information in order to improve their agricultural production (Adomi et al., 2003). Access to information is clearly a key determinant for maintaining a successful farming business (World Bank, 2013). Utilization of available information by farmers is very important because it justifies the efforts by research and related organizations to improve farmers' activities and output, among other factors (Fawole, 2006).

Coupled with corresponding innovation in existing social and institutional arrangements, mobile phones have the potential to significantly increase the income of the small-scale fish farmers (Verheye, 2000). As mobile phones converge with other devices such as notebooks and tablets, opportunities will proliferate. Affordability will remain an issue, but cell phone capability and market penetration will grow. However, little is known about the use of mobile phones and the needs and interests of fish farmers in Uganda.

### **1.5 Research objectives**

There is a need to understand the use of mobile phones, and the needs and interests of fish farmers. Public agencies, non-governmental organizations, and cellular service providers may be able to facilitate the use of cell phone as a means to guide, coordinate, and instruct fish farmers. To clarify these matters, the study has three objectives:

1. To review literature on the use of mobile phones in agricultural development.
2. To assess mobile phones as a source of information for fish farmers in Uganda.
3. To examine the reported experiences and perception of mobile phone use among fish farmers in Uganda.

The second chapter reviews mobile phone literature and presents a conceptual framework for understanding the results.

## **Chapter 2**

### **Conceptual Framework**

This chapter provides an overview of information and communication technology as a tool for advancing African aquaculture. Previous research on the topic provides a context for understanding primary data from Ugandan fish farmers

#### **2.1 ICT in African agriculture**

The emergence of Information and Communication Technologies (ICT) has many implications for both social and economic development all over the world (Ogunsola, 2005). Information and Communication Technology is rapidly becoming more and more visible in the society and in agriculture (Reza and Zahedi, 2012). Farmers have benefited from the ICT revolution, and the latest innovations in ICT have enhanced the development of the agriculture sector (McNamara et al. 2012).

New information and communication technologies are being used across the fisheries sector, from resource assessment and processing to commercialization (FAO, 2008). Some are specialist applications, such as sonar for locating fish, while others are general-purpose applications, such as Global Positioning Systems (GPS), used for navigation and location finding. Mobile phones facilitate international trading, information exchange and emergency response. Radio programming, with fishing communities and web-based information and networking resources, also channel through mobile phones (FAO, 2007).

As with other economic sectors, effective agricultural development requires access to information. To increase productivity, guidance will be required on crop cultivation, water management, fertilizer application, harvesting, transport of products, packaging, food preservation, value addition, quality management, food safety, food storage, and food marketing

(Jones, 1997). In each case, information and communication technologies are essential because they aid in transmission of necessary knowledge that can be utilized by producers to improve their enterprise. ICT has already shown what is possible and the important role it plays in delivering information to developing countries in this sector (Zijp, 1994).

The application of ICT in agriculture generates opportunities to help solve the problems of rural people and promote agricultural production by providing technical information in a timely and direct way. ICT-based services such as information, advice, inputs, finance, and other resources can enhance a farmer's participation in commercial value chains. ICT can help overcome finance, input and information markets (Barrett et. al., 2010). ICT can enable extension workers to gather, store, retrieve and disseminate a broad range of information needed by farmers.

Access to agriculture information is a very important factor in achieving competitiveness (e-agriculture, 2010). Empowering farmers with relevant, timely information can significantly reduce farming risks. In both developed and developing countries, millions of households own radios, televisions and mobile phones, which are used as a source of information to people at all levels. Utilization of ICT in agriculture ranges from advanced, modern technologies such as GPS navigation, satellite communication and wireless connectivity, to older technologies such as radio and television (Shambani, 2013).

Despite the growth of the ICT industry, many Africans still lack the basic communication infrastructure necessary to access information and make timely decisions; ICT can help bridge the gap between extension workers and farmers. Much of the information provided by extension workers is sometimes out of date, irrelevant and not applicable to small farmers' needs, leaving farmers with very little information or resources to improve their productivity. The application of

ICT in agriculture can help generate possibilities to solve problems faced by farmers by enabling extension workers to gather, store, retrieve and disseminate a broad range of timely information needed by farmers, thereby promoting agricultural production. Extension systems often cannot keep pace with farmer needs and technical possibilities. ICT can empower farmers to solve their own problems and enable extensionists to provide better assistance needed by farmers.

## **2.2 Use of mobile phones in agriculture**

The telecommunications industry has long been at the heart of global commerce, having transformed businesses across all industry sectors. However, it is only in recent years that mobile communications technology has been widely accepted as an enabler of sustainable growth. Reviews from sub-Saharan Africa (Gakuru et al., 2009; Munyua, 2008) identified mobile phones as a key innovative technology in support of livelihoods, with evidence of growing integration into agricultural extension, information provision and marketing systems.

Mobile phones have a rapid diffusion rate and facilitate farmers' access to information, helping increase their bargaining power, control over external events, develop new skills and grow revenues (Myhr and Nordstrom, 2008). For instance, in Tanzania the arrival of mobile phones, under the Vodafone Group, transformed agricultural business performance at all points by augmenting farmers' access to education and vital market information (Timuray, 2014).

Cell phones have transformed markets in low-income countries. Aker (2008) assessed the impact of mobile phones on grain market performance and found the introduction of mobile phones to be associated with a 20-percent reduction in grain price differences across markets, with a larger impact for markets that are farther apart and those linked by poor-quality roads. He also contended that cell phones have a larger impact over time; as more markets have cell phone coverage, the greater the reduction in price differences. This was primarily due to changes in

grain traders' marketing behavior. Cell phones led to reduced search costs, more market information and increased efficiency in moving goods across the country.

A study from Uganda found that market participation rose with mobile phone access (Muto and Yamano, 2009). Although better market access can be a powerful means of alleviating poverty, the study found that market participation still depended on what producers had to sell. Perishable bananas were more likely to be commercially sold than less-perishable maize. Also, the flow of information improved among banana farmers following expansion in mobile phone coverage, leading to greater market participation and a rise in profits by 10 percent.

In Malaysia, Shaffril et al. (2009) reported the use of mobile phones by 134 younger agriculture-based entrepreneurs resulted in an expansion of their information network and faster information accessing speed that positively impacted their business profits. Hudson (2006) also reported that information and communication technologies could aid greatly in rural development and poverty reduction within developing countries due to an increase in local people's ability to obtain information for sound decision-making.

Aker (2011) found that the use of mobile phones had positive effects on both traders and consumer welfare in Niger; mobile-use traders' profits increased by 29 percent, and average consumer grain prices fell by 3.5 percent. He also reported that the use of mobile phones enabled traders to reach more markets and establish wider contacts. Furthermore, Aker also found that mobile phones played a big role in providing information on market, weather, transport and agricultural techniques through concerned agencies and departments.

Mobile phones have the ability to provide information, and thus encourage greater production efficiency. Karamagi and Nalumansi (2009) found that many dairy farmers in the



Bugerere District in central Uganda were travelling approximately 75 miles to the main market in the capital (Kampala) blindly searching for buyers at the market. This often times results in farmers having thousands of liters of unsold milk, which inevitably spoil and become worthless. However, after adopting the use of mobile phones, the farmers began using them to connect to Food Net, a service that supplies up-to-date price information for agricultural commodities, as well as contact details for interested buyers via text message.

Jensen (2007) studied the adoption of mobile phones by fishermen along the coast of India's Kerala State. Jensen showed from 1997, as mobile phone coverage became available, the proportion of fishermen who travelled beyond their usual markets in Kerala to sell their fish jumped from 0% to about 35%. Furthermore, time wastage was eliminated completely, and the 'law of one price' – the idea that in an efficient market, identical goods should cost the same – would come into effect. Aker (2008) also reported similar results from her study on grain traders in Niger. Her study showed the primary mechanism by which mobile phones affect market-level outcomes appears to be a reduction in search costs; traders operating in markets with cell phone coverage search over and sell in a greater number of markets.

In Malawi, Katengeza et al., (2013) found that cell phone use is positively affected by literacy, distance to local market, land size, current value of assets, crop income, and region. Intensity of use is conditioned by gender, participation in agricultural projects, mobile phone ownership, current asset value, and distance to nearest public phone services. Asset endowment plays a critical role in enhancing adoption of mobile phone technology. Gender disparities significantly affect adoption, as most women have limited access to assets.

Furthermore, Scott et al., (2004) investigated gender differences in mobile phone uses in rural Uganda and found that many women were not using mobile phones because of the cost of

making a phone call and their lack of knowledge of how to use the device. It was reported that men were more likely to use mobile phones for business purposes than women, while women were more likely to use mobile phones for kinship maintenance. A 2010 study on the use of mobile phones to aid agricultural development in southwestern Uganda revealed that while women used the phone less than men, they were more likely to use the mobile phone to access agricultural information (Masuki et al., 2010). However, men were still more likely than women to use the mobile phone for business purposes, such as accessing market information.

In addition, Martin and Abbott (2013) examined the diffusion and perceived impact of agricultural based mobile phone use among small to medium size limited-resource farm holders in Kamuli District, Uganda. The report showed that 42% of the farm households had a mobile phone and more than half of the farmers used their mobile phones for farm purposes. They sought agricultural inputs, obtained market information, monitored financial transactions and used it for agriculture emergency situations. Slightly less than half consulted with experts via mobile phones. Men tended to adopt mobile phones earlier than women, and those with more education were more likely to use SMS (short message service) text features. Also, women were less likely to use the calculator function, perhaps due to a lack of numerical literacy training. Those who were members of agricultural groups were more likely to use their mobile phones for a variety of purposes. The study identified a number of unique mobile phone uses being made, including taking photos of agricultural demonstrations, using the loudspeaker function to permit a group of farmers to consult with an expert, recording group members pledging when they will repay loans, and storing data such as dates when hens should start laying eggs.

### **2.3 Advantages of mobile phones**

The rapid increase in the use of mobile phones world-wide has greatly influenced agriculture in various ways. The use of mobile phones has enhanced farmers' incomes, made agricultural marketing more efficient, reduced information and transport costs, and provided a platform to deliver services and innovate agriculture. However, availability and accessibility to mobile phones is associated with higher agricultural incomes.

The use of mobile phones can lead to savings in transaction costs. The adoption of mobile telephony by farmers and agricultural traders in Ghana has helped them reduce both their transportation and transaction costs. Members associated with trade networks, with the help of modern telecommunication modes, were able to run their activities in a better organized, more efficient, and cost effective manner. The revolution of mobile telecommunication in Ghana helped reduce lack of information symmetry (Overa, 2006).

A World Bank study conducted in the Philippines found strong evidence that purchasing a mobile phone is associated with higher growth rates of incomes, in the range of 11–17%, as measured through consumption behavior (Labonne and Chase, 2009). This was due to equipping farmers with information that provided a stronger bargaining position within existing trade relationships, in addition to being able to seek out other markets. A study of farmers who purchased mobile phones in Morocco found that average income increased by nearly 21% (Ilahiane, 2007).

Mobile phones can help farmers improve agricultural productivity by giving them access to basic financial services, new agricultural techniques, and new markets. Mobile phones in turn help them secure better prices for crops and a better return on investments. As their income improves with each harvest, they can invest in better seeds, fertilizer and chemicals. Mobile

money transfer services, such as MTN Mobile Money, bring basic financial services to rural farmers in Uganda, together with a wide range of community benefits. Mobile financial services can fill the banking gap felt by the poorest farmers.

Meanwhile, mobile information platforms open up significant additional routes to critical information on how to grow and respond to a context of climate change through the dissemination of reliable seasonal weather forecasts. In Turkey, local weather forecasts transmitted through SMS provided timely warnings of impending frosts or conditions that favored pests. Mobile platforms may also enable rural people to find employment. In Uganda, Grameen Foundation partnered with the government of Uganda and Non-Governmental Organizations (NGOs) to setup an employment opportunity called Community Knowledge Workers (CKWs), which employs farmers to collect information. This method, which relies on local people to transmit data to more centrally located research and extension staff, is much less costly and can provide much more timely information than traditional surveys.

#### **2.4 Limitations of mobile phones**

Despite the various uses of mobile phones in agriculture, there are also limitations related with its use. Mobile phone-based information services have not yet penetrated or become popular with the majority of farmers due to either the cost of purchase or dissatisfaction with the relevance of content.

Molony (2008) conducted a study on the effects of mobile phones on traders of perishable foodstuffs operating between Tanzania's Southern Highlands and Dares Salaam's wholesale market, with a particular focus on the importance of credit in the relationship between potato and tomato farmers and their wholesale buyers. The study showed that the ability to communicate using new information and communication technologies (ICTs) did not

significantly alter the trust relationship between the two groups. It also suggests that farmers, in effect, often have to accept the price they are told their crops because their buyers are also their creditors; irrespective of the method of communication used to convey this message. In this situation, many farmers are unable to exploit new mobile phone-based services to seek information on market prices and potential buyers in other markets. Doing so would run the risk of breaking a long-term relationship with a buyer who is willing to supply credit because of their established business interaction.

Chapter 3 describes procedures used to explore experiences and expectations for mobile phone use among fish farmers in Uganda.

## **Chapter 3**

### **Materials and Methods**

#### **3.1 Sample**

Small to medium scale fish farmers participated in the focused group interviews that were conducted in five districts of Uganda (Masaka, Mpigi, Bushenyi, Mukono and Kalungu). Farmers were purposely selected for their voluntary participation through the help of Grameen Field Officers and Community Knowledge Workers (CKWs). Purposive sampling is “a nonprobability sampling technique that involves careful selection of persons with specific characteristics to participate in a research study” (Singleton & Straits, 2010). Farmers were not remunerated; however, a light lunch was served and each fish farmer was given refreshments. All the interviews were conducted in Luganda and each was 2 hours in length and digitally recorded. This research project received Auburn University Institutional Review Board approval, and consent from participants was obtained prior to the interview. Focused group interview guides were used to secure information about:

1. Mobile phone use among fish farmers.
2. Needs and interests of fish farmers.
3. Problems faced by fish famers while using mobile phones.

#### **3.2 Data collection**

In this study, five focused group interviews were conducted in five districts of Uganda to answer the following three research questions:

1. How do fish farmers use mobile phones for their day-today aquaculture activities?
2. What are the limitations of using mobile phones by fish farmers?

3. What are fish farmers’ interests and needs on the content and design of information for improving and expanding the existing cell-based system?

Focused group interview is one of the qualitative research methods that involve a guided discussion on specific issues, with predetermined group of people participating in an interactive discussion (Hennink, 2014). The aim of focused group interviews is to gain a broad range of views on the research topic over a 60-90 minute period, and to create an environment where participants feel comfortable to express their views (Hennink et al., 2011). Focused group discussions also provide an opportunity for obtaining general background information about a topic (Berg, 2009).

Non-threatening group environments were created to allow participants feel comfortable to share their views, beliefs and attitudes without the fear of judgment from others. This provided a room for effective generation of important insights into topics that were not previously well understood (Hennink, 2014). A total of 48 farmers, comprising of 34 men and 14 women, participated in these focused group interviews between the months of May and July, 2014. This sample size was in line with Roscoe’s (1975) rule of thumb that states a sample size between 30 and 500 is sufficient for a research study. A breakdown of the focus group is presented in Table 2, and a pictorial in Figure 4.

**Table 1: Sites of focused group interviews with fish farmers, Uganda 2014**

<b>District</b>	<b>Date</b>	<b>Meeting place</b>	<b>Number of participants</b>
Bushenyi	07.07.2014	Fish farmer home	9
Mpigi	07.18.2014	Fish farmer home	8
Masaka	07.15.2014	Hotel	8
Kalungu	08.05.2014	Sub-county office	9



**Figure 4: Focused group discussion held outdoors**

### **3.3 Focused group interview participants**

As proposed by Hennink (2014), focused group interviews should consist of people with certain common characteristics and similar levels of understanding of a topic, hence aiming for homogeneity rather than diversity. In this study, the population included small and medium-scale fish farmers in Central, Eastern and Western regions of Uganda. From each district, participants were recruited depending on how long each farmer had been involved in fish farming as a business activity. This approach allowed free expression of views and avoided participants being suppressed by others dominant and more knowledgeable participants.

Most fish farms in Uganda are owned by men. In order to include both genders in the discussion, one group was organized based on gender and at least one or two female fish farmers, out of the seven or eight total participants, were included. The size of each group was decided according to the proposition of Hennink, (2014), who argues the number of participants in each



group should be between six to eight for easy management, smooth interaction, rich details and for equal opportunity to share insights. Total number of participants in all five FGIs was 48.

### **3.4 Focused group interview guide**

A summary of the information in the participant consent form was used to make sure all participants' understood the purpose of the study and the need for confidentiality (Appendix 1).

### **3.5 Thematic data analysis**

Responses to sources of information, use of mobile phones, needs, interests and challenges faced by fish farmers were transcribed verbatim and treated in English using thematic analysis. Thematic analysis 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” (Boyatzis, 1998). All responses were read multiple times, both to manually develop appropriate codes (Kelle, 2004) and to uncover new or unique themes not identified in prior research. The data was systematically coded by writing names and a brief description of each code on a separate piece of paper to indicate potential patterns that simultaneously categorized, summarized, and accounted for each theme in the data (Hennink, 2014). Identified codes were then matched with data extracts to form a codebook from which themes emerged. From the codebook, themes that emerged from the coded data (discussions) were identified and the name of each theme was finalized by writing a description to help communicate the meaning as shown in chapter four.



**Figure 5: Transcribing data**

## **Chapter 4**

### **Results and Discussion**

Chapter 4 presents themes or categories formed from the analysis of responses of fish farmers in five districts of Uganda.

#### **4.1 Use of mobile phones among fish farmers**

Participants identified a number of roles that mobile phones play within the context of the aquaculture industry. These include marketing and coordination services, in particular, technical guidance, payment collection and contacting family members. Extension services were discussed, but less emphasis was placed on it by participants in all the five focus group interviews. Mobile phones save time and reduce the distance between fish farmers and producers, as well as other fish farmers, making the sharing of information and knowledge easier and more effective.

##### **4.1.1 Coordination purposes**

Farmers recognized the significance of mobile phones as a new form of technology not previously available to use. The farmers' response to mobile phone usage and its efficiency were based on how mobile phones were used to make plans for procurement of fish farm inputs, such as seeds and feeds from fellow fish farmers, fisheries research centers and non-governmental organizations (NGOs) that help to increase their income and productivity. This is in line with Randrianarisoa and Minten (2005), emphasizing that access to inputs has a positive effect on crop productivity.

Mobile phone use also included farmers receiving calls from their fellow fish farmers inviting them to attend group trainings on a village level. They also indicated that intermediary farmers play an important role in providing technical guidance and information regarding fish

farming. This is in line with Shuaib (2000), who found that fellow farmers were the main source of agricultural information.

Access to mobile phones helps farmers communicate with customers in surrounding villages and negotiate prices for their fish. Farmers reported that mobile phones provide monetary savings over what would have been spent on travelling. They also reported some benefits in terms of greater convenience, such as time saving as a basic mode of communication from using mobile phone. This corresponds with Overa (2006) who reported that the adoption of mobile telephony by farmers and agricultural traders in Ghana helped them reduce both their transportation and opportunity costs. In the same study, the members associated with trade networks with the help of modern telecommunication modes, and were able to run their activities in a better organized, more efficient and cost effective manner.

For some of these farmers, a mobile phone represented the only appropriate and efficient means of communication. For many of the small farmers, the savings stemmed typically from avoiding local travel, with a cost range of 5000-10,000 Ugandan Shillings per trip. The use of mobile phones also delivered convenience benefits to farmers who were starting to substitute some physical meetings with mobile phone conversations. Our findings also corroborate with Jensen (2007), who asserts that as mobile phone coverage became available (from 1997) the proportion of fishermen who travelled beyond their usual markets in Kerala to sell their fish jumped from zero to around 35%.

*“Without a phone, I would have been forced to walk and look for the market. That would have taken a lot of time”, (woman, about 55 years).*

During harvesting, farmers use their mobile phones to call fellow farmers who have been in fish farming for some time, or call technical personnel from the Kajjansi Aquaculture Research Development Centre (KARDC) seeking advice on better ways of harvesting and handling fish during harvesting and transportation.

*“....., without mobile phones, we could spend a lot of money on travelling in order to get feeds and seeds without even contacting the service providers, but only to find that they are out of stock, I do not wish to live that kind of life anymore.....It is good that I now own a mobile phone so I do not have to leave my fish ponds to get inputs. All I need to do is contact the service providers via my phone to know if the products are available” (man about 40 years old)*

#### **4.1.2 Attain prices and market access**

The long distance from farm to market has hindered the gathering of information about prices, but mobile phone use is efficiently fulfilling this gap by providing timely information about the market situation, transport and agricultural prices. Farmers pointed out that the existence of mobile phones have made it easier for them to communicate with businessmen and middlemen by informing them of the availability of fish. A similar study in Morocco (Ilahiane 2007) showed that farmers with mobile phones increasingly dealt directly with wholesalers or larger-scale intermediaries, rather than smaller intermediaries. This has helped reduce transportation costs involved in moving fish products from one market to another, and enabled products to be sold in time with a price reduction. Similar studies by Karamagi and Nalumansi (2009) found that after farmers in Bugiri district adopted mobile phones they began to connect to Food Net, a service that supplies up-to-date price information for agricultural commodities, as

well as contact details for interested buyers via SMS, which enabled them to sell their products in time.

Phones also enabled farmers to know the prevailing market prices of cultured fish in various markets, which enabled them to have bargaining power and sell fish at higher prices. Selling at higher prices enables farmers to earn more income, and in turn to apply sufficient inputs for better yield (Muto and Yamano, 2008). Before selling their fish, farmers called middlemen or brokers to substantiate market prices, giving farmers the ability to have control over the existing market prices. When satisfied with the prices and after agreeing on quantity, the broker either decides to come to the village to pick up the fish, or advises the farmer via a phone call to transport the fish to the businessman's place or the nearby market where they can meet for business transactions and payments.

*“... we talk with brokers by making a phone call and asking them about prices of fish per kilogram and also find out whether there is market for our fish, and if you have more than one ton of fish, they come directly to your farm and purchase them ....they offer good prices and sometimes low prices... if you are not lucky enough on some days you can end up selling your fish at a zero profit. The government should set up standard market prices” (man about 40years).*

Using mobile phones to make arrangements for timely supply of inputs and selling of fish products in high priced markets was associated with a positive impact on fish productivity. Few farmers reported to have derived greater benefits from the ability to make better decisions about where to sell their output, after getting information about market prices for several local and distant markets. This has greatly improved their livelihood and has reduced poverty. Similar studies by Hudson (2006) reported that information and communication technologies could

greatly impact rural development and poverty reduction within developing countries due to an increase in local people's ability to obtain information for sound decision-making.

#### **4.1.3 Mobile banking and making payments**

Farmers indicated that mobile payment systems gave them opportunity to access financial services and provided an inexpensive and secure way to transfer and save money using their mobile phones by incurring less charges. They allow small-scale farmers to save money, receive payments quickly in times of need, and pay for agricultural inputs via their phones. Kirui et al. (2012) reported that mobile phone-based money transfer (MMT) services facilitate transfer of money in a quick and cost effective way. In the same line, they offer a majority of rural populations, with no access to formal financial services, an easy and secure platform to establish small savings.

Mobile payment systems replaced costly traditional bank transfer services and the need to travel long distances to collect funds from financial institutions. Before the introduction of mobile-money banking and transfer, farmers would spend too much time moving from financial institutions (such as Pride Micro Finance (PMF), Stanbic bank, Bank of Africa, Barclays, Finance Trust bank, Orient bank, and Tropical bank) to save or receive money. Farmers would rather make use of mobile money services, and highlighted they no longer have to travel long distances to visit a bank, get funds, or make a transfer;

*“.....Mobile money helps us to save small amounts of money, receive payments quickly in times of need, pay for agricultural inputs, make mobile payments... replaces costly traditional transfer services and reduce the need to travel long distances to collect funds....before the introduction of mobile-money, warid pesa, Mpesa, we used to waste too much time moving to financial*

*institutions to make payments, receive money or save money, and sometimes we could end up foregoing family activities” (youth about 26years)*

#### **4.1.4 Technical guidance**

A number of farmers mentioned that they have tried to get technical guidance from their fellow fish farmers via their mobile phones. A few literate farmers have even tried to use the Google search engine on their phones to get information related to farming, but the information available is hard for them to follow and understand. In addition, farmers indicated that voice calls are more frequently used than SMS due language barriers and illiteracy. Studies by Ashraf et al., (2005) and Frempong et al., (2007) reported that the extent of SMS usage by farmers was lesser due to a higher rate of illiteracy. They gave an example of the Drum Net study that revealed only 9% of the respondents know how to send an SMS for business purposes, while the corresponding figure in Ghana was 21%.

*“Farmers make voice calls more than sending and receiving SMS. The reason behind is that most farmers stopped in lower levels of education, they really find it hard to type and read a text message, and some think typing a message takes too much time; therefore, they prefer voice calls since they also have a good response rate than SMS. (man, about 35 years)*

Grameen Foundation has also developed a mobile-based system with the aim to help farmers in over 100 districts of Uganda improve agricultural productivity and income generation by accessing agricultural related information. Farmers reported that they receive updates on cropping through text messages with information that helps them improve agriculture productivity and boost incomes. Likewise, Labonne and Chase (2009) and Ilahiane (2007)



reported that purchasing a mobile phone is associated with higher growth rates of incomes, in the range of 11–17 percent and nearly 21 percent respectively.

Some farmers who had Grameen smart phones indicated that they have used them to search for information about cropping, livestock farming, piggery and poultry. However, they have never noticed fish farming information as part of the search until we asked them during the focus group discussion to give it a try and search for it; that is when they came to realize it was available to use for their day-to-day activities, but not sufficient since the people who created it did not have a fisheries back ground.

It was indicated that farmers usually have no one to contact in case of an emergency on their farm. Some of them have never had anyone give them any technical advice on how to go about fish farming. Farmers venture into fish farming without any fisheries background and this has resulted into low productivity.

*“We have more than 100 fish farmers in our district, but we have only one district Fisheries Officer to serve both fish farmers and fishermen –yet, farmers have diverse questions which an Officer may not handle even if he reached them since he is not a trained personnel” (man, about age 48)*

#### **4.1.5 Contacting family members**

Another main use of mobiles for the Ugandan fish farmers is to keep in touch with their relatives while in the field or while carrying out other businesses far away from home. This is a very good opportunity for them to make good progress in their daily fish farming activities without worries. Before the introduction of mobile phones, they were either prevented from getting in touch with relatives or had to forego farming activities in the case of family

emergencies. Today, whenever the need arises, they are able to stand with their households while farming. These findings support Sife et al. (2010) who emphasize the importance of maintaining the social network and claims conversation between family members is particularly important to enable farmers to manage their resources and increase their ability to deal with emergencies.

*“...where I make my daily fish farming activities is far away from where my family and other relatives live. Through the use of my mobile phone, I can easily communicate with my family, getting to know how they are doing. Sometimes when there is an emergency, for example one of the family members is sick.. When contacted, I immediately tell them to go ahead and take him or her to the hospital and then send money for covering the expenses through mobile money or Warid pesa.” (man, about 42 years)*

#### **4.2 Challenges faced by fish farmers while using mobile phones.**

Mobile phones can act as a means of aquaculture information dissemination because of its wide reach and low cost of delivering critical information. Another benefit is greater flexibility since they enable information dissemination to the fish farmers through both voice and text messages. Despite this, there are certain factors that constrain the full utilization of the potential use of mobile phones by small-scale fish farmers in Uganda. Some fish farmers’ perceptions of the dominant constraints of mobile phone use are outlined below.

##### **4.2.1 Lack of access to electricity**

Many farmers in rural communities of the country have no proper electric connections, and even where there is power the challenge of power cuts is more recurrent than power accessibility. Some farmers indicated that their phone batteries do not hold a charge for a good

period of time. Staying in areas where the power cuts are frequent and power availability is limited negatively impacts fish farmer's day-to-day activities.

*“Weaker mobile battery systems that need to be always charged are a very serious issue yet we have no constant power supply”. (woman, about 45years)*

Fish farmers find it quite challenging to pay electric bills associated with cell phone use since these payments are high. This confirms with Aminuzzaman et al. (2003) who found that despite the positive effects associated with the use of ICT tools for augmenting livelihood opportunities, electric power and cost are encumbering factors.

#### **4.2.2 Poor network connectivity**

Mobile phones are accelerating ways in which farmers acquire, exchange, and maneuver information in developing countries, but around a million mobile users in rural communities of Uganda face unreliable networks. Therefore, more needs to be done to improve the network signal strength provided by mobile phones. It was mentioned that mobile phones are very useful mainly for communication purposes when faced with problems while on the farm, however, optimum use of mobile phone applications is prohibited by poor signals in villages, which limit its possibilities.

*“Sometimes you can have a problem with your water inlet, and outlet not working perfectly, your fish is not responding to feeding very well, the fish are swimming in a sluggish form, or pond is all covered with algae, and you need to contact one of the farmers or extension worker who can provide some guidance on how to handle such issues, but all to find poor network coverage and*

*there is no way can keep in touch with any one. We really get stuck when such cases occur”.*  
*(Man, about 47years)*

#### **4.2.3 High maintenance costs**

Many farmers said that it is expensive to maintain and afford the services provided by mobile phones. Lack of access to calling credit is a serious problem faced by the majority of fish farmers, since this hinders communication with customers and access to important information about fish farming. They stipulated that due to their inability to make calls no standard market prices have been set to be able to exploit price differences that exist between major and minor markets.

*“Inadequate calling credit affects the ability to purchase important inputs and this also decreases the chances of getting the best price because of choice limitations on where we could sell ready fish and fingerlings. The middlemen dominate the supply chains and are the key price setters in the system. The farmers are often ignorant of how prices are set and end up taking whatever price they are offered”.* (Man about 30years)

#### **4.2.4 Lack of awareness and promotion**

Most of the time, the farmers are not aware of important application services they can get through mobile phones. Sometimes, they do not know whom to call when they have problems with utilization of the few known services offered on their mobile phones. Therefore, most of them only make phone calls with their ordinary mobile phones. They lamented that poor promotion has prevented them from taking advantage of available mobile services for their farming activities.

*“Though most of us use ordinary phones that do not have internet applications, less information has been provided about the use of smart phones and the important benefits they can provide; having inadequate knowledge on mobile phone applications has really affected achievements of our daily farm activities”.(woman, about 45years)*

### **4.3 Interests and needs of fish farmers**

Most fish farmers lack information on how to manage the different stages of fish production. This has partly hampered aquaculture development in most rural areas of Uganda. For this reason, potential farmers have not opted into fish farming and even others are becoming inactive because the usefulness of aquaculture has not been demonstrated to them. If the goal of reducing food insecurity is to be realized, practical actions must be taken to ensure that farmers receive the full package of technical support and guidance they need to benefit from fish farming.

Five focused group interviews with fish farmers indicated that there is great need for a wide range of varying information throughout the aquaculture production process. The broad categories of contextual information required were common to all the farmers, irrespective of their location and species cultured. These information categories were: pond construction, pond management, stocking and harvesting, feed management, brood stock management, water quality management, fingerling production, marketing information, and disease management.

#### **4.3.1 Pond construction and management**

Farmers acknowledged lack of knowledge on planning and constructing a pond, yet the most important aspect of pond management is deciding where and how to build the pond. Many farmers were broadly interested in knowing how to choose and prepare the site, construct a pond,

locate a sustainable drainage area, determine the level of water a good pond can accommodate, locate a good water source depending on the fish species to be cultured, and finally how to determine the best water control structure. Many problems in fish farming can be avoided when ponds are properly designed and constructed.

A common concern raised by all the farmers was lack of technical support on pond management. Many of these fish farmers were concerned about learning how to measure water pH and alkalinity, how to determine the amount of lime needed, when and how lime should be applied, the kind of fertilizer to use, when and how fertilizer should be applied, which fish species should be farmed, what type of soil to use, and how to maintain ponds. Farmers acknowledged that inadequate information has been made available on pond management, and those with great experience in fish farming as a business are not always willing to provide the necessary help. A few of the farmers mentioned that they have had extension workers from both Kajjansi Aquaculture Research and Development Centre and district headquarters visit their farms and have not been of great help to them.

Farmers in Great Bushenyi acknowledged that technical guidance was given to them by Community Knowledge Workers (CKWs) from Grameen Foundation, Uganda. They were advised not to pour used water with soap foam into the ponds, as this can have a great impact on water quality. They were also given advice on how to construct ponds, and most of them have been successful in establishing ponds in their places of residence. Most of the farmers were frustrated by extension workers who are never available when they are needed. Therefore, often they rely on a combination of traditional knowledge and guesswork. Some farmers were frustrated by their lack of money to hire people who construct ponds; they end up doing it

manually. A few of the fish farmer's ponds visited were poorly constructed due to lack of technical advice (Figure 6).

*“My family and I would love to take fish farming to the next level, however, relying on traditional knowledge and guesswork will soon make us opt out of the business... it has not done us good yet we have invested too much money and time... training opportunities should be made available and farmers should be informed whenever the fish farmer's symposium is to be held because most of them just hear about it, but never have an opportunity to participate in it.”(man age 58years)*



**Figure 6: Fish farmer pond**

#### **4.3.2 Stocking and harvesting**

A major concern that was raised by most of the fish farmers was lack of technical knowhow on proper fish stocking and harvesting techniques. A few reported attending at least

one or two fish farming trainings. Some indicated that fisheries scientists visited their farms and gave them some advice on how to stock and harvest fish. However, they noted inconsistencies in the information given to them during the trainings or visits. Many farmers were disappointed by fish crops they harvested due to the varying information on stocking densities and sizes from the different training programs they had attended.

*“.....at one training we were taught a stocking density for Nile tilapia fingerlings of only three fingerlings per square meter, so we stocked exactly as were told, and at a different training session, we were told to stock six fingerlings per square meter.....we are always left confused .... “seriously, which stocking densities should we take?” she asked.” (Woman, about 35 years)*

A few farmers felt their needs and interests are not always met because the trainings undertaken did not always completely cover important topics. They asserted that the information given to them was insufficient to advance their farm activities. This has limited their day-today activities; stocking ponds with the proper fish species and numbers of fish at the proper time, combined with good management practices, is necessary to maintain a good fish culture. They showed a desire to have regular access to consistent trainings. However some farmers found it difficult to be away from their farms and families because some trainings could take one or two weeks. Along the same lines, farmers recognized a lack of good record keeping and resources also limited their ability to put into practice what they had learned in the trainings attended.

*“We really need continuous trainings and we should be taught on how to keep good records, since most of us did not reach to higher levels of education. If not, there should be a way of providing daily information to us in inform of text messages or daily training programs on radios and televisions” (man, about 55 years)*



Pond harvesting is one of the most important parts of fish farming that has been frequently overlooked in Uganda. Small-scale fish farmers are under-equipped with harvesting techniques. Most of the farmers were frustrated for not knowing how long they should rear each fish species (tilapia and catfish), what should be done prior to harvesting, when they should stop feeding before harvesting, how to drain and seine (total) the ponds, and time of the day they should have the harvest. Some farmers mentioned that they do not have nets or holding tanks so they find it challenging to go into the ponds at the time of harvest. They fear their lives are in danger, believing that pond water has many organisms that can bite and harm them.

*“Farmers often find difficulties when harvesting their fish since most of them do not have the necessary harvesting equipment. Therefore, we call upon the government of Uganda, Ministry of Fisheries and research institutions to provide the necessary extension services”. (Young man, about 26 years)*

#### **4.3.3 Feed management**

Feed availability, quality of feeds, feeding rates and acceptable food conversion ratios remain major constraints for small-scale farmers in Uganda. Farmers showed interest in knowing how to acquire good quality feeds, how much should be fed, when to feed, where to place the feeds and how to make their own feeds. Most of the small-scale farmers mentioned this as a serious challenge to them simply because most of them venture into the business without any training, relying instead on peer information and guidance. This means that they do not have a firm idea on how to raise fish or how to keep good feeding records. It was mentioned that when farmers buy fingerlings from prominent fish farmers close to their areas of residence, the sellers

do not provide them with the necessary information on how to manage and feed the fish. Along these lines, fish farmers noted shortcomings in the quality of feeds sold to them by fellow farmers and other agricultural stores.

*“We tend to feed the fish as we are told by some agricultural stores where we buy the feeds...however, manufactured feeds are generally of a low quality...yet farmers use too much money on buying these feeds, and when they do a sell, they find themselves working at a loss”.*  
*(man, age 40 years)*

#### **4.3.4 Brood stock management**

Like any other farming sector, fish farmers require information on how to choose, breed, and manage their broodstock. Farmers showed interest in organizing hatcheries and producing their own fingerlings. They indicated a great interest in acquiring skills about selection of good brooders, fertilization, incubation and hatching, breeding, fish eggs and fish seed management, sex differentiation, suitable environmental conditions for breeding, stocking density of brooders per square meter, containers to be used, amount of water and oxygen needed, recommended optimum temperature and light for mainly tilapia and catfish production. This is because most complained about buying fingerlings of poor quality from their fellow fish farmers who do not give clear information about the parental background of fingerlings being sold.

Farmers raised an issue of getting fingerlings without even knowing the sex composition of the lot purchased. They buy seeds with the intention of buying only all-male fingerlings, but sellers give them mixed sexes. This is challenging to them since the mixed sex fish breed produce many small fish and limit the growth rate of the stocked fingerlings, thus increasing in numbers with the available limited space. This causes the fish farmers to use more money to buy

more feeds than what they had budgeted. Farmers think if necessary training opportunities were made available to them, they could breed their own fish and be in better position to produce good quality seeds.

*“Most of us have the desire to produce our own fingerlings because we are really fed up of buying poor quality seeds at an expensive price, which when fed, they do not show good feeding response and this makes them to be stunted... and at the end of the day you will make a loss. Having technical skills in fish production is essential for the sustainability of commercial aquaculture production”. (Man, about 62 years)*

#### **4.3.5 Marketing information**

Marketing has presented major challenges for many smallholder farmers, with almost all farmers in the five focused group interviews noting poor market infrastructure, unfair trading systems by middlemen, and poor prices as their major drawbacks to better income. Farmers were concerned about getting daily information updates on market prices since all business activities involved in the movement of fish from production to consumption is based on marketing. Market information enables farmers to make rational and relevant decisions. Farmers mentioned that market information such as prices, demand indicators, and logistical information should be made available in the form that is relevant to their decision-making.

The market information needs of small scale fish farmers included: information on product planning, current prices, and group marketing. Farmers indicated that when their fish is ready for harvest, they inform potential customers by cell phones about the availability of fish. Some farmers have to look for customers through word-of-mouth or face-to-face advertisement because they find it easier than making telephone calls. Depending on the size of fish, some sell

their farmed fish in nearby local communities. A few of the farmers were frustrated by the cost of middlemen who link them to buyers each time their fish are ready for harvest. This market is generally very small simply because the customers are usually low-income consumers who determine the price at which they buy each piece of fish. This discourages the farmers since no standard price has been set, and no daily market information is made available to them.

With an increasingly competitive and expanding market, the amount of marketing information needed daily by farmers is often underappreciated. Fish market information to both small and large-scale farmers should be provided by the Department of Fisheries through the field level extension workers, aquaculture scientists and by the broadcasting media. However, this information needed by farmers is not always available to provide. still has to be done in this area. Those in charge of market information are not always trained for the job and end up providing information that is not of any help to the farmers.

*“Accessing market information is very essential to aquaculture development; if updates on daily market prices are made available by trained personnel, then my life will improve a lot. I will surely put an end to the use of middlemen”. (Woman about 52 years)*

#### **4.3.7 Water quality management**

Managing water quality is one of the major challenges for fish farmers in Uganda that often limits the success of fish farming enterprises. Water quality refers to anything in the water, be it physical, chemical or biological that affects the production of fish. The key water quality parameters for pond production are temperature, oxygen, pH, alkalinity, hardness and nitrogenous waste. Each dimension has a measurement approach and management responses. The objective of pond management is to control water quality, so as to provide a relatively

stress-free environment that meets the physical, chemical and biological standards for the fishes normal health and production performance. However, small-scale farmers in Uganda often are not aware of the appropriate environmental conditions for the fish species they raise. When asked what they use to know the quality of water on a daily basis, or before the introduction of seeds, most of them said they never take measurements. Few of them said they use their hands by inserting them into the water to determine the temperature. This could be one of the reasons why some were not making good business progress, since it was indicated that some fish die off a few days after the stocking process. They indicated the government and fisheries research institutions have not been any help in providing required skills and knowledge regarding water quality management.

*“...the only solution to this is may be to form fish farmer’s groups that could access essential services and information at district level while addressing challenges being faced by farmers”*  
*(man, about 38 years)*

## **Chapter 5**

### **Conclusion**

Chapter 5 reviews the fundamental findings of the study and identifies the practical and empirical implications of this research.

#### **5.1 Summary**

This study indicates that the use of mobile phones is common among fish farmers in Uganda. Majority of the farmers reported that their mobile phones were primarily used for purposes that improve social development and livelihoods. This supports Donner (2008), who emphasizes that mobile telephony can contribute towards increased communication with institutions responsible for livelihood development. Many fish farmers indicated that they use their mobile phones to acquire technical guidance, contact family members, and communicate with those who provide agricultural inputs and market information, which results into increased income. These findings are consistent with (Hudson, 2006), who reported that mobile phones are tools that encourage efficient and informed action to lead to greater poverty reduction.

Farmers also indicated that mobile phones increase money savings by avoiding unnecessary travels, which increases their ability to access market prices, obtain technical guidance, contact family members, and take advantage of financial opportunities. Jensen (2007) asserts that as mobile phone coverage became available from 1997, the proportion of fishermen who travelled beyond their usual markets in Kerala to sell their fish jumped from zero to around 35%, which increased their savings. Most of the famers also indicated that they use their mobile phones to communicate with their households. This finding supports Sife et al. (2010), who emphasizes that conversation between family members is particularly important to enable farmers to manage their resources and increase their ability to deal with emergencies.

The study also highlighted that access to agricultural information has been widespread, but support is needed for disseminating information on market prices and fish production. At present, most farmers depend on the word of mouth to get information from extension officers and intermediary fish farmers, who are not always available when needed. Farmers also rely on middlemen and friends as sources of information on market prices. Government fisheries Officers and aquaculturalists are unable to reach all farmers and guide them on best fish farming practices. Therefore, it was noted that one of the major problems faced by Ugandan fish farmers is the lack of information among the farmers due to the communication gap between the information provider and the farmer.

It was found that fish farmers prioritized information on; pond management, feed broodstock and water quality management, stocking and harvesting, and most importantly market prices. Although farmers were also interested in other categories of information, like fish diseases, seed variety, fish species to be cultured, etc., only a small sample prioritized them. There appears to be a great deal of potential for reaching smallholder fish farmers in Uganda since all the fish farmers who participated in the focused group discussions have access to at least one mobile phone. It was also indicated that farmers enjoy the benefits of mobile phones because of the greater flexibility they offer through both voice and text messages. However, factors such as poor network coverage, frequent power cuts, lack of calling credit, awareness and promotion has constrained the full utilization of the potential use of mobile phones.

In conclusion, the study revealed low capacity and usage of mobile phone applications. In addition, it was found that farmers were excited about using mobile phones to access information on fish farming and market prices. This suggests that using cell phones, given fast growth and expanded connectivity in the country, could boost agricultural development in Uganda, and best

opportunities for use should be further explored by government, mobile phone service providers and fisheries research institutions. In order to improve fisheries productivity in Uganda, farmers must be able to access agricultural information and current market prices.

## **5.2 Empirical implications**

Focused group interviews provided a guideline for identification of a range of perspectives on the research topic and provided an understanding of the issues from the perspective of the participants themselves. These discussions provided an opportunity for obtaining general background information about the research topic and learning how participants talked about the subject. They also provided a basis for gathering large volumes of data from participants in a short period of time. This approach afforded understanding on how farmers reached their conclusions and provided information about how farmers interacted when discussing the research topic. The group environment enabled farmers to react to the contributions of others in the group, which led to reflection, justification and refinement of comments made during the discussion. The focused group environment provided a clear and potentially deeper understanding of the research topic.

The group setting created a comfortable environment to discuss issues and encourage reluctant participants to share their views (Hennink, 2014). This setting makes group members feel less inhibited and comfortable to share negative views (Green and Thorogood, 2004). A quiet and neutral location was critical for the participants to hear one another and to get a clear recording of the discussion. Hennink et al. (2011) argues that focused group interviews should not be held outdoors because onlookers can disrupt group dynamics causing participants to withhold comments because of lack of privacy. The focused group venues we provided were open areas and good environmental settings that enabled us to hear responses of all participants.



### **5.3 Limitations of focused group interviews**

Although focused group interviews strength lies in the richness of the information provided by participants, there are limits to the method's applications. In focused group discussions, the fluid nature of group discussion can lead to a less controlled environment for data collection. It requires skilled personnel to facilitate the discussion and manage the group to generate useful data, particularly when the group discussions are held in another language and moderators often need to be quickly identified, briefed and trained for the task.

A second limitation of focused group research can be some participants may dominate the discussion, or others may conform to what is said though may not actually agree, yielding little discussion. Influences of social pressure may limit the information shared and thus reduce data quality (Hennink, 2014). Additionally, focused group discussions can generate a large volume of data. This can make data analysis more complex. The researcher may need to account for the context of the group whereby participants may change their views or provide contradictory opinions during the course of the interaction (Hennink, 2007).

Finally, focused groups can identify different needs or impacts of a program and the reasons for them. However, focused groups cannot measure a impact or tell how many people helped by a project or program. Focused groups do not provide inferential statistics as a survey using a random sample would. The goal of focused group interviews is not to generalize to a larger population, but to provide valuable information the insightful reader may transfer to other contexts (Lincoln & Guba, 1985).

### **5.4 Practical implications**

The use of mobile phones as a means of providing timely information about agricultural information and market prices can help farmers significantly, and in many ways reduce risks by

empowering them to make good decisions. Therefore, this study would recommend the following:

- Farmers should receive the support they require to produce and market their fish so market processes facilitate the expansion of the industry and broader consumption throughout the country. Government agencies and NGOs need to combined efforts so, technical assistance gets to those who need it the most.
- The government and National Fisheries Resources Research Institute (NaFIRRI) should develop a system to allow fish farmers to receive a wide range of information about aquaculture production and market prices. Mobile phones, communicating directly with farmers and delivering pertinent information, will increase the growth of fish farming as an interactive and current culture in Uganda.
- The government, service providers and extension officers should sensitize farmers about the functions and use of mobile phones, especially smartphones, to their full benefits. This will increase awareness of its potential as an extension and outreach tool.
- All information should be delivered in languages that are comfortable for farmers. In Uganda, Luganda is a primary language in many areas, as well as English.
- Mobile service providers in Uganda should develop programs specifically targeted to fish farmers to enhance farm productivity and fish consumption.
- The government and mobile phone companies should reduce mobile tariff plans. Farmers should be able to access fish farming information on their mobile phones at a reasonable cost; thus, improving agricultural productivity and income.

- Mobile phone coverage should be extended to the far rural communities of Uganda. This would offer farmers to easily contact input service providers, fellow fish farmers and family members.
- Government should consider subsidizing smart phones equipped with necessary functions to leading farmers to provide liaison services to other fish farmers in their districts.
- To establish supporting infrastructure to support cell-based technical services. Farmers will require training to learn and utilize cell-based information.

### **5.5 Future research**

Future research on cell-based technical and informational services for fish farmers will explore the implementation process for cell-based applications. Studies will identify sustainable organizational models that are affordable to fish farmers, while providing incentives and supporting resources for information service development and maintenance. Additional studies will compare various forms of institutional locations for cell-based aquaculture applications that will ensure timely renewal and expansion of information systems for new species, emerging problems and changing conditions in Uganda.

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## Appendix

### Information letter summary

Below is a summary of the information in the consent form used to ensure participant understanding of the purpose for the study, confidentiality, and condition of participation.

### Introduction

Thank you all for coming today. We are very pleased you have agreed to join us today.

My name is Moureen Matuha, and this is a note-taker.

We are here to talk about how mobile phones have been used in fish farming to acquire fish farming information and technical guidance, and obtaining inputs on the content and design of information and expanding existing cell-based system. The discussion we are going to have is called a Focused group. For those of you who have never participated in one of these sessions I would like to explain a little bit about this type of research.

Focused groups are used to gather information informally from a small group of individuals who have a common interest in a particular subject in this instance, you're all fish farmers who have at least used cell phones in your life. This discussion will provide invaluable information to public agencies, nongovernmental organizations, and cellular services about how they can improve on the fisheries sector in the future. The Focused group discussion is part of our overall strategic planning process.

In Focused groups, there are no rights or wrong answers. We want to hear from everyone in the room. We are not fish farmers but just collecting information on how fish farmers have used their cell phones in aquaculture. We are pleased you can be part of this group because we think you have important ideas regarding our study. Please do not feel shy; we want to hear from you all about this interesting study. You are experts in this field and we want to learn more from your experiences. Don't hesitate to speak up when you have a point you would like to make.

I will be moderating the session and moving us along so that we touch on all of the key subjects on our research topic. I would like to avoid getting bogged down on issues that don't pertain to everyone in the group. If I think that we are spending too much time on one subject, I will step in to keep the discussion moving. During our discussion, the note-taker will be taking notes and remind me if I forget to ask something, but since she cannot write down every word we say, we would like to record the discussion so that we don't miss anything. I like to follow what is being said and then go back later to review what you said again so I can accurately convey your ideas and opinions.

My role today is to see that we have a productive discussion and to summarize the group's interactions. I will not refer to any participant by name in the reports I prepare. The recordings will stay confidential and only the research team will listen to the recordings. Also everything that you hear today should be confidential and not to be shared with people outside this group. The discussion will last for about 90minutes, please help yourself to the refreshments. Are there any questions before we start?

### **Interview Guide**

1. I would like to begin by going around the table and asking each of you to tell us a little about yourself and, your age, level of education, how long you have been practicing fish farming, number of ponds and type of fish species stocked.
2. Do you have a mobile phone?
3. How do you use your mobile phone to achieve day-to-day activities?
4. How do you use your mobile phone to acquire technical assistance?
5. What are your sources of fish farming and market information?
6. What are the sources of your farm inputs?
7. How do you get market for your fish?

8. Who determine the price between a farmer and a buyer?
9. What are the issues associated with using a mobile phone?
10. What are the kind of information do you think should be made available that can lead to the success of aquaculture?