New Approaches to Inform, Motivate, and Advance Small and Mediums-scale Fish Farmers: Building Industry Capacity Through Cell Phone Networks, Training, and Market Participation

Production System Design and Best Management Alternatives/Study/13BMA04AU

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ABSTRACT

Mobile phones can improve aquaculture productivity by increasing access to technical guidance, extension services, product assembly, input coordination, and price discovery for small- and medium-scale fish farmers. Data were obtained in five focused group interviews held across Uganda. The findings indicate 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. Many fish farmers report using 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. 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 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, such as fish diseases, seed variety, fish species to be cultured, etc., only a small sample prioritized them.

INTRODUCTION

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 rely on traditional knowledge, experience and guesswork to make decisions for day-to-day activities, which has proved to be ineffective in managing a nontraditional enterprise like aquaculture.

Access to appropriate information, inputs, and technical support are significant determinants for maintaining a successful farming business (World Bank 2013). Farmers need to have access to agricultural information in order to improve their agricultural production (Adomi et al. 2003). 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 (World Bank 2013). Information and communication technologies, such as mobile phones, 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 (Hudson 2006). Mobile phones can improve aquaculture productivity by increasing access to technical guidance, extension services, product assembly, input coordination, and price discovery for small-scale fish farmers. 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). They can enable traders to reach more markets and establish wider contacts. Furthermore, mobile phones play a big role in providing information on market, weather, transport, and agricultural techniques through concerned agencies and departments (Aker 2011). 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).

Mobile phones have the ability to provide information, and thus encourage greater production efficiency. 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 at 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 (Karamagi and Nalumansi 2009).

The adoption of mobile phones by fishermen along the coast of India's Kerala State showed that 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 (Jensen 2007) studied. 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. 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 (Shaffril et al. 2009).

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. There is a need to understand the use of mobile phones, and the needs and interests of fish farmers. Public agencies, nongovernmental 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.

OBJECTIVES

- Assess fish farmer needs and expectations for cell phones as a source of information, technical guidance, and applications;
- Develop a program of technical collaboration among researchers, government technical staff, and cellular providers to advance aquacultural development; and
- Build on existing farmer-based institutions to use national trade shows, train-the-trainer, symposia and other events to stimulate value chain development and attention to proven production practices.

MATERIALS AND METHODS

Five focused group interviews were conducted in five districts of Uganda (Masaka, Mpigi, Bushenyi, Mukono, and Kalungu). A total of 48 small to medium scale fish farmers, comprising of 34 men and 14 women, participated in the interviews between the months of May and July 2014. 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 23 group should be six to eight for easy management, smooth interaction, rich details, and for equal opportunity to share insights. This research project received Auburn University Institutional Review Board approval, and consent from participants was obtained prior to the interview. A breakdown of the focus group is presented in Table 1 and a pictorial in Figure 1.

All the interviews were conducted in Luganda, and each was two hours in length and digitally recorded. 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. Farmers were purposely selected for their voluntary participation through the help of Grameen Field Officers and Community Knowledge Workers (CKWs). All the participants were not remunerated, however, a light lunch and refreshments were given to them. All responses were transcribed verbatim and treated using thematic analysis. 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 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. 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.

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

District	Date	Meeting place	Number of participants
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
Mukono	06.16.2014	Primary School	14

RESULTS

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. Participants identified a number of roles that mobile phones play within the context of the aquaculture industry.

Coordination purposes. Farmers recognized the significance of mobile phones as a new form of technology not previously available to use. The farmers' responses 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. 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.

"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 old)

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 5,000–10,000 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.

"… 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).

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 harvest and transportation.

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. 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.

"… 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 40 years old)

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 fewer charges. They allow small-scale farmers to save money, receive payments quickly in times of need, and pay for agricultural inputs via their phones.

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, Back 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 26 years old)

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.

"Farmers make voice calls more than sending and receiving SMS. The reason behind is that most farmers stopped is 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 old)

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 old)

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.

"…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 old)

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.

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 45 years old)

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.

"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 30 years old)

"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 anyone. We really get stuck when such cases occur." (Man, about 47 years old)

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.

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 45 years old)

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.

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.

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 discrepancies 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.

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.

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, and recommended optimum temperature and light for mainly tilapia and catfish production.

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.

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. 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 fish's 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.

CONCLUSION

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. 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. 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 prioritized information on: pond management, feed management, 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 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.
Additionally, we have been in discussion with developers of cell phone applications in the private sector and within NaFIRRI. Several efforts are being made to develop a program of technical collaboration among researchers, government technical staff, and cellular providers to advance aquacultural development, reflecting our Objective 2. We seek to identify sustainable business models that weave government expertise and private sector responsiveness to stimulate marketing, disease, and technical assistance applications that are readily accessible, technically current, and economical for producers.

We continue to work with WAFICOS and other fish farmer cooperative to build on existing farmer-based institutions to advance the development and use of cell phone applications by fish farmers (Objective 3). Presentations have been made to national trade shows, train-the-trainer events, and NaFIRRI symposia to stimulate the development of cell phone applications. Cell phones applications seem most immediately to advance value chain development by facilitating price discovery and product availability. These services also can reinforce proven production practices and help resolve management problems.

QUANTIFIED ECONOMIC BENEFITS

Identify target groups and direct and indirect benefits accruing from the research and outreach work. Benefits must be quantifiable.

- Availability of text-based fish market and fingerling supply information;
- New extension mechanism for reaching fish farmers on broad-scale; and
- Augmented value chain for tilapia and other species resulting in added farm-level income.

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