IMPLEMENTING AND ASSESSING CELL-BASED TECHNICAL AND MARKETING SUPPORT SYSTEMS FOR SMALL AND MEDIUM-SCALE FISH FARMERS IN UGANDA

Food Safety, Post-Harvest, and Value-Added Product Management/Study/16FSV02AU

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ABSTRACT

The rapid development of mobile technology, the increased penetration rates and the inherent characteristics of mobile phones are the reasons mobile phones are currently emerging as the fast widespread form of electronic communication system in African countries. Mobile phones can, therefore play a key role in disseminating relevant information to fish farmers in Uganda. This report summarizes critical aquaculture needs of the farmers, socio-demographic Characteristics of the farmers, most important anticipated benefits of the app, reviews, comments and suggestions on the design and structure of the aquaculture application. Majority of the participants appreciated the design of the prototype as well as its applications while a few of the participants requested that the look (design) of the app be improved. Information on mixing feeds and feeding, up-to-date fish market, pond management (water exchange, site selection, pond construction, infrastructure development, management, and stocking, input suppliers and buyers' location, predator and health issue, success stories of farmers, booking keeping and fish farming videos were mostly needed by farmers. Respondents' characteristics such as age, gender, and education level were found to be determinants of mobile phone type ownership. Thus, the developed Aqua-application can be used to achieve various activities involved in fish farming and be adopted by policy organizations and government agencies in their proposals on the usage of technology as a key driver towards aquaculture economic growth. However, to leverage the full potential of information dissemination enabled by the designed mobile App will require capacity building amongst farmers on how to effectively use the app, use of different local languages, scaling the app through fish farmers' groups and awareness through different social media. Further work is needed to evaluate the usage and impacts of the app on aquaculture development and the livelihoods of farmers.

INTRODUCTION

Fish farmers in rural and remote areas of Uganda are facing many unprecedented challenges brought on by the changing global economy, dynamic political contexts, environmental degradation, and inadequate information access. To deal with these challenges, and to make critical decisions, fish farmers must be able to access critical information. Access to appropriate farming and market price 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 (World Bank 2013). Information and communication technologies like 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.

Mobile phones have also been used in different African countries for a variety of purposes. For example: Aker and Mbiti (2010) identified five potential mechanisms through which mobile phones can be used for economic benefits to consumers and producers in Sub-Saharan Africa. These mechanisms include the use of mobile phones to improve access to and use of information, thereby reducing search costs while improving coordination among agents and increasing market efficiency; an improvement of firms' productive efficiency due to the increase communication by allowing the firms to better manage their supply chains; the creation of new jobs to address demand for mobile-related services, thereby providing income-generating opportunities in rural and urban areas; facilitating communication among social networks in response to shocks, thereby reducing households' exposure to risk; and finally the usage of mobile phone-based applications and development projects to facilitate the delivery of financial, agricultural, health and educational services.

Muto and Yamano (2009) also found out that mobile phone coverage was associated with a ten percent increase in farmer's profitability in the bananas market. In agreement with Aker and Mbiti (2010), it is clear that the introduction of mobile phones in agriculture and other trade sectors has increased the traders' welfare, by increasing their sales prices, as they were able to take advantage of the spatial arbitrage opportunities.

In addition, mobile phones have been used for geo-referenced environmental monitoring. Vivoni and Camilli (2003) developed a wireless prototype system to acquire, store, display and transmit actual geo-referenced environmental data between numerous field teams and remote locations. Motorola Laboratories also developed a system that is used to sense agricultural, environmental and process parameters (Perkins et al. 2002). Lee et al. (2002) also came up with a silage yield mapping system that included a moisture sensor, a Global Positioning System (GPS) and a Bluetooth wireless communication module. Besides spatial data collection, Cugati et al. (2003) developed an automated fertilizer application for tree crops. The system had had a decision module for estimating the optimal amount and spread of fertilizer and an output module to regulate the rate of fertilizer application. The various modules communicated via Bluetooth network.

Furthermore, short Message Service (SMS) system is another form of mobile application that is being widely used in agriculture. Farmers can interact with technical experts via SMS. In Rwanda, the eSoko project was launched in 2009 to allow farmers to access prices of different agricultural commodities via SMS (Hellström2012). An SMS service system that brings information on demand and supply to farmers and extension workers has been developed in Uganda (Hellstrom 2012.). In Ghana, farmers in Tamale were able to send a text message to learn corn and tomato prices in Accra, which is more than 1,000 kilometers away (Aker & Mbiti 2010).

Even though the use of mobile phones have continued to be the best hope for farmers in most of African countries, fish farmers in Uganda still face major challenges including inefficiencies in information delivery, reconciliation of records between farmers and traders, and lack of information on best practices to farmers and timely market price information. Previous AquaFish research identified some of the challenges fish farmers face (Matuha et al. 2016). To deal with these challenges and for farmers to be able to make critical decisions, an aquaculture mobile application has to be developed. This application will help farmers to have access to critical farming and market price information. Therefore, the purpose of this study was to develop, review, launch and introduce the Application to fish farmers, dealers in aquaculture inputs, extension workers, researchers and policy makers and to assess the efficacy of the tool among different users in Uganda.

OBJECTIVES

1. Develop and implement a cell-based system that will enable fish farmers to access fish production and market information.
2. Conduct trials of cell-based aquaculture applications for fish farmers.
3. Conduct trial usage and assessment of cell-based aquaculture applications among the target population of fish farmers.
4. Evaluate utilization of cell-based applications for technical support, marketing and input discovery among the target populations of fish farmers.
5. Introduce mobile-based application to the network of agencies and organizations that support aquaculture.

MATERIALS AND METHODS

Activity one: focused group interviews

This effort developed and implemented a cell-based system enabling fish farmers to access fish production and market information. A total of 45 fish farmers, comprising of 34 men and 11 women, participated in the focus group interviews. The study population included small and medium-scale fish farmers from five districts (Wakiso, Mpigi, Gulu, Kole and Kalungu) of Uganda (Table 1). The interviews were conducted during the months of July to September, 2016.

The guided conversations were conducted mainly to assess the socio-demographic characteristics of farmers, identify critical aquaculture information needs and anticipated benefits of using the designed mobile application platform. Secure and quite environments were created, which allowed participants to feel comfortable to share their views, beliefs and attitudes without the fear of judgment from others. All the discussions were conducted in the indigenous languages spoken by people in the study areas and each lasted one and half hours. The discussions were digitally tape recorded in addition to manual note-taking of key issues. The data were transcribed, verified and coded using ATLAS. ti (Version 8). The codes were then exported into a computer Statistical Package Statistical Package for the Social Sciences (SPSS) (version 21), which yielded descriptive statistics such as percentages, means, and frequencies.

Activity two: trials of cell-based aquaculture applications for fish farmers

In order to improve the design and application of Aqua-App on both android smart phones and the basic phones, an IT Technocrat from Likamis Software demonstrated the design and structure of the app (Figures 1&2) to researchers, farmers, traders, and representatives from NARO, MAAIF and other governmental agencies. Demonstrations were carried out in March and May 2017 during two workshops organized at Kajjansi Aquaculture Research and Development Centre (KARDC). The workshops aimed at training the participants on how to use, review and improve the design of the App according to issues raised by participants. A total of 35 participants attended the workshops. Immediately after the demonstration, participants were allowed to evaluate the design and applications of the App; ask questions; make suggestions; comments and inputs. Information from the evaluation and suggestions records were entered into Microsoft Excel 2013 and analysed.

Activity three: introduce mobile-based application

To introduce the applaction to the network of agencies and organizations that support aquaculture several different efforts were made. Following the reorganization of the modules of the app, a presentation was made by one of the IT staff of Likamis Sofware to farmers, buyers, processors, and government and non-government agency representatives during the Fish Farmers' Symposium that was held in January 2018. The workshop aimed at introducing and equipping users with skills on how to download, subscribe and use the application on their mobile phones. The mechanisms for continued sharing of aquaculture information among farmers, researchers, policy makers and ICT

professionals were emphasized. This meeting was also a central aspect of the project exit strategy in Uganda.

RESULTS

Activity one: focused group interviews

Characteristics of respondents:

Out of the 45 respondents, 33(75.56%) were males, while 11 (24.44%) were females (Table 2). Close to half of the respondents (48.89%) owned smart phones while the rest had basic phones. Smart phones give farmers' access to millions of Apps and saves a lot of their time than basic phones. Furthermore, of the 45 respondents, 40 (88.89%) were young, aged between 25-45 years old. This implied that over two thirds of the young respondents owned mobile phones. Such findings agree with Souters et al. 2005 who found that majority of Information Communication Technology users tends to be young adults. In terms of education, most respondents, 15 (33.33%) were secondary school leavers, 27 (60%) had either certificate or diploma education and 3 (6.67%) had attained university education. These findings show that all these categories of farmers are in position to use the app.

Critical aquaculture information packages/topics:

In terms of the kind of information that should be included on the app, most farmers indicated that the development of the app is a good initiative and that it will go a long way in easing access to information needed to advance fish production. Table 3 shows the information topics that were emphasized by farmers for inclusion on the app during the designing process. The interviews showed that information on mixing feeds and feeding (32%) was the mostly needed by farmers, followed by providing information on up-to-date fish market prices (25). 19.5% of the participants indicated that pond management (water exchange, site selection, pond construction, infrastructure development, management, and stocking) is very vital for a farmer and that this should not miss on the app, 14.2% of the participants indicated that all farmers, input suppliers and buyers' location and contact information should be included on the app, 12% of farmers emphasized information on predator and health issue management. 10.3% preferred information on success stories of farmers and booking keeping while 9% indicated that fish farming videos should be included on the app for farmers to download and watch at their own convenience

Anticipated benefits of using the designed mobile applications in aquaculture:

Farmers anticipated that the use of use mobile phone application to be designed could confer diverse benefits as a communication link in isolated areas because of its distinct feature of mobility. Table 4, shows that about third (1/3), (33.3%) of the respondents reported that, the mobile application to be designed would greatly help farmers to easily obtain fish production and market information. Respondents also named a number of virtues that would be associated with the use of a mobile phone app. For example, during the discussions, it was pointed out that the use of mobile app would help farmers to discuss prices with buyers and crosscheck prices for their produce, instead of relying on middle men/brokers (24.4%). This will assist them to make better choices on where and when to buy or sell their farm produce. The interviews further indicated that farmers would be in best position to exchange information at their convenience (20.2%).

Mobile phones were therefore, reported as a good delivery tool that would save fish farmers' time and costs associated with travelling long distances to procure farm inputs and other related activities (13.3%). Likewise, Jensen (2007) asserted that mobile phones have an ability to save farmers' costs, by providing quick access to agricultural information, communication with trade partners and opens new market possibilities. On the other hand, farmers mentioned that the mobile app would help them make timely decisions (8.8%).

Activity two: trials of cell-based aquaculture applications for fish farmers.

Aqua-application evaluation

Majority of the participants appreciated the design of the App as well as its applications especially that of the USSD phones. A few found the App very easy, especially when checking, contacts, price and checking sellers' details (Figure 3).

Suggestions from participants

Sixty five percent of the participants were satisfied with the design and application of the prototype. The participants noted the App will be useful to the farmers and further requested that the appearance of the app should be improved (Figure 3). Eleven percent suggested improving functionality of the application whereas the remaining 10% suggested that the fish production information be improved.

Activity three: introduce mobile-based application

For example, members suggested that Modules (site selection, pond construction, infrastructure development, management, and stocking) should be merged into one broad topic named management. The merger would create more space for inclusion of information on other production systems like cages and tanks. In addition, participants suggested the app should only focus on tilapia and Catfish, the species mostly cultured by Ugandan farmers. Basing on suggestions by participants, modules were re-assessed, improved and reorganised. The overall functionality of the App was improved with features such as ability to add commodities, buyers and input suppliers, how to compare prices, ranking of prices and classifying by area.

CONCLUSION

The study established that mobile phone Aqua-Application acceptance to fish farmers is high and e to accompany it with a predictable positive economic impact. Therefore, most fish farmers anticipated that the designed mobile application is a good technology that will mostly enable them to have proper access to timely fish production and market information since these are the major bottle-necks to Ugandan aquaculture. Information on mixing feeds and feeding, up-to-date fish market, pond management (water exchange, site selection, pond construction, infrastructure development, management, and stocking, input suppliers and buyers' location, predator and health issue, success stories of farmers, booking keeping and fish farming videos were mostly needed by farmers. Respondents' characteristics such as age, gender, and education level were found to be determinants of mobile phone type ownership in the study area.

The Aqua-App is being used to carry out various business activities involved in aquaculture. The app currently allows more contacts amongst farmers, enables exchange of information any time the need arises. In addition, the app enables making contact with customers easily, saves time and other transaction costs as well as eliminating brokers. The farmers are also able to get daily market prices of agricultural commodities across the entire country. Producers are able to price their products appropriately, and can learn better practices conducted in aquaculture production

The design could also be adopted by policy organizations and government agencies in their proposals on the usage of technology as a key driver towards aquaculture economic growth. It is evident that the developed prototype presents a workable solution towards the design and implementation of mobile applications in fish farming as this will help to improve on the aquaculture development of Uganda. Researchers can use the designed prototype as a basis for improvement towards existing mobile application development models and frameworks or to develop new ones. However, there is need to popularize the app among different categories of people (extension workers, input dealers, traders, processors, and farmers), conduct workshops in different regions of Uganda about the use of the app, continuous monitoring and evaluation on order to track the level of use and evaluate the impacts of the use of Aqua-App on the livelihoods of farmers and aquaculture development in Uganda.

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TABLES AND FIGURES

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

District	Meeting location	Number of participants	Gender	
			Males	Females
Wakiso	District Council Offices	13	8	5
Mpigi	District Council Offices	10	7	3
Kalungu	Former District Council Offices	7	7	0
Gulu	Sub-county offices	8	7	1
Kole	Sub-county office	7	5	2
Total		45	34	11

Table 2: Socio-demographic characteristics of respondents (N=45)

Characteristics	n	%
Male	34	75.56
Female	11	24.44
Respondent's age		
Young (($\leq$ 45 years)	40	88.89
Old ((> 45 years)	5	12.11
Educational level		
Primary/Secondary education	15	33.33
Certificate education	9	20.00
Diploma education	18	40.00
University degree	3	6.67
Type of phone owned		
Smart phones	22	48.89
Basic phones	17	37.78
Both smart and basic phone	6	13.33

Table 3: Aquaculture information topics suggested for inclusion on the app (N=45)

Variable	Percentage (%)
Mixing feeds and feeding information	32
Up-to-date fish market prices	25
Pond management (water exchange, site selection, pond construction, infrastructure development, management, and stocking	19.5
Fish farmers, input suppliers and buyers' location and contact information	14.2
Predator and health issue management information	12
success stories of farmers and booking keeping guidelines	10.3
Fish farming practice videos	9

Table 4: Most important anticipated benefits of using the designed mobile applications (N=45)

Variable	n	%
Help farmers to discuss prices with buyers	15	33.3
Help farmers to easily get fish farming and market information	11	24.4
Exchange information at their convenience	9	20.2
Allow more contacts amongst farmers	6	13.3
Saves time and costs in dealing with related activities	4	8.8
Total	45	100

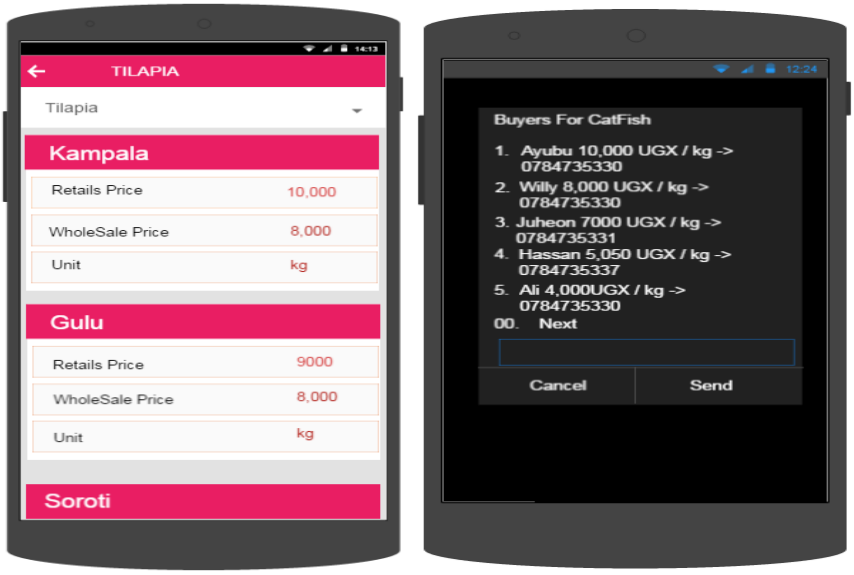

Figure 1: Market price information for different buyers in different locations

Smartphone

USSD phone

Figure 2: Fish farming information

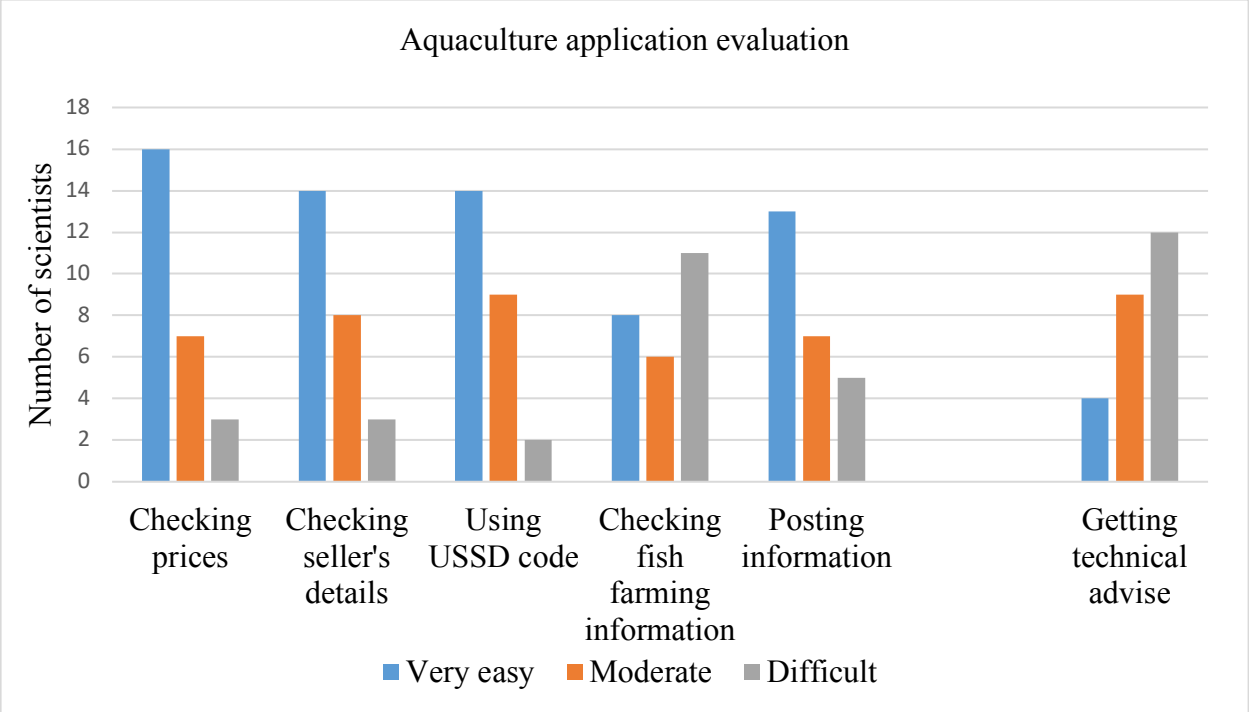

Figure 3: Aqua- application evaluation

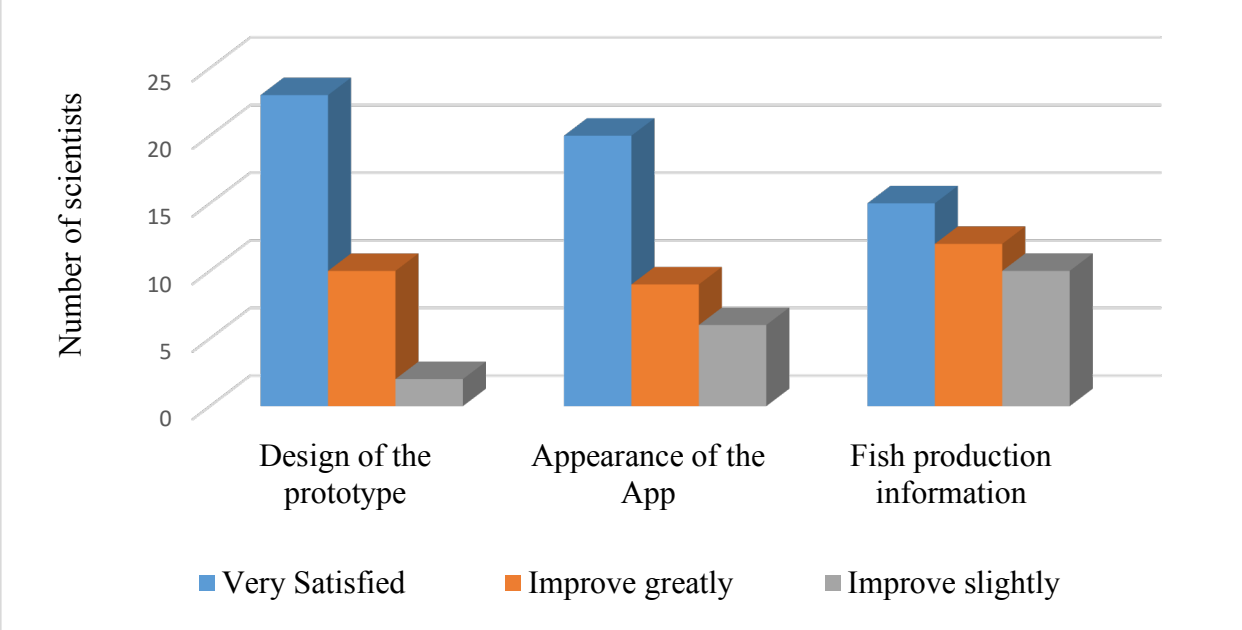

Figure 4: Suggestions from participants