African Journal of Rural Development, Vol. 2 (1): 2017: pp. 41-53 ISSN 2415-2838

Date received: 27 August, 2016 Date Accepted: 12 October, 2016

The benefits and challenges of using ICTs to strengthen university-farming community engagement in Uganda

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ABSTRACT
Agricultural Universities like many other organizations have used conventional communication channels in sharing information with farmers and other stakeholders. There are however increased limitations of ensuring real-time and sustainable exchange of relevant information and knowledge between researchers, extension workers, farmers and other stakeholders. Integration of information communication technologies (ICTs) in communication has been found to facilitate timely, efficient and cost effective information sharing in agriculture. Makerere University piloted the development of an information and communication technology (ICT) mechanism to enable farmers' to access information from a University information centre. This study aimed at understanding the factors influencing the application of the ICT-based information exchange model for strengthening university-farming community engagement in a pilot project between Makerere University and farming communities in northern Uganda. Qualitative data were collected from 30 project farmers, project managers and the system designers at the university through key informant interviews. The study findings suggest that successful integration of ICTs in the information pathways is important in enhancing timely information sharing between universities, farmers and other stakeholders. Universities have a unique advantage of having a broad array of expertise and students to run an agricultural ICT platform. Partnering with relevant agricultural organizations from whom to access and integrate relevant information would improve the quality of content shared with farmers. Exploring ways of establishing an equipped agricultural ICT laboratory/center at the university, and strengthening partnerships with other stakeholders is very crucial if efforts of applying ICTs to strengthen engagement with farmers and other stakeholders are not to stop at experimentation.

Key words: Community engagement, ICTs, information centres, Makerere University

RESUME
Les universités agricoles comme beaucoup d'autres organisations ont utilisé les moyens conventionnels de communication pour partager l'information avec les agriculteurs et d'autres parties prenantes. Il existe cependant des limites accrues pour assurer un échange en temps réel et durable d'informations et de connaissances pertinentes entre les chercheurs, les vulgarisateurs, les agriculteurs, et les autres parties prenantes. L'intégration des technologies de communication de l'information (TIC) dans la communication a été prouvée utile pour faciliter le partage ponctuel d'information dans le secteur agricole, de façon efficace et rentable. L'Université de Makerere a piloté le développement d'un mécanisme de technologies de l'information et de la communication (TIC) permettant aux agriculteurs d'accéder à l'information provenant d'un centre d'information universitaire. Cette étude visait à comprendre les facteurs qui influencent l'application du modèle d'échange d'informations basé sur les TIC pour le renforcement de l'engagement des universités agricoles dans un projet pilote entre l'Université

de Makerere et les communautés agricoles du nord de l'Ouganda. Des données qualitatives ont été recueillies auprès de 30 agriculteurs faisant partie du projet, des gestionnaires de projet et des concepteurs de systèmes à l'université par le biais d'entrevues auprès d'informateurs clés. Les résultats de l'étude suggèrent que l'intégration réussie des TIC dans les voies d'information est importante pour améliorer le partage ponctuel d'informations entre les universités, les agriculteurs, et les autres parties prenantes. Les universités ont l'avantage unique de disposer d'un large éventail de compétences et d'étudiants pour gérer une plateforme TIC agricole. Le partenariat avec les organisations agricoles compétentes auprès desquelles accéder et intégrer les informations pertinentes permettrait d'améliorer la qualité du contenu partagé avec les agriculteurs. Il est très important d'explorer les moyens d'établir un laboratoire / centre de TIC agricole équipé à l'université et de renforcer les partenariats avec d'autres parties prenantes si on veut que les efforts d'application des TIC pour renforcer l'engagement avec les agriculteurs et les autres parties prenantes ne s'arrêtent pas à l'expérimentation.

Mots clés: L'engagement communautaire, les TICs, les centres d'information, l'Université de Makerere

INTRODUCTION

Universities do generate information, knowledge and technologies which are useful in facilitating social transformation and in effect strengthen university-farming community engagement if properly shared (Daudu *et al.,* 2009; Opolot *et al.,* 2016). In the engagement process, universities too benefit by tapping community knowledge to make university teaching and research functions relevant to real life situations (World Bank, 2011; Mugabi, 2015). The use of appropriate mechanisms of information and knowledge exchange therefore, is critical in driving adoption and utilization of university technologies by farmers as well as obtaining their feedback to inform university teaching and research processes. Universities like many other organizations have used various communication channels including extension workers, print and electronic mass media, on-farm demonstrations, farmer field schools and field days in engaging with farmers. These modes of information dissemination in addition to the most academically preferred journal publications (Mirembe *et al.,* 2016), have had limitations in enabling real time exchange of relevant information and knowledge between researchers, extension workers, farmers and other stakeholders (URT, 2008; MAAIF, 2010; Ayubu *et al.,* 2012). Most often, the use of these approaches is based on short-term projects which cease to be applied once a project winds up. Through farmer field schools, there have been attempts to train farmer-facilitators (Isubikalu, 2007) to beef up extension numbers as well as sustain information sharing after projects close. This approach is said to enhance information transmission from farmer-farmer through the most basic ways such as village meetings, local drinking places, markets, water points, places of prayers and funerals. While these remain the most common methods among farmers, without technical back-up support from experts, there is inadequate reliability of the information and experiences shared (Ayubu *et al.*, 2012) given the limited technical abilities of the farmer facilitators. These physical contact methods all the same remain too expensive for universities to reach large numbers of geographically dispersed farmers (Okello *et al.,* 2010a). According to Mirembe *et al.* (2016) and Opolot *et al.* (2016), communication models that give universities opportunity for continuous linkage and sharing information in real time with farmers and other stakeholders even after particular projects close are important for sustaining information sharing.

The use of Information communication technologies (ICTs) has been recognized as critical in facilitating timely, efficient and cost effective information sharing in agriculture (Mital and Mehar, 2012; UNDP, 2012; Mirembe *et al.,* 2015). As World Bank (2011) states: "ICTs offer the opportunity to improve knowledge flows among knowledge producers, disseminators and users. Among network partners, they support the opening up of the research process to interaction and more accessible knowledge use, and more cost-effectively widen the participation of stakeholders in the innovation processes". While use of ICTs in agriculture and rural development among developing countries is not sufficiently widespread (UNDP, 2012; Bello and Aderbigbe, 2014), several success stories have been documented in many African countries including Uganda (de-Silver, 2008; Okello and Jakinda, 2008; Okello *et al.,* 2010a; World Bank and FAO, 2012; UNDP, 2012). Empirical evidence on the value of ICTs has been shown to go beyond streamlining information sharing to actual impact on farmers' production and productivity. In Kenya for example, farmers' productivity and incomes

increased by an average of over 25% as a result of using of ICTs (Carvalho *et al.,* 2011). The use of ICTs has aided integration of farmers into higher value chain and marketing activities that has led to them earning prices that are 20% higher than other farmers (Okell*o et al,* 2010b).The lessons leant and reported on the revolutionary effect of ICTs on agriculture by enabling two way communications between stakeholders while providing more than one service simultaneously (Sife *et al.,* 2010) make no mention of Universities in developing countries applying ICTs to enhance their outreach activities. It is this opportunity that Makerere University explored in piloting development of a framework for utilizing ICTs to enhance consistent and two way engagement with farming communities and other stakeholders so that the knowledge and information generated is shared effectively and sustainably (Ebanyat *et al.,* 2010).

Makerere University pilot ICT model for strengthening information sharing. In a bid to move away from simple outreach to long-term engagement with farming communities, the Makerere University School of Agricultural Sciences (SAS) with support from the Regional Universities Forum for Capacity Building in Agriculture (RUFORUM) piloted a Community Action Research Project (CARP) titled an "Developing Outreach Framework for Strengthening University-Farming Community Engagement for improved and sustainable livelihoods (SUFACE)" as per Ebanyat *et al.* (2010). The main objective of the project was to "operationalize partnerships between Makerere University, selected farmer communities and other critical stakeholders within a framework of action research, to enhance productivity, competitiveness, responsiveness and impact of university-led research on smallholder agriculture and agricultural development in Uganda". Specifically the project sought to: (1) Pilot an experiential learning model to strengthen the quality of graduate training and engagement with farming communities; (2) Develop and test the effectiveness of information based capacity development outreach model for disseminating university generated technologies and best practices to farmers and agribusiness communities; (3) Build entrepreneurial capacity of smallholder farmers and students by strengthening soybean and groundnut value chains in two regions of Uganda, and; (4) Develop an information and communication technology (ICT) mechanism to enable farmers' to access information from a University information centre. This study focused on the latter project objective referred to as the SUFACE - ICT platform.

As described by Mirembe *et al.* (2016), the SUFACE-ICT platform was meant to enable farmers to access information from the university, share their experiences to enable experts at the university to learn from farmers and provide prompt responses to farmers' queries. The farmers engage with the university by accessing knowledge materials uploaded in the website and submitting requests for specific information (queries) via a mobile or web application in a preferred language. The farmers could also submit their queries through a community knowledge worker, information center manager, intern students or extension workers. It was envisaged that through creation of knowledge and information centers, the University could proactively intensify its engagement with the farming communities and make meaningful contribution to agricultural development.

While the system had been developed and was at the early stages of deployment by the time of the study, there was great interest to upscale it to other projects within the university as well as other areas/districts. However, with no empirical assessment done so far, what makes it work well or not to sustain linkage between farmers and the university was not well understood. It was therefore, important that the performance of system as well as factors that may influence its effectiveness and sustainability are assessed.

Studies on the use of ICTs in agriculture have shown several factors that enhance or constrain their effectiveness in knowledge and information generation, packaging storage, retrieval and dissemination. From literature, there are technological, human capacities and content related factors that influence effective application of ICTs in agriculture. Technologically, the extent and quality of internet coverage, affordability, efficiency, access to electricity and ease of use,

constrain ICT usage (Muriithi *et al.,* 2009; Mwakaje, 2010; Carvalho *et al.,* 2011; UNDP, 2012). The human capacity factors include education levels, land holding, gender, age, and income levels (Kituyi-Kwake and Adigun, 2008; Gakuru *et al.,* 2009; Csoto, 2010; Lwoga *et al.*, 2010; Ayubuet *et al.,* 2012). In addition, the timeliness, presentation, relevance, accuracy, scope, authenticity and localization of content do influence the effectiveness of ICTs (Mihaly, 2010; Mital and Mehar, 2012; Bello and Aderbigbe, 2014; Singh *et al.*, 2015). With these factors, sustaining ICT systems in agriculture is reported as a huge challenge. Evidence shows that over 90 percent of ICT projects in agriculture and rural development have not become sustainable (Saravanan, 2010; World Bank and FAO, 2012). Above all, ICTs alone are no panacea to agricultural knowledge and information dissemination challenges but rather have to be used in combination with appropriate traditional approaches (Csoto, 2010; Okello, 2010b).

While the benefits and challenges of ICTs application in agriculture have been widely elaborated, no such studies have been undertaken in the context of university-farming community engagement. It is equally an empirical fact that these benefits as well as challenges do vary from country to country just as from community to community (Okello *et al.,* 2010b; Ayubu *et al.,* 2012). There was need therefore, to establish the context specific constraints to sustainable application of ICTs in a bid to improve effectiveness and scalability. This study aimed at understanding the factors that are influencing the application of the ICT-based information exchange model for strengthening university-community engagement using a pilot project between Makerere university and farming communities in northern Uganda. The study focused on analyzing the SUFACE ICT platform in terms of: stakeholder perceptions on the system functioning, the quality of content, constraints/ challenges faced in the operation of the system as well as the sustainability mechanisms. This is important in efforts to enhance application of ICTs to strengthen and sustain engagement between universities, farmers and other stakeholders in the agricultural sector.

METHODOLOGY

The study was undertaken at Makerere University School of Agricultural Sciences and the SUFACE project districts of Lira and Kole in northern Uganda. Data were collected largely using qualitative approaches. Information in the platform was assessed to determine its quality in terms of the relevance and adequacy of content to the farmers' needs/queries. Key informant interviews were held with thirty (30) project farmers from the two districts of Kole and Lira who had been trained in the use of ICTs for seeking and accessing information from the university experts using an interview guide. In addition, key informant interviews were held with two project managers at the university and two designers of the platform as well as the experts who responded to farmers' queries. The study focused on only those engaged with the platform so as to obtain deep understanding of the systems functionality and effectiveness based on the Flyvberg (2006) information-oriented selection criteria. The qualitative data generated were analysed using framework content analysis (Pope *et al.*, 2000) to generate themes and categories/codes in relation to the objectives of the study of the parameters interrogated as shown the Table 1.

Table 1: Aims, themes and axial categories of the study

Aim	Theme	Axial codes/Categories
Functioning of the SUFACE ICT system	*Performance of the system*	Queries and responses
		System coverage
	Information adequacy	
	Stakeholder responsibilities	System design and maintenance
		Content development
		Information collection and dissemination
		Capacity building
	Nature and delivery of content	Type of content
		Timeliness
		Accuracy/clarity
		Localisation
Quality of content	*Benefits of the system*	Information sharing
		Production and productivity
		Education
		Networking
Motivating and constraining factors	*Challenges*	Technological
		Human capacity
		Content
	Sustainability	Website hosting and maintenance
		Expert networks
		Role of students
		Partnerships

FINDINGS AND DISCUSSION

Functioning of the SUFACE ICT platform

The functioning of the platform was analyzed on the basis of its performance and stakeholder responsibilities.

Performance of the system. The SUFACE ICT system performance was assessed basing on the ease of submission of queries by farmers and corresponding responses by the experts, geographical coverage of the system and adequacy of information provided in relation to the farmers' demands. An analysis of the system web-portal showed that over 2000 queries were submitted by farmers mostly in text and picture form. It was noteworthy that not all the queries were submitted by the project farmers as majority were from other areas of Uganda outside the SUFACE project districts. Similarly, while the project focus was on groundnut and soybean crops, the queries submitted covered a broad range of crops as well as livestock. This demonstrated the widespread need for information by farmers in all aspects of agriculture and the great opportunity to reach out many farmers in widespread areas using ICTs. The range of queries also pointed to the fact that an agricultural ICT platform has to provide comprehensive information meeting the diverse needs of the farmers at any given time and place as emphasized by Dhaka and Chayal (2010). Some of the queries were responded to while others were not. According to the project managers and experts, some of the comments were not addressed because the focus of the project was on only two crops and as such expertise involved in the project was limited in scope. In terms of the most demanded information categories for both crops and livestock were on marketing, pests and diseases, value addition, agronomy in that order. The system thus provided a quick summary of the information requirements of farmers that can enable scientists to respond appropriately than supplying generic information as is common in the traditional extension systems (Okello *et al.,* 2010a; Mirembe *et al.,* 2016). Ensuring that relevant expertise is engaged to respond adequately to farmers' concerns is a critical success factor in application of ICTs in agriculture.

Stakeholder responsibilities. The study findings show that there was a multi-disciplinary team involved in the operation of the SUFACE ICT system. The SAS lecturers conceptualized the idea, sourced for funding and managed the project. The system was designed and maintained by lecturers and students from the college of computing in the same university. The content was developed, uploaded and updated mainly by graduate students of SAS involved in the project with the guidance of the SAS lecturers. The farmers posted queries which in a way contributed to content development. Responding to farmers' queries was done by graduate students as 'experts'. Training of experts on how to upload content as well as respond to queries, and farmers on how to use the smart phones to collect and submit information/queries was done by the design team. At the field level, a local NGO supported farmers with translation, submission of queries and delivery of feedback from experts at the university. This engagement highlighted the fact that an ICT system requires involvement of different stakeholders (Pretty *et al.*, 2011) for effectiveness. While Mirembe *et al.* (2016) as well as the project document listed many stakeholders, the study findings show that very few played their roles actively. Limited involvement of other stakeholders from within and outside the university limited the scope of content and the reach of the system. Lessons for developing strong stakeholder collaborative mechanisms were highlighted as will be discussed in the sustainability section of the paper.

Quality of content developed and shared. For ICTs to be seen to be effective, the nature of content should be relevant to stakeholder needs, accurate, addressing local stakeholders' issues and delivered efficiently and at the time required (Mihaly, 2010; UNDP, 2012; Singh *et al.,* 2015). By the time of the study, the content available in the SUFACE ICT platform was mainly the queries submitted by farmers in text and picture form. The responses provided by experts to some of the queries were in text form and some value chain information on groundnuts and soybean commodities was also available. All the text in the platform was in English. In terms of nature of content therefore, it was majorly text and pictures although the designers indicated relevant publications were to be uploaded while voice, video and animated message applications were still under development. According to the project managers, the platform was meant to provide good quality and timely information and technologies.

The findings of the study thus show that the available and intended content in the web-portal took into consideration the diverse information needs and abilities of the different stakeholders. Specifically, the SUFACE project farmers were characterized by low education levels (Opolot *et al.,* 2016) and providing picture, video, voice and animated content to an extent make the system user friendly. The designers of the platform were cognizant of this fact as they stated that farmers preferred to have 'actionable' content given their limited literacy levels. For the language, it was observed that the farmers lacked expressiveness in English and preferred to submit queries and receive feedback in their local language. It is therefore critical that, as has been observed elsewhere (Mital and Mehar, 2012; UNDP, 2012), ICT systems should consider the language capabilities of users to be useful. As mentioned earlier, translation services have to be part of the system. While the SUFACE platform presented information in English alone, the information from and to the farmers was translated by the knowledge worker at the community information center. This information was in away localized to the project area/ farmers and applicable to the two crop commodities promoted by the project. But being hinged on a world wide web, requests for information were posted from other areas of the country although most were not responded to due to the limited focus of the pilot project. An internet based information system should to the extent possible provide information relevant to the local, national and international stakeholders.

Timeliness in information dissemination through the SUFACE ICT system was the other element of content quality analyzed. Timely delivery of information is perhaps one single most important reason advanced for promotion of ICTs in development (Okello e*t al.,* 2010b; Singh *et al.,* 2015; Mirembe *et al.,* 2016). In this study, the timeliness parameter was assessed on the basis of experts responding to farmers' queries. In the first instance, among the 30 project farmers interviewed, only 33% submitted queries (Fig. 1). Most of the queries submitted therefore were from outside the project area. For the queries submitted by the project farmers, there was only 7% response and all of which were received late by the respective farmers. While this appears a contradiction to the real aim of using ICTs to provide real-time information, it is understandable that that the SUFACE ICT system was at the early development stage by the time of the study.

The reasons non-the-less given for this scenario by the managers and designers of the system was that the farmers queries were not limited to the study crops and also included livestock for which the project had not assembled relevant experts. The available experts being students spent more time on their study programmes than attending to farmers queries. Matters were made worse by the absence of the auto-response mechanism built into the system. According to the farmers, the limited and untimely responses discouraged them from submitting anymore queries or try to seek information from the system. There should therefore be comprehensive planning to ensure that the technological and human components of an ICT system are in place for effective performance especially the timeliness of information that bedevils the traditional information dissemination systems.

In addition, some of the queries posted, according to the experts could not be easily understood for an appropriate response to be provided. Sometimes, pictorial messages were submitted without clear or related annotations. At the same time, messages were not accompanied with the farmers' particulars like cell phone numbers to enable quick follow-up by experts for clarification before responding. As Bello and Aderbigbe (2014) observed, limitations in farmers' abilities not only in use ICT tools but also description of their problems can be a hindrance to effective use of ICTs. In effect, in implementing ICT interventions, in addition to developing context-specific content, farmers' capacity and support systems (professional field workers) should be in place as university scientists or even students cannot be in the field all the time. Part of the intension of SUFACE in developing the ICT system was to allow for direct contact between farmers and university scientists in terms of sharing information/knowledge and technologies (Ebanyat *et al.,* 2010) as depicted by the outer arrows in Fig. 2.

The findings of this study however show that, based on the particular farmers characteristics and the "thin" university field presence, there is strong need for intermediaries like established extension structures. These intermediaries play a critical role not only in clarifying information shared, but also undertaking training and demonstrations in situations where a query raised needs such an intervention above information provision. As ICTs cannot do it all (Okello *et al.,* 2010b; Ayubu *et al.,* 2012), ways of partnering with other public and private actors especially in application of integrated information dissemination approaches, is important. Indeed the farmers interviewed urged for the inclusion of other

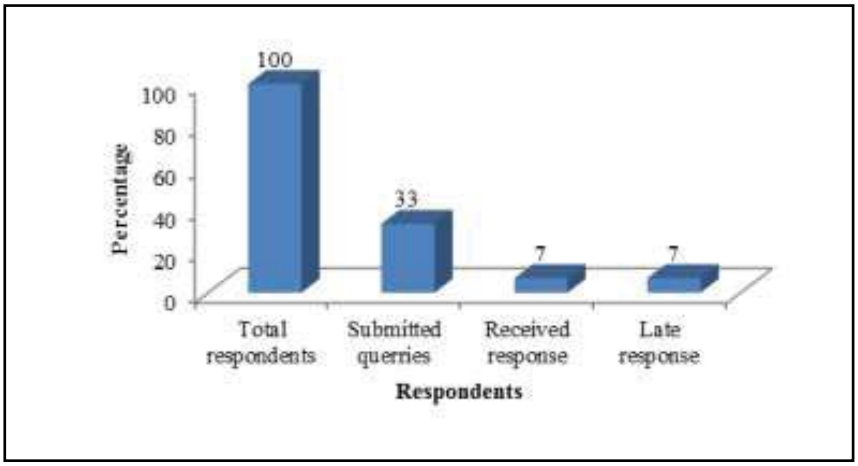

Figure 1: Response to farmers queries by experts

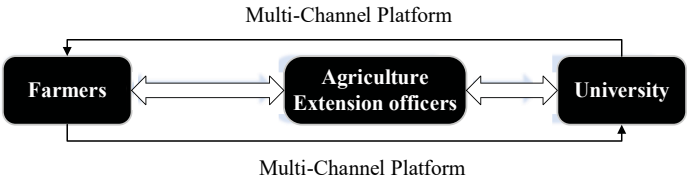

Figure 2: Typical Interaction Channels (Source: Mirembe *et al.,* 2016)

stakeholders operating in their area such as local NGOs and district agricultural/extension staff. These they stated do understand their local challenges and language.

Motivating and constraining factors application of SUFACE ICT system. The study analyzed some of the factors that in the view of the project managers and farmers promoted or hindered the success of the SUFACE ICT platform in a bid to generate lessons for improvement. The benefits of using ICTs were seen as a motivation while the challenges and sustainability issues were some of the constraints recorded.

Benefits of the SUFACE ICT system. Discussions with the farmers showed that they accessed information on improved agricultural production, value addition and marketing albeit limited to the project study crops of groundnuts and soybean. The system also enabled farmers to have direct contact with agricultural 'experts' from the university from whom they could receive advise that contributes to enhancement of farm productivity. To others, it was just exciting to use the smart phone provided for communication. For the managers (lecturers at the university), the system provided a great opportunity for networking with other organizations. The queries from farmers in different formats were useful as teaching aids for practical learning at the university. These benefits are largely reported in use of ICTs for agriculture (Okello *et al.,* 2010a,b; UNDP, 2012;Singh *et al.,* 2015). Two issues are important to note however. The direct contact created between farmers and university lectures is a powerful pointer to the capacity of ICTs to enhance university-farming community engagement without physically going to the field. On the other hand, the universities are able to gather teaching material/case studies from diverse geographical locations and from other stakeholders to make teaching and learning more relevant to real situations. While the SUFACE system was at infancy stage, the benefits reported were few but the potential impact for universities in enhancing their role in agricultural development is great.

Challenges of implementing the SUFACE ICT platform. The challenges in application of ICT systems are majorly related to technology, human capacity and content (UNDP, 2012). Findings of this study show challenges in these categories expressed by farmers, system designers as well as project managers. Table 2 shows a summary of the challenges mentioned by each stakeholder.

Table 2: Challenges experienced with the SUFACE ICT platform

Stakeholder	Challenges		
	Technological	*Human capacity*	*Content*
Farmers	Access to smart phones Electricity Internet signal Timing of radio programs Unfamiliar mobile application	Awareness of platform Navigation skills Internet and computer knowledge Limited capacity building	Limited coverage Delayed response No coordination of radio talk shows
Project managers	No reference model Technology costs	Reliance on students Motivation of experts Time limitations	Unclear queries Limited scope
Designers	Unclear system requirements Interactive applications development	Limited linkage with field agricultural extension workers Limited experience with ICTs at field level	Language translation Limited scope and formats

The project provided one smart phone per group of about 30 farmers. The whole group had to rely on one person holding the phone to send or receive information. Being in rural areas, sources of power for charging the phones were either distant or costly and as such the batteries were often flat for many days. In the same vein, farmers faced intermittent internet coverage that often delayed message delivery. It was also revealed that most times, the radio programs were aired at inappropriate times especially for the female farmers. Above all, due to low familiarity with the system's mobile application, errors often occurred that the application got deleted. Enhancing access to ICT tools, supporting infrastructure and technical support to farmers are critical in promoting effective use of ICTs by farmers. The challenges of technology applied to the project managers and ICT experts as well. The managers had difficulty in finding a reference model to guide development of system requirements yet the available off-the-shelf models already in use such as for Grameen Foundation (World Bank and FAO, 2012) proved very costly for the project. There was therefore, a lot of 'build and break' design process by the designers which greatly delayed the deployment of the SUFACE ICT pilot system. This view is well elaborated by Mirembe *et al.* (2016). More challenging was the development of voice, video and auto-response (interactive) applications which were the farmers' preference given their low literacy levels. In essence, the cost of setting up an ICT system is high and need to be put into consideration for effective design, deployment and performance.

In terms of human capacity challenges, findings show that limited awareness, knowledge and skills on internet and computer use among farmers constrained use of the SUFACE ICT platform. Indeed at the time of the study, introductory training on use of mobile phones had been conducted. However, with the low literacy levels, farmers noted that they required longer and frequent trainings on the use of ICTs. Building farmers' capacity is a crucial element so they are able to receive and share information using ICTs. To do this, as recommended by Saravanan (2010) and Bello and Adnerbigbe (2014) requires that the socio-economic situation of the target audience is established to guide the design and deployment of ICT systems. It was also found that the managers relied on graduate students sponsored by the project to develop content as well as respond to farmers' queries. However, the students' knowledge was focused on the project study crops and mostly on postharvest practices. In the same vein, due to limited project funding, there was little motivation for experts/lecturers to invest time in promoting the system. This was made worse by the teaching and research loads of different lectures, making them have limited time to attend to the system. Above all, the lecturers assert, such outreach work is not recognized and considered in performance assessment by the university.

The designing of the SUFACE ICT platform was undertaken by lecturers and students from the Makerere University College of Computing. But having no prior experience with such systems in agriculture, the designers reported taking a lot of time in consultations to get right the actual requirements for the system development. There was also no linkage established between the university college of computing and the agricultural extension system in the country. In addition, the designers reported joining the project late and without formal contractual obligations. These experiences bring to the fore the view of Pretty *et al.* (2011) and Nyirenda-Jere and Kazembe (2014) that social infrastructure is as important as technical and physical infrastructure in enhancing the effectiveness of ICTs in development. Building linkages between university ICT and agricultural colleges as well as field-based organizations is an essential requirement in designing appropriate ICT systems.

On the content of the platform, all stakeholders interviewed contended that it was not satisfactory in terms of scope, submission and response to queries as well as language and dissemination formats. The value and actionability of information shared is improved by its relevance, timeliness and context specificity (Glendenning and Ficarelli, 2012; Bello and Aderbigbe, 2014). To address this challenge for the SUFACE ICT platform, the project managers and platform designers indicated that options were being explored to improve content, including: partnering with local organization and experts to enhance localization of content and provide back-up support to farmers; creating linkages with related national and international platforms to enhance scope of content; promoting translation of content to key languages; and setting up panels of experts from public and private institutions to provide quality assurance of content before disseminating to farmers. These insights are in tandem with recommendations by Mital and Mehar (2012), World Bank and FAO (2012), UNDP (2012) and Mirembe *et al.* (2016).

The World Bank and FAO (2012) presents a case of Grameen Foundation in Uganda that has made strides to improve content through extensive use of community knowledge workers, installing call centers supported by agricultural experts fluent in local languages as well as documenting local farmers' practices and sharing with scientists.

Universities by their nature have a unique and huge opportunity to develop, translate and disseminate quality content. Experts and students in diverse fields and languages exist in Universities. Harnessing this potential and then filling in the gaps with external expertise can go a long way in strengthening university outreach ICT systems. With the nascent nature of ICT applications in agriculture, building capacity of both experts and students in content development and packaging as well as communication skills is critical. Integrating ICT for agriculture in the graduate agricultural programmes ought to be looked into by universities so as to produce graduates with competencies relevant to advancement of information communication technology in agricultural development.

Sustainability of the SUFACE ICT platform

The SUFACE – ICT platform was piloted as part of a three – four year project. With the project having a definite timeline, the study sought to find out the stakeholders views on how the initiative will be sustained given the experiences of activities ending with projects closures. As seen from the above challenges, questions of hosting the web-portal, enrolling and motivating experts, training of farmers, content development as well as maintenance of the ICT tools and equipment arose. Lack of clarity on these issuers is what World Bank and FAO (2012) attributes to the non-sustainability of 90% of ICT initiatives in agriculture. The challenges often rotate around funding to sustain the systems set up.

The findings of the study show that on the farmers' part as users of information, they expressed willingness to pay for information received through purchases of internet bundles or airtime from mobile phone service providers. This agreement was tagged to type of information needed. As shown in Fig. 3, pest and disease control and value addition topped the farmers' priority information needs followed by postharvest handling and marketing. Understanding the farmers' information needs and which in most instances mirror their key value chain development challenges at a given time, is a way to get them to agree to contribute to the systems maintenance costs. Continuous assessments and engagement with farmers on their needs is critical in ensuring responsiveness of ICT systems to farmers' real challenges.

The bigger challenge was perhaps the institutionalization of the system at the university level. The project managers and system designers proposed a number of strategies for sustaining the system. First was that the web-portal should be integrated into the

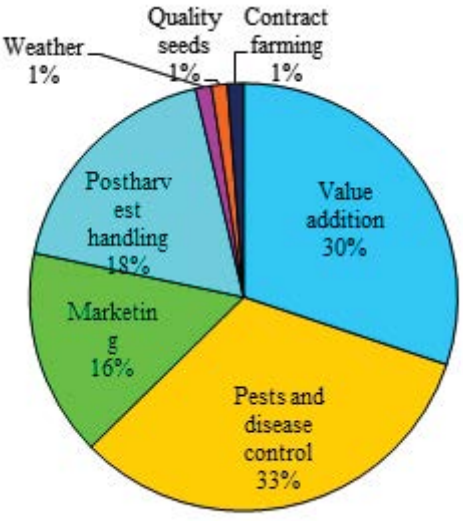

Figure 3: Type of infomation farmers are willing to pay for

university website. This would ensure there is no separate cost for its maintenance. Secondly, the time spent by lecturers in such outreach activities needs to be recognized and quantified as part of official work that can be rewarded. In this way lecturers would be motivated to dedicate time to the operations of the ICT system. Thirdly, that a computer laboratory managed by students with the support of lecturers be set up at the university dedicated to agricultural information development, packaging and dissemination.

In reality, availability of diverse agricultural expertise and cultural diversity among lecturers and students at the university lends credence to this proposal. A lot more however would be required to build capacity of both students and lecturers in appropriate communication skills. This would equally be of benefit to the university as a tool to enhance teaching and learning of students. There is also the need to establish proper linkages and mainstreaming the university ICT systems to existing agricultural extension systems in the field. This would ensure sustainable and quality assured information delivery to the farmers as well as to the experts at the university. These findings are in agreement with recommendations of World Bank and FAO (2012) and Bello and Aderbigbe (2014). In effect, a multimedia information sharing system as presented in Fig. 4 could be a possible model for improving information sharing between the universities and other stakeholders especially farmers.

There should be a central agricultural information center at the university, manned by students with technical back-up support of lecturers, and linking to other relevant platforms. This is critical in improving up-to-date content availability and information sharing with farmers. It is also important that community information centers linked to the central platform are established and managed by local extension or community knowledge workers and sometimes students on internship. This will support localization of content, continuous support to farmers and improved feedback mechanisms. The critical issue here is for the university to explore avenues for forming partnerships with other organizations for purposes of having quality information sharing.

CONCLUSION

At the time of the study the development of the SUFACE ICT platform was still in progress. The results of this study so far suggest that successful integration of ICTs in the information pathways is important in enhancing timely information sharing between universities, farmers and other stakeholders. The pilot ICT system showed great opportunity for universities responsiveness to farmers needs as well as improve the quality of teaching and learning at universities. Farmers have preference for use of telephones and radios, and timely, localized, relevant and broader information. Taking these into consideration will enhance effectiveness of the ICT applications.

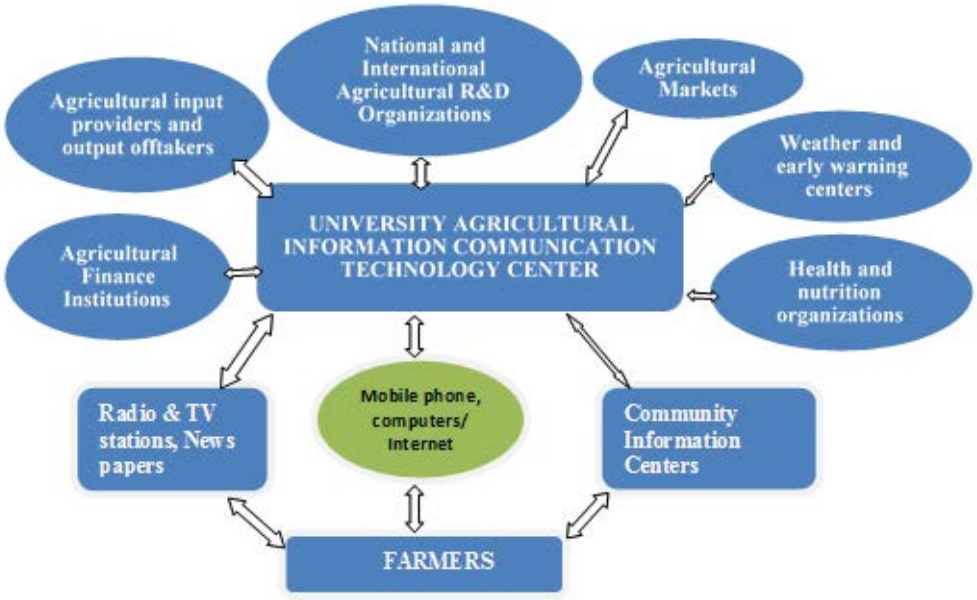

Figure 4: University outreach ICT model

Generating, packaging and disseminating relevant content requires the deployment of appropriate technologies, assembling and building the IT and communication capacity of experts as well farmers. Universities have a unique advantage of having a broad array of expertise and students to run an agricultural ICT platform. While farmers are willing to pay for information responsive to their needs and can access information directly from the university, the use of intermediaries is preferred for content localization. For development of comprehensive content, universities need to partner with relevant agricultural organizations from which they access and integrate relevant information to be shared with farmers. For sustainability, outreach systems should be an integral part of university programmes with the involvement of other public and private agricultural value chain actors. Exploring ways of establishing an equipped agricultural ICT laboratory/center at the university, and strengthening partnerships with other stakeholders is very crucial efforts in applying ICTs to strengthen engagement with farmers and other stakeholders.

ACKNOWLEDGEMENT

The authors thank the College of Agricultural and Environmental Sciences (CAES), Makerere University and the Regional Universities Forum for Capacity Building in Agriculture (RUFORUM) for their support of this work through the RU/CARP03: Strengthening University Farming Community Engagement (SUFACE) Project Grant.

STATEMENT OF NO CONFLICT OF INTEREST

We the authors declare that we have no conflict of interest in this publication.

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