ICT AND TECHNOLOGICAL DEVELOPMENT IN ADVANCING TEA RESEARCH IN KENYA

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ABSTRACT

Agriculture is the backbone of the Kenyan economy and it is constantly influenced by changes in technology. Because of the rapid development of Information and Communication Technology (ICT) in the world, each organization or person has to show more concern about their products and services more towards modernized and ICT. This research endeavors to understand the technological development& use of ICT in advancing tea research, identify the constraints associated with ICT use and propose recommendations with managerial implications towards the improvement of present ICT systems in the agriculture sector of Kenya. Tea producers and farmers in Kericho County were involved in the survey. A scoring system was used to develop continuous dependent variables which were used in regression models to identify the variables most significantly influencing ICT use. Least significant difference technique was used to identify comparisons of constraints in ICT use in advancing tea research.

We found out that 60.6% of the participants used ICT related equipment or facilities for their tea production and tea related business while 76.1% of the participants having ICT uptake problems, where telecommunication and internet reported higher impact on tea sector. The participants stressed the cost of technology, lack of training, trust level in the ICT system, lack of ICT proficiency and lack of technological infrastructure as constraints for ICT use in advancing tea research. Managers can use these results to promote ICT use in tea research that can lead to more efficient communication and increased demand for the firm's products and services. The usage of different ICT applications was comparatively high in tea sector and in general the usage of mobile communication was common among all participants. The survey results provide insights which suggest corrective steps to expedite ICT and technological development in advancing tea research and prioritize the necessary research in the sector.

KEYWORDS; *ICT* Use, Constraints, Tea, ICT, Technological Development

INTRODUCTION

Today, ICT is developing rapidly all over the world. Recently, the use of Information and Communication Technology such as electronic mail (email), mobile communication, teletext, fax, Decision Support Systems (DSS) and the World Wide Web (WWW) has become widespread. For the betterment of the future of the country as a whole, agriculture industry and services sectors have to couple with this phenomenon. Information is the lifeblood of any organization. It's vital to collect accurate and complete information for all market sectors and industries including Tea production. Information promotes competition and improves market performance (Thompson and Sonka, 1997). Information also increases the level of trust on consumers in a product or firm leading to increased demand. Information and communication technologies offer the ability to increase the amount of information provided to all participants in the tea research sector and to decrease the cost of disseminating the information (Kurtenbach and Thompson, 2000). ICT in the tea sector facilitates knowledge sharing within and among a variety of agriculture networks including researchers, exporters, extension services and farmers. ICT enables vital information flows by linking rural agricultural communities to the Internet, both in terms of accessing information and providing local content.

Agriculture is the backbone of the Kenyan economy and it contributes to higher Gross National Production (GNP) of Kenya (Kenya National Bureau of Statics, 2013). The tea industry plays a key role in the agriculture sector and the economy at large with tea output contributing about 11% of the agriculture sector's contribution to Gross Domestic Product (GDP) with tea exports, which amounted to about Kshs 62 billion in 2008, contributing 26% of the total foreign exchange earnings (ibid). In addition, the tea industry supports directly and indirectly approximately 5 million people making it one of the leading sources of livelihood in Kenya. The demand for agricultural products in Kenya is increasing annually with the population that grows at an average rate of 2.27% (2013 est.) per year. Achieving this continuously increasing demand is the challenge in the agriculture sector in Kenya (ibid).

 In Kenya, few agriculture sector participants (organizations / individuals) use ICT in their day to day activities or agricultural production and research. For an example some tea sector participants use e-commerce applications and a few farmers use ration formulating software to prepare feeds(Government of Kenya, 2003). But developed countries use portals, DSS / expert system and e-commerce applications like higher ICT heavily in agricultural research. For example large scale horticulture industries use automated fertigation systems (Taragola

and Gelb, 2005). A few works could be found that attempt to address the use of ICT in agriculture sector in Kenya. Therefore, adoption and use of ICT in tea sector, and its use in advancing research is recognized as an urgent need in present day agriculture. Hence the research on ICT and technological development in tea research is very scarce in Kenyan agriculture sector; the need exists to understand the adoption and use of ICT in advancing research, reason for some agriculture sector participants tend to use ICT faster and more readily than others. An understanding of the factors associated with ICT adoption and use in tea production will enable the development of strategies to promote ICT and technological development in advancing tea research and increase the effectiveness and efficiency of information use in the sector. More specifically, advances in ICT have progressively reduced the costs of managing information, enabling individuals and organizations to undertake information-related tasks much more efficiently, and to introduce innovations in products, processes and organizational structures in agriculture sector in Kenya. The key policy goals of the sector are in line with Kenya Vision 2030, and are guided by the Agriculture Sector Development Strategy (Government of Kenya, 2003).

Literature review

ICT use in advancing tea research and its adoption

ICT use in research and its adoption is usually not spontaneous, the technology has to be taught and learned - adopted to existing experiences and integrated into production. In several countries where ICT adoption researches were done it focused mainly on computer adoption for general agricultural production. Batte *et al.,* (1990), & Warren *et al.,* (2000), clearly demonstrated that, the adoption of ICT is strongly associated with the education level of the farmer and farm size and negative effect of age of the farmers. It is suggested that there is disparity in adoption and use to advance research between different sizes and types of farm (Warren, 2002). Several studies supported the argument that, the ICT adoption devoted much time and effort (Rosskopf, 1999; Kurtenbach and Thompson, 2000; Gibbon and Warren, 1992). Gelb & Bonati (1998) revealed that presence of the internet is very useful for present day agriculture.

Factors Affecting the Use of ICT in Tea Research

It's clearly demonstrated that the complexity of farm, degree of external support, age, time, experiences, network, availability of information, personality and approach to learning

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enhanced or diminished a farmer's computer use (Iddings and Apps, 1990). Factors like lack of ICT proficiency, lack of ICT benefit awareness, too hard to use, lack of technological infrastructure, cost of technology, trust level in the ICT system, lack of training, system integration and software availability also limit the use of ICT by farmers (Taragola and Gelb, 2005). The numerous factors that influence ICT and technological adoption and use in tea organizations can be grouped into five categories such as access to IT, demographics, IT training/education, trust, and time (Kurtenbach and Thompson, 2000). It is possible for adoption factors to fit into more than one category (Gelb and Parker, 2005). The most important limiting factors in developing countries in terms of infrastructure and cost of technology are no longer a threshold for ICT adoption in developed countries (Kurtenbach and Thompson, 2000).

Global Use of ICT in the Agriculture sector in advancing research

Several examples for ICT adoptions and implications of agriculture sectors are can be cited. In Kenya for instance, the Kenya Agricultural Commodity Exchange (KACE) is harnessing this ICT technology to disseminate market information and intelligence to related stakeholders. In Philippines, there are lots of portals, e-commerce applications and innovative technologies used to provide relevant agricultural information in the country with a specific focus in the rural areas. Specially, eAGRIKultura, e-Consortia, e-Farm & KAgriNet are playing a major role in this regard among others. In Thailand a multi-lingual Internet portal, Agricultural Information Network (AIN) is enabling Thai farmers, field officers, policy-makers and the government to communicate and **access** relevant and useful agricultural information. Farmers in India use the e-Choupal as one of the portals to set up a kiosk network that provides mediated access to them. E-Choupal has already become the largest initiative among all Internet-based interventions in rural India (Anon., 2006). Also, members of the Primary Agricultural Credit Societies (PACS) in South India can access both procurement prices and markets on a click of the mouse.

Farmers can gain access to the best of advice across the globe using DSS / Expert System. Some of the expert systems that have been developed for use in agriculture are given as: COMAX which provides information on integrated crop management in cotton, POMME, which offers information about pest control and orchard management of apples, SOYEX-soybean oil extraction expert system and FINDS -a Farm level Intelligent DSS which is used to assist in determining optimal machinery management practices for farm-level system

(Anon, 2006). This therefore is a clear testimony that ICT use in agricultural practice has received some good amount of uptake in the rest of the developing world. In this paper, we are proposing a partnership between the Ministry of agriculture and the Ministry of Information and Communication Technology to open up a "Tea Rural Knowledge Centres" which will empower villagers including small scale and large scale farmers by linking up with the WWW. This will enable farmers to gather relevant market information in all major distribution and exchange points in the country. Indeed ICT projects should be implemented to meet the infrastructure requirements in order to address the information and communication needs of rural areas in all parts of the country.

Methodology

Source of Data

Kericho County Tea farmers served as the observation groups. At the beginning, preliminary interviews of selected employees of both observation groups were done to identify important user and organizational characteristics and current applications of ICT and Technological developments in advancing tea research in both groups. The results from the interviews which could include input from the technical and managerial staff of tea producers and various farmers were used as the basis for structuring the final survey (detailed questionnaire). The final survey was conducted using randomly selected participants of the above two groups and included detailed information of WWW use, e-mail use, DSS use, other ICT related practices as well as user comfort level with these technologies.

The interviewee questioned how research was enhanced using information Technology and the new technological developments being implemented by farmers and the tea factories within the county. Kipkelion East, Kipkelion West, Ainamoi, Bureti, Belgut and Sigowet – Soin Constituencies were selected for the survey areas for tea producers in Kericho County of Kenya.

Statistical Analysis

The data obtained from the survey were analyzed using statistical methods with the aid of Statistical Analysis System (SAS), SPSS and MS Excel software. Least significant difference (LSD) technique and general linear models (GLM) procedure were also used to identify the comparison of the limiting factors. A scoring system was applied to a selection of the survey questions to create MINDEX (skilled and talented employees) to represent WWW, e-mail

and mobile communication use respectively, Kurtenbach and Thompson, (2000), & Fredrickson, (1984), clearly demonstrate the method of creating a scored index from categorical data. MINDEX was computed by applying scores to the responses for each of the questions which were included in the questionnaire.

Variables Formed for the Scored Index

It is hypothesized that, the following variables were affected by the use of ICT and technological development in advancing research, the use of World Wide Web (WWW), e-mail and mobile telephony communication. These variables were categorized into four groups such as (a) access to ICT (receive/send email attachments, percentage work related to email) (b) ICT training and knowledge (days of training, knowledge of HTML), (c) trust (solve ICT related problem myself or with some help, using the Internet is easy, email is helpful for day today business, using the mobile phone is easy) and (d) time taken in using computer related devices in analyzing research. Each scored indices was represented as a function of the related variables being formed. Therefore, MINDEX was analyzed as a combined data set.

Regressions were run using this one index as dependent variable to determine which factors from the survey had the greatest impact on WWW, e-mail and mobile communication adoption and use in advancing tea research.

Results and Discussions

Table 1 shows the summarized details of the participants in ICT and technological development use in advancing tea research survey. There were 218 participants involved in the survey and out of them 135 participants were males while the rest were females. The results show that 60.6% of the total participants use at least one of the ICT related equipment or facilities in research.

Generally, this result does not imply 100% that all of the 60.6% of the participants use ICT related equipment for their business, research and or farm operations. This is because of some farmers who own the computers use it for other unrelated activities such as watching films and playing games only.

Table 1. Participants of the ICT and Technological Development use in research survey

	Use ICT	Not use ICT	Total Surveyed
Females	60	23	83
Males	72	63	135
Sub total	132	86	218

Use of ICT equipment in business

The study gives some indication of the use of ICT related equipment by the tea sector participants. It was found that 60.6% of the participants use ICT related equipment/facilities for their business. Statistically, it is a very clear significant difference between the use of ICT and those who do not use of ICT in tea sector. Therefore we can say that, 60.6% of the tea sector participants in Kericho County use ICT for their business. To cope up with the global market they have to use more sophisticated technologies. Therefore, they tended to use ICT related equipment or facilities for their businesses heavily.

Summary statistics of the entire survey.

83% of the tea industry participants in Belgut Sub-County indicated that they have problems with the uptake of ICT in their business or farm operations. In an average, 76. In Kericho County situation, people do not engage in modern technologies like process control in glass house production, precision farming and production models like applying in poly-tunnels etc. The most important ICT uptake problems indicated by the participants were, use of telecommunication and the Internet. The tea sector at 69.% for the Internet and 60.% for the telecommunication were reported as ICT uptake problems. The marginal ICT uptake problems resulted due to the use of sophisticated ICT facilities such as e-commerce, precision farming due to the fact that most of the farmers are unaware of these new technologies and the inability of using it.

Therefore it is important to identify the possible reasons which limit the use of ICT in tea sector.

The study further summarized some of the limiting factors for use of ICT and technology in tea research. The tea industry participants cited the cost of technology (62.6%), inability of farmers to use ICT (56.6%) and lack of training (45.7%) like limiting factors which gave the highest impact on ICT use. The result implies that if a farmer is willing to adopt the new technology the main barriers to adapt to ICT is cost of technology itself. Taragola & Gelb,

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(2005) say that most of the developing countries face this type of challenge. According to the mean separation of each and every limiting factor, inability of farmers to use ICT and lack of training are not significantly different.

By considering the farmer's percentage use of different ICT applications based on all who use ICT, the tea industry in Kericho County use 85% Internet, 90% email, 96.7% of the mobile communication and 28.3% of the DSS. Some of the possible reasons were the cost of technology, inability of farmers to use ICT and poor infrastructure development.

Percentage use of ICT applications by tea farmers in Kericho County

Using the theory and stepwise regression results in the MINDEX model, the following variables were identified as providers of greatest explanatory power with respect to WWW, e-mail and mobile communication use. Variables like "Days of training (trdays)" and "knowledge of HTML (knhtml)" related to the ICT training and knowledge category were positively significant implying that farmers with more days of training and html knowledge use ICT more. These results indicated that ICT training and literacy promotes the adoption of ICT. (In that scenario, the people with higher ICT literacy will adopt and use ICT more than those who don't). In the trust category, variables like "e-mail is helpful for day today business (emhelp)", "solve ICT related problem myself or with help (prbslv)", "using the Internet is easy (intezy)" and "using the Mobile is easy (mphezy)" were found to be significant in influencing ICT usage. All these variables resulted significant, positive coefficient indicating more trust individual in the ICT system, use more ICT. In the access to ICT category, "Percentage work related to email (wkhrse)" and "Frequency of mobile phone usage (freump)" variables were not significant though they have positive coefficient. In the time category, there were no any variable formed because, this survey doesn't have data in several years. Therefore statistically, MINDEX described 62.2% of the variables used for final regression model.

Conclusions

We found out that 60.6% of total participants use at least one of the ICT related equipment or facilities for their business. The survey shows 76.1% of respondents having ICT uptake problems in tea sector research. The telecommunication and Internet result higher uptake problems whereas DSS, precision farming and production model like new technologies result lower uptake problems because of their limited use due to lack of awareness by the

participants of mostly how their technologies operate . The results suggested that the most important limiting factor which affects the use of ICT in tea research is cost of technology. It shows 62.6% of tea production sector ICT use is affected by cost of technology. Lack of training and inability of farmers to use ICT is the second factor that affects this issue. The factors namely trust level in the ICT system, lack of technological infrastructure and lack of ICT proficiency are in the third level category that affects the use of ICT in tea research in the county. It appears that the usage of mobile phone is very common among the tea farmers. The use of mobile phone is high compared to other ICT application such as Internet, WWW, e-mail and DSS. Statistically, the MINDEX described that the variable used represents 62.2% in the regression model. Variable related to the ICT training and knowledge category which consist of "days of training" and "knowledge of HTML" were positively significant. In trust category, variables like "e-mail is helpful for day to day business", "solve ICT related problem myself or with help", "using the Internet is easy" and "using the Mobile phone is easy" are also positively significant.

Determining the factors that influence ICT and technological advances in tea research can assist companies in deciding the ICT use profile of their customers based on the significant adoption factors identified in this study. The knowledge of ICT and technological adoption and use will help in understanding the potential of customers and product and services of the firm / company. The company / farm can then focus marketing and advertising campaigns aimed at attracting these individuals to their business. A customer's comfort and trust level with a company may increase as they are able to gain more information about a company via ICT. At the same time, tea production constantly experiences advances in technology and the use of information and communication technologies is becoming more common place each day. Therefore, it is essential for firms and managers to understand the reasons for ICT adoption and use in advancing research to remain competitive and to best serve their industry and customers.

Recommendations

Tea production efficiency needs to be enhanced by improving use of ICT in collaboration with management skills of the producers. Identifying the constraints of ICT adoption and use in advancing tea research will help industry participants to increase information flow and increase the level of trust in the firm and the demand for the firm's products or services. Managers can gain alot of benefits if they use DSS or Expert System in tea production.

Because these systems provide knowledge and inference procedures to solve problems that are difficult enough to require significant human expertise for their solution and have the potential to help farmers run their business more economically. The critical barrier for the use of ICT, cost of technology needs to be reduced. If the public or private sector enhances / facilitates some funding scheme for ICT, ICT services will result into reduction of the cost of technology barriers to some extent. Public funding would be justified under the assumption that the public at large would benefit from "cheaper and better" agricultural products. Training of farmers also needs to be further improved. Farmer training increases ICT adoption and use in tea research (Batte *et al.,* 1990). Public sector attention regarding this issue would be useful in urban areas. Specially conducting farmer training programs and demonstrations on ICT usage would beneficial. Therefore, firms may benefit from providing training on information and communication technologies for both employees as well as customers.

Managers should proactively use ICT to promote the trust in their employees and customers who are associated in ICT. This will increase the overall use of ICT and promote the use of ICT in all aspects of employees and customers personal lives and work. Increasingly, individuals will turn to ICT when they need information or they want to communicate with the firm for personal or work-related reasons. If we can build trust in ICT systems among farmers, it will eventually be easy to implement good ICT use to enable environment and it will also facilitate efficient and reliable ICT outcome. We recommend that this survey should be continued in future to get clear justification of ICT and technological adoption and use in advancing tea research with time in other parts of tea-growing Kenya as well.

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