

# 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 ICT in the world, each organization or person has to concern their products and services more towards modernized and ICT related manner. This research contribute to understand the technological development and 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 system in agriculture sector of Kenya. Tea producers and farmers in Kericho County were selected for 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. There were 60.6% of the participants who used ICT related equipment or facilities for their tea production and tea related business and 76.1% of the participants had 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 challenges 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. This 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.

**Key words:** ICT, ICT use, Constraints, Tea, Technological development.

## INTRODUCTION

Currently, 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 (DSSs) and the World Wide Web (WWW) have become widespread. For the betterment of the future and as a country, the agriculture industry and services sectors have to comply with this phenomenon. Information is the lifeblood of organization. It is 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 may also increase the level of trust on consumers in a product or firm and 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. 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 Ksh 62 billion in 2008, contributing 26% of the total foreign exchange earnings. In addition, the Tea Industry supports directly and indirectly approximately five 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% per year (2013 est.). Achieving this continuously increasing demand is the challenge in the agriculture sector.

In Kenya, few agriculture sector participants (organizations / individuals) use ICT in their day to day activities or agricultural production and research. For example, some tea sector participants use e-commerce applications while a few farmers use ration formulating software to prepare feeds. However, 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. Research on ICT and technological development in tea research is very scarce in Kenyan agriculture sector and the need exists to understand the adoption and use of ICT in advancing research as well as why 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 agriculture 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.

## **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) and 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 (Roszkopf, 1999; Kurtenbach and Thompson, 2000; Gibbon and Warren, 1992). Gelb and Bonati (1998) reveal that presence of the internet is very useful for present day agriculture.

### **Factors affecting the use of ICT in tea research**

It is clearly demonstrated that the complexity of farm, degree of external support, age, time, experiences, network, availability of information, personality and approach to learning enhanced or diminished a farmers computer use (Iddings and Apps, 1990). Also 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 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, demographic, 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).

### **Use of ICT in the world agriculture sector in advancing research**

Several good examples for ICT adoptions and implications of agriculture sectors are found. Kenya Agricultural Commodity Exchange (KACE) is harnessing this ICT technology to disseminate market information and intelligence. In the Philippines, there are lots of portals, e-commerce applications and innovative technologies used to provide relevant agricultural information in the country specifying the rural areas. Specially, eAGRIKultura, e-Consortia, e-Farm and KAgriNet place a major role among them. In Thailand, a multi-lingual Internet portal, Agricultural Information Network (AIN) enables Thai farmers, field officers, policy-makers and government to communicate and access relevant and useful agricultural information. Farmers in India use e-Choupal one of the portals to setting 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 the 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 uses in agriculture are given as: COMAX provides information on integrated crop management in cotton, POMME-provides information about pest and orchard management of apples, SOYEX-soybean oil extraction expert system and FINDS-a Farm level Intelligent DSS to assist in determining optimal machinery management practices for farm-level system (Anon, 2006).

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 Centre” which will empower villagers including farmers by linking up with the WWW, so farmers can collect the market information in all major markets in the country. 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 all observation groups were done to identify important user and organizational characteristics and current applications of ICT and technological developments in advancing tea research. The results from the interviews, which included 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 participant of the above two groups and included detailed information of website use, email use, DSS use, other ICT related practices and user comfort level with these technologies. The interviewer 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 with proper statistical methods with the aid of Statistical Analysis System (SAS), SPSS and MS Excel software. Least significant difference (LSD) technique and general linear models (GLMs) procedure were 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, email and mobile communication use, respectively. Kurtenbach and Thompson (2000) and 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 questionnaire.

## **Variables 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 WWW, email and mobile communication. These variables were categorized into four groups such as i) access to ICT (receive/send email attachments, percentage work related to email), ii) ICT training and knowledge (days of training, knowledge of HTML), iii) trust (solve ICT related problem myself or with help, using the internet is easy, email is helpful for day today business, using the mobile phone is easy) and, iv) time taken in using computer related devices in analyzing research. Basically, each scored index 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 index as dependent variables to determine which factors from the survey had the greatest impact on WWW, email and mobile communication adoption and use in advancing tea research.

## **RESULTS AND DISCUSSION**

The summarized details of the participant in ICT and technological development use in advancing tea research survey are shown in Table 1. Out of the 218 participants involved in the survey, 135 were males and the rest females. The results show that 60.6% of the total participants use at least one of the ICT related equipment or facilities in research. But in general, the results do not imply that the whole of 60.6% of the participants use ICT related equipment for their business, research and or farm operations because, for instance, some farmers who own computers use it for watching films and playing games only.

**Table 1: Participants of the ICT and technological development use in research survey.**

	Use of ICT	Not use of ICT	Total Surveyed
Females	60	23	83
Males	72	63	135
<b>Sub-total</b>	<b>132</b>	<b>86</b>	<b>218</b>

## **Use of ICT equipment in business**

This study gives some indication of the use of ICT related equipment by tea sector participants. The tea industry indicated that 60.6% of the participants use ICT related equipment/facilities for their business. Statistically, there is a very clear significant difference between the use of ICT and not use of ICT in tea sector participant. Therefore we can conclude 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 used ICT related equipment or facilities for their business heavily.

### **Summary statistics of the entire survey**

Tea industry participants (83.1%) in Belgut Sub County indicated that they have problems with the uptake of ICT in their business or farm operations in tea. In an average, 76.1% of the farmers' reply that they have ICT uptake problems in tea sector, because of more than 90% of the participants in developed countries used ICT for their business and the people incorporate more modern technology, they have to face lots of problems, challenges and afterwards they gained lot of experiences. However, in Kericho County people do not engage in modern technologies such as process control in glass house production, precision farming and production models applying in poly-tunnels, among others. The most important ICT uptake problems indicated by the participants were use of telecommunication and internet. The tea sector at 69.8% for the internet and 60.2% 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 and precision farming because 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 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%) as the limiting factors with the highest impact on ICT use. The result implies that if a farmer is willing to adopt the new technology, the main barrier in adapting of ICT is the cost of technology. Taragola and Gelb (2005) state that obviously 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, email 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 the literacy promote the adoptions of ICT. In that scenario, the people with higher ICT literacy will adopt and use ICT more. In the trust category, variables like "email is helpful for day to day 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 (wkhkse)" 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 does not have data in several years. Therefore statistically, MINDEX described 62.2% of the variables used for final regression model.

## **CONCLUSIONS**

There were 60.6% of total participants who used 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 of these technologies. The results suggested that the most important limiting factor which affects the use of ICT in tea research is cost of technology. It shows that 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. The factors, namely: trust level in the ICT system, lack of technological infrastructure, and lack of ICT proficiency are 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, email 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 “email 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 on 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. For example, a customer’s trust level with a company will increase if he is able to track her or his shipment order via the Internet. Some individuals and organizations within society have a fear or mistrust of 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 lots 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 enhance / facilitate some funding scheme for ICT, ICT services will result in reducing 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. Farmer training 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 programmes and demonstrations on ICT usage would be 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 to communicate with the firm for personal or work-related reasons. If we can build trust in ICT systems among farmers, it is very easy to implement good ICT use to enable environment and it will facilitate efficient and reliable ICT outcome. 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 Kenya.

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