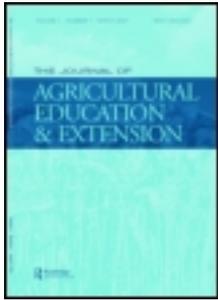


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Evaluation of Information and Communication Technology Utilization by Small Holder Banana Farmers in Gatanga District, Kenya

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ABSTRACT Purpose: *The study was carried out to identify information communication technologies (ICTs) used in production and marketing of bananas, to determine factors influencing intensity of use of ICT tools and to assess whether use of ICT has a significant influence on adoption of tissue culture bananas by small-scale banana farmers in Gatanga District, Kenya.*

Design/methodology/approach: *A multi-stage purposive sampling and proportionate allocation technique was used to select 116 respondents. A pre-tested questionnaire was used to collect data. SPSS and STATA were used for descriptive and quantitative analysis.*

Findings: *Radio, television and the mobile phone were found to be the most accessible ICTs and were often used to access information on production and marketing of bananas. The least accessible ICTs were computers, internet services and video cassettes. Socio-economic factors like age, gender, income and acreage of bananas planted had an influence on the intensity of use of ICT tools as a source of agricultural information by smallholder banana farmers. Use of ICTs was found to influence adoption of tissue culture (TC) bananas. Low levels of education and distance to internet services were found to be the most constraining to the use of ICT tools. Other constraints included: lack of money to buy internet services, digital cameras and computers. Farmers were of the opinion that radio and the mobile phone were the most useful ICT tools while television, print media, internet/email and video cassettes/DVDs were the least useful as a source of information on banana production.*

Practical implications: *This study elucidates the important role of ICTs in disseminating agricultural information. There is need for the government to demystify ICT training at all levels of education to improve local content development. Reduction of taxes on radio-wave licensing and improving accessibility to affordable and quality handsets will aid in intensifying the use of radio and mobile phones by farmers in acquiring information.*

KEY WORDS: ICTs, Dissemination, Smallholder banana farmer, Information

1. Introduction

Small-scale agriculture is the main source of livelihood for over 70% of the population in Africa. According to Munyua (2008), about 80% of the farmers are smallholders. In Kenya the agricultural sub-sector of the economy provides a livelihood for over 80% of the rural population (Davis 2004). Dissemination of agricultural information to this rural people poses a big challenge to development agents. Information and communication technologies (ICTs) offer a solution to this challenge. ICTs include technologies and media that capture, store and disseminate data and tools such as video, print media, television, radio, mobile phone and computer-mediated networks among others (Munyua 2008). The rapid development of internet, mobile phone and other forms of ICTs in the Kenyan agricultural sector has provided an opportunity for the transfer and access of agricultural information. Farmers in central Kenya, particularly those with resources and good education, have been known to use ICTs (African farming and processing 2006a, 2006b). Smallholder farmers are now able to identify new market opportunities for their crops and access new input technologies, which was otherwise difficult and expensive to obtain.

In Kenya, the National Agricultural Sector Policy (NASEP) presumes that extension service providers and clients will increasingly apply ICT for sharing agricultural information (Government of Kenya 2008). Frequency Modulation (FM) radio stations, internet, email, websites and web-based applications are becoming increasingly important in small-scale agriculture for the purposes of sharing and disseminating agricultural information (Munyua 2008; Munyua, Adera and Jenson 2008). Shujaaz FM radio station in Kenya is estimated to reach over six million youth with its agricultural extension messages as well as other messages (Hall et al. 2010). Studies by Farooq et al. (2007) in Pakistan reveal that the majority of respondents reported print media (100%), radio (75%) and television (80%) as their source of information. A study by Adolwa et al. (2012) in western Kenya found that radio and farmer field days were the most accessible, informative and reliable channels of information dissemination. In Punjab, 56% of farmers listened/watched agricultural programmes on radio and television (Irfan et al. 2006). A study by Ovwigho et al. (2009) showed that television was the major ICT used in extension delivery in Nigeria, while radio was the most important ICT followed by television and video in Kenya. In Uganda, banana traders have used mobile phones to carry out transactions with producers in rural areas and buyers in urban markets increasing profits and sales (Muto and Yamano 2008).

Banana is an important fruit crop in Kenya, providing food security and incomes for smallholder farmers under very low input regimes. The production of bananas for local and export markets continues to decline due to low adoption of modern agricultural technology (Wambugu and Kiome 2001). The Kenya Agriculture Research Institute (KARI) and stakeholders have promoted pathogen-free bananas from the TC laboratory technique since 1996 (Njuguna et al. 2007). The TC banana has high yields, a fast growth rate and uniform maturity compared to conventional suckers (Wambugu and Kiome 2001; Njuguna et al. 2007). However, farmers still plant unimproved varieties and are subject to inadequate and unfair market conditions because of the lack of timely and adequate information (Kiplang'at and Ocholla 2005; Munyua 2008). Socio-economic factors such as education level, wealth

status, proximity to information centres and off-farm income have been cited as major determinants of farmer awareness and comprehension of agricultural technologies and eventual adoption (Adolwa et al. 2012; Marenya and Barrett 2007). This study investigates the role that ICTs play in the promotion of banana biotechnology among smallholder farmers in Gatanga District, Kenya. The general objective of the study was to analyse the factors which influence the farmers' access and use of ICTs, and how the ICTs affect the adoption of improved farming technologies in banana production. Specific objectives were to: (i) identify ICTs used in the production and marketing of bananas, (ii) determine factors influencing intensity in use of ICT tools in small-scale banana production, (iii) assess whether use of ICTs has a significant influence on adoption of TC bananas, (iv) find out the constraints to the use of ICTs and (v) ascertain farmers' opinions on the extent of ICT usefulness to banana production by farmers in Gatanga District, Kenya.

2. Theoretical Consideration and Conceptual Framework

The theoretical approach informing this study was drawn from three theories: (1) Diffusion of Innovation (DoI) theory, commonly referred to as Rogers' innovation diffusion theory, (2) communication theories and (3) theories and practices of development communication. Rogers has defined diffusion as a process by which an innovation is communicated through certain communication channels over time among members of a social system (Rogers 1995). The theory presumes that a new idea, practice or object has a perceived channel, time and mode of being adopted by individuals or organizations. The theory has been used as the theoretical basis for a number of information systems projects and diffusion of agricultural innovations (Rogers 1995; Rogers and Scott 1999; Kiplang'at and Ocholla 2005). Thus, its wider application in information technology and agriculture made it applicable for this study.

In this study diffusion is viewed as a process by which the innovation, that is, TC bananas, is communicated through certain channels, including the ICT-based channels such as radio, mobile telephony, internet, and so on (awareness creation programmes of the TC banana), over time among smallholder banana farmers (members of a social system). Each adopter's willingness and ability to adopt an innovation would depend on awareness, interest, evaluation and trial. The study also considered communication theories. Claude Shannon, the founding father of information theory, introduced the idea of communication as information processing (Casmir 1994). Shannon focuses on using maximal line capacity and reducing distortion at the same time. The Greek-Roman rhetoric theory puts a great emphasis on oratorical training (Casmir 1994). It says that language has to be beautiful in order to cause an emotion, followed by an action. Using ICTs, agricultural innovation can be codified, repackaged to suit the target group, and disseminated to a wide range of clientele, quickly, cheaply and with minimal distortion. Most rural communities have access to mobile phones, television and national and community-based radio stations with call-in and Short Messaging Services (SMS), making verbal and visual forms of communication easier to establish and exploit. The study also borrows from the theories and practices of development communication. Development communication is the utilization of existing communication tools and applicable theories for

result-driven strategies for the advancement of society (FAO 2000). Development communication can also be defined as purposive communication intended for a specific target audience that allows for translation of information into action resulting in a higher quality of life (Mazammel 2012). By using ICTs, players in the agricultural value chain can be targeted with specific messages and/or innovations that aim at increasing agricultural productivity.

The conceptual framework of the study shown in Figure 1 defines the role of ICT in enhancing the decision-making process by smallholder banana farmers and entrepreneurs in the banana sub-sector. The decisions made could lead to the adoption of new technologies or approaches by the farmers and entrepreneurs and subsequently an increase in income. ICT forms an important component of any Agricultural Innovation System (AIS) which provide the timely dissemination of information to users and feedback to information producers. Information producers include researchers, extension agents and private companies, among others. AIS is an evolving framework whose elements include education and research, enterprise, demand and intermediary domains, the linkages between its components, and the institutions and policies that constitute the enabling environment for innovation (World Bank 2008). The AIS is a response to the increased speed at which the farming and rural communities change in tandem with emerging challenges. The AIS approach is important because it ensures that existing and new knowledge will be used more effectively for the livelihoods of the rural poor. Improved communication, information and interaction through ICTs allow the use of new ideas and knowledge from various sources. These theories and approaches define the theoretical and conceptual framework of this study.

A multi-stage purposive sampling and proportionate allocation technique was used in the study. The first stage involved purposive selection of main banana growing administrative Divisions in the District. These were Gatura, Kigio and Kigoro. Second, a list of banana producer groups working with African Harvest was generated. African Harvest is a non-profit organization involved in the promotion of TC bananas in Kenya. TC is a laboratory method of micro-propagation that enables rapid multiplication of pathogen-free planting material (Wambugu and Kiome 2001).

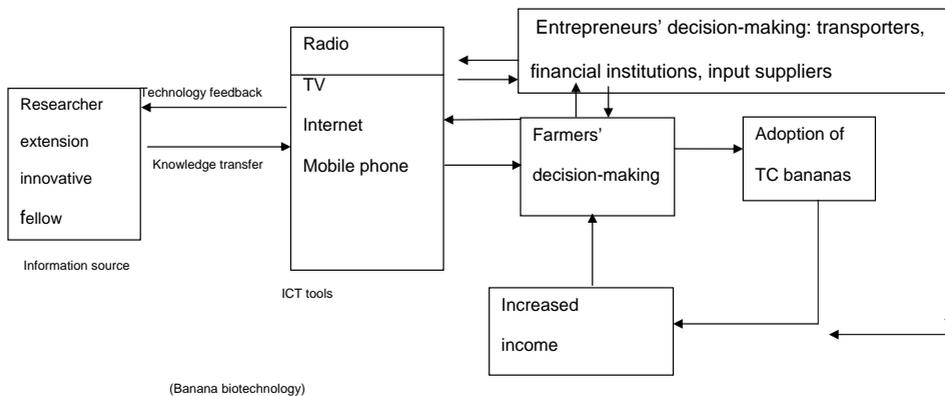


Figure 1. Conceptual framework on ICT
Source: Adapted from Madhur (1999).

The technology significantly reduces diseases and increases yields. The non-governmental organization (NGO) uses the strategic value chain approach with TC banana technology, which includes: awareness creation and information outreach, access to TC banana seedlings, agronomic best practices, post-harvest fruit handling, best practices and linkage to competitive markets. To cut costs, three producer groups from each administrative division were randomly selected. Groups from Gatura were: Mugaka, Mwagu and Kiganjo banana growers, with memberships of 21, 22 and 56, respectively. Groups from Kigio were: Ithang'arari, Wakio and Kabuni, with memberships of 21, 16 and 26, respectively. While those from Kigoro were G2, Kiambere and Mununga with memberships of 18, 40 and 23, respectively. These groups were part of 20 farmer groups with a membership of over 400 banana farmers working with African Harvest in Gatanga District, with a population of 125,718 persons and 20,980 smallholders. A systematic simple sampling technique was then used to select half of the members from each group at an interval of two, who were interviewed using a pre-tested questionnaire. Mugenda and Mugenda (1999) argue that a 50% sample is large enough and can be used to represent a target population. The study was also informed by informal interviews of farmers and key informants. The completed questionnaires were reviewed to determine their usability. Four questionnaires were discarded because they were incomplete. A total of 116 questionnaires were usable. STATA was used to determine factors influencing intensity in use of ICT tools using the Poisson Regression (PR) technique while the Statistical Package for Social Scientists (SPSS) was used to test whether use of ICTs had a significant influence on adoption of TC bananas. The PR technique was also used to determine the factors conditioning the number of ICT tools used by smallholder banana farmers. The variables were tested for multi-collinearity to avoid bias when fitting to models (Table 6).

3. Empirical Models

3.1 Intensity of Use of ICT Tools: Statistical Modelling of Count Data

Intensity in use of ICT tools in this study refers to total numbers of ICT tools used by a farmer for information sourcing. Farmers use a number of ICT tools to access information, the number of ICT tools used (intensity of use) assumes integer values of a discrete nature and is a non-negative count variable. Poisson and negative binomial regression models have become the standard models for the analysis of response variables with non-negative integers. This study applied the PR model (Gitonga 2009; Greene 2008; Areal et al. 2008; Okello Narrod and Roy 2007; Zurbrigg et al. 2005; Famoye, Wulu and Singh 2004).

$$f(y_i|x_i) = \frac{e^{-\lambda(x)} \lambda_i(x)^{y_i}}{\Gamma(1 + y_i)}$$

3.2 Factors Influencing Adoption of Tissue Culture Bananas

Applicable to a broad range of research situations, logistic regression analysis can be applied where the dependent variable is of dichotomous nature. The coefficient of the

regression can be used to estimate the odds ratios for each of the independent variables included in the model (Ekanem et al. 2008; Sirak and Rice 1994).

3.3 Constraints to the Use of ICT by Banana Farmers

Constraints to the use of ICT were determined by using a range of values from three to zero. Mean constraint values were calculated, a value of two and above indicating 'very serious constraint' while a value of less than two indicated not a 'serious constraint at all' to the use of ICT tools.

3.4 Farmers' Opinion on Extent of ICT Usefulness

Farmers' opinion on extent of ICT usefulness was ascertained by using a four-point likert scale ranging from four to one. Values close to four indicating 'very useful' while those close to one indicating 'not useful at all'.

3.5 Variables

3.5.1 Dependent Variables Used in the Study. The dependent variables used in the study were adoption of TC bananas and the intensity of ICT tools used by the respondent. The ICT tools include radio, television, video, print media, among others, used by smallholder banana farmers in Gatanga District.

3.5.2 Independent Variables Used in the Study. The independent variables used in the study were some selected socio-economic characteristics of the farmers that were hypothesized not to influence intensity of use of ICT tools. These included age, gender, education level, acreage of bananas planted and income levels of the respondents, among others.

4. Results and Discussions

4.1 Existing ICT Available to Small-Scale Banana Farmers in Gatanga District

Table 1 shows various ICT tools available to smallholder banana farmers in Gatanga District, the degree of ownership, accessibility and use. Accessibility in this study referred to being able to reach and use an ICT tool from a relative, neighbour or public/private utility. The results show that the majority of the respondents interviewed own a radio (91.4%), television (57.8%) and a mobile phone (80.2%). All the respondents accessed a radio while a large number accessed television (72.4%) and a mobile phone (91.4%). The results indicate that 83.6%, 19.8% and 31% use radio, television and a mobile phone respectively to get information on production and/or marketing of their bananas. This study confirms Kiplang'at and Ocholla (2005), Farooq et al. (2007) and Ovwigho et al.'s (2009) findings that radio and television were used widely by agricultural researchers and extension workers to disseminate agriculture information to the farming community. The most common FM radio stations broadcasting agricultural programmes in the local language include *Inooro* (*Mugambo wa murimi*, 'voice of the farmer'), *Kameme* (*Kenyu na Kenyu*, 'piece by piece') and *Coro* (featuring programmes by agro-chemical companies and the Ministry of Agriculture).

Table 1. Ownership, accessibility and use of ICT sources for banana production and marketing

	Type of ICT tool	Ownership	Access	Used for banana info
1	Radio	106 (91.4%)	116 (100%)	97 (83.6%)
2	Television	67 (57.8%)	84 (72.4%)	23 (19.8%)
3	Mobile phone	93 (80.2%)	106 (91.4%)	36 (31%)
4	Newspaper/magazine	28 (24.1%)	55 (47.4%)	23 (19.8%)
5	Computer	2 (1.7%)	11 (9.5%)	0 (0%)
6	Digital camera	0 (0%)	5 (4.3%)	0 (0%)
7	Internet (www) services	3 (2.6%)	14 (12.1%)	0 (0%)
8	Video cassette/DVD	9 (7.8%)	16 (13.8%)	0 (0%)

Source: Author's field survey, based on sample size n = 116, 1 = yes, 2 = no.

The least accessible ICTs were computers (9.5%), internet services (12.1%) and video cassettes (13.8%), which were never used for getting information on banana production and marketing. Most farmers lacked requisite skills and physical access to the internet and computer-related services, confirming an observation by Kiplang'at and Ocholla (2005) that most extension workers relied entirely on printed sources of information such as pamphlets, brochures and posters to obtain and disseminate agricultural information. None of the respondents owned a digital camera, although 4.3% had access to one but never used it for issues concerning bananas.

4.2 Determinants of Intensity of ICT Tools Used

Table 2 shows the output of the PR model that was fitted on the data. The result shows that the p-values for gender (0.003), income (0.027) and banana acreage

Table 2. Results of the poisson regression model

Definition of Variables	Poisson regression model	
	coefficient	p-value
<i>Dependent variable—intensity of ICT use</i>		
<i>Independent variables</i>		
Age	-0.0064296	0.389
Gender	0.5096335	0.003***
Marital status	0.1342787	0.803
Education	0.229894	0.661
Income(in)	0.4185542	0.027**
Distant to agric. office	-0.01677796	0.519
Distance to internet	0.0103656	0.214
Acreage of bananas	0.2393224	0.095*
Source of suckers	0.3693907	0.111
Constant	-0.2569166	0.621
No. of obs. = 116 LR chi2(10) = 23.9 Prob. >chi2 = 0.012 Pseudo R2 = 0.069 Log likelihood = - 161.665		

Source: Author's fieldwork, 2010. **significant at 1%, **5% and *10% confidence level at P ≤ 0.05.

(0.095) were significant at 1%, 5% and 10% significant levels respectively. The results show that males were more likely to use more ICT tools as sources of information on bananas than females. Those with higher incomes are more likely to use ICT as a source of information on bananas than those with lower incomes. Intensity of use of ICT tools increased with increase in the acreage of bananas planted. The null hypothesis should therefore be rejected and the alternative accepted that socio-economic factors mainly have an influence on the intensity of use of ICT tools as a source of agricultural information by smallholder banana farmers.

The significant relationship between gender and use of ICT as a source of information for banana production is due to the fact that men have more free time to listen/watch radio and television agricultural programmes. Women, on the other hand, are engaged in domestic chores and other productive activities, leaving them with very little time to tune in to media such as radio. This is supported by the earlier findings for men using radio and television (54.3% and 15.5%) compared to women users (29.3% and 4.3%, respectively). Income directly determines ability to purchase and own ICT tools. The higher the income, the higher the purchasing power of ICT tools and hence the higher the number and frequency of use of these tools for agricultural information. The more acreage of bananas planted means that the farmer is motivated by the income received from sale of bananas. He/she is encouraged to seek information on production and marketing from various sources. This study partially agrees with Wejnert (2006) that use of a particular type of ICT tool depends more on economic variables than on socio-demographic variables like gender, marital status and education level.

4.3 Influence of ICT on Adoption of Tissue Culture Bananas

Logistic regression results (Table 3) yielded a p-value of 0.026, thus significant at the 5% level. Therefore, the use of ICTs had a significant influence on the adoption of TC

Table 3. Results of logistic regression model

Dependent variable: plants TC banana	Logit regression	
	Coefficient	p-value
<i>Independent variables</i>		
Age	0.0774289	0.039**
Gender	-1.487708	0.093*
Marital status	-0.7128584	0.461
Education	-0.8783833	0.001***
Income	2.256187	0.002***
Banana acreage	-1.749246	0.008***
Use of ICT	0.8423881	0.026**
Constant	-22.78967	0.002
No of obs. = 116		
LR chi2 = 29.84		
Prob > CHI2 = 0.001		
Pseudo R = 0.3340		
Log likelihood = -29.748186		

Source: Author's fieldwork, 2010. ***significant at 1%, **5% and *10% confidence level at $P \leq 0.05$.

bananas. A unit increase in frequency of use of ICT would increase the adoption rate of TC bananas by 84%. The result shows that farmers who use ICTs for information on bananas are aware of the availability and advantages of growing TC bananas and therefore willing to purchase the suckers and plant. Promoters of TC banana biotechnology have used various ICT tools including mass media to promote the technology.

The p-values for income (0.002), banana acreage (0.008) and education (0.001) influenced adoption of TC bananas at the 1% significant level, whereas gender (0.039) and marital status (0.093) were significant at 5% and 10% levels, respectively. Respondents with high incomes have the ability to travel and purchase TC suckers from research institutions that promote TC biotechnology. The positive coefficient indicates that a unit increase in income increases adoption of TC bananas significantly. The negative coefficient for acreage of bananas planted indicates that a unit increase in acreage planted reduces the adoption rate of TC bananas by 17%. This could mean that respondents with larger acreages have adequate planting material on their farms and therefore are less willing to purchase TC planting material.

4.4 Constraints to the Use of ICTs by Banana Farmers

The study participants were asked to indicate constraints to the use of ICTs in receiving agricultural information, from very serious (three), serious (two), not serious (one) and not applicable to the respondent/refused to answer (zero). The constraints indicated were lack of money to buy the ICT tool, cost of batteries, lack of electricity, irrelevant content, wrong time of the programme and low level of education. The ICT tools in question were: radio, television, mobile phones newspaper/magazines, computers, digital cameras, internet and video cassettes/DVDs. Mean constraint values were calculated after 'not applicable to the respondent/refused to answer' (zero) were eliminated. A mean score below two was considered not to be a serious constraint and a mean score equal to and above two was considered to be a serious constraint to the effective use of the ICT tool.

Lack of money to buy internet services (2.7069), a digital camera (2.6638) and a computer (2.6379) and level of education (2.5690) had the highest scores for constraints to the use of an ICT tool. Distance to internet service could be another constraint since 87.7% of the respondents were 10–40 km away from the nearest internet service (Table 1). This study partially agrees with Ovwigho et al.'s (2009) findings that major constraints to the use of ICTs include limited access to a computer and rural poverty. Interestingly, lack of money to buy a radio and a mobile phone were not a constraint, with least scores of 1.0862 and 1.5172 respectively. The low score for radio and mobile phone could be attributed to the existence of a wide range of these two tools on the market at affordable prices. With its multiple uses, the mobile phone has become a gadget of choice for many people, these include: improved communication among friends and relatives, money transfer services, business transactions at reduced costs, information storage, timely and efficient market information sourcing, among other benefits. The use of a cell phone for SMS, voice services and as an FM radio receiver provides an effective and efficient means of information sourcing and communication. Electricity posed the least challenge to

Table 4. Responses for constraints to the use of ICTs for information on bananas

Constraint	Type of ICT equipment	Likert scale	
		Mean response	Std deviation
Lack of money to buy an ICT tool	Radio	1.0862	0.33800
	Television	1.5172	0.82865
	Mobile phone	1.1552	0.44922
	Newspaper/magazine	2.0431	0.77339
	Computer	2.6379	0.69026
	Digital camera	2.6638	0.65864
	Internet (www) services	2.7069	0.72252
Cost of batteries	Video cassette and DVD	2.6724	0.64303
	Radio	1.0948	0.34837
Lack of electricity	Television	1.3534	0.71328
	Radio	1.1466	0.46165
Lack of money to buy air time	Television	1.6195	0.79416
	Mobile phone	1.0086	0.09285
	Digital camera	1.1638	0.50980
	Computer	1.7759	1.00508
	Internet (www) services	1.7241	1.01798
	Video cassette and DVD	1.8017	0.94381
	Mobile phone	1.1034	0.40388
Irrelevant content	Internet (www) services	2.4224	0.89589
	Radio	1.3966	0.72086
Wrong time of the programme	Television	1.5603	0.74936
	Newspaper/magazine	1.8276	0.70125
	Computer/internet (www) services	2.0259	0.89890
	Radio	1.3879	0.73154
Low level of education	Television	1.7241	0.80850
	Newspaper	1.6034	0.70870
	Internet/computer	2.5690	0.66233

Source: Author's fieldwork, 2010. Based on sample size $n = 116$, 1 = not serious, 2 = serious, 3 = very serious.

use of the mobile phone (1.0086), radio (1.1466) and all other ICT tools, which agrees with the study finding that 57.8% of the respondents had electricity in their homes while the remainder had access within 3 km of their home states. A detailed constraint ranking is provided in Table 4.

4.5 Farmers' Opinion on the Extent of ICT Usefulness

Opinion surveys have been used extensively in research in all disciplines, including agriculture. When used correctly, the technique can generate useful information (Ekanem et al. 2008). The participants were asked to rate, in their own opinion, the level of help received from different types of information sources using a four-point likert scale ranging as follows: four = very great extent, three = great extent, two = little extent and one = not at all. The six sources of information were radio, television, newspaper/magazines, the internet/email, the mobile phone, video cassettes/DVDs.

Table 5. Response to extent of usefulness for banana information sources

No.	Type of information source	Mean help values	Std dev.
1	Radio	2.5345	0.88888
2	Television	1.3448	0.63388
3	Print media	1.2759	0.44889
4	Internet/email	1.2759	1.59666
5	Mobile phone	1.8793	0.88618
6	Video cassette/DVD	1.0345	0.26147

Source: Author's field survey, 2010. Based on sample size $n = 116$, values close to 4 indicate great extent of help while those close to 1 indicate no help at all.

Mean levels of help values were calculated. Values closer to four would indicate a high level of usefulness while those closer to one would indicate not useful. Radio (2.53) was found to be the most useful followed by the mobile phone (1.9), while television (1.34), print media (1.28), internet/email (1.28) and video cassettes/DVDs (1.03) provided the least use as a source of information on banana production. Video cassettes/DVDs were not widely used for repackaging extension messages to farmers and extension workers; this is in contrast to Kiplang'at and Ocholla (2005). A detailed extent of help ranking is provided in Table 5.

5. Conclusions and Recommendations

The study reveals that smallholder farmers can access a number of ICT tools within their community. The majority of the respondents interviewed owned/accessed radio, television and mobile phones. The results indicate that 83.6%, 19.8% and 31% use radio, television and mobile phones respectively to get information on production and/or marketing of their bananas. The least accessible ICTs are computers, the internet and video cassettes/DVDs. Age was found to influence use of radio, television and mobile phones as a source of information on bananas. The majority of users of these information sources were found among the younger group and decreased as age increased. Gender was found to influence use of radio and television. Males were more likely to use radio and television as a source of information than females. There was no significant relationship between gender of the respondents and use of mobile phones and print media as a source of information on bananas.

The higher the income, the lower the use of radio and television; however, those with a higher income tended to use print media as a source of information. Income levels had no effect on use of mobile phones as a source of information for banana production and marketing. Other constraints influencing use of ICTs were lack of money to buy internet services/airtime, digital cameras and computers. Money was not a constraint to the use of radio and mobile phones as a source of information to smallholder banana farmers. Requisite skills and physical access to internet and computer-related services were found to affect use of these ICT tools as a source of information. Smallholder banana farmers were of the opinion that radio provided the greatest utility followed by the mobile phone, while television, print media, the internet/email and video cassettes/DVDs were the least helpful as sources of information on banana production.

Table 6. Correlation Matrix for Multicollinearity

	Use of ICT	Income	Plant TC	Age	Gender	Marital status	Education	Distance to agricultural office	Distance to electricity	Acreage
Use of ICT	1.000									
Income	0.289	1.000								
Plant TC	0.207	0.311	1.000							
Age	0.003	0.058	0.080	1.000						
Gender	0.331	-0.051	0.018	0.048	1.000					
Marital status	-0.194	-0.294	-0.113	0.240	-0.386	1.000				
Education	0.117	0.222	-0.158	0.076	0.183	-0.173	1.000			
Distance to Agricultural centre	-0.067	0.102	-0.050	-0.099	0.003	0.089	-0.114	1.000		
Distance to electricity	-0.033	-0.166	-0.210	-0.096	-0.030	0.186	-0.014	0.048	1.000	
Acreage	0.120	0.319	0.077	0.329	-0.176	-0.176	-0.242	-0.018	-0.1358	1.000

Based on the results from this study, whereas it is advisable to disseminate agricultural information through popular channels like radio, it is important for policy makers to focus on local content development in order to reach a majority of smallholder farmers in rural areas. The local content could include local language text messages and dissemination of commodity market price information for distance and local markets. This could be achieved through demystifying ICT training at all levels of education to encourage youth to acquire skills in local content development. One way of achieving this is by inculcating ICT-based courses in education curricula starting at the primary school level. Reducing taxes on radio-wave licensing to encourage more FM radio stations, reduction of the cost of mobile phones and air time recharge vouchers as well as provision of subsidies to agriculture-related adverts are other options that could encourage use of ICTs in agricultural information dissemination. Most mobile phone handsets have FM radio receivers that can be used conveniently and effectively at all times. Complementarity of ICTs with other channels of agricultural information dissemination such as farmer groups or farmer field days will reinforce information delivery to farmers in this region. This has previously been suggested as a very effective means of disseminating agricultural information (Opara 2008).

Food security remains a major challenge to development partners. Technologies that enhance dissemination of information on production and marketing of food security crops like bananas should be encouraged. The year-round fruiting habit of bananas ensures that households have a sustainable food supply and income throughout the year. Putting up a systematic procedure for collecting, analysing, storing, sharing and dissemination of agricultural information by various value-chain players is essential. Investment in well-equipped rural knowledge centres (RKC) or information centres particularly in this region of the country would be a worthwhile venture given the incentives created by increased proximity of farmers to large urban markets. These centres will increase farmer access to computers and the internet, improving utility of these ICTs while at the same time providing opportunities to train farmers on how to effectively use such tools to their benefit. Further research should be conducted to investigate technology-specific attributes that impede actors in the agricultural sector from effectively promoting the use of ICTs in their day-to-day endeavour of meeting farmers' needs. The importance of the banana crop in terms of its contribution to food security, cash income and resource allocation should be determined.

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