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EFFECTIVENESS OF INFORMATION COMMUNICATION TECHNOLOGIES IN DISSEMINATION OF AGRICULTURAL INFORMATION TO SMALLHOLDER FARMERS IN KILOSA DISTRICT, TANZANIA

BY

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DECLARATION

I **Levi Charles** hereby declare that this research work is original and has never been published or presented to any institution for an award of any degree.

…….. …….

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DEDICATION

To my wife Miriam and children Maureen and Ivan

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DEFINITION OF TERMS

Effectiveness: The ability to bring a desired result. Under this study effectiveness reflect the ability of ICT to bring about timely and relevant agricultural information to the farmers for improved livelihood.

Smallholder farmers are farm households that own and/or cultivate less than 2 hectares of land

Livelihood: A set of activities that help the smallholder farmers to secure their basic necessities that is food, shelter and clothing; and the capacity to acquire the named necessities to meet the requirements of the self and his/her household on a sustainable basis with dignity.

Agricultural Productivity: is measured as the ratio of agricultural outputs to agricultural inputs.

ACRONYMS

ICT	Information Communication Technologies
SUA	Sokoine University of Agriculture
iAGRI	Innovative Agricultural Research Initiative
APAARI	Asia-Pacific Association of Agricultural Research Institutions
EPINAV	Enhancing Pro-poor Innovations in Natural Resources and Agricultural Value-chains
RUFORUM	Regional Universities Forum for Capacity Building in Agriculture
IICD	International Institute for Communication and Development
MDG	Millennium Development Goals
TCRA	Tanzania Communication Regulatory Authority
AKIS	Agricultural Knowledge and Information System
ITU	International Telecommunication Union
TV	Television
FM	Frequency Modulation
URT	United Republic of Tanzania
MVIWATA	"Mtandao wa Vikundi vya Wakulima Tanzania"
VAEO	Village Agricultural Extension Officer
WAEO	Ward Agricultural Extension Officer
DAEO	District Agricultural Extension Officer
RML	Reuters Market Light

SPSS	Software package used for statistical analysis
NGOs	Non-Governmental Organizations
REA	Rural Energy Agency
UN	United Nations

ABSTRACT

This study assessed the potential of information communication technologies (ICT) in contributing to agriculture and rural development by looking into the effectiveness of radio, television and mobile phone in dissemination of agricultural information. Effectiveness is measured in terms of accessibility, timeliness as well as relevance of the information provided. Specifically the study determined the relationship between farmers' socio-economic characteristics and access to information through ICTs. It further described the complementarities between ICTs in enhancing improvement of the quality of information available to farmers. Lastly, the research established the farmers' perception of the effectiveness of ICTs in dissemination of agricultural information. Different approaches of data collection were employed including questionnaire administration, key informant interviews, farmer meetings, general observations and documentary review. It was found that some ICTs have an association with age, sex, education level and marital status of the respondents while some have no association. Complementarities were also found to exist between radio, television and mobile phone. Despite the fact that there are some shortcomings in each of the ICT modes, still the farmers perceived ICTs as effective in dissemination of agricultural information. Based on the findings, it is recommended that the socio-economic characteristics (age, sex, education level and marital status) of the farmers should be considered when planning for different programs that involve ICTs in provision of agricultural information. The district extension system should also design programs that use the right mix of these ICTs for agricultural extension service delivery. This will allow in fully utilizing their potential in complementing other extension and knowledge services. Furthermore, ICTs should be used in complementarity to ensure equitable access of quality information by the majority of farmers. In addition the smallholder farmers need to be sensitized on the presence of effective ICTs in their area. This will increase awareness of the farmers on the role of ICTs and how to access and use them for their farming activities.

CHAPTER ONE - INTRODUCTION

1.1 Background

Information Communication Technologies (ICTs) refer to hardware, software, networks and media for collection, storage, processing, transmission and presentation of information in the format of voice, data, text and images (World Bank, 2002). The potential of ICTs to contribute to agriculture and rural development has been well recognized (Singh, 2006). ICT can play a significant role in rural development by helping the rural farmers to access new knowledge, up-to-date information and entrepreneurship skills. There are different ICTs including computers, internet, geographical information systems, mobile phones and traditional media (radio, television) which are used in delivering agricultural information to the farmers (Stienen *et al*., 2007).

In different parts of the world ICTs are seen to have positively contributed towards rural development. Stienen *et al.*, (2007) indicated that extension workers use ICTs to gather, retrieve, adapt, localize and disseminate a broad range of information needed by rural families. A study conducted by Fu and Acter (2010) in India found that the amount, speed and quality of the extension services delivery have been improved significantly through the use of mobile phone technology. Also Singh (2006) indicated radio and TV programs to have helped the farmers in South Korea to receive support for improved crop production, quality control methods, processing, packaging and marketing. This shows that ICTs have helped to fill the gap that exists in extension service provision. Therefore effective use of ICTs in agricultural extension system can lead to the improved agricultural productivity and perhaps realization of the first Millennium Development Goals (MDG).

For many years in Tanzania, farmers have been accessing agricultural information from extension workers through interpersonal communications. In the current situation, this seems to be inefficient given that the ratio of extension staff to farmers is increasing. Factors such as poor infrastructures have also contributed to this inefficiency. For example most of the roads in rural remote areas are not passable during wet season; and this prohibits communication between farmers and the extension staff. According to United Nations (UN, 2005) access to information and knowledge for

farmers in remote villages is restricted due to the lack of infrastructure. This situation icalls for an alternative approaches for agricultural information dissemination such as use of ICTs in extension service delivery. The need for use of ICTs in agricultural extension is further justified by the fact that the farmer-extension officer ratio in Tanzania exceed 10,000:1 (Rukonge *et al.*, 2008) and this complicates face-to-face interactions.

Most farmers in Kilosa are smallholders cultivating maize, millet, cassava, sorghum, paddy and/or legumes as food crops (URT, 2007). Cash crops grown include Sugarcane, Sisal, Oilseeds and coconuts; they are also engaged in livestock keeping such as cattle, pigs, goats and local chicken (URT, 2007). In the presence of traditional ICTs such as radio and television as well as the modern ICT like mobile phone in rural households, the agricultural extension system in the district could make use of this variety of tools to enable the greatest number of smallholder producers to access a variety of timely and relevant agricultural information. Individuals can also benefit from the availability and use these ICTs in many ways. For example; substituting phone calls for travel which is costly in terms of time and money, also using them to acquire information on prices of which radio, television and mobile phones can provide, to sell their agricultural produce and make purchases (Mwakaje, 2010). In these various ways, ICTs can have a significant impact on a country's ability to achieve the Millennium Development Goals (MDGs) (Yonazi, 2009).

Kilosa district is rich of ICT infrastructures such as radio station and mobile phone service providers. The area is also reached with television broadcast. The presence of these ICT infrastructures can help the farmers, extension workers and others in rural development to effectively use their combination to make contact. According to Heeks and Molla (2009), farmers need to access market information, land records, accounting and farm management information as well as management of pests and diseases. These can be accessed through well planned rural development programs and ICT use in extension services. The services offered by the extension system through ICTs can help farmers to access timely and relevant information about new crop varieties and livestock breeds, husbandry practices, fertilizers and pesticides that will help them attain their maximum potential and hence realization of the first MDG goal which focuses on eradication of extreme poverty and hunger.

1.2 Problem Statement

Sustainability and productivity of the agricultural sector worldwide largely depend on the quality and effectiveness of extension services (Kimaro *et al.*, 2010). For many years in Tanzania, farmers have been accessing agricultural information from extension workers through interpersonal communication but the number of extension workers has been decreasing while farming families have been increasing. This leads to low achievement of the current extension service in the country with respect to reaching out to farmers with timely and relevant agricultural information. Since relevant and timely information is critical in agriculture, ICTs are seen as a partial solution to rapidly get information to the increasing number of farming families. Use of ICTs has the potential to enable farmers obtain up-to-date knowledge and information about agricultural technologies, best practices, markets, price trends, consumer preferences, weather, and soil-moisture conditions.

Studies by different researchers in Tanzania show that ICTs have helped smallholder farmers to adopt new technologies including new varieties and also to access market and other important information. The extension system in Kilosa district, like in many other parts of Tanzania, is also gradually changing to the use of ICTs to deliver appropriately packaged agricultural information to farmers so as to improve agricultural productivity. In Kilosa a study by Mtega and Msungu (2013) established that ICTs are suitable for the provision and dissemination of agricultural information among farmers due to a number of services they offer, portability, infrastructural coverage and affordability. However, the study did not describe how effective the ICTs are in terms of accessibility, as well as the relevance and timeliness of the information provided. Understanding ICTs' effectiveness would therefore help the district extension system to properly utilize them to convey agricultural information as required by farmers. It can also be guiding the extension workers on which ICTs or combination to use.

1.3 Research Objectives

The overall objective was to assess the accessibility, timeliness and relevance of agricultural information provided through ICTs.

Specifically, the research sought to

1. Determine the relationship between farmer's socio-economic characteristics and access to information through ICTs

2. Describe complementarities between the different ICTs to enhance the quality of information available to farmers.

3. Establish the farmers' perception of the effectiveness of ICTs in disseminating agricultural information.

1.4 Hypothesis

There is no association between the farmers' age, sex, education level and marital status and access to information through ICTs.

1.5 Significance of the study

The findings of this study highlight the effectiveness of radio, television and mobile phones in disseminating agricultural information to smallholder farmers. This will enable farmers and extension staff to be in a position to understand the importance of these ICTs in extension services and hence be able to fully utilize their potential to complement other extension and knowledge services. This research also provides evidence based on methodological assessment of the effectiveness of ICTs in delivering agricultural information to smallholder farmers. It is therefore projected that the study will help the policy makers and the district extension system to design policies and programs that use the right mix of ICTs available for agricultural extension service delivery. This will lead to the improvement of agricultural extension service provision for better farm productivity. Furthermore, the study will help the extension staff to properly utilize the present ICTs to provide critical access to knowledge, information and technology that farmers require in their farming activities.

1.6 Scope and Limitation of the Study

This research was conducted to assess the effectiveness of ICT in dissemination of agricultural information to smallholder farmers of only Kilosa District. This limits the generalization of the findings beyond the district to explain the general issues concerning ICT in the country's extension services. The district has many ICTs including radio, television, mobile phone, landline telephone, magazine and internet. It also has one telecenter. This research only focused on issues related to effectiveness of radio, television and mobile phone but it did not consider the rest of ICTs which can also positively impact the rural lives dealing in agriculture. Although the other ICT are also recognized to be useful in the dissemination of agricultural information to smallholder farmers they were beyond the scope of this study.

CHAPTER TWO - LITERATURE REVIEW

2.1 ICT Status in Tanzania

Tanzania has a fairly vibrant mobile market which grows well with annual subscriber growth of more than 20% (Tanzania Communication Regulatory Authority, TCRA 2012). According to TCRA (2012), the mobile sector contributes to 99% of all voice subscription. The adoption rate of mobile phones in Tanzania is significantly high, with the teledensity (penetration) of 62% by June 2012 (TCRA, 2012). The country has four largest mobile operators which are vodacom, airtel, tigo and zantel. The first three operators control more than 87% of Tanzania's mobile market (Materu and Diyamett, 2010).

According to Materu and Diyamett, (2010), radio and television services are also growing with a good speed although most FM bandwidth radio and TV stations are urban-based and a relatively small number of radio stations on FM bandwidth cover the rural areas. On the other hand, AM/MW bandwidth radio stations cover both urban and rural areas. The radio and TV stations can be categorized into three groups (National, Regional and District) depending on the area covered. According to Materu and Diyamett (2010), many of the stations cover a district or certain region, but it is only four radio stations and three TV stations which boast a countrywide coverage.

2.2 Role of ICTs in enhancing knowledge and information access

The use of ICTs particularly radio, television and mobile phones can accelerate agricultural development by improving access to information and knowledge services. They can provide useful and relevant information to solve problems of individual farmers and farming communities by enabling individuals and households to learn and acquire new skills and technologies and also share innovations globally. This will help to foster transfer of knowledge for sustainable and equitable agricultural development and help to bring about increased production in agricultural activities and improved livelihoods of the farmers. This is further supported by Soriano (2007) that through ICT use, there are more benefits linked to economic aspects in increased earnings and production.

From the perspective of agricultural information and knowledge systems (AKIS), ICT can be seen as a useful tool in improving linkages between research, farmers and agricultural extension

systems (Balaji *et al.*, 2007). ICT build-in linkage through enhancing the exchange of information especially technology among the three domains and make them function as one institution. In research institutes, small extension sections as well as research–extension committees are created, and ICTs such as mobile phone are used to easier communication. Using ICT, the Agricultural extension brings information and new technologies to farming communities, allowing them to improve their production, incomes and standards of living.

Several ICT facilities commonly used in different parts of the world are also found in Tanzania today. Statistics indicate positive trends in the ICT sector in the country. According to Materu and Diyamett (2010), voice subscribers (mobile and fixed-line) increased from about 1.5 million in 2003 to 17 million in 2009 and the subscriptions broadcasting especially cable television and radio services have also gradually developed over the years; up to 2010 there were 28 TV license holders and 53 radio license holders. However, in most places of the country, radio and television continue to be the most common ICTs in rural households. From the past years up to date, radio stations have gained publicity and their numbers have increased which have created more chances of farmers to receive important information needed in boosting their agricultural production. New ICTs like the mobile phones were introduced in the mid 1990 (Yonazi; 2009, Mwakaje; 2010), and since then people welcomed the technology which created the possibilities of integrating rural households into agribusiness. Farmers can use mobile phones to find out information related to market access, bargaining of the suitable price for their commodities by reading information of the current price standings using mobile messages/SMS before trading off their produce. The mobile technologies significantly reduce costs associated with communication and information sharing (Aker, 2010). Such costs include the time and distance in accessing information.

It is true that the effective use of radio, television, mobile phone and other ICT facilities in agriculture extension services can have a great contribution to the information access. For example, studies in rural Thailand and Columbia (ITU, 1999) show that the introduction of telephones enabled farmers to check prices regularly which led to doubling of farm incomes. Lio and Liu (2006) also indicated that the adoption of modern industrial inputs in agricultural production relies on the information and communication infrastructure. Brynolfsson and Hitt (1995) further found out that ICT has positively impacted the agricultural outputs for large farms in the USA.

In Kilosa district majority of the farmers operate on the small scale level cultivating on fragmented land characterized by low soil fertility. Increasing the efficiency and productivity of small scale farms is an area where ICT can make a significant contribution. According to Stienen *et al.*, (2007), farming involves risks and uncertainties, with farmers facing many threats from poor soils, drought, erosion and pests. For the farmers to be able to find solutions of the listed problems, the first key improvement is using ICT to provide information about pests and disease control especially early warning systems, new varieties, new ways to optimize production and regulations for quality control. Effective use of ICT can also make farmers identify the market opportunities both within and beyond their local settings. In most cases, the smallholder farmers are unaware of strategic opportunities within their own region and therefore they lack information about; which crops and commodities are fetching higher prices in surrounding towns and which products are in high demand (International Institute for Communication and Development, IICD, 2006). Getting precise and up to-date price information to farmers will greatly impact on their negotiating position in selling their agricultural produce. Most of the smallholder farmers in isolated rural areas find themselves in a poor negotiating position with middlemen, who routinely under-represent the final selling price and overstate transaction costs (IICD, 2006). However, the effective use of ICT will help to update these farmers with current market information. Awareness of up-to-date market information on prices for their produce and agricultural inputs can improve their livelihoods substantially and improve their negotiating position.

2.3 Relevance of the radio in dissemination of agricultural information

Radio is one of the effective ways of communicating agricultural messages such as technologies and best practices that can help farmers improve production. This can be achieved through different programs like radio forums tailored to local communities. Dodds (1999) reported about the relevance of the radio information with example of the 50% of Zambian farmers who confirmed that their crop yields increased by listening to the radio programs on agricultural extension education.

Availability and use of radio in delivering agricultural information help farmers to improve production with quality in order to acquire more profit. Djankov *et al.*, (2001) reported that independent radio broadcasting services have been found to be positive about rural development outcomes such as programs focusing on improving rural lives through farming and functioning

markets. In Indonesia, vegetable farmers used the prices that were being broadcast by their local radios as a starting point in negotiating with traders the following day (Shepherd, 2000). This makes the farmers to sell their produce at the right price instead of being under represented by the middle men. Also Studies in Pakistan show that widely available information on prevailing market prices for seed cotton strengthened farmers' position when bargaining with traders (Mwakaje, 2010).

2.4 Use of mobile phone to access agricultural information

Mobile phone offers easy accessibility of information to the users. There is widespread use of mobile phones by farmers and extension workers during information exchange which is very useful to both parties in improving the agricultural activities. Different researches have been conducted to see the extent of the usefulness of mobile phones in agricultural development. For example; Kwadwo and Ayalew (2011) indicated that in Philippines, the Nutrient Manager for Rice Mobile program send the information to the rice farmers via their mobile phones about optimal timing of harvesting and planting, application of the right amount and type of fertilizers at every growth stages. This can help the farmers in the way that they maximize on the crop produce as well as minimizing on the losses through rice growth monitoring. The farmers and extension workers are able to dial a toll-free number and hear a voice instruction in their preferred local language, which after prompt them to use their keypad to answer 12 to 15 questions about their rice crop.

Another study by Jensen (2007) in Kerala state of India shows that adoption of mobile phones by fishermen helped in reducing price dispersion, elimination of waste, and adherence to one price, thereby benefitting both fishermen and traders. According to Kwadwo and Ayalew (2011) in Ghana, Esoko, a local company, implemented Cocoa link, a pilot program that provides cocoa farmers with useful information about improving farming practices, farm safety, crop disease prevention, postharvest and production. In this program, farmers receive information and specific answers to questions at no charge through voice and SMS messages in their local language or English. Also in India, Reuters Market Light (RML) sends four SMS messages a day to its subscribers, farmers who subscribe to the system receive information about the weather, crops, and the current and projected commodity prices at different markets (Kwadwo and Ayalew, 2011).

Another example that shows the usefulness of mobile phone in helping farmer activities is the use of mobile phones to synchronize production practices with export market requirements in Colombo (De Silva, 2008), and the use of mobile phones by grain traders in Niger to obtain price information in other markets (Aker, 2008).

2.5 Accessibility and Timeliness of Television in Dissemination of Agricultural Information

Television is also becoming an important tool used by the farmers in rural communities. According to the Tanzania Communication Regulatory Authority (TCRA, 2012), television is used by almost 26% of Tanzanians. The main reason why television is becoming popularly used among masses is that people are able to easily get information which builds their learning skills through educational programs about health and agricultural development (Buren, 2000). Much of its success in teaching lies in the unique combination of sight and sound; and this coupling of audio and visual stimuli has proven that it can change human behaviour and ultimately improves farmer learning (Sher *et al.,* 2004).

Television is one of the important and effective information and communication tools available today which can be used effectively to transfer agricultural information among the farming communities. Apart from using the radio and mobile phone in accessing agricultural information, farmers in Kilosa district are also using television to watch agricultural and other entertaining programs. It is one of the powerful channels of communication which transmits information very fast and it has the potential of providing information very easily to large audience dispersed over wide geographical areas. Effective use of television would also help the smallholder farmers in the area to obtain different information which are important in improving agricultural productivity. Sher (2001) described that significance of television for rural communities and development of agriculture cannot be denied as it produces many agriculture programs for the rural communities in their local languages.

2.6 Complementarities between ICTs in enhancing quality of information

The three ICTs interested in this study i.e. radio, television and mobile phone have distinct strength and weaknesses. For that reason, complementarities between them is very much encouraged so as to make sure that the information brought to farmers is adequate and of high quality. Jung (2013) found that the listeners of radio have moved from being passive consumers to active participants. They use their mobile phone to call or send sms when a certain program is run and ask different questions they have. Therefore mobile phone has helped the radio to establish rapport with the listeners/farmers. Generally the use of new technology (mobile phone) by radio station has brought a qualitative improvement in the services they offer allowing for greater speed in processing and disseminating information and hence satisfying the needs of many farmers Jung (2013).

Different researches also reported a behaviour relating to TV viewing through smart phone. For example Jung (2013) reported that smart phones offers various services including web surfing and TV watching. However in real sense this is affordable to only a small proportion of the smallholder farmers in Tanzania. Perhaps the mobile phone owners use their device to find relevant information on TV programs they are interested in watching and so mobile phone may offer complementarities for consumption.

We can also observe the radio-television simulcast programs. Dia (2002) revealed that the link between radio and television is characterized not only by a degree of complementarily, but also the two ICTs draw information on the same sources. The complementarities between radio and television can also be seen in the allocation of listening hours of their respective audiences. Sometimes radio and television operate in complementary manner with one ICT airing a certain program, later on the other ICT repeat the same program.

Generally, ICT in Tanzania is acknowledged as having the potential to accelerate the socio-economic development of the country (Esselaar *et al.*, 2001; Mwakaje, 2010). This stems from the fact that the cost of such technologies has declined, making it possible for many farmers to own mobile phones, as well as accessing other ICT facilities including the radio and television (Mwakaje, 2010). The ability to own ICT facilities by farmers allows agricultural extension

services in the country to use ICTs in providing agricultural information and education to these farmers for better Agricultural productivity. Rao (2007) added that, ICT can accelerate agricultural development by facilitating knowledge management. One way of managing the knowledge is to embed it into products, where it is more easily disseminated. This can be done through a broad range of activities including effective information management i.e. gathering, filtering, classifying, storing and then disseminating.

Since it was observed that mobile phone, radio and television are suitable for the provision and dissemination of agricultural information among farmers, it was therefore necessary to find out their effectiveness in terms of accessibility, relevance and timeliness of the information they provide and explore how they can complement each other to convey the quality information to farmers.

CHAPTER THREE - METHODOLOGY

3.1 Study area

The study was conducted in Kilosa district, Tanzania located at latitude 06°49′48″S and longitude 036°59′15″E. The district covers 14,918 square kilometers (URT, 2013). It is bordered to the north by Manyara Region, to the northeast by Tanga Region, to the east by Mvomero District, to the southeast by Morogoro Rural District, to the south by Kilombero District, to the southwest by the Iringa Region and to the west by the Dodoma Region(URT, 2007).

Population in the area is 438,175 (URT, 2013). The dominant tribes in Kilosa are wakaguru, wasagara and wavidunda. Also wamasai and wasukuma are now widely observed. Climate in the area is semi arid with annual rainfall ranging from 500-1000mm (URT, 2007). Food crops grown include maize, millet, cassava, sorghum, paddy and legumes while cash crops raised include Sugarcane, Sisal, Oilseeds and coconuts (URT, 2007).

3.2 Research design

The study employed cross-sectional descriptive design to explore various issues regarding effectiveness of ICTs in dissemination of agricultural information. The design was chosen because it is cost effective. According to Agresti and Finlay (2009), the design allows a combination of various survey methods for gathering a body of both qualitative and quantitative data and offer quick results with minimal costs. A descriptive survey also allows rapport establishment with the respondent. Acquisition of more in-depth information through interaction with the respondents was also done. Extensive observation and note-taking during interviews and farmer meetings were done. This helped to obtain visual clues for those behaviours which were observed firsthand or when the respondents became reluctant to discuss the topic.

3.3 Population and Sampling Procedure

The study targeted smallholder farmers in Kilosa district. A sample size of 240 smallholder farmers was involved in the study. This was determined using the formula proposed by Israel (2012).

$$n = \frac{Z^2 \times pq}{e^2}$$

Where: n= required sample size,

Z = confidence level at 95% (standard value of 1.96),

p = is the estimated proportion of an attribute that is present in the population, (for this case p= 0.4 i.e. 40%).

e= margin of error at 5% (standard value of 0.05)

i.e. n = 1.96^2x 0.2 (1- 0.4) / 0.05^2 = 245.86

Simple random technique was used to select the three wards that were involved in the study. In this technique a lottery method was used to select those three wards. The technique was chosen because the subjects are selected objectively such that no opportunity for human bias to manifest. The researcher used Stat Trek's Random Number Generator. Cards of random numbers to represent each ward among the 37 available in the district were then developed and mixed in a box. After picking one number from the box, it was put aside. The process was repeated three times to obtain the required number of wards to be involved in a study.

Three villages from each ward were also randomly selected using similar method (lottery). In each village the researcher obtained a list of farmers from the village agricultural extension officer (VAEO). From a list of those farmers in each village, 27 of them were selected using systematic sampling technique to obtain 243 respondents. In this technique the researcher randomly selected a starting number which was referred as the first subject. He then picked another integer (2) which served as the constant difference between any two consecutive numbers in the progression. That means the sampling was done at an interval of 2, which is after two individuals the next is included in the sample. However, a researcher used a sample size of 240 because the three farmers were unable to be contacted. Figure one illustrates how sampling was done.

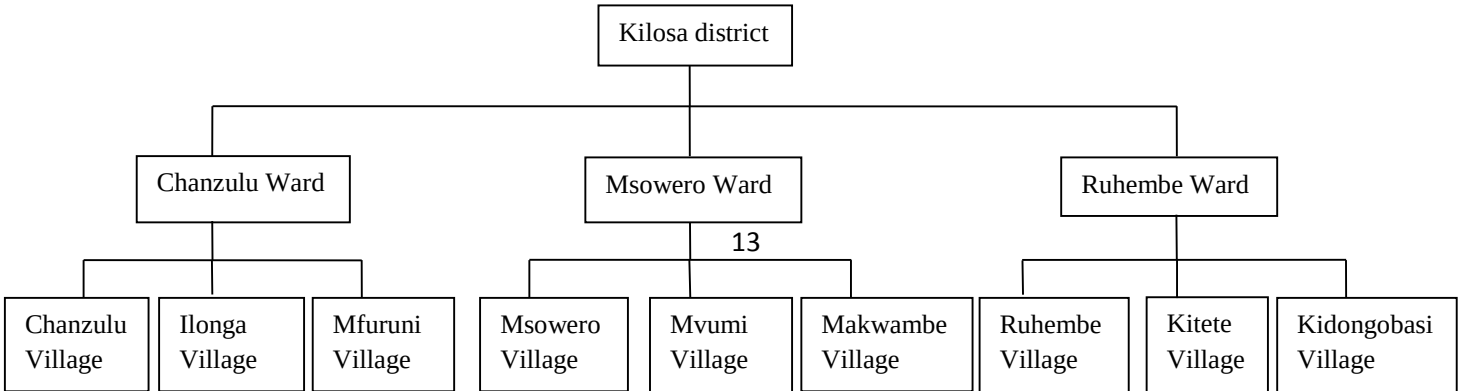

Figure 1: Sampling procedure for the study

3.4 Validity and reliability of the instruments

Questionnaires and checklist were used for data collection. To ensure that the instruments used to collect data addresses the study objectives, their basic content validity and reliability issues were analyzed.

3.4.1 Content validity

Content validity refers to how well an instrument includes a representative sample of questions that relate to the content domain being measured (Patten, 2004). To ensure content validity of the survey instruments, review of related literature was done. The instruments developed were checked and critiqued by the supervisors to determine whether they contain items that can measure study objectives. The supervisors also proposed possible questions to be included. In addition, a peer review by my colleagues from Makerere and Sokoine University was done specifically to check for face validity of the instrument i.e. clarity of printing, font size and type, adequacy of workspace, and language. After the instruments were being checked by the supervisors and peers corrections were made and the final instrument was developed (see appendix 1).

3.4.2 Reliability

Reliability indicates the degree to which a survey instrument is consistent with what it measures (Litwin, 1995). A split half reliability test was conducted to determine the consistency of the survey instrument. To carry out the split half reliability test, the questionnaire was administered to 30

smallholder farmers who were randomly selected from a list of farmers in Dumila village in Gairo district. Gairo district is close to Kilosa and the two districts have more/less similar characteristics. According to Israel (2012) a sample size greater or equal to 20 can yield meaningful results in a survey study. A Spearman Brown coefficient of 0.78 was obtained which showed that the questionnaire was reliable. A post hoc analysis using the pre test sample generated a Spearman Brown coefficient of 0.8 to confirm the reliability of the questionnaire.

3.5 Data Collection Procedures

1. Survey research method was used in which semi structured questionnaires were administered to collect primary data from the respondents. The questionnaire collected demographic data such as occupation, age, sex, education level and marital status of the farmers. Other primary data collected include the ICT facilities owned by farmers; type of agricultural information accessed through each ICT, and numbers of times the farmer access that agricultural information using ICT. Others are the rank of each ICT in terms of coverage, timeliness and relevance, and the factors used for the ranking. The questionnaire was filled at one point in time with the help of research assistants. Before administration of the questionnaire to farmers, a training of research assistants was conducted to give them skills on data collection.

2. To complement the quantitative data that were generated by the questionnaires, qualitative data were also collected from key informants (extension staffs and ICT service providers). Information about the radio and TV programs, basis of programming, type of agricultural information provided by the ICTs, sources of information and role of the farmers in the process were among the qualitative data which were collected. This enabled the researcher to put interpretation in context. An interview with key informants also helped a researcher to gain more insight into the environment and the contextual factors related to accessibility, timeliness and relevance of ICTs in dissemination of agricultural information.

3. A meeting with a mixed group of farmers in Ilonga juu hamlet led by their chairperson was also conducted to obtain their views on how would they want the information to flow. Listening/watching/dialing was done to determine the quality and relevance of radio/television and mobile phone infrastructures i.e. how well the information can be heard, seen/demonstrated to

farmers as well as the accessibility of some programs on a mobile phone. This helped to get a firsthand experience of the issues generated in the interviews.

4. Documentary review was also done at the District council, department of agriculture to collect secondary data. The data collected were about the information that was received by the farmers through Farmer voice radio program. Also the questions asked by the farmers through their mobile phones when FVR program was on.

3.7 Data Analysis

Primary data collected were checked for accuracy, coded, and then entered into a computer. Analysis of quantitative data was conducted with respect to the objectives of the study using the Software Package for statistical analysis (SPSS).

Frequencies and percentages were computed to describe various matters related to ICTs and they were presented in tables and figures to show the differences and options of respondents on which the discussion is based. A Chi-square was run to test for a relationship between access to ICTs and age, sex, education level and marital status of the farmers.

Analysis of variance was conducted to assess the degree to which means for coverage, timeliness and relevance of ICTs vary from each other. If the probability was found to be at less than 0.05 significant levels a post hoc test (Duncan multiple comparison test) was run to compare means. Likert scale was used to measure the farmers' perceptions of the effectiveness of ICTs in dissemination of agricultural information and the frequencies were run to establish the level of perceptions

Content analysis of qualitative data was conducted to identify the socially constructed nature of reality. The process involved identifying, coding and categorizing the primary patterns in the data. The first step was to properly scrutinize the data through reading the collected information. Secondly, the information was then categorized by identifying themes or patterns i.e. ideas, concepts, behaviours, interactions, incidents, terminology or phrases used. Here the data collected were made into field notes. Codes were analytically developed in the data and affixed to set of

notes. These codes were then transformed into categorical labels or themes basing on their relationship, and commonalities or disparities. The identified themes or patterns were then organized into coherent categories that were summarized to bring meaning to the text. These identified patterns were considered in light of previous research and theories and a small set of generalization was then established.

CHAPTER FOUR - RESULTS AND DISCUSSION

4.1 Socio-Economic Characteristics of the Respondents

Two hundred and forty farmers from three wards of Kilosa district namely; Chanzulu, Msowero and Ruhembe were involved in the study. The socio-economic characteristics of these farmers are described (Table 1) to provide a background for discussion of the results. The characteristics described include age, sex, marital status and education level of the farmers.

Table 1: Socio - economic characteristics of the respondents

Variable	Categories	Percentage
Age	15-24	6.7
	25-34	26.2
	35-44	28.8
	45-54	25
	55-64	7.9
	65 and above	5.4
Sex	Male	42.1
	Female	57.9
Education level	No formal education	7.1
	Primary	84.6
	Ordinary level	7.1
	advanced level	0.4
	Tertiary	0.8
Marital Status	Married	60.8
	Single	21.7
	Divorced	7.9
	Widow/widower	9.6

Source: Survey data, 2014. The age category is according to UN standard international age classification (1982) basing on economically active group, by occupation: Categorization for education level is based on the education system of Tanzania

Results in table 1 shows that over 60% of the respondents are 44 years or lower. The result matches that of Okwu and Ioorka (2011) who found the age group between 21 to 40 years as the most prevalent among farmers due to the responsibilities they have to feed the families. This means that the active group is engaging in farming as their major economic activity. From the results it was also noted that a fairly good number of respondents (32.9%) were in the age between 45 to 64 years. This is also a working group that has responsibility of feeding the families as well as generating more income that can lead them into a better life. The elders aging 65 years and above were about 5%. It is important to note that the farmers in this group do not have enough energy to engage in productive activities and that is why they are few as compared to other groups.

Results further indicate that about 58% of the respondents were females whereas the males were 42%. This shows that both males and females are involved in farming. Their participation in agricultural activities is because both depend on farming as an activity that can fulfill the family needs; feeding the families as well as giving proper services to the children. According to Scott *et al*. (2005), both males and females are equally participating in production because of the increase in responsibilities to both parties. The results also carry a sense of great gender equality in the area. According to Food and Agricultural Organization, FAO (2010) rural women provide 50% of agricultural labour force.

From table 1, the biggest proportion of the farmers (84.6%) had completed primary education. About 7% and 0.4% attended ordinary and advanced level respectively. One (1%) percent attended tertiary education while over 7% did not attend any formal education. These results conform to the findings by Churi *et al.* (2012) and this implies that majority of farmers in rural areas have not gone for higher level education. In a discussion with the district extension officer it was noted that low education among the farming communities affects their ability to adopt different technologies. Most of these farmers are not confident to try new innovations in their farms, given an example of some farmers who are not ready to use fertilizers with the notion that fertilizer affects their soils. A study by Voh (2002) reported that there is a positive and significant relationship between formal education and adoption of technologies. It was also noted during the survey that the farmers with limited education are also not conversant in using new technologies in accessing agricultural

information. All these situations impact to limited ability to access timely and relevant information for their farming activities.

Results also show that about 61% of the respondents are married, 21.7% are single whereas 7.9% and 9.6% are divorced and widow/widower respectively. This indicates that married people dominate the farming activities in the area than the other categories. During a group discussion with the farmers it was pointed out that the married, in most cases have dependents to take care of and their participation in farming helps to improve income that can help them to provide adequate care for the dependents. A study conducted by Mwilomo (2012) in Tanzania revealed that majority of the rural households comprises of up to 10 persons. Since farming is a major economic activity for most of people in rural areas, the married ones participate in farming activities so as to cater for family needs. On the other hand, the dependents provide labour for agricultural production activities as indicated by Daudu *et al.* (2005).

4.1.1 Farming systems and farm enterprises in Kilosa

The agricultural practices of the farmers in Kilosa generally embrace cultivation of crops (crop-based farming system) involving crops like maize (50.6%), rice (69.8%), sunflower (14.6%), tomatoes (11.2%) and sugarcane (11.2%) or rearing of livestock (animal-based farming system) such as cattle (10.8%), pigs (10.4%), goats (9.2%) and local chicken (12.2%) and the farmer's livelihood is attached to either of these two categories (table 2).

Table 2: Major enterprises undertaken by the respondents

Type of Enterprise	Percent (n=240)

Crop Enterprises	
Maize production	50.6
Rice production	69.8
Sunflower production	14.6
Tomato production	11.2
Sugarcane production	11.2
Livestock Enterprise	
Pig rearing	10.4
Local chicken rearing	12.2
Cattle keeping	10.8
Goat keeping	9.2
Sheep rearing	1.0

Source: Survey data, 2014.

From the findings regarding farming it is obvious that crop-based farming system dominate the farmers' production activities where rice and maize production are the major enterprises. Sunflower, tomato and sugarcane are also important crops; pigs, cattle, goats and chicken are also rising as important economic activities for farmers who are engaging themselves in animal-based farming system. This implies that the use of ICT in extension service should focus more on these enterprises that seem to be of high importance to the farmers.

4.1.2 Constraints in the farming systems

The farming systems in Kilosa face many constraints which have continually affected the agricultural production and thus very low produce are fetched than what is expected. Lack of access to information has been the helm of being some of the biggest challenges since there is limited number of extension workers compared to the available farmers. Table 3 shows the challenges as indicated by farmers.

Table 3: Challenges in the farming system (n=240)

Challenge	frequency	percent
Lack of market for agricultural produce	233	42.2

Lack of access to information	231	41.8
Pests and diseases	49	8.9
Unreliable rainfall	39	7.1

Source: survey data, 2014.

From table 3, more than 40% of the respondents show that lack of information and lack of market for agricultural produce are the critical challenges in the farming systems. Other challenges observed include pest and diseases (8.9) and unreliable rainfall (7.1%). In a discussion with the farmers it was noted that lack of market information makes them to sell their agricultural produce at farm gate price to the middlemen or in their local market hence continuation of poverty among the farming communities. Also inadequate access to extension services has led to the increased inability to access market and other important information that would help them participate well in agribusiness. The situation is supported by this statement from one of the farmers: *'...all what we have are not problems if we were reached by the extension officers to help us...*' (Female farmer in 27th March 2014, at Mfuruni village). Actually she was trying to explain as to what extent they are faced with a challenge of information and in this, the use of Information Communication Technologies (ICTs) for agricultural extension can be one way of addressing the information needs of farmers. With the help of ICTs, agricultural extension is expected to become more diverse and hence more effective in meeting farmers' information needs. It is therefore important to discuss the effectiveness of ICTs in addressing the challenges which are facing the farming systems in the area.

4.1.3 Type of agricultural information accessed by farmers through ICT

The respondents were asked on the types of information they are currently accessing using each of the ICT. It was found that information on farm inputs such as fertilizers, seeds and agrochemicals; pest and diseases and that of land disputes between farmers and livestock keepers are the one that is mostly received. These are indicated by more than 50% of the respondents. Table 4 below illustrates the results from a survey

Table 4: Type of agricultural information accessed by the farmers (n = 240)

Type of agricultural information accessed	Percentage (%) of farmers receiving information from the ICTs		
	Radio	**TV**	**Mobile phone**
Farm inputs	39.2	12.1	24.2
Land disputes	22	9.2	47.1
Best practices (sowing methods, ploughing)	10	13.8	5
weather	15.4	15.8	2.9
Irrigation technologies	12	15	2.1
Weight and measures	14.2	0	0
Pest and diseases	34.2	2.1	32.1
Post harvest management	15.2	10	17.9
Environmental conservation	12	21.7	2.9
Market/price trends	15.7	3.3	29.2
Animal husbandry	6.6	12.9	10.8

Source: Survey data, 2014.

Results in table 4 further indicate that small proportion (less than 50%) of the farmers received information on animal husbandry, methods of environmental conservation, post harvest losses and management, standard measures, weather, irrigation technologies, market and best agronomic practices. In a group discussion with the farmers in Msowero village on 21st /March/2014 it was pointed out that, farmers would prefer mostly the information on market, weather, farm inputs as well as information on various methods of preserving agricultural produce. According to the farmers, there have been times where they received information on traditional methods of rice post harvest management through radio, but the information is rarely given. Table 5 below shows the types of information that the farmers would want to access.

Table 5: Kinds of information that farmers wanted to access (n = 240)

Type of information farmers would want to access	Frequency	Percent
Market places/price trends	184	76.7
Weather	128	53.3
Fertilizers, chemicals and improved seed varieties	119	49.6
methods of preserving agricultural produces	59	24.5
Irrigation technologies	41	17.1
Pests and diseases	27	11.3
Sowing methods and contour ploughing	23	9.6
Livestock care	16	6.7
Vaccine	5	2.1

Source: Survey data, 2014.

From table 5, large proportion of the farmers (76.7%) consider market information as very important agricultural information that can help them secure a reliable market to sell their agricultural produce and gain more income that will help them to improve farming activities and their living standard. It was indicated by IICD (2006) that market information about best time of when to buy and sell goods and at the right place, is instrumental in making decisions about future crops and commodities. Information about weather was also indicated by a fairly good number of the respondents as among the important information that is needed in the study area. In this regard, it was established by Churi *et al.* (2012) that climate information is an important input to farming decisions in rain-fed agricultural systems of dry land areas because the farmers expect weather information to help them decide on the right time to implement a particular farming activity for better results. Other information that was found to be important in contributing to improved productivity and food security include; accessibility of improved seeds, fertilizers and agrochemicals. Others are irrigation technologies, pests and diseases as well as best practices. It

was also established during a discussion with the farmers that there is some information which is not provided at all and farmers would wish to have it provided. This includes information about the right feeding ratios that can help to fatten cattle and pigs, and information on vaccine for local chicken. What this suggests is soliciting for farmers' input and feedback about information needed for improved agricultural productivity.

4.1.4 Farmers' access to ICT

The proportions of farmers who use ICT to access information are 78.7%, 76.2% and 77.5% for Chanzulu, Msowero and Ruhembe wards respectively (see figure 2).

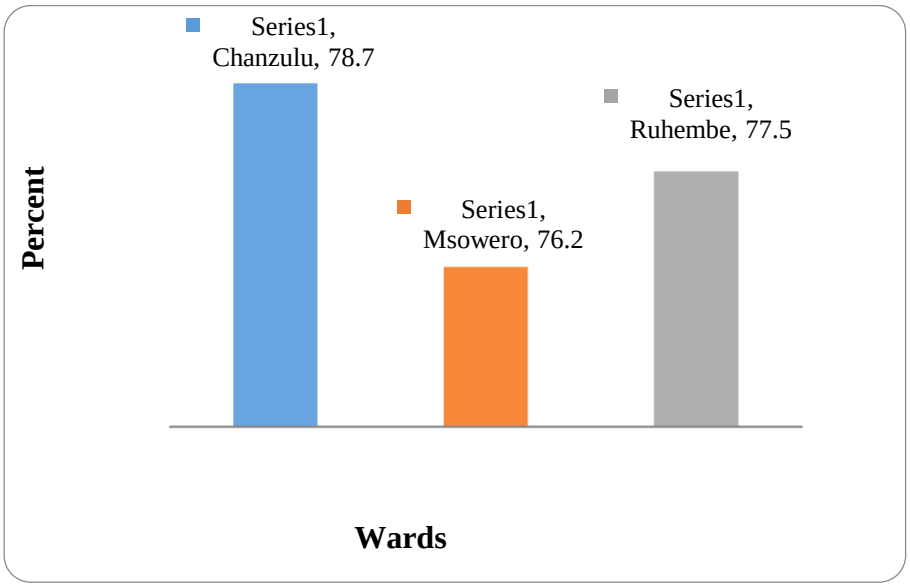

Figure 2: Percentages of the Farmers using ICT in each ward

As figure 2 above reveals farmers from all the three wards have high access to ICTs. During interviews with extension staffs and ICT service providers it was recognized that the ICT infrastructures are well distributed throughout the district. Mobile phone services, radio waves and television networks are everywhere and that becomes a motivation for farmers to use ICT in seeking for information.

The farmers who are able to access information using radio are 88.3% followed by mobile phone (51.7%) and those who use television to access agricultural information are 17.1% as it is shown in table 6.

Table 6: Farmer's access to information using different ICTs (n=240)

Type of ICT	Frequency	Percentage
Radio	212	88.3%
Television	41	17.1%
Mobile phone	124	51.7%

Source: Survey data, 2014

The findings in table 6 agree with Abubakar *et al.* (2009) and Manyozo, (2009), who described that access to agricultural information in most developing countries has been provided through radio. Also Churi *et al*. (2012) discovered that majority of farmers possess mobile phones which are cheap and easy to use and therefore they can obtain various services including transfer of money that can be used in agricultural activities. Also knowledge sharing through mobile phones is enhanced as these farmers can make calls or send short messages (sms) to input dealers, extension workers and other agricultural stakeholders. High usage of radio to access agricultural information in the area is due to a good number of radio stations reaching the study area, low cost, and appropriate airing time. During a survey for this study it was discovered that most of the agricultural programs on radio are aired in evening hours from 4pm to 7pm.This time is found to be convenient to majority of the respondents as the programs finds them back at home after busy work from morning up to the afternoon. Kilosa district has a local FM radio station known as Radio Jamii. There are also other stations not based in the district but their airwaves can be received in the district such as; Radio Abood FM, Radio free Africa, Radio Maria and TBC Taifa. Studies conducted by Olaleye *et al.* (2009) in Nigeria and Sife *et al.* (2010) in Tanzania established that dependence on radio by rural people is mostly due to the wide coverage of radio frequencies and availability of many radio stations.

4.2 Relationship between farmer's socio-economic characteristics and access to agricultural information through ICTs.

Analysis was conducted to determine the percentage of respondents with respects to different ICT as per socio-economic characteristics. A chi-square test was then run to establish if there is any

relationship between farmer's access to ICT information with age, sex, education level, and marital status of the farmers. The results are presented in table 7.

Table 7: Farmers' socio-economic characteristics with respect to ICT use

Socio-economic variable		Percentage of respondents with respect to different ICT		
		Radio	Television	Mobile Phone
Age	15-24	9.2	16.7	25.5
	25-34	15.4	45.2	41.2
	35-44	24.9	15.9	14.2
	45-54	12.6	9.2	7.3
	55-64	31	5.5	6.7
	65 and above	6.9	5.4	5.0
	Chi-square Estimates[1]	0.040*	0.689	0.015*
Sex -	male	40.6	63.4	48.4
	female	59.4	36.6	51.6
	Chi-square Estimates[2]	0.224	0.003**	0.051
Education -	no formal education	7.1	5	5.4
	primary	79.2	16.7	76.6
	ordinary level	5.8	5	7.1
	Advanced level	0.4	0.4	0.4
	tertiary	0.8	0.8	0.8
	Chi-square Estimates[3]	0.176	0.016*	0.002**
Marital status -	Married	64.6	73.2	56.5
	single	22.6	24.4	32.3
	divorced	6.3	5.0	6.7
	widow/widower	9.0	5.4	7.3
	Chi-square Estimates[4]	0.241	0.025*	0.026*

Source: survey data, 2014. *significant at 5%, **significant at 1%. Chi- square test of independence
Ho: there is no association between socio-economic characteristics and access to ICT

H1: there is an association between socio-economic characteristics and access to ICT

4.2.1 Respondent's age and access to agricultural information through ICTs

Survey results (table 7) indicated that farmers in all age group categories have access to information from all the three ICTs in varying degrees. Results further show that there is an association between respondent's age and access to agricultural information through radio and mobile phone with chi-square estimates of 0.040 and 0.015 respectively ($p<0.05$). However, it was found that there is no significant difference between age of the respondents and access to

information through television (P=0.689). This implies that, access to information using television is independent of respondent's age. Results conform to what was observed from a group discussion with farmers on 3rd April 2014 at Chanzulu village where both the youth and old farmers indicated that they watch television due to different programs that are available.

On the other hand, results suggest that the age of farmers have an influence on the farmers' access to information using radio and mobile phone. During survey, it was observed that most of the older farmers (55 – 64 years) prefer to use radio in accessing information as compared to other ICT facilities because of their familiarity to radio as they have been using it for a number of years. This is supported by Olaleye *et al*. (2009) who state that the dependence of the radio as the source of information makes the older farmers to more receive radio agricultural information. In a discussion with the farmers it was discovered that radio is the preferred source of information for older farmers. It is also used to entertain them in evening hours after work on their farm holdings. Sometimes agricultural tips or adverts are aired when the entertaining programs continue, and this makes them receive that agricultural information by chance.

Table 7 shows that over 66% of the youth with age between 15 to 34 years use mobile phones. Mobile phone is one of the modern technologies which are highly preferred by the young generation because of the different services it can provide including games. They also simplify communication among them making it easy to make contact and maintain social relationship. For the few farmers who are able to own smart phones they can access internet, and other social network applications such as facebook, twitter, instagram, whatsapp and viber. This helps to engage the youth in social relationships and also accessing other services like mobile money and agricultural information services. During interviews with extension staffs in the study area, it was found that most of the older farmers were not aware of the various information services on mobile phone and that is a reason why they have limited access to this information communication tool as compared to the youth.

4.2.2 Sex of farmers and access to agricultural information through ICT

Results also show that both males and females are able to access information using radio, television and mobile phone. Chi-square test also indicated that there is no association between sex of farmers

and access to agricultural information through radio and mobile phone (P>0.05). This implies that information access through radio and mobile phone is not significantly influenced by sex of the farmers. This further explain that both male and female farmers set aside some times to listen to radio agricultural related programs as well as use their mobile phone to seek various information. Both groups are occupied with a lot of activities; both production and reproduction-related for women, and men with other production roles. However, they all find that information is important in their day to day activities. Mobile phones are portable and can be carried anywhere; for that case the farmers ability to access agricultural information using their mobile telephone is not questionable. The farmers can use their mobile phones at any time whether when they are at home or at the garden to access and share different information; among themselves, extension workers and other important stakeholders of agriculture sector.

On the other hand a chi-square test indicated an association between farmers' sex and access to information using television (P=0.003). More men are likely to watch TV agricultural program as compared to women farmers because of the differences in the roles they are performing. On further discussion with the farmers it was discovered that, it is tricky for the women to watch television agricultural programs which are in most cases aired in evening hours. At this time women have to fetch water for domestic use, take care of children and also to prepare food, which are termed as female related chores; at least they can continue to listen to radio programs while continuing with their work.

4.2.3 Farmers' education level and access to agricultural information using ICT

Results in table 7 further indicated that formal education is important in information access. Chi-square estimates indicated a relationship between the farmers' education level and access to information through television and mobile phone (P=0.016 and P=0.002 respectively). The findings suggest that the ability to access information using television and mobile phone differs between the more educated and those with limited education. Sometimes limited education leads to low ability to accessing the information as compared to the literate ones. It was found by Okwu and Ioorka (2011) that the literate farmers can effectively use ICTs to access information. This contradicts the findings of this study which finds that majority of the mobile phone users are those with primary education (table 7). Probably this is because they are the ones who mostly participating in agricultural activities. On further discussion with the farmers it was noted that they

became conversant in using mobile phone technology due to some trainings provided especially on "tigo kilimo" program. These are informal trainings from friends/relatives, extension workers or Tigo mobile phone service providers.

Meanwhile access to information using radio was found to be independent of the education level (P=0.176). This implies that use of radio in Kilosa may not be affected by lack of education among the smallholder farmers. It was reported by Olaleye *et al.* (2009) that radio is equally effective with literates and non – literates. All the farmers with radio sets can access agricultural information especially if agricultural radio programs are aired in Kiswahili language which they are familiar with. During a survey it was observed that in Kilosa the farmers prefer to listen to Swahili broadcasted programs other than those in other languages such as English. Some of the farmers who access information through radio do not intentionally tune their radio sets for agricultural information but rather they just receive information as they are listening to other programs.

4.2.4 Marital Status and access to agricultural information through ICT

Results also show that the married, singles, divorced and the widow/widower have access to information through all the ICTs in varying magnitudes. However a chi-square test established that there is an association between marital status and access to information using television and mobile phone (p=0.025 and P=0.026 respectively), implying that marital status is an important factor that can influence information access through television and mobile phone. There is a possibility for the married couples to influence one another in what kind of a television program to watch. It can also happen that both have interest in watching educative programs like agricultural related programs; if that happens then it can lead to increased ability to access agricultural information. But in case one is not interested he/she can be influenced by his/her partner unlike for the singles, if one doesn't have interest in watching to agricultural programs on television he/she may end up watching other programs e.g. music as a result a chance of accessing agricultural information is minimized. Chhachhar *et al.* (2012) confirmed that there is a significant relationship in terms of choosing television programs to watch between the married and those who are single, with the singles prefer to watch programs that are more entertaining. It is also possible for the married one to share the information aired in case one of them missed the program due to other obligations. For mobile phone it is possible for both husband and wife to possess mobile handsets due to their

relatively low cost and they can individually seek agricultural information at their convenient time and thus high chances of receiving information.

It was however observed that access to information through radio is independent of marital status (P=0.241). This means that access to information using radio is not influenced by marital status of the farmers instead it can be influenced by different pathways used to access such information. The results further suggest that all farmers with radio sets can equally access agricultural information through radio regardless of their marital status.

4.3 Complementarities of ICTs in enhancing access to quality information to farmers

4.3.1Coverage of radio, television and mobile phone

The farmers were asked to rank the ICTs in terms of coverage i.e. the content and distance it covers. About 77% of the farmers ranked radio as the leading ICT in terms of coverage. Those who ranked mobile phone and television to be the leading were 12.1% and 10.8% respectively.

Table 8: Rank of ICT in terms of coverage (n=240)

Type of ICT	**Percentage of farmer and their respective ranking for the different ICT (n=240)**		
	1st	**2nd**	**3rd**
Radio	76.7	19.6	3.7
Mobile Phone	12.1	60.0	27.9
Television	10.8	20.4	68.7

Source: survey data, 2014

Most farmers access information using the radio as shown in table 8. Radio is ranked first because of the good radio waves and many radio stations widely spread throughout the district (Mtega and Msungu, 2013). Also the radio sets are sold at relatively low prices ranging from Tanzanian shillings 5,000-20,000 for small set (note book size) thus many farmers can afford to buy and own a radio as well as using mobile phone to access the radio stations. According to Olaleye *et al.* (2009), radio is the number one source of agricultural information due to its affordability because of the low cost, timeliness of information, appropriate airing time and quality of agricultural information. Mtega and Msungu (2013) added that with the current technology convergence, it is

possible to access radio through mobile phones which are owned by almost half of the Tanzanian population. The different factors that make radio to be ranked first are indicated in table 9.

Table 9: Factors that make radio to be the leading ICT in terms of coverage (n=240)

Factor	frequency	Percent
It can be used in absence of electricity	193	26.8
It helps to receive new information more often than the rest	184	25.5
It is easily accessible	138	19.2
It is cheap	110	15.3
Availability of local radio station	95	13.2

Source: survey data, 2014.

Results in table 9 show that access to information using radio is made possible because of many factors including its affordability as it was indicated by 15.3% of the respondents. Over 19% indicated that radio information is easily accessible. The main reason is that radio can use different modes of energy such as electricity and batteries. But, some of them who are far away from the national grids opt for the radio which uses batteries. This is according to 26.8% of the interviewee who indicated that there is an increased spread of radio coverage since they can also be used without electricity. Other ICTs like television can also be used on other sources of energy such as solar energy but this is expensive. Solar energy is expensive in terms of the initial costs incurred during purchasing the system components and its installation which seem not affordable to the most farmers. Over 13% of the farmers indicated availability of a radio station in the study area as one of the factors contributing to its high usage by the population whereas 25.5% indicated radio to have high coverage due to a good number of radio agricultural programs per week. It was indicated by the farmers that there are always not less than two agricultural programs per week and this makes them to get new information more often.

Also radio is found to take the lead because of the farmers being unaware of the rest of ICTs in their contribution towards knowledge sharing as pointed out by Kameswhari *et al.* (2011). Another study by IICD (2005) conducted in Tanzania, Zambia and Ghana also indicated that mobile phones are mostly used in improving communication with family and friends. The same applies to Kilosa; one farmer on 23rd/March/2014 at Msowero village said that '*we use mobile phones primarily to*

maintain social networks'. This farmer was confirming that mobile phone can be used for many purposes including accessing agricultural information; however their primary purpose is that of improving communication and networking among people. Although in some villages within the study area were found out that television is more popular than radio because of its audio- visual nature, but still it is not used to get important agricultural information but is instead seen as an entertainment object for watching movies and soccer. This is supported by Kameswhari *et al*. (2011) who found out that television is mostly used for pleasure seeking despite regular broadcast of agriculture programs.

Sixty percent (60%) of the farmers indicated mobile phone to be the second ICT after radio in terms of coverage. Table 10 shows some attributes which makes mobile phone to be an important ICT.

Table 10: Reasons for high coverage of mobile phone (n=240)

Reason	**frequency**	**percent**
Mobile money services	206	42.9
Adequate number of mobile service providers	179	37.3
Presence of cheap mobile handsets	51	10.6
Strong network connection	44	9.2

Source: survey data, 2014

Mobile phone could be among the easiest way to use when sharing information between farmers and extension staff. This creates an environment of one to one interaction as well as learning from each of the party thus getting solutions to problems in a shorter time, In Kilosa this is made possible because of the presence of a good number of mobile service providers as acknowledged by 37.3% of the respondents. The mobile service providers found in this area include; airtel, vodacom and tigo. It was reported by Mtega and Msungu (2013) that the extending mobile phone infrastructure and the increasing number of services on offer by mobile phone companies is a reason why there has been increased number of customers using the tool in knowledge sharing. Many farmers and

extension staff own mobile phones which they could use to communicate when seeking for agricultural information. This is because of the presence of cheap mobile handsets that many people can afford to buy. About 43% of the respondents indicated mobile money services as among the factors contributing to the wider usage of this ICT tool. Each of the mobile networks that are vodacom, tigo and airtel has mobile money services which are 'M-pesa', 'tigopesa' and airtel money respectively. The mobile money service was found to help people of Kilosa including the farmers in receiving or sending money to or from friends and relatives. On the other hand 9.2% of the respondents pointed out the presence of strong network connection for some mobile network especially airtel as among the factors contributing to high use of the tool in information gathering.

Television is ranked as the last ICT in terms of coverage. Television coverage is limited by many factors including lack of electricity and low economic status of the farmers. Despite the establishment of Rural Energy Agency (REA) with the aim of ensuring that all villages of Tanzania are electrified, still most of the rural remote areas do not have access to electricity. Mtega and Msungu (2013) found out that limited rural electrification has to a great extent reduced the usefulness of television in rural areas. In Kilosa this is witnessed by 47% of the respondents who mentioned lack of electricity as a limiting factor to access television services. About 38% of the respondents reported television to have wider coverage; however poverty seems to affect its accessibility as it either makes them fail to install electricity in their houses or buy television sets. Close to 15% of the farmers mentioned poor television infrastructures i.e. television masts in the study area as the limiting factor (see figure 3).

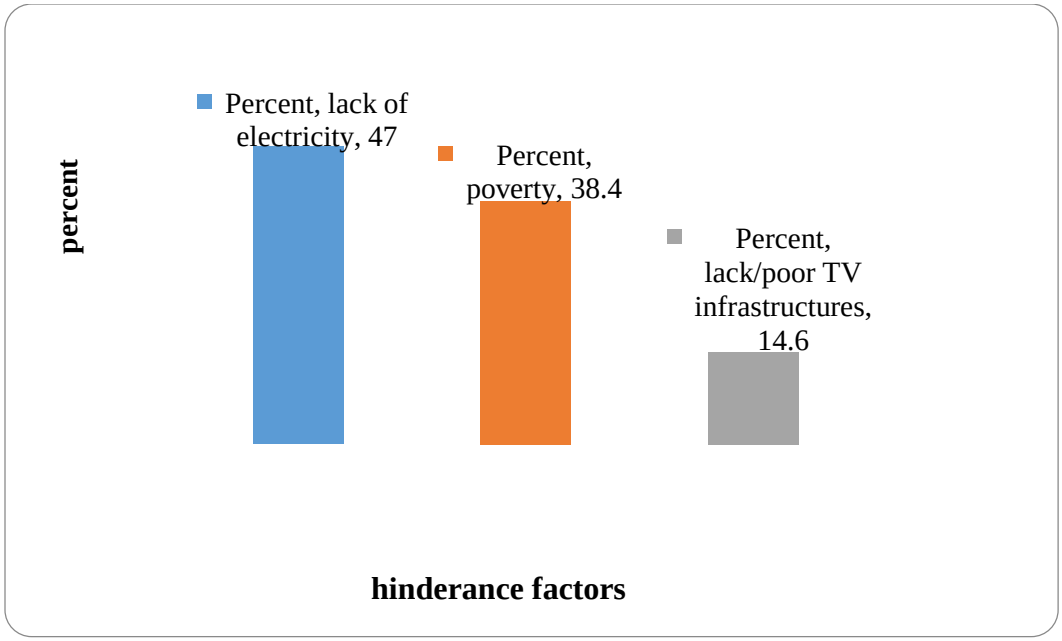

Figure 3: Factors that hinder television coverage and its accessibility

The findings presented in figure 3 corresponds to that of Sife *et al.* (2010) who established that television access in rural Tanzania has been largely constrained by mostly lack of electricity. Since access to television requires electricity, it is difficult for the farmers to access information through this information communication tool. Poor television masts that reach the study area also tend to affect the access of television information to many of the farmers. Also due to their low economic status many farmers cannot afford to buy television sets which are sold at a higher price as a result their chance of watching television programs is minimized. For example a small TV set (14 inch) is sold at an average price of one hundred thousand Tanzanian shillings. Installation of electricity from the National grid line is also very expensive to many of the smallholder farmers as it can cost up to three hundred and eighty thousand shillings. Diyamett *et al.* (2010) also pointed out that many of TV stations in Tanzania cover either a district or region and only three TV stations boast a countrywide coverage. Kilosa district does not have its own TV station; therefore the quality of infrastructures of the television stations which boast countrywide coverage is the one to dictate access of information to the farmers in this district.

4.3.2 Relevance of the agricultural information accessed by farmers through ICTs

The ability to bring changes in agricultural production is the indicator used in this study to measure relevance of agricultural information conveyed to farmers through ICTs. Slightly more than 45% of the farmers indicated radio to be the leading ICT regarding relevance of the aired information. From table 11, 45% of the farmers supported television and 9.6% of the respondents opt for mobile phones which seem to be a marginal number as regards to providing relevant agricultural information. The findings differ from those of other researchers like Kameswhari *et al.* (2011) and Dia (2002) who found television to edge out the radio due to the visual nature of television and the diversified content that leads to multiple gratifications. Also Churi *et al.* (2012) discovered that radio messages do not address the agricultural information as required by the farmers who perceives information as poorly organized. Whereas it is true that TV may have multiple benefits due to the visual nature, findings of this study indicate that majority of farmers in Kilosa do not have adequate access to television. This is because of limited power access and poor television masts that reach the study area. On the other hand this study finds that radio is the relevant source of agricultural information to the farmers of Kilosa. A discussion with the farmers and the extension staff in the area reveals that the local radio and other radios from outside the district provide suitable and useful information that is needed by the rural farmers.

Table 11: Rank of ICTs in terms of providing relevant information to farmers

Type of ICT	**Percentage of farmer and their respective ranking for the different ICT (n=240)**		
	1st	**2nd**	**3rd**
Radio	45.4	40.0	14.6
Television	45.0	28.7	26.3
Mobile phone	9.6	56.6	33.8

Source: survey data, 2014

The reason why radio was placed in the first position is because of the clear information it conveys to the farmers. The information provided by radio can easily be understood by all the farmers as most of the radio programs are in Kiswahili language which is spoken by almost all the Tanzanians. Results from the survey, shows that 40.6%, 47.3% and 12.1% of the respondents indicated radio

information to have helped them improve their production activities, increase the volume of agricultural produce and improve the quality of agricultural produce respectively (table 12). There are different innovations made on the different radio programs which have contributed to its increasing relevance. For example radio Abood FM through a program called 'Kilimo hifadhi' involves both experts and the local people in development of content i.e. various methods of conserving the environment as well as improving soil nutrients. This finding contrasts observation made by Churi et al (2012). Probably this is due to new programs such as soil health programs that are incorporated by the radio stations.

Table 12: Changes in production activities as a result of agricultural information aired on radio (n=240)

Change in agricultural production	Frequency	Percent
Increased volume of agricultural produce	227	47.3
Improved production activities	195	40.6
Improved quality of agricultural produce	58	12.1

Source: survey data, 2014

With the findings in table 12, it is obvious that radio plays a great role in helping the farmers improve their agricultural production. In an interview with the Kilosa district extension officer, it was noted that not only radio agricultural information has led to improvement in the farming activities but also other factors including access to farm inputs and credit. However, he acknowledged the local radio through FVR program that have significantly helped the farmers in the area to gain useful information. In this program the farmers are linked with extension officers via radio. The extension officers working for FVR program usually select a small group of farmers to disseminate agricultural knowledge and the farmers are involved in the process by capturing their voices in topic selection, broadcast and feedback. The recorded interviews are incorporated into radio programs and broadcast to reach many other farmers. It was also reported elsewhere that radio has achieved impressive results in the delivery of useful information to poor people, for

example Dodds, (1999) in Zambia confirmed that information given by radio is relevant as radio programs are found to help the farmers increase their crop yields through extension and education.

Television is ranked the second ICT after radio in terms of bringing relevant information to farmers. Table 13 illustrates some attributes that makes the farmers to rank television next to radio in terms of disseminating relevant information.

Table 13: Factors contributing to relevance of television in disseminating agricultural information

Factor	Frequency	Percent
Audio visual nature	211	43.9
Right source of information	162	33.8
Content coverage	107	22.3

Source: survey data, 2014

As shown in table 13, the farmers perceived television to be a relevant ICT tool for delivering agricultural information because the information accessed can easily be adopted due to audio-visual nature of television and hence help them to increase production. This is supported by 43.9% of the respondents. Others (33.8%) and 22.3% appreciated the source of information (right content) and content coverage respectively as the factors contributing to the improvement of their farming practices. Sher (2001) described that television produces many agriculture programs for the rural communities in their local languages and the TV stations in most cases invite agriculture experts to suggest new techniques and methods of sowing, ploughing, harvesting and planting the crop. This also applies to Tanzanian context where most of the agricultural programs in TV are run by agriculture experts in collaboration with the TV presenters. And many of these programs are aired in the farmers' language-Kiswahili which helps the farmers to grasp the content since they are familiar to the language used for communication. There is also an advantage of the audio-visual nature interface used in a television which simplifies the information shared and is thus easily adopted.

Each of the attributes i.e. coverage, timeliness and relevance of ICTs were rated by numbers from 1-3 where 1 stands for the lowest rate and 3 for the highest. An analysis of variance was then run to assess the degree to which their means vary from each other. It was found out that there was a significant difference between the ICTs in terms of coverage ($p<0.05$). However, there was no significant difference between ICTs in terms of timeliness and relevancy of the information they are providing. The results are displayed in table 14.

Table 14: Coverage, timeliness and relevance of ICTs

Sov	SS	df	MS	F	P-value
Coverage	214.7	2	107.4	291.1	0.000
Timeliness	207.5	2	103.8	273.9	0.975
Relevance	84.6	2	42.1	77.0	0.990
Total	506.8	6			

Source: survey data 2014

Note: - Coverage refers to the number of people reached by the ICT
- Timeliness means the information reaches the farmers at the time of need
- Relevance means the information fits the context in which the farmers are operating

Results in table 14 indicate that radio, television and mobile phone differ in terms of coverage. This implies that coverage is the most important factor to consider when comparing the ICTs. Means for coverage were then generated and compared using Duncan multiple-comparison test and the results are shown in table 15.

Table 15: Summary for mean comparison of the ICTs

Type of ICT	Radio	Mobile phone	Television
Mean	2.73[a]	1.84[b]	1.42[c]

Source: survey data, 2014. Superscripts: a = highest rate, b = 2nd rate, c = lowest rate

From the results in table 15, Radio is found to be the leading ICT in terms of coverage with a mean of 2.73 followed by Mobile phone (1.84) and lastly television (1.42). The findings indicate that the strength of ICTs in terms of coverage is different with radio being stronger than the rest of ICTs. This suggests complementarity between these ICTs so as to ensure access to information to all the farmers. Xu *et al.* (2013) reported that when different channels have different comparative advantage, use of one may increase the use of the other i.e. they complement each other. This study then attempted to describe the complementarities between different ICTs so as to enhance the quality of information available to farmers.

4.3.3 Different ways in which ICTs work together

Farmers in Kilosa reported different ways in which the ICTs are combined to deliver agricultural information as indicated in Table 16.

Table 16: Ways in which ICTs are combined to deliver agricultural information to farmers (n=240)

Combination of ICT	**Frequency**	**Percent**
Radio & mobile phone	94	39.2
Radio &television	75	31.2
Television & mobile phone	42	17.5
Radio & TV & mobile phone	21	8.8
None	8	3.3
Total	240	100

Source: survey data 2014

Over 39% of the respondents indicated a combination of radio and mobile phone whereby the farmers uses their mobile phones to communicate to an expert when there is an agricultural program on radio. These farmers had calls or send sms to ask anything related to his/her production activities and the expert on a radio station replies back by giving clarifications. This kind of complementary has helped to modify the one way traffic of communication since farmers have moved from being passive listeners to active participants as they can combine the use of both mobile phone and radio hence improved communication. To further explore this, documentary review about farmer voice radio program (FVR) was done at the department of agriculture in the district council and it was noted that in march 2014 through FVR program on the local radio (radio jamii), one farmer via sms on his mobile phone asked*, 'can I sow maize seeds and then apply herbicides immediately?'* Another farmer asked '*can I use Minjingu organic hyper phosphate (Mohp+) as a top dressing fertilizer?'* Other two farmers wanted to know the best maize seed variety (short term seeds) and the quantity of fertilizer per acre.

Also a complementary between television and mobile phone has been observed where the farmers have chance to watch some demonstrations on television and at the same time they can use their mobile phones to contact the presenters/expert and get solutions/answers for their various questions or just to gain more insight of a particular activity under demonstration. Over 17% of the farmers seem to be aware of that kind of a combination. Some research also reported a behaviour relating to TV viewing through smart phone. For example Jung (2013) reported that Smartphone allows people to surf the internet and watch TV. This reduces the problem of television access due to unavailability of electricity as it is easy for someone to charge the phone battery from a neighborhood.

Another combination involves radio and television as it is revealed by 31.2% of the farmers. According to the farmers this is common during "nanenane"; agricultural shows which are held from 1st to 8th August every year. During this period, it is very common to find radio and television broadcasting same programs especially for the Tanzania broadcasting corporation (TBC) radio and television and the media owned by IPP i.e. Independent television (ITV) and Radio one. So the farmers have chance to listen to their radio and those with TV sets can listen and watch directly what is happening in the exhibition. Sometimes the radio program is held in the afternoon and television repeats the same program/content in the evening. This allows one ICT to supplement another ICT in terms of utilization of the content.

According to Dia (2002), radio and television operate in complementary manner with television showing the same program in the evening hours where as radio in the early hours of the day. This kind of relationship helps to reduce weakness of one ICT in a scenario of allowing listeners to fully understand the information which was delivered by one of the ICTs and was not understood at first, say aired in the morning and a farmer has the second time to listen to the content and understands it very well. In this sense if it is the television to broadcast last it creates a good environment for the reviewer to critique and listen to every detail because of the benefits of hearing and watching the program. Sher *et al. (*2004) indicated that coupling audio and visual stimuli can change human behaviour and ultimately improves farmers' learning. Chiou and Tucker (2011), added that new media channels can complement existing channel if media consumption on new channel drives awareness of content on the old. This is also what is happening in Kilosa. During a survey it was observed that the preferred listening hours for radio audience (farmers) in Kilosa is from 4pm to 6pm while the preferred time for TV programs is from 8pm. It is common to find a program on TV especially in evening hours that was earlier broadcasted by radio and this increases awareness of what was delivered by a radio.

Meanwhile 8.8% of the respondents indicated a combination that involves all the three ICTs. On further discussion with the farmers, it was recognized that there has been times when radio, television and mobile phone work together to convey agricultural information to the farmers. When a radio television simulcast program is aired; the farmers are provided with a phone number to call or send sms whenever they have a problem or question to be answered by the expert. This kind of a relationship helps the farmers to easily capture what is delivered as they can use their ears and eyes to listen and watch; and at the same time use their mobile phones to call or send sms so as to gain more insight hence easy adoption. The mobile phone sms can also be stored and read later on. One farmer on 27th April 2014 in Ilonga village said that … "I can use my mobile phone to record what is presented on radio/TV and use it at any time I want to recall. Therefore, knowledge exchange between the farmers and experts is enhanced and assured.

In addition; famers in Kilosa have suggested various ways by which radio, television and mobile phone can work together to ensure that the information provided is of high quality, relevant and reaches at the convenient time. A discussion with farmers revealed that they want information to

flow in an interactive way where they use mobile phone to call or send sms to extension staff and the extension staff communicates to farmers via all the three ICTs. This would provide equal chance for all the farmers to receive that information because the farmers own different kinds of ICTs; some are having only radio/television or mobile phone, some possess two out of the three ICTs and very few are owning all the three ICTs. This will offer a balance of the information provided by radio, television and mobile phone.

4.4 Farmer's Perception of the effectiveness ICTs in Dissemination of Agricultural Information

Farmers in Kilosa district were asked about their perception of the effectiveness of ICTs in dissemination of agricultural information in their area. They were asked to give their opinion on the relevancy of the aired information in their farming context, usefulness as well as timeliness of the information they receive. They were also asked to indicate their level of satisfaction to the quality of information (in terms of content) provided by the ICTs.

4.4.1 Farmers perception on timeliness of the Information brought through ICTs

Timeliness of agricultural information is very crucial to farmers' success. Farmers need to be provided with the information at the right time so as to apply that information in their farming activities for better farm productivity. Rodriguez (2008) showed that timely availability of information is vital for effective performance of managerial functions such as planning, organizing, leading, and control. Farmers need timely information to be able to plan for activities to be done according to the situation encountered. For example timely information about rainfall will help them plan for the time to start preparation of their farms. Also this information will make them aware of the kinds of crops to plant depending on the rate of rainfall in a particular season as most of these farmers depend on rain fed agriculture. On the other hand timely information on pest outbreak will allow the farmers to organize themselves on how to combat the problem so as to overcome losses.

This study measured the timeliness of the agricultural information provided to farmers basing on the seasonal activities to which ICTs can be used as information tools required by the farmers. The respondents were asked to rate the information on the three grounds; being timely, average or late. Timely delivery of information meant that the farmer received information when they were able to make use of it. Average meant the farmers could only use part of it whereas late meant the information is outdated and the farmers were not able to use any of it. About 82% of the farmers indicated that mobile phone provides timely information whereas 59.2% and 50.4% indicated radio and television respectively to provide timely information.

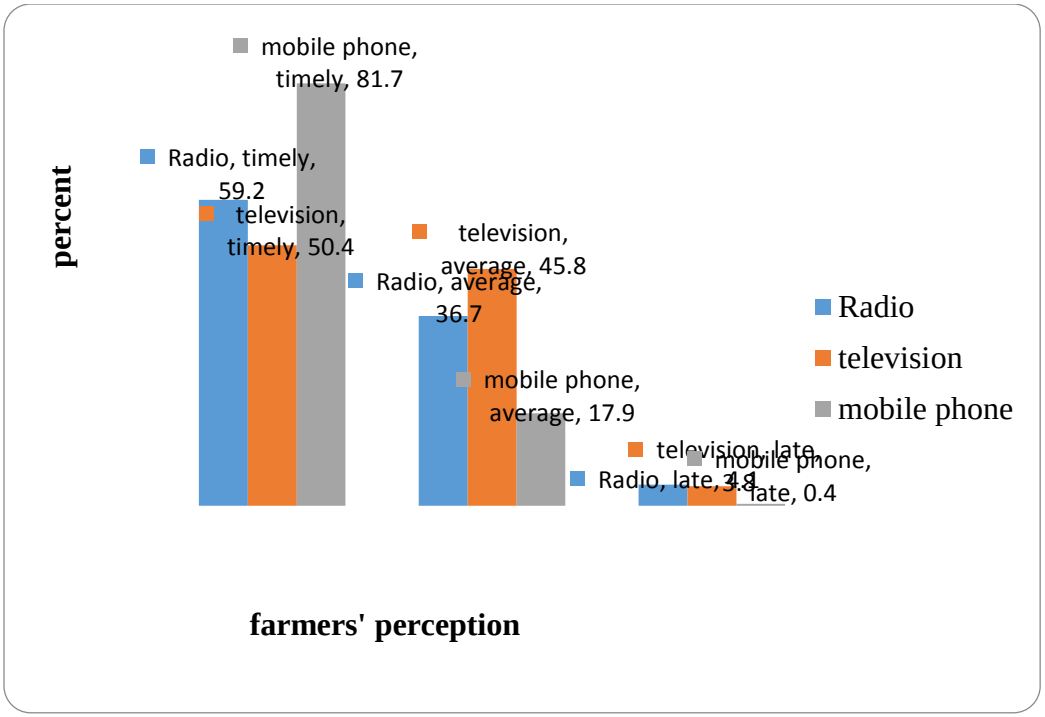

Figure 4: Farmers' perception on the timeliness of the information delivered through ICTs

From figure 4, it is clear that mobile phone is very timely in disseminating agricultural information as indicated by the majority (81.7%) of the respondents. The main reason is because the farmers find it easy to move with phones because they are light and thus can access the information at their time of convenience at home or on their farms. The farmers usually use mobile phones to communicate with a friend or an expert at right time or using programs from mobile service providers such as "tigo kilimo". Mitta et al., 2010, argued out that timeliness is one of the important features that enable farmers to use mobile-enabled agricultural information effectively.

Radio and television as well play a key role in providing timely information to farmers as indicated by more than 50% of the respondents in each case. In Kilosa, the local radio (radio jamii) in collaboration with a project called enhancing pro-poor innovations in natural resources and agricultural value-chains (EPINAV) and Sokoine University of Agriculture (SUA) through a program called farmer voice radio, have been providing the farmers with timely information according to season activity as a base factor. The program was run every Thursday from 4.00 to 4.30pm and repeated on Saturday from 5.00 to 5.30pm and it was divided into ten different promo

which include land preparation, use of improved seed (Situka, Tani 254, Staha), planting, weeding, fertilizer application, pest control, harvesting, storage, marketing as well as surplus keeping where the farmers are guided on how to keep their money in banks to use in the next season for buying inputs. Most farmers confirmed that the information they have been receiving was timely. This implies that all the ICTs were effective in delivering agricultural information on time.

4.4.2 Farmers perception on the relevancy of information received through ICTs

The information should not only offer the benefits of timeliness, but also able to suit the relevant context. Relevant information is one of the key requirements for increased productivity and increased income to reduce poverty among food producers in underprivileged communities (Rodriguez, 2008). This study addressed the relevance of information provided to farmers using ICT facilities by looking into the usefulness and the suitability of the information in the farmer's context. That is the information brought to the farmers should address the challenges of a particular farming system undertaken by the farmers at a particular area. About 62%, 76.8% and 52.6% of the farmers who are using radio, television and mobile phone respectively, indicated that the information sent to them is relevant to their farming requirements (see figure 5).

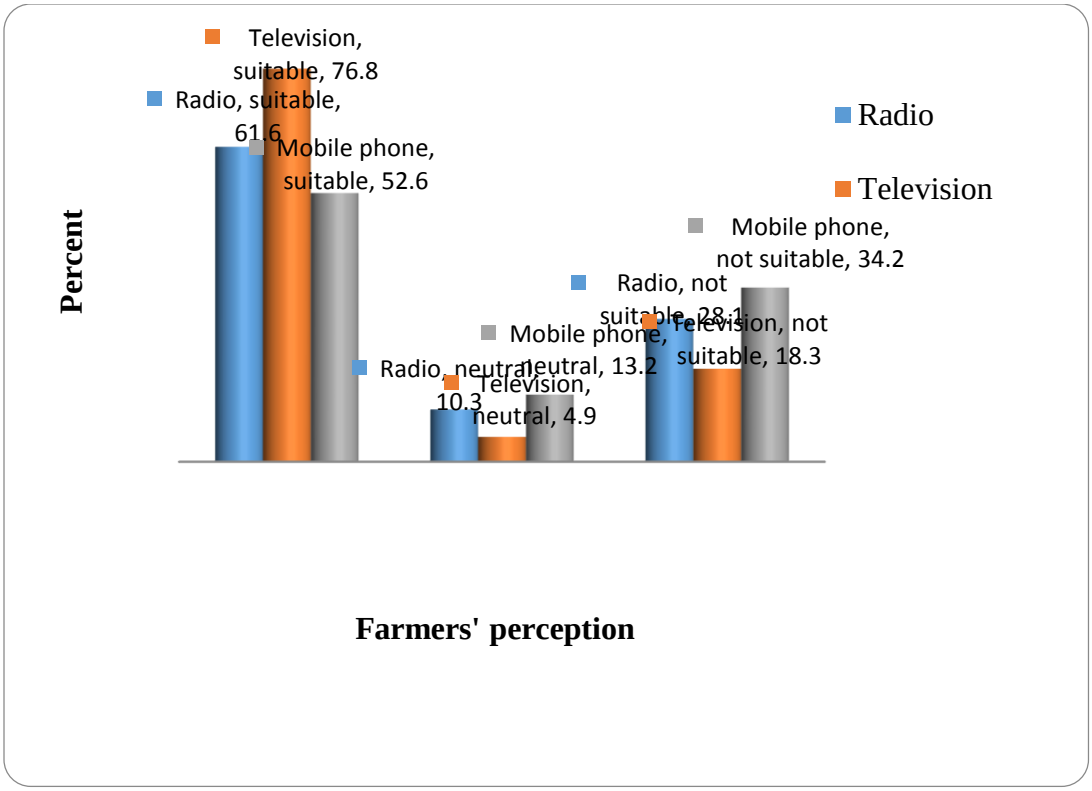

Figure 5: Farmers' perception on suitability of the aired information

With the findings in figure 5, it is clear that the ICTs are relevant in providing information as needed by farmers. Most of the farmers indicated that the information sent to them via three ICTs contribute to the improved farming activities which increased the profits gained since the yields produced then are of high quality. The radio results collected in this research were similar to that found out by Dodds (1999) who claimed that the information listened from the radio programs is very suitable in helping farmers to increase their crop yields. There are other claims of a small percentage of the respondents who believe the radio information is not suitable because information was not suiting the enterprises being done. For example in 14th/March/2014 at Ilonga village one farmer said '*they always give general information while my interest is about tomatoes'*. In other words the information received is not the one he wants. This is supported by Churi *et al.* (2012) who states that agricultural information programs on radio sometimes do not provide messages that address agricultural information required by the farmers. Despite the information broadcasted by ICTs to be seen as suitable to many of the farmers, the proportions that find the information as not suitable should not be denied. Instead some improvements can be done in

provision of the right information needed by different groups of farmers. The ICTs should try to categorize their programs targeting the particular areas which have different farming systems.

Meanwhile 52.4% of the respondents who use television to receive agricultural information reported that they have always been using the information received through TV. For radio about 54% said they are using the information in their day to day farming practices whereas 76% of the mobile phone users revealed that the information sent to them is useful to their agricultural activities. Information from mobile phone was found to be more useful because the farmers have chance of selecting what they need as compared to the information from other ICTs. The results are presented in figure 6.

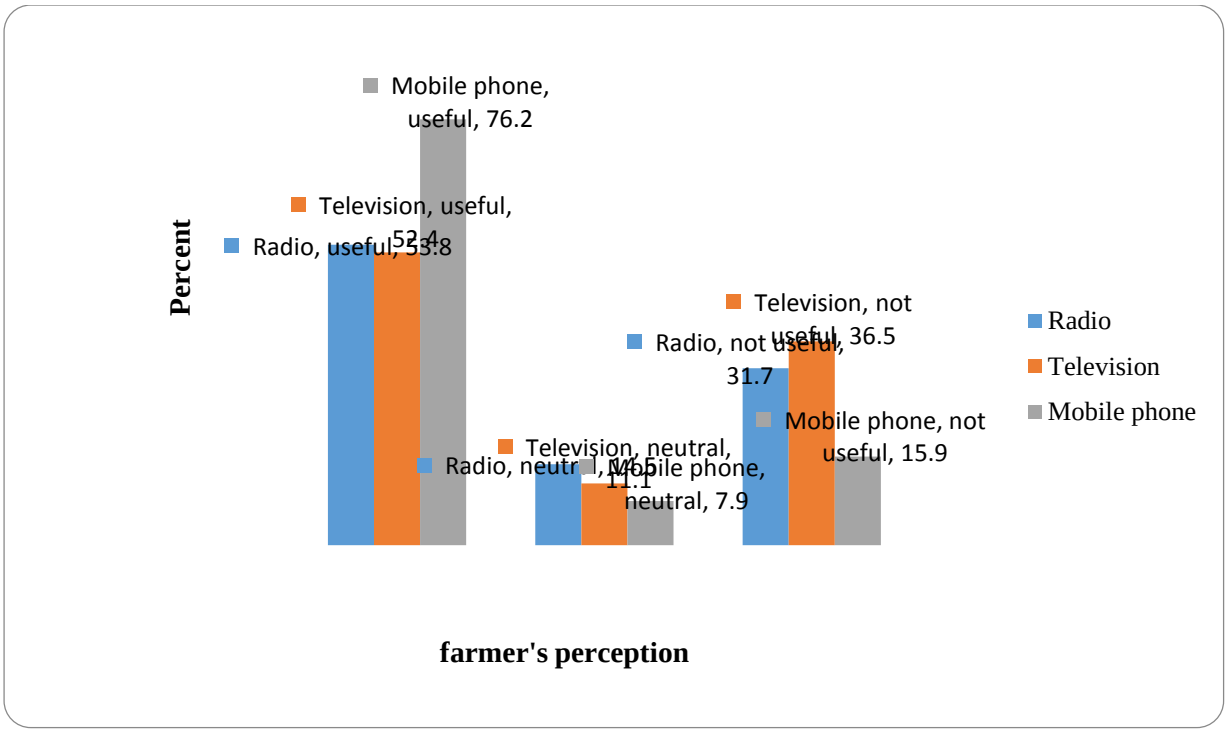

Figure 6: Farmer's perception of the usefulness of information received through ICT

Results shown in figure 6 indicate that most of the farmers have been using the information from ICTs to a large extent. The usage of information brought to farmers in the area is a result of different programs that involve farmers. Focal problems such as extreme weather, pests, army worm, subsidy or any political advert has been a drive to the farmers to seek for basic information they would require and the district extension system has been providing them with that information through ICTs. For example the local radio (radio jamii) through FVR program provided farmers

with different agricultural information basing on the season activity and the sources of information were subject matter specialists from the district council. Farmers were provided with phone numbers which they can use for asking questions so as the expert provides answers directly. Similarly, Radio Abood FM has a program called 'Harakati za Kilimo" which brings together farmers and agriculture experts; and mobile phone plays a big role in helping these groups share their experience. Also for TV programs the source of information has been the agricultural institutes such as research and extension.

4.4.3 Farmer's level of satisfaction of the quality of information received through ICT

Despite some shortcomings of ICT use in extension services, ICTs are found to satisfy the needs of the majority of farmers. Out of all the respondents, those who are satisfied with the kind and quality (in terms of content) of information aired by radio were 53.6% while 52.9 and 50.4 are satisfied by the information they receive from television and mobile phone respectively (see figure 7).

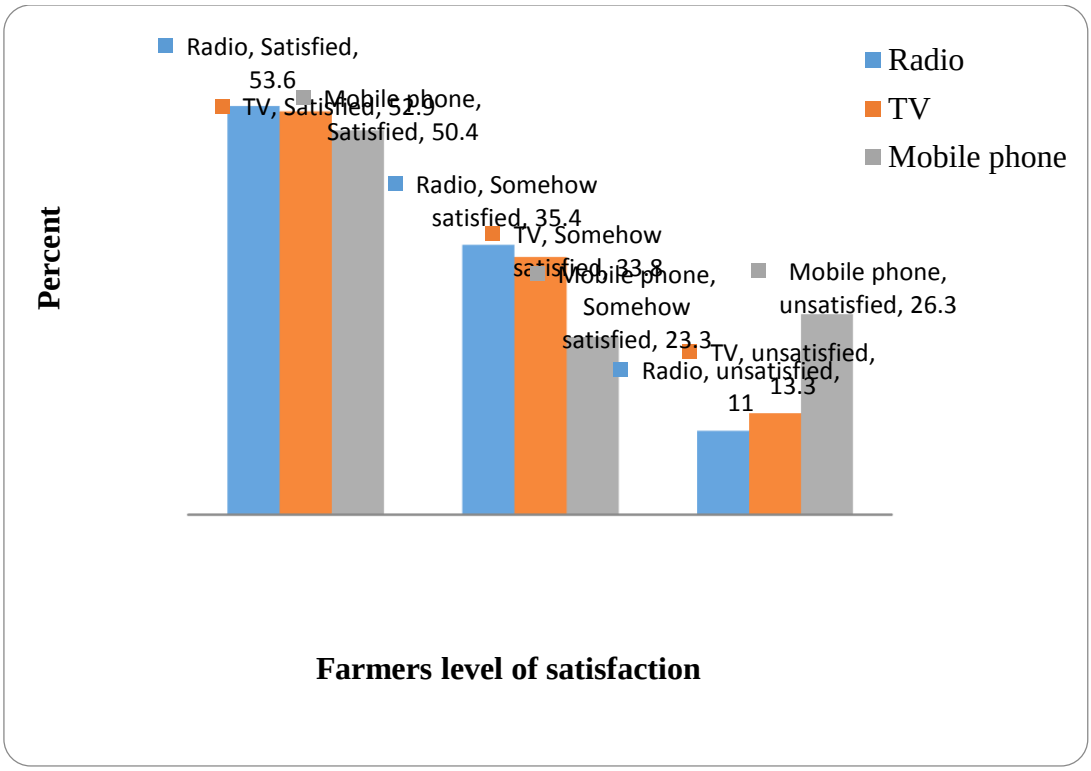

Figure 7: Farmer's level of satisfaction with the quality of information received through ICT

The findings in figure 7 shows that ICT have helped the farmers in the area to access important information used to solve their various problems related to agricultural activities. According to Asia-Pacific Association of Agricultural Research Institutions, APAARI, (2004), the farmers' information needs through ICTs will be satisfied only if information on input and support services as well as market related information including price trends is provided. The same information should help the farmers to getting solutions of individual and community based agricultural problems such as pests and disease control. Farmers in Kilosa are fairly satisfied with the services offered by ICT service providers especially the local radio as well as Abood radio and TV because they are directly involved and share their experience. Tigo mobile service provider, use their program ("Tigo Kilimo") to provide different information to farmers about daily weather forecast, comprehensive details on soil management, pest control methods, and information on livestock care and life-cycles. Farmers can access this service via their mobile phones by dialing *148*14# to go to Tigo Kilimo menu which displays a list of various information that can be accessed.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

In this study it was found that age of the farmers has an association with access to information using radio and mobile phone while information access through television was found to have no association with respondents' age. Furthermore the results indicated an association between sex of the farmers and access to information using television. On the other hand the information access through radio and mobile phone were found to be independent of the farmers' sex. Education level of the farmers was also found to influence the farmers' access to information using television and mobile phone. However it was found that there is no association between farmers' education level and access to information using radio. In addition survey results indicated an association between marital status of the farmers and access to information using television and mobile phone whereas information access via radio was found not to be influenced by the farmers' marital status. From these findings, farmers' access to information using ICTs has a lot to do with the socio- economic characteristics.

Results also indicated a difference between the ICTs in terms of coverage. It can therefore be concluded that the ICTs have different strength in terms of reaching the farmers which are widely dispersed. This disparity can affect farmer's ability to access relevant and equitable information that are useful in their farming activities. For example low television coverage makes the farmers not to enjoy the benefits which are associated with the audio-visual nature of this ICT tool. The findings further suggest an existence of some complementarities between radio and mobile phone, radio and television, television and mobile phone as well as radio and television and mobile phones.

Majority of the farmers indicated to receive timely, relevant and useful information that satisfies their information needs. However, small proportion of the farmers revealed some weaknesses in ICTs such as provision of general information instead of specific information that is direct to the farmer's enterprises. From the findings, ICTs are an effective means of conveying agricultural information to farmers. In order to convey timely, relevant and quality information, use of ICTs in

agricultural extension system is therefore inevitable. Effective use of ICTs will help to improve access of information to farmers so as to achieve the broader objective of improving agricultural productivity.

5.2 Recommendations

- Socio-economic characteristics of the farmers such as age, sex, education level and marital status should be considered when planning for different programs that involve radio, television and mobile phone in provision of agricultural information to farmers. The extension staff should think of the right type of ICT to use when communicating to a particular group of farmers.

- Because of the disparity between ICTs especially in coverage, each ICT should not be used as a standalone; the extension system should think of using them in combination so as to broaden access of information by farmers. In this the extension system programs should be designed in such a way that it involves the right mix of these ICTs for agricultural extension service so as to ensure equal access to information by all the farmers.

- ICT service providers especially television should focus on improving and setting up proper infrastructures which could create an interaction with the extension and research, to be able to use ICTs in provision of important knowledge, information and technology that is easily accessed by the farmers.

- District council should ensure that a well coordinated system among agricultural institutions, ICT service providers and the farmers is established. These should be networked so that available information/knowledge is shared and transmitted easily to the farmers. These institutions should work complementarily so that they develop relevant content and design an Information flow in such a way that it improves farmer's access to information.
- Extension officers in the district should sensitize the smallholder farmers on the presence of effective ICTs in their area including the traditional ICT (radio) and modern ones

(mobile phone). The sensitization will increase awareness of the farmers on the ICT about accessing and using them for their farming activities.

- Farmers should take initiatives in using the available ICTs to seek for various agricultural information that they think can help them to improve their agricultural practices. They should use their mobile phones to communicate with extension staff, input dealers and other farmers. They should also listen/watch various agricultural programs on the radio and television.

- Mobile phone service providers should provide some training to mobile phone users so that they become effective in searching electronic information from various programs like *tigo kilimo*. Extension staffs should also be well trained with use of ICTs to simplify their work in areas of information sharing, application and development. This will help them to become information specialist hence provision of quality and relevant information to the farmers' context.

5.3 Suggestion for further research

There is a need for further study on how the ICTs can effectively work together. Since the ICTs were found to have different strength and weaknesses in terms of accessibility, relevancy and timeliness, a study can be carried to come up with the best integration of the ICTs. This will help to overcome the shortcomings in each ICT thus knowledge and information exchange will be enhanced. In addition, this will help to inform and guide the best ICT model for easy information flow between the farmers and other stakeholders in agriculture sector.

Research can also be conducted to explore the relevancy and applicability of other ICTs which were not part of this study but are also known to benefit farmers elsewhere, in Tanzania. Since the study finds that ICTs are effective in delivering agricultural information to smallholder farmers, therefore another study can be conducted to assess the cost effectiveness of using ICTs for agricultural production and marketing, compared to other alternative options.

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APPENDICES

Appendix 1: Questionnaire

Individual Farmer Survey Questionnaire

Interviewer's name …… **Date ……**

This study investigates the effectiveness of ICTs in dissemination of agricultural information to smallholder farmers in Kilosa District, Tanzania.
Note: All the information collected will be used strictly for academic purposes. Thank you for your co-operation.

Section A. Demographics Details

Respondent's name……

Ward…….. Village…….

1. Respondent's age …….

2. Gender	1) Male	( )
	2) Female	( )
3. Marital status	1) Married	( )
	2) Single	( )
	3) Divorced	( )
	4) widow/widower	( )
4. Education	1) Nil	( )
	2) Primary	( )
	3) Ordinary level	( )
	4) Advanced level	( )
	5) Tertiary	( )

6) Other (specify)…….

5. What is your major occupation?.....

6. Please give two major enterprises you are undertaking…….

Section B. Access to agricultural information

	Radio	TV	Mobile phone	
7. Do you own the ICT tool/facility?				8. Give two most important types of information you access through this ICT in order of priority?
9. Are you able to access agricultural information through this tool?				
10. Are you aware that you can access agricultural information using this ICT facility?				
11. Do you use the facility to access agricultural information?				12. If yes, how often (weekly)? 13. For how long have you been using the ICT tool to access agricultural information (years)?
14. Do you have control over the ICT tool/facility in terms of utilizing it at your convenience?				

15. Can you use this ICT to access agricultural information?				
16. Have you had any training on how to use the tool to access agricultural information?				17. Who provided the training?
18. Is there a cost associated with access to this information?				19. If yes, what is the cost (TZ shillings)?
20. Would you be willing to pay for this service?				21. How much would you be willing to pay for this service per week? (TZ shillings)

22. Mention any two programs you are aware of that provide agricultural information

	Program	Time aired	Preferred time	Who listens (see codes)
Radio				

	Program	Time aired	Preferred time	Who watches (see codes)
TV				

***Codes*:** 1. Household head; 2. Spouse; 3. Children; 4. other (specify)

23. With whom do you share the information that is accessed?.....

24. What type of agricultural information do you currently access through the ICT

    ……

25. What type of agricultural information would you like to access through ICT

    ……

26. What kind of information is not provided by the ICT and you would wish to have it provided?.....

Section C: Relevance and timeliness of the information brought by ICTs

On a scale of 1 – 5, score the following statements regarding the relevance and timeliness of the information, where 1 is the lowest possible score and 5 the highest

Item	ICT facilities		
	Radio	TV	M-Phone
27. The aired information is suitable in my farming context			
28. I have always used the information accessed through the ICT			
29. I can make a choice on the type of information accessed through the ICT tool			
30. I can provide feedback to the source regarding the relevance of information provided			
31. I comprehend the information provided by the ICT			
32. Time allocated for broadcasting the program is enough to grasp the content			
33. The time is convenient for me to listen/watch			
34. I have been receiving a particular package of agricultural information at the right time			
35. I always receive the information at my convenience			

Section D: Rank of ICTs in terms of coverage, timeliness and relevance

36 a). Basing on the scope of coverage which of the ICT tool comes first? Please rank.

1) Radio ( )

2) Television ( )

3) Mobile phone ( )

b) What factors leads to its high coverage? (Tick all that applies)

1) It provides right information at the right time ( )

2) Its availability ( )

3) It makes getting to new information quicker than the rest ( )

4) It is cheap and easily accessible ( )

5) Others (Specify) ……..

37. In terms of timeliness in conveying agricultural information which of the ICT tool is leading?

1) Radio ( )

2) Television ( )

3) Mobile phone ( )

38 a). Regarding relevancy of information, which ICT tool will you first choose? Please rank

1) Radio ( )

2) Television ( )

3) Mobile phone ( )

b). Indicators that leads to relevance of the ICT you have first chosen (tick all that applies)

1) Change in the methods of production ( )

2) Increase in the volume of agricultural produce ( )

3) Improvement in the quality of agricultural produce ( )

4) Others (specify) ……

Section E: ways by which the ICTs work together

39. (a) Is there any way(s) by which the ICTs are being combined or can be combined to deliver agricultural information to farmers? (1) Yes ( ) (2) No ( )

b) If the answer above is yes, please list those ways

……

……

……

Are you satisfied with the kind and quality of information/services provided by the ICTs?

1) Yes ( )

2) No ( )

(b) Indicate by ranking the level of satisfaction

1) Very satisfied ( )

2) Satisfied ( )

3) Somehow satisfied ( )

4) Unsatisfied ( )

5) Very unsatisfied ( )

Thank you!

Appendix 2: Checklist for ICT Service Providers

1. Do you have any agricultural related program?
2. What are the basis for the programming
3. Type of information provided
4. Which sources of information do you use? Why these sources?
5. What is the role of a farmer in the process?
6. How do you obtain feedback regarding their information

Appendix 3: Work plan

ACTIVITY	OCT 2013	NOV	DEC	JAN 2014	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT
Preparation of data collection tools													
Questionnaire pre-testing													
Analysis & editing/review													
Pre-survey & selection of study villages													
Questionnaire distribution													
In-depth interview & FGD													
Data entry & Analysis													
Write – up													
Submission of first draft													
Making corrections													
Submission of final draft													