INFORMATION COMMUNICATION TECHNOLOGIES ADOPTION IN IRRIGATED RICE PRODUCTION: CASE STUDY OF MWEA IRRIGATION SCHEME

BY

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DECLARATION

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This project report has been submitted with my approval as the university supervisor.

Signature…… Date……

Hezron Mogambi, PhD

DEDICATION

This work is dedicated to these great people:

My Lovely wife Maureen Wayua,

My parents Mr. Nzonzo Kimonyo and Mrs. Josphine Nzonzo

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ABBREVIATIONS AND ACRONYMS

CEC	County Executive Committee
DIT	Diffusion of Innovation Theory
GDP	Gross Domestic Product
GNP	Gross National Production
ICTs	Information Communication Technologies
KACE	Kenya Agricultural Commodity Exchange
KNBS	Kenya National Bureau of Statistics
MDGs	Millennium Development Goals
NACOSTI	National Commission of Science Technology and Innovation
NIB	National Irrigation Board
REP	Rural Electrification Program
SDGs	Sustainable Development Goals
TAM	Technology Acceptance Model

ABSTRACT

The general aim of the research was to assess Information Communication Technologies (ICTs) adoption in irrigated rice production in Mwea Irrigation Scheme. The study was guided by three specific objectives: to identify uses of ICTs in irrigated rice production; identify barriers of ICTs use in irrigated rice production and examine influence of ICTs use in irrigated rice production in Mwea Irrigation Scheme. The descriptive cross-sectional survey was adopted and it used both qualitative and quantitative methods. The sample size for the study was 362 respondents and the researcher was able to collect 96 completed questionnaires which were used for data analysis. Questionnaires and Key Informant Interviews to collect data. Descriptive statistics were employed to summarise the data and create categories of answers for interpretation. The study found that ICTs were used to source for information on available paddy seed varieties, prices of the paddy seed and packaged rice. The major barriers facing ICT adoption among irrigated rice farmers in Mwea Irrigation Scheme are lack of training, shortage of ICTs expertise and inability to apply and cost of ICTS and/or funds and the most influence of ICT adoption among rice farmers was increase in rice production output, followed by increase of farmers' skills/knowledge in rice production and accessing agricultural market information. The study concludes that ICTs are used to source for information on available paddy seed varieties, prices of the paddy seed and packaged rice; that major barriers facing ICT adoption among irrigated rice farmers in Mwea Irrigation Scheme are lack of training, lack of ICTs skills and inability to use and cost of ICTS and/or funds and that the most influence of ICT adoption among rice farmers was increase in rice production output, followed by increase of farmers' skills /knowledge in rice production and accessing agricultural market information.

CHAPTER ONE
INTRODUCTION AND BACKGROUND OF THE STUDY

1.0 Introduction

This chapter consists of the background of the study, statement of the problem, the objectives of the study which are distinguished by the general objective and specific objectives, research questions derived from the research objectives, justification of the study, significance of the study, scope of the study and operational definition of terms.

1.1 Background of the Study

Agriculture remains a major sector in most African countries where it accounts up to 40% of the total Gross Domestic Product (GDP) and up to 60% of export revenue. It is considered a major source of income to a significant share of rural households. Despite this importance, the agricultural sector in Africa has consistently faced a crucial problem of low productivity. As consequence, increase in agricultural crop production relies mainly on area expansion (Alia, Nakelse & Diagne, 2013). However, area expansion is becoming difficult because of the demographic pressure due to population increase and urbanization. Similarly, water is becoming a rare commodity in many economies, especially in Sub-Saharan Africa.

The Sustainable Development Goals (SDGs), known as the Global Goals, reinforce the Millennium Development Goals (MDGs), 8 anti-poverty objectives that the globe is dedicated to attaining come 2015. Goal number two (2) intends to get rid of the issue of hunger, attaining food stability and enhanced diets, and enhancing productive agriculture. Irrigation has been a key factor behind the almost tripling grain production since 1950 and in the next thirty years, the world cereal production is going to increase two-fold to attain the requirements of ballooned population. About 90% of this increased population will originate from existing lands and 70% of this food generation will come from watered lands while 20% will come from land reclamation (Gao, 2012).

In Kenya, irrigated crops is an area of focus in agricultural transition and food security technique of the current regime. Risen accessibility of irrigation and less reliance on rain to water crops is treated as a means to accelerate food output and autonomy of the ever rising population of the country (Mwenzwa & Misati, 2014). However, threats to agricultural production are worsening with the negative effects of climate change. Thus,

raising productivity through technological adoption could be the most sustainable option (Alia, Nakelse & Diagne, 2013). The use of Information Communications Technology in irrigated rice production presents an opportunity for farmers in irrigated rice production to increase their yields through gathering, preserving, processing, conveyance and exhibition of information to increase their farm yields.

ICTs basically describes the widening groups of technologies utilised to deal with data and assist dissemination. They encompass hardware, software, media for gathering, storage, producing, dissemination, and depiction of data in any manner. That is, voice, information, text and image, PCs, and the World Wide Web, CD-ROMs, electronic mail, telephone, radio, TV, video and digital cameras. Information Communication Technologies are perceived to lead to both economic and social growth by developing a favourable surrounding. Approximately, each action in the contemporary world is headed to total reliant on the use of ICTs for a single purpose or the other. The advantages of Information Communication Technologies attain even those without primary access (Asenso-Okyere & Mekonnen, 2012).

Agriculture is the pillar of Kenya's wellbeing and it adds to immense Gross National Production (GNP) for the country (Kenya National Bureau of Statistics [KNBS], 2013). The need for agricultural commodities in Kenya is growing per year with the population that increases at an average rate of 2.27% per annum. Attaining this persistently rising demand is the issue in the sector in Kenya (Oluoch & Osida, 2015).

In agriculture, compared to other areas of the economy, data is now a primary component, while intelligence and data performs a big function for farmers to align to chances which may enhance their farming output. Information Communication Technologies (ICTs) have thus persistently been the best hope in least developed nations to increase their growth process (Nyamba & Mlozi, 2012). Data is relevant for allowing agricultural and rural growth and leading to socio-economic transformation. Unluckily, most underdeveloped nations have not dedicated sufficient resources to giving consumers access to data, particularly in less developed areas, where 70-80% of the populace thrives. ICTs facilitates communication among people from different social categories; enable quick allow to data required for exchanging, purchasing, generating, and trading commodities and result in high yield (Agu, 2013).

Literature indicates that technology has a good effect on the development of any nation. In Thailand, the state has allowed people to use ICTs to improve the cultivation of rice and other agricultural activities (Sangbuapuan, 2012). In India, Syiem and Raj (2015) found that farmers stated that mobile handsets have helped in the event of health emergencies. In Burkina Faso, Alia et al. (2013) found that farmers who have listened to rice program on radio before 2008 are more probably to embrace enhanced varieties than those who do not. Most importantly we found the indirect effect of listening to rice program on radio is significantly positive. In Kenya, Njoroge and Kinyua (2014) agree that ICTs have also had an effect on the agricultural sector, such as agribusiness and agricultural production. The agricultural sector continues to adopt technological innovations and ICTs are also some of such innovations.

1.2 Statement of the Problem

In agriculture, the function of information and communication in disseminating agricultural knowledge has been well established (Das, 2013). Bachhav (2012) pointed out that, the application of information in the farming sector is improving agricultural productivity in a many ways. Giving information on weather patterns, good practice in agriculture, convenience to market data assists farmers make appropriate choices regarding the type of crops to plant and the location of selling their produce and acquire inputs. Richardson et al. (1998) illustrated that the information demands of farmers vary with time because of the transforming agricultural technologies, environment, rules and regulation and the surfacing of agricultural inventions. Some of the challenges that rice farmers encounter include inadequate of a good way of collecting farm produce information, document input costs, as well as expenses on farm inputs and obtain information from other partners (Oluoch & Osida, 2015).

Studies (Mambala, 2007; Uphoff, 2012) have shown that there is evidence to suggest that there is ICT use among irrigated rice production farmers. Mambala (2007) study of the Munaka outgrowers' community based organisation in the Bunyala Rice Irrigation Scheme found that in this era of ICTs, mobile phones were the most used form of ICTs in sending and receiving money transacted in rice business. Uphoff (2012) study on empowerment of farmers through ICTs found that mobile banking was the major use of ICTs among farmers, followed by communication with extension workers. The mobile phone is only one form of ICTs but there are other information communication technologies that can be adopted in rice production which aren't adopted in Kenya. The

study therefore seeks to assess the strategic application of information communication technologies in rice production; barriers to ICTs use and examine influence of ICTs use in irrigated rice production in Mwea Irrigation Scheme.

1.3 General Objective

The general objective of the study was to examine Information Communication Technologies (ICTs) adoption in irrigated rice production in Mwea Irrigation Scheme.

1.3.1 Specific Objectives

The study was guided by the following specific objectives;

i. To identify use of ICTs in irrigated rice production in Mwea Irrigation Scheme
ii. To identify barriers of ICTs use in irrigated rice production in Mwea Irrigation Scheme.
iii. To examine influence of ICTs use in irrigated rice production in Mwea Irrigation Scheme.

1.3.2 Research Questions

The study aimed to answer the following research questions;

i. How do farmers use ICTs in irrigated rice production at the Mwea Irrigation Scheme?
ii. What are the barriers to ICTs use in rice production at the Mwea Irrigation Scheme?
iii. How do ICTs use influence irrigated rice production at the Mwea Irrigation Scheme?

1.4 Rationale and Justification of the study

Agricultural advancement in Kenya is crucial since it has certain and immediate significance in achieving the Sustainable Development Goals (SDG) on eradication of extreme poverty and hunger. The acquisition of existing and emerging advancements in the agricultural sector provides an opportunity to improve the performance of the sector as a major contributor to the nation's development (Mureithi, Bett & Ogaleh, 2009). One of the key sectors in agriculture is irrigation and more so irrigated rice production.

The Kenya Vision 2030, a long-run goal for the country encouraged by an overall ambition for an efficient society come 2030 aims at making Kenya "a globally

competitive and prosperous country with a high quality of life by 2030". Its aim is to change the country to "a newly-industrializing, middle-income country providing a high-quality of life to all citizens in a clean and secure environment" (Kenya Vision 2030).

Both the Kenya Vision 2030 and National Irrigation Board's (NIB) third strategic plan 2013-2017 recognize the important role that irrigation is expected to play in improving agricultural productivity and meeting Kenya's food security needs. The SP estimates that irrigation can improve yield four times and baseed on the crops, multiply incomes by up to ten times. To promote agricultural productivity, the government plans to increase the area under irrigation and drainage from the current 140,000ha to 1.2 million ha in 2030 (NIB, 2013).

There has been an exponential growth on the availability and accessibility of ICTs in Kenya which are being used in industries to enhance their productivity. Similarly, there are available ICT that can be used in irrigated rice production. Kenya is experiencing an increase in ICT use to enhance and improve its competitiveness in the global market. There is an opportunity for irrigation rice farmers to use these technologies and ICT innovation to improve their productivity. The study is therefore timely and justified as it will investigate the use of ICT in rice irrigation schemes and make recommendations to enhance ICT use in rice production. The study's rationale is based on the poor performance of irrigated rice production which has not been able to meet the nation's demand for rice.

1.5 Significance of the Study

The study is of importance to policy makers and key players in the irrigation sector because it identified the barriers to ICTs adoption and the information needs for rice producers. This information goes a long way in providing a foundation for policies and strategies to improve ICTs adoption in rice production in Kenya. The study is of significance to Mwea irrigation scheme rice farmers as it provides a source of information on ICTs adoption. It also provides an opportunity for farmers to discuss the factors affecting or influencing adoption of ICTs in rice production. The study is of significance to scholars and academia as it contributes to the body of knowledge on ICTs adoption among rice producers in Kenya. It also adds value to researchers as it suggests areas of further studies on ICTs adoption in irrigated rice production.

1.6 Scope and Limitations of the Study

The study was limited to Mwea Irrigation Scheme, Kirinyaga County. The perception on ICTs and its effectiveness differ from farmer to farmer and that is accountable to many factors/criteria. The study focused on the influence of ICTs in irrigated rice production in Mwea Irrigation Scheme, the barriers of ICTs use in irrigated rice production in the Mwea Irrigation Scheme and influence of ICTs use in irrigated rice production in Mwea Irrigation Scheme. The study was conducted from June 2016 to August 2016. A limitation of the study was that the study was conducted off season where not all the rice farmers were in the field during the data collection exercise. In order to delimit this, the researcher added one more week to the proposed data collection period of two weeks and the data collection from rice farmers was thus done for three consecutive weeks. Three weeks were adequate for the researcher to administer the questionnaire in the rice farms rather than visit farmers' households which were widely dispersed and would require more financial and time resources.

1.7 Operational Definition of Terms

Information Communication Technology – These refer to modern technologies which are used for communication purposes. These include radio, mobile phones, tablets, and television and internet portable devices.

Barriers – Refer to the challenges and constraints of farmers in their ability to use ICTs to enhance irrigated rice production**.** These constraints are those that limit the use of ICTs among irrigated rice farmers.

Adoption – In this study, it refers to the application of information communication technologies to rice farmers in agricultural production. This means the actual use of ICTs in seeking information on irrigated rice production.

Agricultural Production – This refers to the production of crops and livestock. Agricultural production in this study refers to the production of rice and refers to all the activities involved in irrigated rice production.

CHAPTER TWO
LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.0 Introduction

This chapter of the study focuses on the available literature on the relationship between ICTs adoption in rice irrigation production. The section also presented the theoretical framework on which the study was premised.

2.1 Communication and ICTs Use in Irrigated Rice Production

A significant proportion of the queries posed by farmers (encompassing those on how to enhance outputs, reach markets, and cope with the weather patterns) may at the moment be responded immediately, with immense ease, and high level of accuracy via use of ICTs. Many of them may further be answered through dialogue where the concerned stakeholder choose desired solutions in line with the existing set of skills and experience (Bohara, 2014).

ICTs allowed services mostly utilise diverse technologies to offer required data. This postulate is being applied to give rural farmers domestic (non-urban) premonitions to ready themselves for weather-associated events. In resource strained environments particularly, providers employ satellites and sensors for the purposes of gathering temperature information, the website to document huge quantities of information, and handsets to relay atmospheric condition data to rural farmers at fair prices to avoid losses and lower impacts from natural calamities (Joshi & Ayyangar, 2010).

Adegbidi, Mensah, Vidogbena and Agossou (2012) conducted a study on determinants of ICTs application by rice farmers in Benin. The results revealed that all farmers sampled were not utilising ICTs items for farming. Approximately 31% of them were ICTs non-users while 69% of them did use ICTs tools in their farming activities. All the ICTs tools employed never had similar importance of application. Almost did all users (90%) rely on radio programs as the desired media type. The three most regular forms of media after radio programs mobile phone calls (41%), TV (17%) and text messages from handsets (10%). The study was however limited in its methodology as it targeted respondents from an ICTs project, a sample which could be influenced by training received from the project. There is need to conduct a study among farmers who have not been involved in any ICTs project.

Tembo, Simbanegavi, Owei and Peninsula (2010) study on impacting the application of ICTs by Farm Employees in the Western Cape identified important roles that ICTs can play for farmers. One, farmers mainly encounter risks such as infertile soils, drought, and pests. Key sectors where technology can assist enhance this is through the provision of latest data regarding pest and disease management, early warning signs and systems, recent varieties, and ways to maximise output and regulations for better control. Two, enhancing by providing recent information such as consumer trends can enhance a farmer's negotiating position and his social welfare and enabling him to make informed choices.

ICTs may be utilised to reinforce households and agricultural organisations support their own abilities and efficiently showcase their constituencies when handling production costs, land demands, and infrastructural projects. Non-Urban households are well equipped to socialize with others through the application of technology that lowers social alienation that they could otherwise be encountering. However, ICTs have the ability to develop processes such as making of laws and approvals of land titles more open (Sangbuapuan, 2012).

Berman (2008) illustrated that latest ICTs methods had performed an important role in the growth of emerging economies. There are several ICTs that have been adopted in agricultural production globally. According to Jayathilake, Jayaweera and Waidyasekera (2008), there are various scenarios of ICTs acquisitions and applications in agriculture sectors. The Kenya Agricultural Commodity Exchange (KACE) is championing this ICTs to relay business data or knowledge. Philippine has a significant number of online portals, internet-based business apps and creative inventions used to offer crucial agricultural data in the country and especially the rural areas.

Abdegbidi et al. (2012) conducted a study on determinants of ICTs use by rice farmers in Benin. The study found that the percentage of farmers employing utilising ICTs tools in their endevors (69 %) was higher than those already members of ICTs project. The 4 primary usual sorts of media utilised for farming roles were radios, mobile phone calls, TVs and text messages. Armstrong and Gandhi (2012) found that a large number of farmers rely on TVs and handsets to gather agricultural data, which implies that they are well prepared to access agricultural data and execute effective practices to enhance output. This finally results in improved yields regionally.

The World Wide Web is among the most relevant sources of locating data regarding agriculture and other associated issues (Burke & Sewake, 2008). Joshi & Ayyangar (2010) found that farmers are constantly relying on the internet and their emails to communicate with their loved ones in various locations of the country. The web was popular among farmers among farmers in India. So far, they are applying a number of sites to access data on effective application of pesticides. It has generated an opportunity for farmers to acquire the latest data on market (Chhachhar, Qureshi, Khushk & Ahmed, 2014).

Browsing the internet for banking information is among the most significant agri-business activities among farmers. In Malaysia, the latest statistics indicate that 94% of the farmers utilise the web use to access agricultural information whereas 85 % of the farmers get information through text messages (Hassan et al., 2010). Barton (2003) pointed out that the internet offer farmers with communication facilities and therefore makes it less complicated to exchange information with fellow farmers, extension officers, and agencies dispersed in different locations. Moreover, sites are the most known internet services for farmers, and are less expensive than telephone application. Farmers can now access data via ICTs on a timely manner, and facilitates the creation of channels with growth bodies and other farmers, and ultimately raise their probabilities to increase their agricultural produce (Obiechina, 2004).

Mobile handsets have eliminated the gap between traders and farmers. It implies that farmers communicate on a first hand basis with consumers to determine the appropriate costs for their goods (Chhachhar et al., 2014). The application of mobile devices by farmers has led to improved income levels and productivity as a result of the immediate communication with customers which enable them to sell their products in good price (Fafchamps & Vargas Hill, 2005). Moreover, farmers are applying text messages to keep up with current trends and utilise pesticides in their farms (Murthy, 2009).

In Ghana, mobile phone apps connect farmers and buyers without interruptions and they get directly costs of commodities from agents and consumers. Mobile phones enable consumer's access information and hence no need to go to the market. In such a situation, they save a lot of resources like money, time and energy (Lee & Bellemare, 2013). Studies done in South Africa stated that mobile handsets have a good effect on their income (Aker, & Mbiti, 2010; Klonner & Nolen, 2008). In Uganda, Muto and Yamano

(2009) found that between 2003 and 2005 the mobile phone coverage increased 10% farmers' probability of market participation.

According to Chhachhar et al. (2014), the TVs have offered farmers with choices to look out the diverse agricultural plans on different channels. Farmers choose the best way for staying relevant and tracking different data on agriculture. It also indicated that TV is not entirely the ultimate source of agricultural information though there it is important to give alternative technologies for current information to farmers.

In developing countries, the radio and television played a crucial role in enhancing the ability for farmers by showcasing diverse associated programs (Chhachhar et al., 2014). In Iran, Nazaril and Hassan (2011) found that 68% of the participants believe that television produced agriculture programs that were beneficial to farmers. In India and Ethiopia, mass media has performed exemplary as a technique of relaying information to farmers. It indicates that people have a higher chance of viewing the agriculture associated programs on TV (Murty & Abhinov, 2012).

The radio is a diverse point of conveying data especially in rural areas of the least developed nations and the effect of radio depicted desirable effects in diverse communities with the inclusion of farmers (Murty & Albinov, 2012). Bolorunduro et al. (2004) did a research in Nigeria on communication of agricultural data which suggested that they were able to access livestock and fisheries information and was a common means of communication. Abbas et al. (2009), conducted a study in Bhawalpur, Pakistan which indicated that the most reliable form of communication among farmers was the radio.

Lwoga, Stilwellb and Ngulube (2015) conducted a study on application of agricultural data and knowledge in Tanzania. The research revealed that many of the farmers (89%; 161) relied on technology to obtain beneficial agricultural information. Many (96.3%; 155) utilised mass media to retrieve data and intelligence on farming systems. The effective medium of dissemination was the radio and a significant proportion of the farmers used it as they considered it pocket friendly and convenient. Handsets (44.1%; 71) were also being integrated in agriculture to access relevant information, for example, livestock and plant diseases, from agricultural officers, agencies, among other stakeholders. The research findings showed that TVs (39.8%; 64) as an essential technology to farmers to retrieve beneficial agricultural data.

2.2 Barriers to ICTs Use in Agriculture

Barriers to adoption of ICTs in agricultural production includes inadequate ICTs skills, shortage of ICTs advantage recognition, complex, inadequate infrastructure, expensive, mistrust issues, poor training, and inaccessible software by farmers (Taragola & Gelb, 2005).

Chete and Fayosiro (2014) conducted a study on the effect of ICTs-Based Initiative (Mobile Phone) on Market Access by Women Farmers in Nigeria. The authors enumerated barriers and challenges to developing rural ICTS facilities for farmers to include insufficient content and for rural society, human resource ability, control weakness, strategic coordination, lacking infrastructures, investment risks, and poor rural infrastructure.

Jayathilake, Jayawira and Waidayasekera (2008) conducted a study on ICTs adoption and its' implications for Agriculture in Sri Lanka. The findings of their exploration showed that the vital inhibiting element that impacts the application of ICTs in farming is affordability of technology. Insufficient training and farmers unable to utilise ICTs is the another variable impacting adoption. Other elements like mistrust issues in the ICTs and its systems; inadequate technical infrastructure and ICTs know-how are the issues affecting the utilization of ICTs in farming.

Bohara (2014) study indicated that technical challenges mainly impacted by the application of IT in communication of agricultural data. The findings indicated that limited ICTs centres and lack of skilled individuals are the major issues that need immediate attention. Musa et al. (2012) found that 50.8 % of farmers have little or no access to electricity (grid or solar) making it difficult to use ICTs gadgets such as TV that cannot easily run on batteries. Similar figures were obtained for access to roads with 54.2% of the farmers indicating that there is little or no road infrastructure in the places they lived. With regard to telecommunications infrastructure, 30.8 % reported little or no infrastructure indicating relatively good coverage of the target population.

Mahant (2012) study on ICTs adoption in agriculture suggested shortage of physical and human resource infrastructure happens to a big barrier. Findings referring to the wireless connectivity as an eliminating element for instance never added to the fathoming of this complication because wireless items require infrastructure. In this case, infrastructure is associated with technology as a whole. Price and as barriers are leveraged because

advanced and advancing nations encounter Cost similar challenges when it comes to the development and adoption of ICTs for Agriculture and Rural Reconstruction. This despite "digital divide" explanations, generation divisions, digital immigration and/or "divide" definition components (Chukwunonso & Tukur, 2012). According to Mahant (2012), a high level of creativity may be a barrier to the application of traditional technologies that can mostly be highly effective and/or by imposing an undesirable expense. The continuous overproduction of technical advancements and cost mitigations integrated with the constantly transforming data and web features focus the critical essence for training.

ICTs application based on operating in households is most scenarios elongated due to inadequate comprehending and recognition of the demands and issues of start-up farmers, inadequate knowledge on the role of ICTs with the inclusion of unanticipated variances from the original farmer and society demands. For instance, Chukwunonso and Tukur (2012) study found that dissatisfied farmers will discourage others from using ICTs, even after installation. Musa et al. (2012) study on the adoption and use of ICTs by small scale farmers in Gezira State, Sudan revealed that 53 % of the participants rated the scarcity of skilled staff and technicians as the top hurdle. Twenty one percent rated weaknesses in methods of dissemination as the second most important barrier to adoption with 13 % rating inappropriate information packaging and shortage of ICTs centres tying in third place.

Kituyi-Kwake and Adigun (2008) conducted a study on analyzing ICTs use and access amongst rural women in Kenya. The study suggested that some of the constraints to ICTs adoption were: ICTs services are unaffordable (32.0 %), time (13.5 %), ICTs services are far away (19.0 %), and computer illiteracy (16.0 %), roads are poor (8.0 %) and cultural taboos (11.5 %). Musa et al. (2012) conducted a cross-tabulation between ICTs and cultural factors that included cultural beliefs, legal frameworks and politics. The findings indicated that there is a statistically significant relationship between adoption of ICTs and these cultural factors.

In Tanzania, Mwakaje (2010) found that a large number of respondents (68%) said that they did not have money to buy the ICTs facilities or services. In addition, around 54% pointed that they had a hard time accessing electricity for using information technology, for example viewing TV among others. Others indicated that various ICTs channels were

unavailable and not credible in their households (15%). Participants stated that other barring elements like operating expenses (8.5%), obtaining broadcasted data (7.5%), and power outages (6.5%). Others accepted that they were unaware of the application of ICT and how to obtain such facilities (3%). Sadaf, Javed & Luqman (2006) stress motivating to apply ICT is essential as a result that much of the farmers still depend on aged structures like families, neighbours among others, to access farming data.

2.3 Influence of ICTs Use in Agriculture

According to Pickerrnell et al. (2004), ICTs has positively affected horticulture. It gives chances to farmers to extend their market and achieve new clients through the Internet. One illustration that demonstrates the effective utilization of ICTs in agribusiness is "mobile telephony". This has been utilized to get to data on market value, climate and numerous different perspectives. These progressions give favorable position to farmers and offer them openings as far as enhancing their personal satisfaction (Abdallah & Samah, 2013).

Syiem and Raj (2015 conducted a study on Access and Usage of ICTs for Agriculture and Rural Development by the tribal farmers in Meghalaya State of North-East India. The study found that the mainly utilised ICT was mobile handsets. Mobile handsets were broadly utilised for dissemination of information, meeting up with middle men for promotion of products and communicating with experts directly for accessing agricultural intelligence. They also pointed out that handsets were essential in emergencies. Data services on presence of inputs, standard of inputs, and diseases and pest regulation by farmer via information technology.

Alia et al. (2013) conducted a study on rural media, agricultural technology adoption and productivity gathering evidence from small rice farmers in Burkina Faso. The study found that farmers who have listened rice program on radio before 2008 are more likely to adoption improved varieties than those who have not. Most importantly we found the indirect effect of listening rice program on radio is significantly positive. Ali et al. concluded that that rural radio could be an effective tool to speed up diffusion and adoption of improved agricultural technologies and increase rice farmer’s productivity in sub-Sahara Africa. The study was limited to the use of the radio as an ICT tool. Therefore there is need for further research on what other tools are used among irrigated rice farmers and their influence on irrigated rice production.

Irungu, Mbugua and Muia (2015) conducted a study on Information and Communication Technologies (ICTs) attract youth into profitable agriculture in Kenya. The study found that the greater part of the adolescent got data from the web; consequently the web was the best stage to advertise and elevate horticulture to the young. They utilized web and online networking to acquire production advancements, advertise data and for data sharing. Most ordinarily utilized devices were MS Office and spread sheets for record keeping. Voice messages and SMS helped auspicious getting to of market costs, achieving customers, sharing creation data and cash exchanges.

The studies highlighted in the literature review show the importance and use of information communication technologies in agricultural production. The studies however are not explicit to ICTs use among irrigated rice production. These studies have also gathered information from only one source of information and preferring only quantitative data. There is need to conduct research on ICTs use in irrigated rice production in an Irrigation scheme setup where the respondents of the study possess similar characteristics, challenges and experiences. There is also need to conduct research on ICTs use in irrigated rice production using both quantitative and qualitative data. The use of both approaches allows the present study to collect rich and in-depth data on ICTs uses, barriers to use and the influence of ICTs use to irrigated rice production.

2.4 Theoretical Framework

Ennis (1999) characterizes theoretical system as a structure that distinguishes and depicts the real components, factors, or constructs that sort out your insightful work. It is utilized to conjecture, comprehend, or offer intending to the connections between the components that impact, influence, or anticipate the occasions or results you determine.

2.4.1 Diffusion of Innovation Theory (DIT)

The first framework is the diffusion of innovation (DoI) based on early work by Rogers (1962, 1995) and then informed by more recent studies of ICTs adoption (Mustonen-Ollila & Lyytinen, 2003; Wainwright & Waring, 2007; Aleke, 2010). The fundamental effect of this system is that it gives extensive knowledge into the complexities of ICTs advancement crosswise over three particular stages. This model is exceptionally compelling to this study, on the grounds that a key component of the model dwells on the investigation of examples of correspondence and relationship between performing artists in ICTs selection (Aleke et al., 2010).

Rogers (2003), whose adoption models is one of the most referred to in the literature of innovation diffusion, outlines four primary components in the diffusion of innovations which are the advancement, correspondence channels, time and the social framework. Rogers depicts advancement "as a thought, practice, or venture that is seen as new by an individual or other unit of adoption (p.12). One of the obstacles to adoption of innovations is uncertainty. To reduce the risk of rejection due to uncertainty, stakeholders should be well-informed through appropriate channels. There are four components to the DIT, which are time, social system, and innovation and communication channels. In this study, the most relevant components are communication and social systems.

Communication is a "process in which participants create and share information with one another in order to reach a mutual understanding" (p.5). The communication channels are the means for the messages to reach the target recipients. As diffusion is a highly social process, interpersonal communication relationships and communication channels can be most influential for acceptance (Sahin, 2006). Rogers (2003) asserts that time however is very important in innovation however its importance has been downplayed in many behavioural studies. As innovations are diffused within a community, the social system is one of the elements in the innovation diffusion.

There are various diffusion models that have been proposed in the ICTs adoption in agriculture. The oldest type of diffusion model, based on communication channels, can be valuable in identifying four stages of the innovation decision-making process (Knowledge, Persuasion, Decision and confirmation) proposed by Rogers (2003). However, the model is a very simple linear one that helps to understand innovation diffusion, but many scholars criticized it for its operationalization limitations. The most influential models in the area of diffusion of agricultural innovations was published by Rogers (1995), who identified a number of factors which influenced the likelihood of adoption, with the most important being the perceived attributes of innovation. He also included factors relating to the nature of the innovation decision, communication channels, and nature of the social system and the extent of extension workers promotional effort.

In regard to the social system, Rogers (2003) defined it as "a set of interrelated units engaged in joint problem solving to accomplish a common goal" (p. 23). Since diffusion of innovations takes place in the social system, it is influenced by the social structure of

the social system. The theory is significant for the study as it gives direction to the adoption of ICTs use among irrigated rice farmers. The rice farmers have personal interaction with each another and are also members of a social system. These factors are important in understanding the choice to use ICTs in irrigated rice production at the Mwea Irrigation Scheme, which may be different from other social systems. This theory is therefore significant to the study, as it provided the direction and framework for the transmission of information on ICTs adoption among rice farmers.

The diffusion of innovation theory explains the rural farmers' network role in facilitating the use of ICTs. The diffusion theory is useful in explaining the use of ICTs among farmers due to their social network use. The diffusion theory highlights that the application of ICTs is much higher when other farmers in the social network of a farmers have adopted the ICTs. The theory is therefore significant to the study as it assisted in analysing how rice farmers use ICTs in irrigated rice production and how this influences farmers to adopt this ICTs However, a limitation of the theory is it does not explain the individual factors that influence adoption and non-adoption of ICTs in irrigated rice production.

2.4.2 Technology Acceptance Model (TAM)

The TAM model was proposed by Davis to anticipate the acknowledgment and utilization of new data innovation (programming and data frameworks) inside companies (Davis, 1989). Some studies use TAM to investigate the factors affecting the adoption and acceptance of technology. TAM is similar to diffusion theory, although it places more emphasis on psychological predisposition and social influences, such as beliefs, attitudes and intentions as important factors in the adoption of technology (Bates, Manuel & Oppenheim, 2007).

The theory recommends that there are various elements that impact the selection and application theory innovation. These are outside variables, perceived relevance and ease of utility. External factors are external contextual variables that influence the acceptance of technology through perceived usefulness and perceived ease of use and may be important predictors of perceived usefulness or perceived simplicity when it comes to application (Musa, 2006).

External variables affect perceived usefulness and perceived ease of use directly or indirectly, and they influence the perception about these two major factors of technology adoption. Perceived helpfulness is how much utilizing innovation would enhance execution and perceived applicability is how much utilizing technology is relied upon to be easy (Lu, Yu, Liu & Yao, 2003). Perceptions, attitudes towards ICTs and ICTs useability are important and suitable for this study but other aspects such as beliefs, behavioural intentions and habits are not taken into account in this study.

The TAM model is relevant to this study as it explores the use of different ICTs in agriculture. ICTs adoption in agriculture is guided by the TAM model as users of ICT will choose a specific tool due to its ability to give the most benefits to the user. The study seeks to identify the uses of ICTs use in irrigated rice production, the constraints of ICTs use in irrigated rice production and the influence of ICTs in irrigated rice production. The theory is significant to the study as the perceptions of the farmer on the usefulness of the technology influence their decision to adopt the technology. These perceptions can either be positive or negative and therefore may be motivators and may also act as barriers to adoption. The researcher therefore proposes to adopt the TAM model to guide the study.

2.5 Research Gap

The literature shows that there are several studies on ICTs use in irrigated agriculture (Jayathilake, Jayaweera & Waidyasekera (2008; Abdegbidi et al., 2012; Joshi & Ayyangar, 2010). However, there are mixed results in regard to ICTs used and for which purposes. Several barriers to ICTs adoption included lack of training and awareness, cost of technology and lack/poor infrastructure. However, these were not specific to irrigated rice production. There is a gap between ICTs use in irrigated rice production and ICTs use in agriculture. The study contributes to knowledge by filling this research gap.

CHAPTER THREE
RESEARCH METHODOLOGY

3.0 Introduction

This chapter presents the different approaches and strategies the researcher adopted to achieve the study objectives. These include the research design, research site, target population, sample and sampling size, data collection methods, data collection procedures and data analysis procedures.

3.1 Research Design

The research was a descriptive survey involving both qualitative and quantitative methods. The study used the cross-sectional survey design which refers to the collection of data during a specified duration of time. According to Arabu et al. (2015), descriptive research as a process of collecting data in order to test hypotheses or to answer questions concerning the current status of the subjects of the study. It is a survey as it is a self-report study which requires the collection of quantifiable information from a sample. The design is appropriate for the study as it sought to investigate the factors influencing ICTs adoption in irrigated rice production. The researcher adopted qualitative and quantitative research approaches. The advantage of using both approaches is enhancing the reliability and validity of the findings as each method strengthens the others' weaknesses.

3.2 Research Site

The Mwea Irrigation Scheme was started way back in 1956 and the predominant crop grown in the Scheme is rice. This is one of the seven public schemes under the management of the National Irrigation Board (NIB). It is situated in Kirinyaga South Sub County, Kirinyaga County. The Scheme is approximately 100 Km North East of Nairobi. The temperatures range from a minimum of 12°C to a maximum of 26°C with an average of 20°C. The rainfall ranges between 1,100 mm and 1,250 mm per annum.

Mwea Irrigation Scheme has a gazetted area of 30,350 acres. A total of 16,000 acres has been developed for paddy production. In addition to this, the scheme has a total of 4,000 acres of out grower / *jua kali* areas under paddy production. The rest of the scheme is used for settlement, public utilities, subsistence and horticultural crops farming (NIB, 2013). There is use of ICTs among rice farmers which was investigated. These include the use of mobile phone banking and communication among farmers and with extension workers.

3.3 Target Population

The target population for the study are farmers in the Mwea Irrigation Scheme, Kirinyaga County. The total number of farmers' households in the Scheme is 6,500 households (NIB, 2013).

3.4 Sampling Technique and Sample Size

In order to calculate the sample size for the study, the following relationship suitable for populations less than 10,000 as suggested by Mugenda and Mugenda (2003) was adopted.

$$n = \frac{n_0}{1 + n_0/N}$$

Where, n is the desired sample size for small populations.

n_0 is the desired sample size when population is less than 10,000 i.e. 384

N is the population size

By applying the sample size formulae,

$$n = \frac{384}{1 + 384/6{,}500}$$

The sample size for the study was 362 respondents. The study adopted purposive sampling technique. The purposive sampling technique is based on selecting the respondents of the study based on the researcher knowledge and judgement. The researcher did a primary indicative study and established that there was poor adoption of ICTs among irrigated rice farmers. The sample of the study was therefore selected from the respondents identified in the primary indicative study. The researcher used 30 questionnaires to pilot the instruments and these were not included in the final sample of the research. The researcher did not use 18 questionnaires as they were incompletely filled and would affect the findings of the study. Out of this, the researcher was able to use 96 questionnaires which met the criteria for analysis.

3.5 Data Collection Methods

3.5.1 Questionnaire

The researcher adopted the questionnaire as the primary tool for data collection. This tool was administered to the farmers. The questionnaire comprised of three sections which

included the respondents' demographic information, the types and use of ICTs adopted and the barriers facing farmers in adopting ICTs in rice production. The questionnaire comprised both close-ended and open-ended question items. Close-ended questions provided a choice of alternative answers from rice farmers are asked to select by ticking; open-ended questions enable the respondent to answer the question using his or her own words.

The researcher used interviewer-administered questionnaires. This involves each respondent being asked the same questions by the interviewer, in the same way, in order to eliminate as far as possible any bias. Advantages of this mode of administration include the collection of more detailed and complex data, the possibility to clarify misunderstandings and the opportunity for the interviewer to probe for additional information (Meadows, 2003). This approach assisted in interpreting the questionnaire to respondents who may be illiterate.

3.5.2 Key Informant Interviews

The study used the key informant interviews to collect data from the County Executive Committee (CEC) member in charge of information communication and technology (ICTs) in Kirinyaga County, two extension officers and two agricultural officers. The study adopted unstructured interviews. Unstructured in-depth interviews is one of the qualitative data collection methods since it encourages respondents to use descriptive mode in giving details, feelings and views on the issue under investigation (Kaddu, 2011).

3.6 Reliability and Validity of Research Instruments

A pilot study was conducted in order to establish the reliability of the research instruments. According to Simon (2011), a pilot study should be conducted among 10 % of the sample size. The pilot study was therefore conducted with 30 respondents who were not included in the final study. The researcher used the Cronbach Alpha function in SPSS to establish the reliability of the link scale items used in the questionnaire. Cronbach's alpha is a measure of internal consistency, that is, how closely related a set of items are as a group (George & Mallery, 2003). The reliability of the instrument was confirmed with an alpha value of 0.71. The appropriate reliability level of an instrument is recommended as 0.7. The validity of the research instrument was established by seeking clarifications on the constructs used in the study with the university supervisor.

Guidance was also sought from the proposal defense panel on the suitability of the constructs in the questionnaire.

3.7 Data Collection Procedures

The data collection was undertaken in between 29th June to 23rd July 2016. The researcher obtained a letter of authorisation from the University of Nairobi to undertake the data collection process. The interviews were conducted by the researcher where I visited the Kirinyaga County Offices in Kerugoya to interview the County Executive Committee (CEC) member in charge of information communication and technology (ICTs) and 1 agricultural officer and 1 extension officer in Kutus. These interviews were conducted in an environment of the respondents choosing to accommodate their schedule and availability to participate in the study. The researcher was able to administer 115 questionnaires. However, 96 questionnaires met the criteria for data analysis inclusion. Some of the questionnaires were self-administered and out of the 19 questionnaires that did not meet the criteria, 5 were not returned to the researcher and 14 had missing responses and were incorrectly filled.

3.8 Data Analysis Procedures

The first step of data analysis was to check the questionnaires for completeness and coding of the responses. The data gathered from the questionnaires were entered into the Statistical Package for Social Sciences (SPSS) Version 22. This quantitative data was analysed using descriptive statistics. Descriptive statistics allowed the researcher to summarise the data and create categories of responses for interpretation. The researcher used the mean, frequencies and percentages to analyse the data. The qualitative data from the in-depth interviews was analysed by identifying the themes and relating these to the study research questions. The qualitative data was presented in verbatim and narrative form to complement the qualitative data. The quantitative data was presented in tables, charts and figures and the researchers' interpretation.

3.9 Research Ethics

Upon successful defense of the project proposal, approval was requested from the University of Nairobi to undertake the data collection process and a Certificate of Fieldwork was issued (see Appendix 3). The researcher requested and acquired a permit from the National Commission of Science Technology and Innovation (NACOSTI), (see Appendix 4). A letter of introduction was issued by the University and attached to the questionnaire to seek consent from respondents before carrying out the interviews (see Appendix 5). The researcher administered questionnaires to farmers, (see Appendix 1) and key informant schedule for the County Executive Committee (CEC-ICTs) in Kirinyaga County, Extension Officers and Agricultural Officers, (see Appendix 2) to collect data.

The researcher defended the project to a team of panellists on 27th October 2016 and after incorporating the corrections, a Certificate of Correction was issued (see Appendix 6). A certificate of plagiarism (see Appendix 7) was issued upon a successful plagiarism test.
The researcher was issued with a certificate of originality upon submission of the final project (see Appendix 8).

CHAPTER FOUR
DATA ANALYSIS, PRESENTATION AND INTERPRETATION

4.0 Introduction

This chapter of the study represents the data analysis and the interpretation following the data collection process. The chapter is presented according to the questionnaires and is complemented by the researchers own interpretation.

4.1 Socio-Economic Information

Socio-economic factors have often been found to influence adoption of ICTs in agriculture, the study sought to understand the socioeconomic background of the irrigated rice farmers in Mwea Irrigation Scheme as this information could be used to predict ICT adoption. The socio-economic factors in the study included the gender, age, marital status, education levels, and household size, farming experience and farm size.

4.1.1 Gender

The study findings showed that the majority of the respondents were male represented by 64.6 % compared to female respondents were 35.4 % as shown in Figure 4.1. The influence of gender difference has been used in past studies to show gaps in adoption of ICTs. Adejo, Idoka and Adejo (2013) study found that female farmers have less access to ICTs compared to their male counterparts.

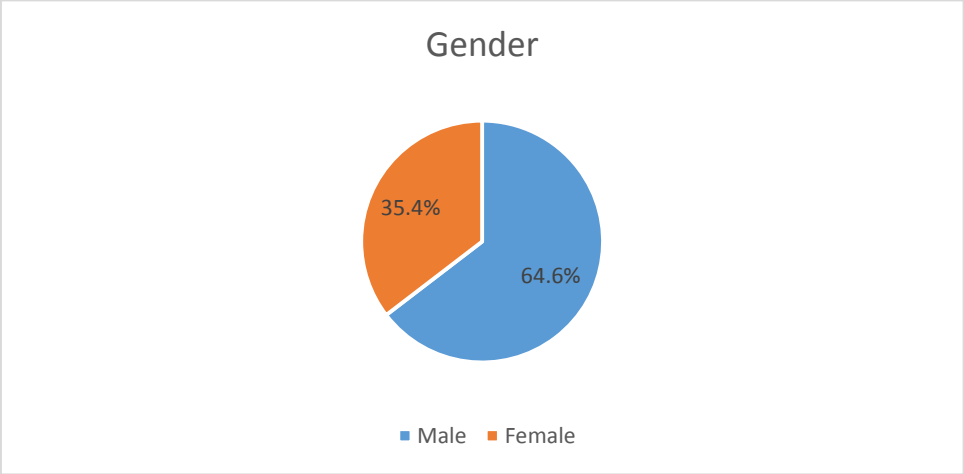

Figure 1: Gender of Respondents

Source: Field Survey (2016)

4.1.2 Age

In regard to the age of the respondents, the findings show that 35.4 % were aged 30-39, 24.0 % were 40-49, 15.6 % were 50-59, 14.6 % were 20-29 and 10.4 % were 60 years and above as shown in Figure 4.2. The importance of age factors in ICT adoption was confined from the key informant interviews. Moreover, respondents indicated other barriers to ICT adoption were age-related factors. The findings revealed that the majority of the respondents were relatively younger between the ages 30-49 years. Past studies (Nyamba & Mlozi, 2012) have shown that majority of ICT users tends to be young adults. The researcher therefore assumes that majority of the respondents have adopted some type of ICTs to validate the findings of the study.

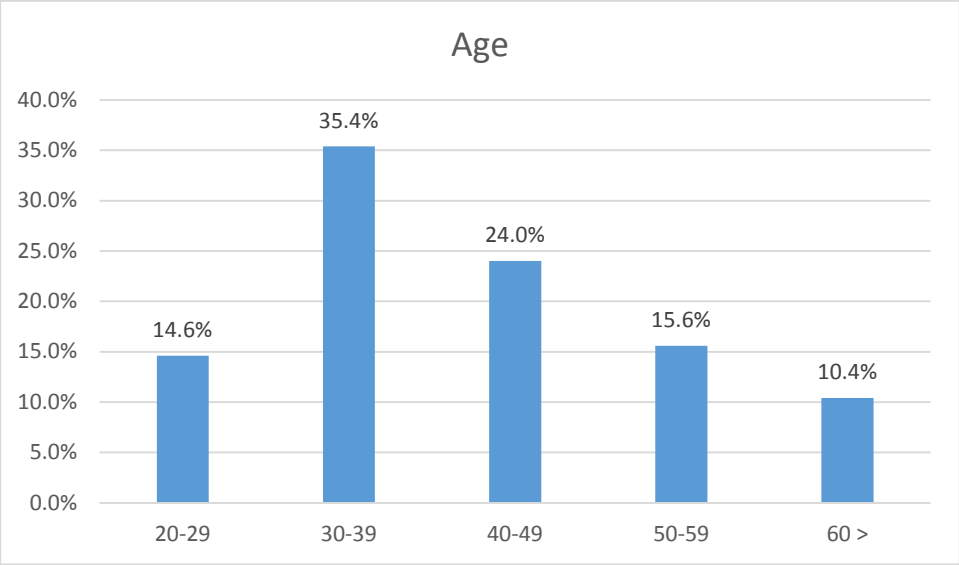

Figure 2: Age of Respondents

Source: Field Survey (2016)

4.1.3 Marital Status

Figure 4.3 shows the marital status of the study participants where 78.1 % were married, 11.5 % were single, 5.2 % were divorced and widowed respectively. Henri-Ukoha, Chikezie, Osuji and Ukoha (2012) investigation concluded that there was no relationship between marital status and ICT adoption in agricultural production. The study therefore does not anticipate that the marital status of the respondents have an effect on use and utilisation of ICT in irrigated rice production.

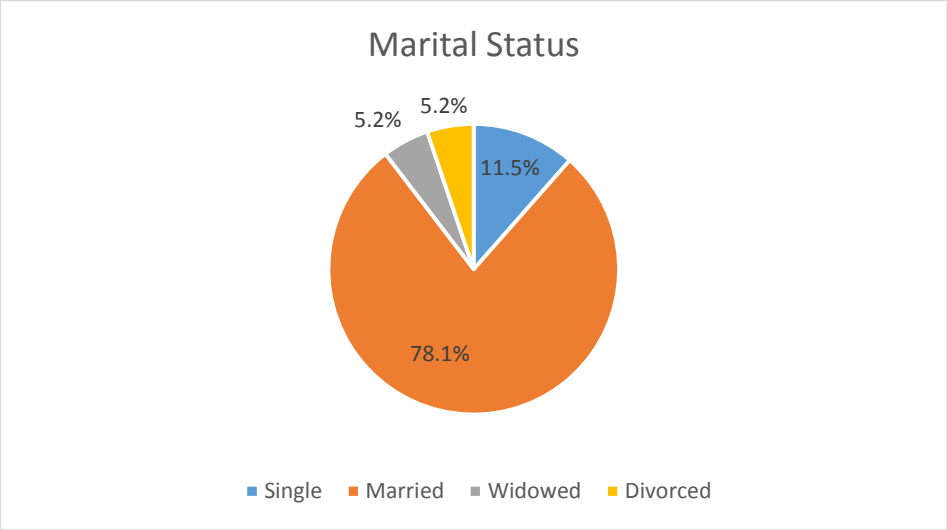

Figure 3: Marital Status of Respondents

Source: Field Survey (2016)

4.1.4 Education Level

The education level of study participants is presented in Figure 4.4. The results show that 21.9 % had attempted secondary school, 20.8 % had completed secondary school education, 19.8 % had completed primary school, 11.5 % had attempted primary school, 14.6 % had no formal education, 6.3 % had a diploma and 5.2 % had a bachelor degree education. The role of education levels in adoption of ICTs is a relationship that has been establish in past studies. Studies (Henri-Ukoha et al., 2012; Chavula, 2014) study on the role of ICT in agricultural production in Africa revealed that higher education levels were correlated to higher levels of ICT adoption.

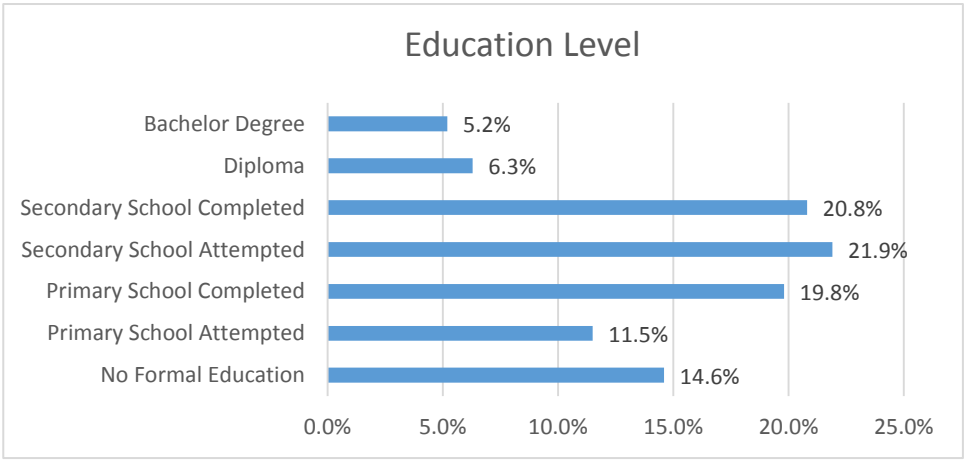

Figure 4: Education Level of Respondents

Source: Field Survey (2016)

4.1.5 Household Size

The majority of the study participants had 1-5 (64.6 %) persons in the household, 27.1 % had 6-10 persons, 6.3 % had 11-15 persons and 2.1 % had only one person as shown in Figure 4.5. There is no conclusive evidence on household size effect on ICT use. Harindranath, Dyerson and Barnes (2008) stated that family size was influential in using ICTs whereas Henri-Ukoha et al. (2012) study found household size was insignificant in ICT adoption.

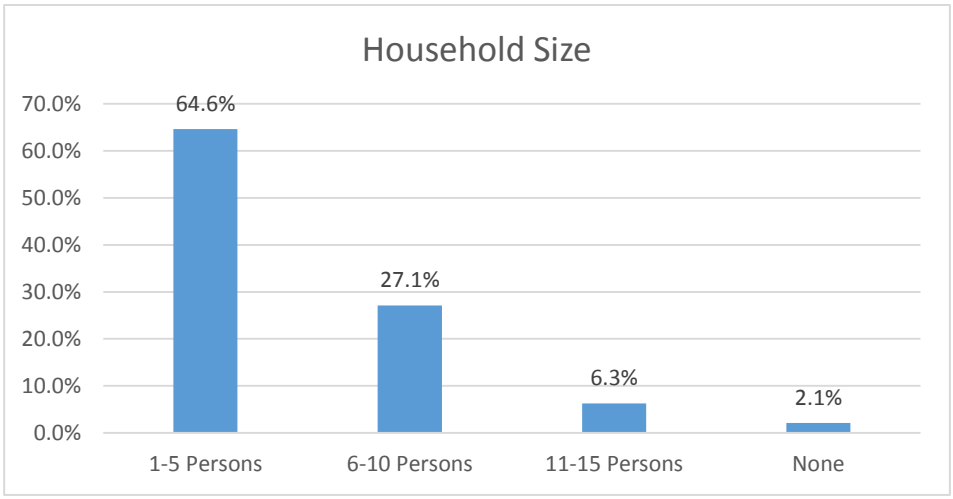

Figure 5: Household Size of Respondents

Source: Field Survey (2016)

4.1.6 Farming Experience

In regard to the their farming experiences, 51.0 % had 6-15 years' experience, 21.9 % had 16-25 years, 12.5 % had 26-35 years, 7.3 % had 36-45 years, 6.3 % had 46-55 years and 1.0 % had less than 6 years of rice production as depicted in Figure 4.6.

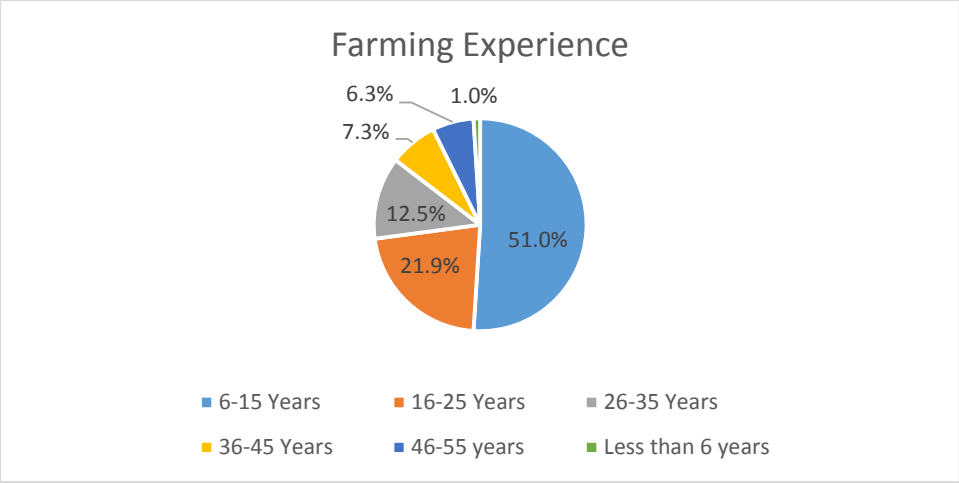

Figure 6: Farming Experience of Respondents

Source: Field Survey (2016)

4.1.7 Farm Size

The study results revealed that 3-4 acres was owned by approximately 41.7 % of the respondents, 32.3 % were 1-2 acres, 15.6 % were less than one acre and 10.4 % were more than 5 acres as shown in Figure 4.6. Warren (2003) found that there was a positive association between farm size and ICT use. This was supported by Njuki et al. (2008) who found that large farm size needed market searches that were largely done using ICTs.

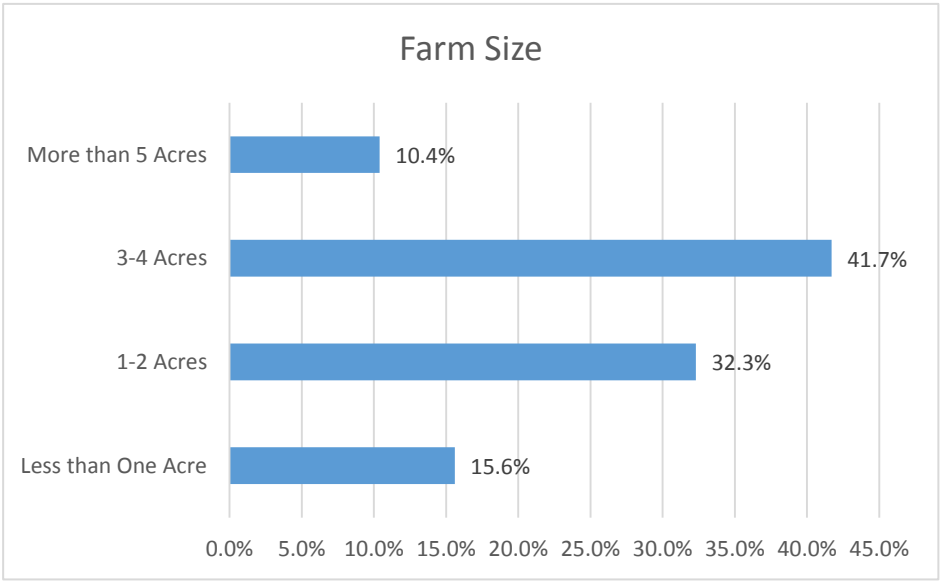

Figure 7: Farm Size of Respondents

Source: Field Survey (2016)

4.2 Uses of ICTs in Irrigated Rice Production in Mwea Irrigation Scheme

4.2.1 Respondents Understanding of ICTs

The researcher sought to establish the understanding of ICTs among the study participants and their responses are highlighted in Table 4.1.

Table 4.1: Understanding of ICTs among respondents

Respondents perception of ICTs	Frequency	Percent
An easier way of passing and getting information	18	18.8
Don't Know or Understand	41	42.7
Use of modern and new technologies to communicate	33	34.4
Use of wireless communication tools/technologies	4	4.2
Total	**96**	**100.0**

Source: Field Survey (2016)

Table 4.1 shows that majority did not know or understand the concept of ICTs as shown by 42.7 %, 34.4 % understood ICT to be the use of modern and new technologies to communicate, 18.8 % explained ICTs as An easier way of passing and getting information and 4.2 % indicated that it was the use of wireless communication tools/technologies.

4.2.2 ICTs with Most Benefit to Rice Farmers

According to the study participants, the most beneficial ICT was mobile phones (45.8 %) followed by radio (26.0 %), Mobile/Phones/Television/Radio (20.8 %) and Internet and computers (7.3 %) as presented in Table 4.2.

Table 4.2: ICTs Most Benefit

ICTs	Frequency	Percentage
Mobile Phones	44	45.8
Mobile/Phones/Television/Radio	20	20.8
Radio	25	26.0
Internet/Computers	7	7.3
Total	**96**	**100.0**

Source: Field Survey (2016)

The study sought to determine the most beneficial ICT according to the respondents. The findings of the study show similarities to past studies. For instance, Adegbidi et al. (2012) study on determinants of ICTs use by rice farmers in Benin revealed that nearly all users (90 %) used radio program as type of media. The three most common types of media after radio program were mobile call-up (41 %), television (17 %) and mobile SMS (10 %).

According to a key informant, there were several ICTs adopted among Mwea Irrigation Rice farmers. These included:

> Listening to Radio programs related to farming on both vernacular stations like Inooro, Kameme and other Kiswahili programs on Radio Citizen, KBC among others. Watching programs on Television stations like Inooro TV, NTV, Citizen TV and KTN. Programs like Smart farm on Citizen, Food Friday on NTV and Farm talk on KBC. Others use the internet enabled devices like mobile phones, personal computers, laptops and others even visit cyber cafes for internet access (Key Informant 4).

Mohammad, Salleh and Hasbullah (2010) agree that radio can be useful medium to educate farmers if it appeals them with new programs having modern agricultural technologies. However, the literacy of farmers is important to understand such programs and apply them appropriately. The study also found that vernacular radio stations were the most preferred as they appealed to the farmers who had lower levels of literacy. This finding supported Haider (2014) conclusion that that local radio agricultural programs helps farmer to adopt new information and apply new methods and practices in their farms.

4.2.3 ICT Uses among Study Participants

The study sought to determine the uses for which ICT tools were used among rice producers of Mwea Irrigation Scheme. The study required respondents to indicate the ICTs used in undertaking selected farming activities. These were: availability of inputs, quality of inputs, market prices of inputs, pest & disease management, farming system information, post-harvest information, value addition information and record keeping.

4.2.4.1 Availability of Inputs

The study sought to identify the uses of ICTs in seeking availability of inputs of irrigated rice production. Table 4.3 shows the respondents' use of ICT in seeking availability of of inputs.

Table 4:3: ICTs used for Availability of Inputs

ICTs Used	Frequency	Percentage
Mobile Phone	29	30.2
Television	5	5.2
Radio	20	20.8
Internet	7	7.3
Computer	3	3.1
All the Above	1	1.0
Mobile Phone/Internet	1	1.0
Mobile Phone/TV/Internet	1	1.0

Mobile Phone/TV/Radio	9	9.4
TV/Radio	6	6.3
Radio/MIAD Centre	3	3.1
Not Applicable	11	11.5
Total	**96**	**100.0**

Source: Field Survey (2016)

In terms of availability of inputs, the findings show that majority used the mobile phone (30.2 %), radio (20.8 %), mobile phone/television/radio (9.4 %), internet (7.3 %), television and radio (6.3 %). This finding support Syiem and Raj (2015) study on access and usage of ICTs for agriculture and rural development by the tribal farmers in Meghalaya State of North-East India where farmers also reported that mobile phones proved to be useful during health emergencies. Information services on availability of inputs, quality of inputs,

4.2.4.2 Quality of Inputs

The researcher sought to establish farmers' use of ICTs in seeking information on the quality of inputs. Table 4.4 shows the responses from the sampled rice farmers.

Table 4.4: ICTs used for Quality of Inputs Information

ICTs Used	Frequency	Percentage
Mobile Phone	8	8.3
Television	16	16.7
Radio	26	27.1
Internet	7	7.3
Computer	6	6.3
Mobile Phone/TV/Radio	2	2.1
TV/Radio	5	5.2
Radio/MIAD Centre	3	3.1
Mobile Phone/TV	1	1.0
Radio/Internet	1	1.0
TV/Internet	1	1.0
Not Applicable	20	20.8
Total	**96**	**100.0**

Source: Field Survey (2016)

The findings show that radio was the most used ICT tool for quality of inputs information. Table 4.4 shows 27.1 % used the radio, 16.7 % were television, 8.3 % were mobile phone, 7.3 % were internet, 6.3 % were computers and 5.2 % used television and radio. Ngowi, Adam Mwakalobo and Mwamfupe (2015) findings that revealed that quality of inputs including credit, weather conditions, sowing time, expert advice on markets and other areas of interest to farmers was often sought through radio.

4.2.4.3 Input Market Prices

The radio was the most used ICT tool to acquire information on the prices of inputs. Table 4.5 shows that 33.3 % used the radio, 26.0 % used mobile phones, 14.6 % used television, 5.2 % used the internet and 3.1 used radio and MIAD Centre and television and radio.

Table 4.5: ICTs used for Input Market Prices Information

ICTs Used	Frequency	Percentage
Mobile Phone	25	26.0
Television	14	14.6
Radio	32	33.3
Internet	5	5.2
Computer	1	1.0
Mobile Phone/TV/Radio	1	1.0
TV/Radio	3	3.1
Radio/MIAD Centre	3	3.1
Not Applicable	12	12.5
Total	**96**	**100.0**

Source: Field Survey (2016)

This finding supports earlier studies such as Abegbidi (2012) who concluded that there is no significant evidence that mobile phone use by producers of pineapple reduces transaction costs. However, findings showed that use of mobile phones has a significant effect on income derived by the household for rice production. Thus, with mobile phones, producers have more access to information and thereby increasing their ability to bargain and therefore the prices they receive (Steinen et al., 2007). These findings further support Irungu et al. (2015) study which found that voice messages and SMS assisted timely accessing of market prices, reaching clients, sharing production information and money transactions

4.2.4.4 Pests and Disease Management

In terms of getting information on pests and diseases management the study found that 33.3 % used the radio, 14.6 % used the television, 12.5 % used the internet, 6.3 % used the television and radio, 5.2 % used the mobile phone, and 3.1 % used radio and MIAD Centre as depicted I Table 4.6. Sangbuapuan (2012) concluded that key areas where ICT can help improve this is by providing up-to-date information about pest and disease control. Babu et al., (2012) found that the important information needs for rice farmers were pest and disease management.

Table 4.6: ICTs used for Pests and Disease Management Information

ICTs Used	Frequency	Percentage
Mobile Phone	5	5.2
Television	14	14.6
Radio	32	33.3
Internet	12	12.5
Mobile Phone/TV/Internet	1	1.0
Mobile Phone/TV/Radio	1	1.0
TV/Radio	6	6.3
Radio/MIAD Centre	3	3.1
TV/Internet	1	1.0
Not Applicable	21	21.9
Total	**96**	**100.0**

Source: Field Survey

4.2.4.5 Farming System Information

The radio was the most used to gather information on farming systems as cited among 30.2 % of the study participants. Other ICT tools used were mobile phones (16.7 %), television (15.6 %), internet (8.3 %), television and radio (7.3 %) and radio and MIAD centre (3.1 %) as presented in Table 4.7.

Table 4.7: ICTs used for Farming System Information

ICTs Used	Frequency	Percentage
Mobile Phone	16	16.7
Television	15	15.6
Radio	29	30.2
Internet	8	8.3
Mobile Phone/TV/Internet	1	1.0
Mobile Phone/TV/Radio	1	1.0
TV/Radio	7	7.3
Radio/MIAD Centre	3	3.1
Radio/Internet	1	1.0
Mobile Phone/TV/Radio/Internet	1	1.0
Not Applicable	14	14.6
Total	**96**	**100.0**

Source: Field Survey (2016)

4.2.4.6 Postharvest Information

Table 4.8 shows the summary of findings in regard to the ICTs used by farmers in seeking postharvest information. In acquiring information on postharvest the results showed that 26.0 % used the radio, 18.8 % used mobile phone, 14.6 % used the television, 3.1 % used the radio and MIAD centres, 2.1 % used the internet, mobile phone/internet and television and radio respectively as shown in Table 4.8.

Table 4.8: ICTs used for Postharvest Information

ICTs Used	Frequency	Percentage
Mobile Phone	18	18.8
Television	14	14.6
Radio	25	26.0
Internet	2	2.1
Computer	1	1.0
Mobile Phone/Internet	2	2.1
Mobile Phone/TV/Radio	1	1.0
TV/Radio	2	2.1
Radio/MIAD Centre	3	3.1
Mobile Phone/TV	1	1.0
Not Applicable	27	28.1
Total	**96**	**100.0**

Source: Field Survey (2016)

This findings confirms earlier findings of Nenna (2014) that the effective use of ICTs have significant positive impacts on agricultural production, marketing and post-harvest activities that can improve the livelihood of poor rural families which in turn can contribute to poverty reduction. Nenna found that farmers preferred to use mobile phones, radio and television to seek this information. The results further showed that ICT is relevant to farmers' production activities, both in pre-planting and post-planting operations.

4.2.4.7 Value Addition Information

The researcher sought to establish the ICTs that farmers used to access information on value addition. Value addition is a process of processing farm produce to a product that can make more profit and benefit the farmer. The findings are shown in Table 4.9.

Table 4.9: ICTs used for Value Addition Information

ICTs Used	Frequency	Percentage
Mobile Phone	16	16.7
Television	11	11.5
Radio	25	26.0
Internet	6	6.3
Computer	6	6.3
TV/Radio	4	4.2
Radio/MIAD Centre	3	3.1
TV/Internet	1	1.0
Not Applicable	24	25.0
Total	**96**	**100.0**

Source: Field Survey (2016)

Table 4.9 shows that the radio (26.0 %) was the most used ICT tool to acquire information among the respondents. Other ICT used were mobile phone (16.7 %), television (11.5 %), 6.3 % used the internet and computers, 4.2 % used the television and radio and 3.1 % used radio and MIAD Centre. These findings support Katengeza (2012) arguments of ICTs as a strategic tool for rural value addition and empowerment. This also supports Mwakaje (2010) findings that farmers can take full advantage of ICT to enhance productivity and generate more income by adopting new technologies, including new varieties, adding value and marketing their products.

4.2.4.8 Record Keeping

In regards to the type of ICTs used for record keeping, the results showed that the radio (26.0 %) was the most used ICT to learn about record keeping, this was followed by the mobile phone (16.7 %) and television (11.5 %). Other ICT tools used included internet and computer (6.3 %) as shown in Table 4.10.

Table 4.10: ICTs used for and Record Keeping

ICTs Used	Frequency	Percentage
Mobile Phone	16	16.7
Television	11	11.5
Radio	25	26.0
Internet	6	6.3
Computer	6	6.3
TV/Radio	4	4.2
Radio/MIAD Centre	3	3.1
TV/Internet	1	1.0
Not Applicable	24	25.0
Total	**96**	**100.0**

Source: Field Survey (2016)

This means that majority of farmers learn about record keeping from radio programmes. The mobile phone was also used and this was attributed to the power of the smartphone to access the internet for information. Television programmes also provided an opportunity for rice farmers to be able to learn about record keeping. These results confirm Nenna (2014) findings that farmers rely on ICTs for record keeping. Oladele (2015) also found that use of ICTs improved quality of information and record keeping respectively.

4.2.4.9 Other Uses of ICT

The study investigated the use of ICTs among farmers' in terms of Availability of inputs, Quality of inputs, Market prices of inputs, Pest & disease management, Farming system

information, Post-harvest information, Value addition information and record keeping. The study also sought to find out what other uses of ICT were undertaken by farmers other uses shown in Table 4.11.

Table 4.11: Other Uses of ICTs among Irrigated Rice Farmers

ICTs Used	Frequency	Percentage
Attending meetings and seminars	33	34.4
Capacity building	5	5.2
Communicate on work arrangements	15	15.6
Comparing other farming Methods	3	3.1
Learning new farming technologies	18	18.8
Assist in water management practices	2	2.1
Information on input prices, marketing and planting time table	13	13.5
Payment of inputs	7	7.3
Total	**96**	**100.0**

Source: Field Survey (2016)

The results revealed that the most popular use of ICTs was attending meetings and seminars (34.4 %), learning new farming technologies (18.8 %), communicate on work arrangements (15.6 %), information on input prices, marketing and planting time table (13.5 %), payment of inputs (7.3 %) and capacity building (5.2 %). The key informant interviews revealed that there were several uses for which ICTs were used among the irrigated rice farmers in Mwea Irrigation Scheme. These were:

> Checking on available paddy seed varieties; Checking on prices of the paddy seed and packaged rice; Issues related to rice from Japan and its quality; Diseases that affect paddy fields and control measures applied across the world; Methods of planting, managing and harvesting paddy; Methods of adding value to paddy by products like the rice husk; Market for paddy and its by-products and Research related to paddy production (Key informant 2)

4.3 Barriers of ICTs Use in Irrigated Rice Production in Mwea Irrigation Scheme

Table 4.12 shows a summary of some of the barriers that face irrigated rice farmers in adoption of ICTs. The mean (M) and standard deviation (SD) were used to show the highest ranked and lowest ranked barriers. The results show that the most cited barrier was lack of training (M=3.59; SD =1.34), lack of ICTs skills and inability to use (M=3.49; SD =1.41) and cost of ICTS and/or funds (M=3.20; SD =1.16). The lowest ranked barriers were Tradition and/or traditional practices (M=2.17; SD=1.20) followed by fear and/or distrust of technology (M=2.19; SD=1.18) and available ICTs unsuitable for practice or zone (M=2.28; SD=1.26).

Table 4.12: Barriers to ICT Adoption in Irrigated Rice Production

Constraints	No extent	Little extent	Moderate extent	To an extent	A great extent	Mean	Standard Deviation
Lack of ICTs skills and inability to use	11.5%	15.6%	21.9%	14.6%	36.5%	3.49	1.41
No perceived economic benefit	18.8%	30.2%	32.3%	14.6%	4.2%	2.55	1.08
Too hard to use	18.8%	21.9%	23.0%	17.7%	18.8%	2.95	1.38
No ICTs access and/or infrastructure	13.5%	27.1%	26.0%	10.4%	22.9%	3.02	1.36
Lack of (personal) ICTs support services	18.8%	15.6%	30.2%	10.4%	25.0%	3.04	1.41
Cost of ICTS and/or funds	6.3%	21.9%	35.4%	17.7%	18.8%	3.20	1.16
Integration, reliability, usefulness of information	10.4%	22.9%	36.5%	21.9%	8.3%	2.94	1.09
Available ICTs unsuitable for practice or zone	32.3%	34.4%	15.6%	8.3%	9.4%	2.28	1.26
Fear and/or distrust of technology	38.5%	21.9%	25.0%	10.4%	4.2%	2.19	1.18
Time limitations	24.0%	20.8%	30.2%	20.8%	4.2%	2.60	1.18
Lack of training	8.3%	14.6%	24.0%	15.6%	37.5%	3.59	1.34
Tradition and/or Traditional practices	37.5%	28.1%	17.7%	11.5%	5.2%	2.17	1.20
Don't understand value, lack awareness	10.4%	29.2%	32.3%	15.6%	12.5%	2.90	2.17
Power cuts	13.5%	19.8%	25.0%	19.8%	21.9%	3.17	1.34

Source: Field Survey (2016)

The study findings showed that the major barriers to ICT adoption among irrigated rice farmers were lack of training, lack of ICTs skills and inability to use and associated cost of ICTs and/or funds. These findings support previous studies highlighted in the literature. Mwakaje (2010) found that a large number of respondents (68 %) said that they did not have money to buy the ICTs facilities or services and their running costs (8.5%) and others admitted that they did not know how to use ICTs (4 %).

Similarly, Kituyi-Kwake and Adigun (2008) study confirmed barriers to ICT use included services were unaffordable (32.0 %). Jayathilake, Jayawira and Waidayasekera (2008) conducted a study on ICTs adoption and its' implications for Agriculture in Sri Lanka. The outcome of the research depicted that the crucial inhibiting element that impacts the application of IT in farming is the price of technology. Inadequate education and farmers unable to utilise IT is another variable impacting its adoption.

According to key informant responses, there many challenges facing rice farmers in Mwea. The findings showed that 37.5 % cited that lack of training was a barrier to rice farmers' use of ICT to a great extent. Most of the farmers have only attained basic education and there are some who are not learned at all. The few farmers we have who have gone past secondary school and have achieved basic education and have a better understanding of ICTs.

The farm managers (casual labourers) employed do not have the literacy levels to use ICT in rice production. One of the issues has been to engage the casual labourers who are farm managers to use ICT. This has stemmed from low literacy levels whereby casual labourers are not willing or ready to adopt ICT. These challenges were summarised as;

> Illiteracy; Lack of ICTs since most of these gadgets are very expensive; most households are not connected to the national grid; Lack of exposure; over reliance on traditional methods of farming which limits their desire to explore other options used elsewhere (Key Informant 3).

4.4 Influence of ICTs use in Irrigated Rice Production in Mwea Irrigation Scheme

The study had found that farmers had adopted several ICTs in rice production at the Mwea Irrigation Scheme. The study sought to establish the influence of these ICTs on irrigated rice production. Table 4.13 shows the respondents'' opinions on the influence of ICTs. One of the major influences was increase in rice production output (M=3.19; SD=1.31), followed by increase of farmers' skills/knowledge in rice production (M=3.08; SD=1.35), Accessing agricultural market information (M=2.95; SD=1.30).

Table 4.13: Influence of ICT on Irrigated Rice Production

Statements	No Effect	Very Little Effect	Moderate Effect	Little Effect	Great Effect	Mean	Standard Deviation
Increase of farmers' skills/knowledge in rice production	15.6%	16.7%	35.4%	8.3%	24.0%	3.08	1.35
Increase in rice production output	16.7%	6.3%	38.5%	17.7%	20.8%	3.19	1.31
Access to production and market information	12.5%	27.1%	31.3%	14.6%	14.6%	2.91	1.22
Enhanced access to agricultural extension services	24.0%	5.2%	40.6%	21.9%	8.3%	2.85	1.25
Accessing agricultural	17.7%	15.6%	36.4%	13.5%	16.7%	2.95	1.30

market information.							
Strategic partnerships with associations and organisations	21.9%	14.6%	27.1%	19.8%	16.7%	2.94	1.38

Source: Field Survey (2016)

From the key informant interviews revealed for those who have adopted these ICTs, there are several good results they have realised. Some of these are:

> Increased paddy yields, increased income from rice paddy and its by-products, market access, knowledge on issues related to innovations on rice paddy production and knowledge on diseases affecting paddy rice and control measures (Key Informant 1)

Several studies show support for this findings. Katengeza (2012) agrees that ICT based interventions have attracted attention because they are more effective in communicating knowledge to rural farmers; are more cost-effective and they facilitate access to markets. Al-Hassan, Egyir and Abakah (2013) study on ICT use in Ghana concluded that there is a latent potential for ICTs, especially the mobile phone to facilitate transactions of rural farm households, which can be realized through positive partnership between the private and the public sectors. Mwakaje (2010) study in Tanzania found that people who used ICT to access market information sold a lot more and received relatively better prices, which has a positive impact on poverty alleviation.

In Kenya, Ogutu, Okelloa & Otienoa (2013) study on impact of information and communication technology-based market information services on smallholder farm input use and productivity found that there was a positive impact of ICT on productivity. Gichoya (2005) admits that a lack of ICT policies and master plans to guide investment in ICT projects in Kenya has been a constraint to ICT use in major sectors of Kenya's economy. To the extent that, with a number donors funding ICT, there have been multiple investments for the same product due to lack of coordination. Odera (2011) agrees that Kenya had not had an ICT policy until 2005 when the government came with an ICT policy in the Sessional Paper No 1 of 2005 for integration of ICT in the education sector. This could go a long way in enhancing the use of ICTs in agriculture as Irungu et al. (2015) have shown.

In order to enhance irrigated rice farmers adoption of ICTs, the researcher asked key informants for suggestions on how this could be achieved. The two levels of government (County and Central Governments) have a huge role to play in assisting farmers in Mwea

to increase rice production in the country to meet rice demands and minimise overreliance on imported rice from Japan and other countries. These included: The county government of Kirinyaga in partnership with the National government should come up with specific projects aimed at building farmers capacity and enhance their understanding of matters ICT; Farmers should be connected to the national grid to have electricity; Have exchange programs locally and internationally for the farmers to gain for knowledge on the opportunities ICTs have for them; Establish a fully furnished e-resource centre in Wang'uru town (Mwea) for farmers who do not have personal ICT gadgets to access the internet and search anything of interest to them; Partner with development partners to help our farmers to understand and adopt ICTs and lobbying the ministry of education to divert the laptop project to our farmers. I believe they stand to benefit more from these laptops than class one kids. If not divert the project, then factor use in the plan.

4.5 Research Objective and Findings

This section presents the research objectives and the findings to validate that research questions were answered. An objective of the study was to identify uses of ICTs in irrigated rice production in Mwea Irrigation Scheme. The study found that ICT was used for communicating information on attending meetings and seminars, learning new farming technologies, communicate on work arrangements and seeking information on Information on input prices, marketing and planting time table. A second objective of the study was to identify barriers of ICTs use in irrigated rice production in Mwea Irrigation Scheme. The mean scores suggested that the major barrier to ICT use among rice farmers was Lack of ICTs skills and inability to use, followed by Lack of training, Cost of ICTS and/or funds and Power cuts. The third objective of the study was to examine the influence of ICTs use in irrigated rice production in Mwea Irrigation Scheme. The most influence seen of ICT among rice farmers was Increase of farmers' skills/knowledge in rice production followed by increase in rice production output, accessing agricultural market information and strategic partnerships with associations and organisations.

CHAPTER FIVE
SUMMARY, CONCLUSION AND POLICY IMPLICATIONS

5.0 Introduction

This chapter presents the summary of the study, conclusion of the study, recommendations of the study based on the findings and suggestions for areas of further studies. The conclusion and recommendations are presented in line with the study objectives. The areas of further studies are derived from the scope and limitations of the study.

5.1 Summary

The general objective of the study was to examine Information Communication Technologies (ICTs) adoption in irrigated rice production in Mwea Irrigation Scheme. The study was guided by three specific objectives: to identify uses of ICTs in irrigated rice production; identify barriers of ICTs use in irrigated rice production and examine influence of ICTs use in irrigated rice production in Mwea Irrigation Scheme. The descriptive survey was adopted which used both qualitative and quantitative methods. The cross-sectional survey design which refers to the collection of data during a specified duration of time was adopted. The target population for the study were 6,500 households in the Mwea Irrigation Scheme, Kirinyaga County. The sample size for the study was 362 respondents and the researcher was able to collect 96 completed questionnaires which were used for data analysis. The sample of the study was therefore selected from the respondents identified in the primary indicative study. The researcher adopted the questionnaire as the primary tool for data collection which was interview administered to the household heads.

Key informant interviews were used to collect data from the County Executive Committee (CEC) member in charge of information communication and technology (ICTs) in Kirinyaga County, two extension officers and two agricultural officers. The researcher was able to conduct three key informant interviews with two agricultural officers, one extension officer, and an interview with the CEC of ICT Kirinyaga County. Descriptive statistics were used to summarise the data and create categories of responses for interpretation. The researcher used mean, frequencies, percentages and standard deviation to analyse the data. The qualitative data was presented in verbatim and narrative form to complement the qualitative data.

The quantitative data was presented in tables, charts and figures and the researchers' interpretation. The study found that ICT was used for communicating information on attending meetings and seminars, learning new farming technologies, communicate on work arrangements and seeking information on Information on input prices, marketing and planting timetable. The mean scores suggested that the major barrier to ICT use among rice farmers was Lack of ICTs skills and inability to use, followed by Lack of training, Cost of ICTS and/or funds and Power cuts. The most influence seen of ICT among rice farmers was Increase of farmers' skills/knowledge in rice production followed by increase in rice production output, accessing agricultural market information and strategic partnerships with associations and organisations. The study concluded that ICTs are used to source for information on available paddy seed varieties, prices of the paddy seed and packaged rice; that major barriers facing ICT adoption among irrigated rice farmers in Mwea Irrigation Scheme are lack of training, lack of ICTs skills and inability to use and cost of ICTS and/or funds and that the most influence of ICT adoption among rice farmers was increase in rice production output, followed by increase of farmers' skills/knowledge in rice production and accessing agricultural market information.

5.2 Conclusion

The study concludes that there were several motivations for using ICTs. These motivations included easy availability of information, easy access to information and reduced costs in acquiring information on rice production. The study concludes that ICTs were used to source for information on available paddy seed varieties, prices of the paddy seed and packaged rice, issues related to rice from japan and its quality, diseases that affect paddy fields and control measures applied across the world, methods of planting, managing and harvesting paddy, methods of adding value to paddy by products like the rice husk, market for paddy and its by-products and conduct research related to paddy production. The study concludes that the major barriers facing ICT adoption among irrigated rice farmers in Mwea Irrigation Scheme are lack of training, lack of ICTs skills and inability to use and cost of ICTS and/or funds. It further concluded that the major barriers of ICTs among irrigated rice producers was personal barriers. The study concludes that irrigated rice farmers' adoption of ICT was hindered by personal barriers such as illiteracy of farmers, age was also a factor that limited ICT adoption and access to funds to acquire information communication technologies and maintenance of these tools.

The study concludes that the most influence of ICT adoption among rice farmers was increase in rice production output, followed by increase of farmers' skills/knowledge in rice production and accessing agricultural market information. The study concludes that important sections where ICT can enhance this is by giving latest data about pest and infection control, early cautioning frameworks, new assortments, better approaches to streamline creation and directions for quality control.

5.3 Recommendations

The study recommends;

1. That adequate workshops, training and awareness should be given to the rice farmers and be promoted by the county and central governments and other private organizations. This training should focus on the uses and benefits of different ICTs available for farmers.

2. That the county, central government and national Irrigation Board should establish ICT centres in the rice irrigation schemes to provide rice farmers with access to ICT tools and services which may not be available to all farmers to utilise according to their needs.

3. That the central government should continue to implement the Rural Electrification Program (REP) within rice irrigation schemes to provide the infrastructural support for ICT use and services.

4. That Media owner should broadcast more agricultural programmes on both radio and television and should make sure that the programmes are broadcast at appropriate and convenient times for farmers.

5.4 Areas of Further Studies

The study was limited to Mwea Irrigation Scheme, Kirinyaga County. There is need to conduct studies on ICT adoption in other rice production irrigation schemes Ahero, West Kano and Bunyala in western Kenya. One can further study on the influence of a selected ICT on adoption of irrigated rice production in Mwea Irrigation Scheme or any other rice growing scheme.

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APPENDICES

APPENDIX 1: QUESTIONNAIRE FOR FARMERS

Section 1: Demographic Information

1. Gender

Male	( )	Female	( )

2. Age (years)

20-29	( )	30-39	( )
40-49	( )	50-59	( )
60 >	( )		

3. Marital status

Single	( )	Married	( )
Widowed	( )	Divorced	( )

4. Educational level

No formal education	( )	Primary school attempted	( )
Primary school completed	( )	Secondary school attempted	( )
Secondary school completed	( )	Diploma	( )
Bachelor degree	( )	Masters / PhD	( )

5. Religion

Christianity	( )	Islam	( )

Other (*Specify*) …….

6. Household size

1-5 persons	( )	6-10 persons	( )
11-15 persons	( )	16-20 persons	( )
21-25 persons	( )	Above 25 persons	( )

7. Years of farming/working experience

6-15 years	( )	16-25 years	( )
26-35 years	( )	36-45 years	( )
46-55 years	( )		

8. Size of farm

Less than one acre	( )	3-4 Acres	( )
1 – 2 Acres	( )	More than 5 Acres	( )

Section 2: Communication and Types of ICTs among Irrigated Rice Farmers

9. What is your understanding of information communication technologies?

……

……

10. What information communication technologies do you use as a rice farmer?

Television	( )	Personal Computer	( )
Internet	( )	Satellite TV dish	( )
Mobile phone	( )	Radio	( )

Other (*Specify*) …….

11. The table below shows some uses of ICTs among farmers. Please indicate which ICTs tool you use and for what purposes

Purposes of using ICTs and sources of information	**Mobile Phone**	**Television**	**Radio**	**Internet**	**Computer**
Availability of inputs					
Quality of inputs					
Market prices of inputs					
Pest & disease management					
Farming system information					
Post-harvest information					
Value addition information					
Record keeping					

12. What other uses do you have for the above information communication technologies?

……

……

13. How often do you use these information communication technologies?

Never	( )
Rarely	( )
Moderately	( )
Often	( )
Always	( )

14. What are some of the benefits of adopting ICTs as a rice farmer?

……

……

15. What ICTs have the most benefit to rice farmers and why?

……

……

……

Section 3: Barriers to Strategic Communication and ICTs Adoption among Farmers

16. The table below shows some of the constraints to adoption of ICTs among farmers. Please indicate to what extent these factors limit your adoption of information communication technologies in rice production.

Constraints	**No extent**	**Little extent**	**Moderate extent**	**To an extent**	**A great extent**
Lack of ICTs skills and inability to use					
No perceived economic benefit					
Too hard to use					
No ICTs access and/or infrastructure					
Lack of (personal) ICTs support services					
Cost of ICTS and/or funds					
Integration, reliability, usefulness of information					
Available ICTs unsuitable for practice or zone					
Fear and/or distrust of technology					
Time limitations					
Lack of training					
Tradition and/or Traditional practices					
Don’t understand value, lack awareness					
Power cuts					

17. What other barriers do you face in adoption of ICTs in irrigated rice production?

……

……

Section 4: Influence of Strategic Communication and ICTs on irrigated rice production

18. The table below shows some of the influence of ICTs on agricultural production among farmers. Please indicate to what extent ICTs influence irrigated Rice production.

Statements	**No Effect**	**Very Little Effect**	**Moderate Effect**	**Little Effect**	**Great Effect**
Increase of farmers' skills/knowledge in rice production					
Increase in rice production output					
Access to production and market information					
Enhanced access to agricultural extension services					
Accessing agricultural market information.					
Strategic partnerships with associations and organisations					

19. What are the other influences of ICTs in irrigated rice production?

……

……

……

Thank you for your co-operation.

APPENDIX 2: KEY INFORMANT INTERVIEW SCHEDULE FOR THE COUNTY EXECUTIVE COMMITTEE (CEC-ICTS) KIRINYAGA COUNTY, EXTENSION OFFICERS AND AGRICULTURAL OFFICERS

1. Do farmers in the mwea irrigation scheme adopt information communication technologies in rice production?
2. What are some of the ICTs adopted by farmers in rice production in the Mwea irrigation scheme?
3. What are some of the factors affecting adoption of ICTs in rice production among framers in the mwea irrigation scheme?
4. What are the constraints facing farmers in the adoption of ICTs in the Mwea irrigation scheme?
5. What assistance do rice farmers in the mwea irrigation scheme require to enhance ICTs adoption in rice production?

APPENDIX 3: CERTIFICATE FOR FIELDWORK

UNIVERSITY OF NAIROBI
COLLEGE OF HUMANITIES & SOCIAL SCIENCES
SCHOOL OF JOURNALISM & MASS COMMUNICATION

Telegram: Journalism Varsity Nairobi
Telephone: 254-02-3318262, Ext. 28080, 28061
Director's Office: 254-02-2314201 (Direct Line)
Telex: 22095 Fax: 254-02-245566
Email: director-soj@uonbi.ac.ke

P.O. Box 30197-00100
Nairobi, GPO
Kenya

REF: CERTIFICATE OF FIELDWORK

This is to certify that all corrections proposed at the Board of Examiners meeting held on 13.05.2016 in respect of ~~M.A~~/PhD. Project/Thesis Proposal defence have been effected to my/our satisfaction and the project can be allowed to proceed for fieldwork.

Reg. No: K50/74918/2014

Name: DANIEL MWANZI NZONZO

Title: STRATEGIC COMMUNICATION AND INFORMATION COMMUNICATION TECHNOLOGIES ADOPTION IN IRRIGATED RICE PRODUCTION: CASE STUDY OF MWEA IRRIGATION SCHEME.

DR H.M. MOGAMBI SUPERVISOR	SIGNATURE	20.06.2016 DATE
Dr Samuel Siringi ASSOCIATE DIRECTOR	SIGNATURE	04/07/2016 DATE
DIRECTOR	SIGNATURE/STAMP	05.7.2016 DATE

APPENDIX 4: NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION RESEARCH PERMIT

THIS IS TO CERTIFY THAT:
MR. DANIEL MWANZI NZONZO
of UNIVERSITY OF NAIROBI, 51281-100
Nairobi,has been permitted to conduct
research in *Kirinyaga County*

Permit No : NACOSTI/P/16/71918/12482
Date Of Issue : 2nd August,2016
Fee Recieved :Ksh 1000

on the topic: *STRATEGIC COMMUNICATION AND INFORMATION COMMUNICATION TECHNOLOGIES ADOPTION IN IRRIGATED RICE PRODUCTION CASE STUDY OF MWEA IRRIGATION SCHEME*

for the period ending:
30th July,2017

.....
Applicant's Signature

.....
Director General
National Commission for Science, Technology & Innovation

CONDITIONS

1. **You must report to the County Commissioner and the County Education Officer of the area before embarking on your research. Failure to do that may lead to the cancellation of your permit**
2. **Government Officers will not be interviewed without prior appointment.**
3. **No questionnaire will be used unless it has been approved.**
4. **Excavation, filming and collection of biological specimens are subject to further permission from the relevant Government Ministries.**
5. **You are required to submit at least two(2) hard copies and one(1) soft copy of your final report.**
6. **The Government of Kenya reserves the right to modify the conditions of this permit including its cancellation without notice**

REPUBLIC OF KENYA

National Commission for Science, Technology and Innovation

RESEARCH CLEARANCE PERMIT

Serial No. A 10479

CONDITIONS: see back page

APPENDIX 5: UNIVERSITY OF NAIROBI RESEARCH INTRODUCTION LETTER

UNIVERSITY OF NAIROBI
COLLEGE OF HUMANITIES & SOCIAL SCIENCES
SCHOOL OF JOURNALISM & MASS COMMUNICATION

Telegram: Journalism Varsity Nairobi
Telephone: 254-02-334244, 332986, 226451 Ext. 28080, 28061
Director's Office: 254-02-229168 (Direct Line)
Telex: 22095 Fax: 254-02-229168
Email: director-soj@uonbi.ac.ke

P.O. Box 30197
Nairobi.
Kenya

OUR REF:
YOUR REF:

DATE: June 21, 2016

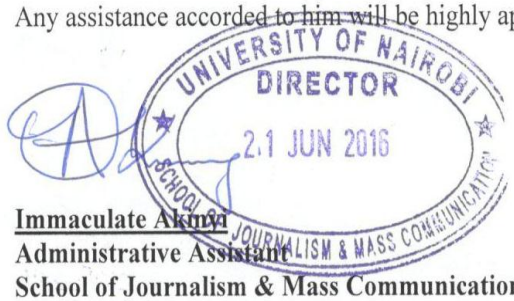
TO WHOM IT MAY CONCERN

RE: NZONZO, Daniel Mwanzi - K50/74918/2014

This is to confirm that the above named is a bona fide student of the University of Nairobi's School of Journalism and Mass Communication registered for Master of Arts degree in Communication Studies.

Mr. Daniel has completed his course work and is currently going to collect data for his research project leading to a Master of Arts Degree in Communication Studies.

Any assistance accorded to him will be highly appreciated.



Immaculate Akinyi
Administrative Assistant
School of Journalism & Mass Communication

/dm

APPENDIX 6: CERTIFICATE FOR CORRECTIONS

UNIVERSITY OF NAIROBI
COLLEGE OF HUMANITIES & SOCIAL SCIENCES
SCHOOL OF JOURNALISM & MASS COMMUNICATION

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Email: director-soj@uonbi.ac.ke

P.O. Box 30197-00100
Nairobi, GPO
Kenya

REF: CERTIFICATE OF CORRECTIONS

This is to certify that all corrections proposed at the Board of Examiners meeting held on 27/10/2016 in respect of M.A/PhD. Project/Thesis Proposal defence have been effected to my/our satisfaction and the project can now be prepared for binding.

Reg. No: K50/74918/2014

Name: N20N20, D.

Title: Information Communication technologies adoption in irrigated rice production: Case of Mwea Irrigation Scheme

DR HEZRON MOGAMBI		27.10.2016
SUPERVISOR	SIGNATURE	DATE
Dr Samuel Siringi		15/11/2016
ASSOCIATE DIRECTOR	SIGNATURE	DATE
Dr. Nderi Nderi		18.11.2016
DIRECTOR	SIGNATURE/STAMP	DATE

UNIVERSITY OF NAIROBI DIRECTOR 17 NOV 2016 SCHOOL OF JOURNALISM & MASS COMMUNICATION

APPENDIX 7: PLAGIARISM REPORT

Turnitin Originality Report

INFORMATION COMMUNICATION TECHNOLOGIES ADOPTION IN IRRIGATED RICE PRODUCTION: CASE STUDY OF MWEA IRRIGATION SCHEME by By Daniel Mwanzi Nzonzo Reg No: K50/74918/2014

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APPENDIX 8: CERTIFICATE OF ORIGINALITY

UNIVERSITY OF NAIROBI

Declaration of Originality Form

This form must be completed and signed for all works submitted to the University for examination.

Name of Student DANIEL MWANZI NZONZO

Registration Number K50/74918/2016

College HUMANITIES AND SOCIAL SCIENCES

Faculty/School/Institute JOURNALISM AND MASS COMMUNICATION

Department SOJ

Course Name MASTER OF ARTS IN COMMUNICATION STUDIES

Title of the work

DECLARATION

1. I understand what Plagiarism is and I am aware of the University's policy in this regard
2. I declare that this Project (Thesis, project, essay, assignment, paper, report, etc) is my original work and has not been submitted elsewhere for examination, award of a degree or publication. Where other people's work, or my own work has been used, this has properly been acknowledged and referenced in accordance with the University of Nairobi's requirements.
3. I have not sought or used the services of any professional agencies to produce this work
4. I have not allowed, and shall not allow anyone to copy my work with the intention of passing it off as his/her own work
5. I understand that any false claim in respect of this work shall result in disciplinary action, in accordance with University Plagiarism Policy.

Signature _____

Date 14/11/2016

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