THE EFFECT OF SHARED MEANING BETWEEN EXTENSION OFFICERS AND FARMERS ON THE ADOPTION OF IRISH POTATO FARMING INNOVATIONS IN MERU COUNTY, KENYA

KINYA KATHURE KIGATIIRA

DOCTOR OF PHILOSOPHY

(Mass Communication)

JOMO KENYATTA UNIVERSITY OF

AGRICULTURE AND TECHNOLOGY.

2019

The Effect of Shared Meaning between Extension Officers and Farmers on the Adoption of Irish Potato Farming Innovations in Meru County, Kenya

Kinya Kathure Kigatiira

A Thesis Submitted in Partial Fulfillment for the Degree of Doctor of Philosophy in Mass communication in the Jomo Kenyatta University of Agriculture and Technology.

2019

DECLARATION

This thesis is my original work and has not been presented for a degree in any other university

Signature …….. Date ……

Kinya Kathure Kigatiira

This thesis has been submitted for examination with our approval as University Supervisors

Signature ……..……. …. Date ……

Prof. Hellen Mberia, PhD.

JKUAT, Kenya

Signature …… Date ……..

Dr. Kyalo wa Ngula, PhD.

Africa Nazarene University, Kenya

DEDICATION

I dedicate this dissertation to my father, the late Prof. Isaac Kirea Kigatiira, who did not live to see its completion. He was my mentor and taught me life skills. I thank him for his unceasing faith in me, support, prayers and goodwill; without which it would have been difficult to complete this piece of work. May his soul rest in eternal peace.

ACKNOWLEDGEMENT

I am sincerely thankful to the Almighty God for the gift of life, health and peace to complete my degree of Doctor of Philosophy in Mass Communication.

I greatly appreciate the help of my supervisors, Prof. Hellen Mberia and Dr. Kyalo wa Ngula, for providing guidance and comments that improved the accuracy and readability of the text.

I wish to express my gratitude to my mother, Mrs. Salome Kirea Kigatiira, for her continued financial and moral support. Her encouragement remains a source of my inspiration to date and in the future.

I thank my husband, Enoch Mugendi and our four daughters: Millicent Murugi, Sally Makena, Erica Wanja and Bianca Isabella for their unfailing love and patience; without which this work would not have been accomplished in time.

Finally, I thankful the farmers, extension officers and all individuals who supported me in any respect during my study and to the completion of this dissertation.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ABREVIATIONS AND ACRONYMS

AEO:	Agricultural Extension Officer
AES:	Agricultural Extension Service
CINADCO:	Centre for International Agricultural Development Cooperation
CJPC:	Catholic Justice and Peace Commission
ACP-EU (CTA):	The Technical Center for Agricultural and Rural Development
EASEED:	East Africa Seed Company Limited
FAO:	Food and Agriculture Organization (of the United Nations)
FGD:	Focus Group Discussion
FIPS:	Farm Input and Promotions Africa Limited
FM:	Frequency Modulation
FAOSTAT:	Food and Agriculture Organization Corporate Statistical Database

GDP:	Gross Domestic Product
GOK:	Government of Kenya
ICIPE:	International Center of Insect Physiology and Ecology
IEBC:	Independent Electoral and Boundaries Commission (of Kenya)
IUCN:	International Union for Conservation of Nature
MDGs:	Millennium Development Goals
MOA:	Ministry of Agriculture (of Kenya)
NAERLS:	National Agricultural Extension Research and Liaison Services
NEP:	National Extension Project
PPD:	People with Physical Disabilities
QPM:	Quality Protein Maize
SMS:	Short Message Service
SS:	Sample Size
TSL:	Total Sub-Location
T&V:	Training and Visit
UNFCCC:	United Nations Framework Convention on Climate Change
WHO:	World Health Organization

DEFINITION OF TERMS

Adoption according to this study is making full use or uptake of an agricultural innovation(s).

Agricultural extension is a service which assists farmers learn ways of improving farming methods and techniques for purposes of improving production efficiency and income (Bardsly, 1982, cited in Nwuzor, 2000).

Communication is the process by which human beings make sense out of the world they live in and share that sense with others by creating meaning through the use of verbal and nonverbal messages (Beebe, Beebe, Redmond, Geerinck & Wiseman, 2015).

Communication channels are the means through which messages move from the source to the receiver and vice versa (Age, Obinne, & Demenongu, 2012).

Communication context is the environment or situation in which the communication process takes place (Steinberg, 2006).

Diffusion of innovation is the process in which an idea, practice or object that is perceived as new by an individual(s) is transmitted through certain media over a period of time to members of a social system (Rogers, 2003).

Message is the information conveyed by the sender to the receiver (Oakley & Garforth, 1997).

Noise	is anything that disrupts the reception of a message (DeVito, 2013).
Shared meaning	is attained when the language and knowledge categories formed by the two communicating parties are understood by them (Tabatabai, 2009). According to this study, shared meaning occurs when the extension officer and farmer understand each other. Feedback helps the communicating parties to know if the message has been understood.

ABSTRACT

The aim of this study was to investigate the effect of shared meaning between extension officers and farmers on the adoption of Irish potato farming innovations in Kibirichia Ward, Meru County. It's objectives were: to determine the effect of channels of communication used between extension officers and farmers on the adoption of Irish potato farming innovations in Meru County; to describe the nature of messages conveyed between the extension officers and farmers on the adoption of Irish potato farming innovations in Meru County; to examine the effect of the context of communication between extension officers and farmers on the adoption of Irish potato farming innovations in Meru County and to determine the effect of noise on shared meaning between extension officers and farmers on the adoption of Irish potato farming innovations in Meru County. The study was guided by the diffusion of innovation and symbolic interaction theories of communication. In this study, qualitative research design was used and qualitative data was collected with the aid of focus group discussions and in-depth interviews amongst Irish potato farmers who were area residents from four sub-locations (Kimbo, Gathuine, Kiamiogo, Mburugiti) and all the extension officers involved in the production of Irish potato crop. A sample size of 39 respondents was drawn. Using qualitative methods in data analysis, focus group and interview data was transcribed, coded and categorized into relevant themes and sub-themes and possible and plausible explanations of the findings drawn. Findings of the study revealed that channels of communication and nature of messages result in shared meaning and high adoption of Irish potato farming in Meru County. However, whereas physical, socio-psychological and temporal contexts of communication positively influenced shared meaning and adoption of Irish potato farming, cultural context did not have an effect on adoption but only influenced shared meaning. Further, noise deterred shared meaning between extension officers and farmers and led to low adoption of Irish potato farming in Meru County. The study recommended that in order to attain increased adoption of Irish potato farming, the government should employ public relations officers and development communication experts, who can develop communication campaigns that will enable effective dissemination of extension information to farmers. Further research should be conducted to determine the role of social media on adoption of Irish potato farming innovations in Meru County. Secondly, since this study focused on Meru County, further studies should be upscaled in other counties in Kenya that cultivate Irish potatoes. The findings are beneficial to farmers, agronomical companies, extension officers, researchers and government policy makers. They could boost planning and implementing of focused agricultural programs geared at increasing agricultural production in line with the Kenya government agenda 2018 and the Sustainable Development Goals, 2017.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

In order to have effective communication with anyone, Birr (2012) asserts that both the sender and receiver of the message must be on the "same page," that is, they should understand or share the meaning of what has been communicated. To have an actual meaning of the ongoing conversation, one has to understand or comprehend what is being said. Communication is a "process of understanding and sharing meaning" as intended by the sender (Pearson & Nelson, 2000). In the symbolic interaction theory of Blumer (1969), meaning is the way human beings act towards others and things and in accordance with the interpretations given to them. Understanding the meaning of another person's message occurs when communication has a common meaning of words, phrases and nonverbal cues. Meaning is shared when the message has been understood and can be used as intended by the sender. Without shared meaning of what is being communicated, there will be no communication (Age, Obinne & Demenongu, 2012).

There is a direct relationship between understanding of extension messages and adoption of agricultural technology by farmers (Ogueri, 2003). Oakley and Garforth (1985) noted that agricultural extension officers may send messages that they feel are clear and concise but in the long run, the receivers of the messages (farmers) end up interpreting them wrongly. Farmers are usually not able to adopt new ideas because they are usually complex, technical and hardly understood (Anaeto et al., 2012). Other barriers of effective communication, according to Age et al. (2012) and Duta (2015) are noise, cognitive dissonance, ethnocentrism, information overload/fatigue, delayed/lack of feedback, feed forward, shortage of material inputs and information sensitivity. Noise directly affects farmers' performance by decreasing efficiency, productivity and

increasing chances of accidents occurring due to lack of concentration (Saeki, Fujii, Yamaguchi & Harima, 2004). Noise, however, cannot be totally overcome, but its effects can be reduced (DeVito, 2015). The reduction of noise leads to shared meaning and high adoption of agricultural technologies. In the process of communication, extension officers need to ensure that farmers understand the message and use it on their farms in order to obtain optimum yields. They should also disseminate new farming methods in conjunction with the farmers (Nisha, 2006).

Agricultural extension is the function of providing need-based and demand-driven knowledge in agronomic techniques and skills to rural communities in a systematic and participatory manner with the objective of improving their production, income and quality of life (Syngenta Foundation for Sustainable Agriculture, 2016). The general extension approach uses trained extension specialists to provide a range of services to farmers that include technology transfers, advisory services and human resource development (Aker, 2011). Currently, countries that lead in agricultural production are the same ones that are leading in technology adoption and have always enjoyed strong extension services. These countries include: the United States of America, China, India, Germany, Denmark, United Kingdom and Russia (Simpson, 2016). However, there is prevalent poor extension agents to farmers' ratio in developing countries, which makes many farmers not to benefit from agricultural extension services (Agbamu, 2005). To resolve this problem, volunteer farmer trainers play the part of extension officers to train other farmers when called upon (Kiptot & Franzel, 2015).

Over the years, agricultural extension communication has been regarded as the most logical, scientific and systematic method of disseminating new knowledge, skills and recommendations to farmers to guide them on how to adopt innovations and make effective use of the land (Melkote, 1988a). Everything that the extension officer does, from speaking, writing, demonstrating techniques, supervising, participating in field days and organizing other extension activities involve communication (Chauhan, 2007). Communication is a process that introduces farmers to knowledge, information and

technologies that can improve their production, welfare and livelihoods (Fu & Akter, 2012). The process of extension starts with the extension agent or the specialist who contacts the farmer and starts the conversation. The extension specialist is the message conveyor and sender. What the agent says is the message, the language used is the channel and the farmer is the receiver (Chauhan, 2007). When the farmer replies or responds, the roles are temporarily reversed. The farmer becomes the sender and the extension worker becomes the receiver. The farmer's reply or response becomes the feedback. Immediate or delayed feedback, helps the sender to know whether the message has been understood or not (Agbamu, 2006; Ofuoku, 2012). Moreover, adoption and transfer of agricultural technology will not take place unless farmers share meaning with extension offices and appropriate feedback received (Oakley & Garforth,1985; Onasanya, Adedoyin & Onasanya, 2006).

In Kenya, the agricultural sector plays a major role in developing the country's economy which directly contributes about 26% of the Gross Domestic Product (GDP) annually; supplies 65% of Kenya's total exports and provides more than 18% of formal employment (Government of Kenya, 2010). Among the Millennium Development Goals (MDGs) that were proposed and which were to be achieved by the year 2015, the first goal aimed at fast tracking interventions geared towards enhancing food availability through increased agricultural productivity in order to boost household access to quantity and quality food as well as surplus for sale (United Nations (UN), 2008). However, poor extension service provision makes the agricultural sector unable to realize its full potential. Despite the increase in quality and quantity of agricultural research in Kenya, information and communication support to farmers' remains traditional and inadequate (Jiyawan, Jirli & Singh, 2009). A World Bank evaluation report found out that agricultural extension in Kenya was based on traditional top-down communication approaches that gave little or no voice to farmers (World Bank Operations Evaluation Department (WBOED), 1999). Farmers received free information but their needs were not taken into consideration (Ponniah, Puskur, Workneh & Hoekstra, 2008). The agricultural sector also experiences challenges in low adoption of

new technology and these experiences reduce agriculture productivity thus undermining food security. To avoid these difficulties, Sakib, Safiul and Ali (2015) recommend that extension workers should be prepared to reiterate or recap the information. Since technology transfer is fully dependent on information source to enhance production, it is important to know the present situation about the use of information by farmers.

Irish potatoes in the country are an important food crop second to maize because of their high nutritional value and its adoption to a variety of production environments (Laititi, 2014). Potatoes are produced in the cool highlands mostly by small-scale farmers under rain-fed conditions. These areas include: Mt. Kenya region (Meru Central, Nyeri, Embu, Kirinyaga, Laikipia and Nyandarua), Aberdares and Eastern Rift Valley, Mau, Mt. Elgon and other highlands such as Taita Taveta (Kaguongo et al., 2008). The national production of Irish potatoes in Kenya is however far below the potential. Food and Agriculture Organization (FAO) (2008) reports that in past years, the national average potato yields for Kenya was 9.5 tonnes per hectare but the figure has since then reduced to 7.5 tonnes per hectare. Low yields of Irish potatoes in Kenya have been attributed to failure to use clean seeds, under and over use of fertilizers, fungicides and lack of water for irrigation (Wang'ombe & Dijk, 2013).

In Kibirichia Ward, Meru County, Irish potatoes are ranked as the most important food and commercial crop. However, a survey by Mbogoh (1976) on the economics of production and marketing potatoes in Meru District, Kenya, found that there was a problem in production extension and organized marketing of potatoes. The problem of production extension referred to the transition of technical information on potato production techniques and husbandry to farmers by extension officers employed by the national government. The information given to farmers on types and amounts of fertilizers used in potato production were based on experimental data or observation rather than on intense research work. As a result, farmers used fertilizers in a haphazard manner and in small amounts which did not seem to have a significant impact on potato yields. A study by Muthoni, Shimelis and Melis (2013) on potato production in Kenya:

farming systems and production constraints, found that high yielding was the most important factor considered by farmers in Kibirichia Ward in deciding which potato cultivars to grow while low yield was the main reason that farmers gave for rejecting some potato cultivars. Further, diseases were the main Irish potato constraints cited by farmers in Kibirichia Ward. These studies do not purely focus on the effect of farmer-extension officer communication on adoption of Irish potato innovations. Therefore, the purpose of this study will be to investigate the effect of shared meaning between extension officers and farmers on adoption of Irish potato farming innovations in Meru County.

1.2 Statement of the Problem

When agricultural extension officers and farmers are separately entrenched in their own domains, miscommunication about farming techniques is usually encountered. On the same note, Ndilowe (2013) notes that different subject matter specialists can come up with excellent agriculture programs and projects, but these interventions will not succeed if they have not been properly communicated to the end user (the farmer) and other key stakeholders. Farmers are usually not able to adopt new ideas disseminated by agricultural extension officers because they are mostly complex, technical and hardly understood (Anaeto et al., 2012; Oakley & Garforth, 1985). This in most cases, leads to reduced positive contribution towards the agricultural sector and interferes with the achievements of the broader economic and social development goals of increased food production (Bankay, 2012).

In Kenya, Irish potatoes are an important food crop second to maize. The crop has a high nutritional value and is adoptable to a variety of production environments (Laititi, 2014). However, the national production of Irish potatoes is far below their potential (FAO, 2008; Njuguna et al., 2015). Various factors have been attributed to the decline in the adoption of Irish potato technology which in turn has led to low production. These factors include: perceptions that improved potato varieties are not resistant to blight;

failure to adopt clean seeds and proper pest and disease management; disorganized marketing systems and lack of clear policies on marketing; under and over use of fertilizers, fungicides and lack of water for irrigation (Njuguna et al., 2015; Riungu, 2011; Wang'ombe & Dijk, 2013). Further, despite numerous efforts, by the national government and private companies, and resources dedicated to the creation and diffusion of new Irish potato technologies, the average farm production has not yet increased (Nyagaka, Obare & Nguyo, 2009). Similarly, speaking at Marimba Farm in Imenti South Sub County of Meru County, the Agriculture and Irrigation Cabinet Secretary, Mwangi Kianjuri, said that the general adoption of certified seeds by farmers was still low despite efforts by the national government to encourage use of qualified seeds by providing farmers with clean seeds (Oyugi, 2018).

From the above literature, it is evident that despite numerous efforts, there is low production of Irish potatoes due to low adoption of farming innovations. One of the reasons farmers are usually unable to adopt agricultural innovations is when they don't understand information conveyed by extension officers. In Kenya, several studies have been conducted on adoption of Irish potato farming innovations (Kaguongo et al., 2008; Kiptoo, Xia, Mchomvu, Ali,& Rehama, 2016; Muthoni & Nyamongo, 2009; Muthoni, Shimelis & Melis, 2013; Ng'ang'a et al., 2003). However, little if any research has explored shared meaning as a factor that influences adoption of Irish potato farming innovations in Kenya, specifically Kibirichia Ward in Meru County. There is therefore need to investigate the effect of shared meaning between extension officers and farmers on the adoption of Irish potato farming innovations in Meru County in order to come up with interventions that will improve share meaning between extension officers and farmers.

1.3 General Objective

To establish the effect of shared meaning between extension officers and farmers on the adoption of Irish potato farming innovations in Meru County.

1.3.1 Specific objectives

1. To determine the effect of channels of communication used between extension officers and farmers on the adoption of Irish potato farming innovations in Meru County.
2. To describe the effect of the nature of messages conveyed between the extension officers and farmers on the adoption of Irish potato farming innovations in Meru County.
3. To examine the effect of the context of communication between extension officers and farmers on the adoption of Irish potato farming innovations in Meru County.
4. To determine the effect of noise on shared meaning between extension officers and farmers on the adoption of Irish potato farming innovations in Meru County.

1.4 Research Questions

1. What is the effect of channels of communication used between extension officers and farmers on the adoption of Irish potato farming innovations in Meru County?
2. What is the effect of the nature of messages conveyed between the extension officers and farmers on the adoption of Irish potato farming innovations in Meru County?
3. What is the effect of the context of communication between extension officers and farmers on the adoption of Irish potato farming innovations in Meru County?
4. What is the effect of noise on shared meaning between extension officers and farmers on the adoption of Irish potato farming innovations in Meru County?

1.5 Justification

Communication and knowledge are critical in agricultural adoption but when they are inadequately disseminated as a result of poor delivery, the agricultural production becomes highly impeded. Poor delivery is what corrupts the shared meaning in extension (Obidike, 2011). Similarly, Ndilowe (2013) asserts that different subject matter specialists can come up with excellent agriculture programs and projects.

However, these interventions cannot succeed if they have not been properly communicated to the end user (the farmer) and other key stakeholders. There is great need for efficient sourcing and dissemination of technical information by extension workers. These opportunities require information delivery that takes appropriate technical knowledge to extension workers and eventually to farmers without much distortion (Idrisa, Ogunbameru & Shehu, 2013). Given the importance of communication in the adoption of agricultural innovations, there was need to determine the effect of shared meaning between extension officers and farmers in the adoption of Irish potato farming innovations in Meru County, Kenya.

In Kenya, Irish potatoes are important food crop with production volumes only second to maize (Omiti & Laibuni, 2014). The national production of Irish potatoes is however far below the potential. FAO (2008) reports that in past years, the national average potato yields for Kenya was 9.5 tonnes per hectare, but the figure has since then reduced to 7.5 tonnes per hectare. Low yields of Irish potatoes in Kenya have been attributed to failure to use clean seeds, poor applications of fertilizers, fungicides and irrigation (Wang'ombe & Dijk, 2013). However, Anaeto et al. (2012) asserts that farmers are usually not able to adopt new ideas disseminated by agricultural extension officers because they are usually complex, technical and hardly understood. As such, shared meaning between extension officers and farmers is important in the adoption of agricultural innovations. There was need to investigate the effect of shared meaning between extension officers and farmers in the adoption of Irish potato farming innovations in Meru county.

Several studies have been conducted on adoption of Irish potato farming innovations. Kaguongo et al. (2008) studied farmer practices and adoption of improved potato varieties in Kenya and Uganda. Kiptoo et al. (2016) investigated the factors influencing adoption and use of clean certified seed potato tubers among small-scale potato farmers. Muthoni and Nyamongo (2009) reviewed constraints that affect Irish potatoes production in Kenya. Further, Muthoni et al. (2013) assessed potato production in Kenya

farming systems and production constraints while Kabungo (2008) did an evaluation of Irish potato production and marketing performance at Mbeya rural district, Mbeya region, Tanzania. These studies have no information on the effect of shared meaning between extension officers and farmers on the adoption of Irish potato farming innovations in Meru County.

1.6 Scope of the Study

This study was conducted in Kibirichia Ward in Central Imenti Constituency, Meru County. Meru County, specifically Kibirichia Ward was purposively selected because it is an area of high potato production in Kenya. A study by Kaguongo et al., (2008) on farmer practices and adoption of improved potato varieties in Kenya and Uganda, found that Meru was the most intense potato farming region amongst the four major potato producing districts (Meru, Nyandarua, Bale and Kisoro) in Kenya and Uganda. Further, Kaguongo, Ng'ang'a and Landeo (2009) who conducted a study on seed potato use and projected demand in Kenya, found that Meru district had the longest experience, that is, 19 years of growing potatoes as compared to Keiyo (10 years), Mt. Elgon (9 years), Nakuru (8 years), Narok (10 years), Bomet (8 years), Nyandarua (17 years), Nyeri (17 years), Taita (8 years) and Kiambu (15 years). In regard to Kibirichia County Assembly Ward, a study by Muthoni et al. (2013) on potato production in Kenya farming systems and production constraints, found out that farmers in Kibirichia ward had cultivated potatoes for the longest time; an average of 23.3 years. The study also revealed that 100% of the farmers in the Ward grew Irish potatoes. In addition, 63.9% of the sampled Irish potato farmers in Kibirichia stated that they cultivated potatoes because they were high yielding. Apart from the favorable climate and high yields that farmers get, Irish potatoes in Meru County are an important commercial crop that have a well-defined market and a premium price (Kaguongo et al., 2008)

This study was limited to establishing the communication channels, nature of extension messages, communication context and noise that affect shared meaning between

extension officers and farmers on the adoption of Irish potato farming innovations in Meru County. Irish potato is grown for food as well as a commercial crop and it is a major source of income among the rural farmers in many African communities (Jwanya, Dawang, Zarmai & Mashat, 2014). However, despite numerous efforts and resources dedicated to the creation and diffusion of new Irish potato production technologies, the average farm produced has not yet increased rather it has decreased (Nyagakaet al., 2009). The national production of Irish potatoes in Kenya is far below the potential. Indeed as FAO (2008) reports, the national potato production in Kenya is far below the potential. Oakley and Garforth, (1985) noted that adoption and transfer of agricultural technology will not take place unless farmers share meaning with extension offices on messages transmitted through an appropriate feedback.

Cross-sectional, qualitative descriptive research design was used in this study. Farmers' and agricultural extension officers' responses were gathered using focus group discussions and in-depth interviews respectively. Interview is commonly used where only the interviewer and the interviewee are present. The format of the interview was a conversation with the interviewer driving the agenda in the beginning and the interviewee asking questions towards the end. Theoretically, the study was narrowed down to the prepositions of symbolic interaction theory and diffusion of innovation theory.

1.7 Limitations of the Study

The study had several limitations. First, the research only looked at adoption of Irish potato farming innovations in Kibirichia Ward. These findings may not translate to adoption of other crops in Kibirichia Ward.

Secondly, this research study focused on the effect of shared meaning between extension officers and farmers on the adoption of Irish potato farming innovations in Kibirichia

Ward, Meru County. More studies need to be conducted locally to enrich literature in this area.

Thirdly, there was limited research on the effect of noise on adoption of agricultural innovations. All the literature related to noise in communication in this study focused on contexts outside Kenya. More studies need to be conducted locally to enrich literature in this area.

1.8 Summary

Studies reveal that there is a direct relationship between understanding extension information and adoption of agricultural innovations. Farmers are usually not able to adopt new ideas disseminated by extension officers because they are mostly complex, technical and hardly understood. This leads to reduced agricultural production. In Kenya, several studies (Kaguongo et al., 2008; Kiptoo et al., 2016; Muthoni & Nyamongo, 2009; Muthoni et al., 2013) have been conducted on adoption of Irish potato farming innovations. However, little if any research has explored the effect of shared meaning between extension officers and farmers on the adoption of Irish potato farming innovations in Kenya. There was, therefore, need to investigate if farmers understood agricultural information from extension officers and its effect on adoption of Irish potato farming innovations in Meru County.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter reviews empirical literature related to communication channels, nature of messages, context of communication and effect of noise on shared meaning between extension officers and farmers on the adoption of Irish potato farming innovations in Meru County. This study adopted both the traditional and systematic approaches in reviewing literature. The traditional or narrative literature review is achieved by presenting a comprehensive background of literature within the topic of research to identify new research streams, gaps or inconsistencies. This type of literature review can help in refining, focusing and shaping research questions as well as theoretical framework and conceptual framework of the study (Coughlan, Cronin & Ryan, 2007). Systematic review of literature on the other hand is a systematic, explicit, comprehensive and reproducible method of identifying, evaluating and synthesizing the findings of relevant studies (Okali & Schambram, 2010). This chapter has the following sub-sections: (a) the theoretical frameworks that guide the study, that is, diffusion of innovations and symbolic interactionism, (b) conceptual framework were the variables of communication channels, nature of messages, communication context, noise and adoption of Irish potato farming innovations were discussed, (c) empirical review of literature, (d) critic of existing literature, (e) research gap and (f) summary.

2.2 Theoretical Review

2.2.1 Diffusion of Innovation Theory

The first theory this study used was the diffusion of innovation theory. Diffusion of innovation theory originated in the field of communication and was developed by Everett M. Rogers in 1962. Diffusion is the process in which a new idea is transmitted

through certain media over a period of time to members of a social system. The theory states that the sources of a new idea (opinion leaders) should be unbiased and trustworthy to the adopters. The four main elements in the diffusion of new ideas are innovation, communication channels, time and social system.

An innovation is an idea, practice or object that is perceived as new by an individual(s) (Rogers, 2003). There are five qualities that determine the spread and adoption of an innovation: (1) relative advantage which is the degree a social system perceives an innovation as better than the idea it supersedes, (2) compatibility is the degree to which an innovation is perceived to be consistent with a social system's values, past experiences and needs, (3) simplicity is the degree to which an innovation is perceived as easy to understand and use, (4) triability, which is the degree to which an innovation can easily be experimented with on a limited basis, and (5) observability which is ease to see results of the innovation.

In regard to this theory, communication channels are the means through which messages are transmitted from the sender to the receiver (Rogers, 2003). "Communication channels include the change agent or agency and the attributes of the communication program" (Hubbard & Sandmann, 2007). For example, an educational channel will consider the type of program and the means of disseminating the information. Rogers asserts that mass media channels are fast and effective in creating awareness of innovations, whereas interpersonal channels are effective in creating and changing attitudes towards an innovation, thus influencing the decision to adopt or reject an innovation. Mass media messages reach a large audience who are scattered in a large geographical area whereas use of interpersonal channels change agents are able to persuade people to adopt the innovation. Rogers states that individuals do not objectively evaluate new ideas on the basis of scientific research but evaluate the innovation subjectively based on the information transmitted to them by other individuals similar to themselves who have adopted the innovation.

Early agricultural extension relied on direct communication with farmers. However, changes in society have resulted in the use of diverse communication channels (Okwu & Daudu, 2011). According to Bello and Obinne (2012) interpersonal and mass communication are the most used channels of transmitting agricultural information to farmers. Licht and Martin (2007) conducted a study on communication channel preferences of corn and soyabean producers in Iowa. Findings of the study revealed that producers preferred mass media channels for general information and interpersonal communication channels for specific and applicable information. However, a study conducted by Okwu and Daudu (2011) on extension communication usage and preference by farmers in Benue State, Nigeria revealed that interpersonal communication channels were more available and used by farmers. "The medium is the message," a statement by Marshall McLuhan means that the choice of channel determines the way the message will be understood (Federman, 2004). The transmission of information through a communication channel affects the meaning of the message.

Time is involved in the diffusion process in three ways. First, it is involved in innovation decision making which is a mental process through which an individual(s) goes through from the initial knowledge about the innovation, to forming an attitude, making a decision to accept or reject the innovation, implementation and confirmation of the decision. In the innovation-decision process, an individual seeks information in five stages: Knowledge, persuasion, decision, implementation and confirmation. Second, time is involved in innovativeness which is the degree to which an individual or other unit of adoption is relatively earlier in adopting ideas than other members of a social system. There are five categories of adopters who are members of a social system: Innovators (2.5%), early adopters (13.5%), early majority (34%), late majority (34%) and laggards (16%). Third, the rate of adoption which is the relative speed with which an innovation is adopted by members of a social system (Rogers, 2003).

A social system is a set of interrelated units that are engaged in joint problem solving to accomplish a common goal. A social system is also referred to as the social context

which is made up of individuals, informal groups, organizations and/or subsystems (Rogers, 2003). Similarly, Oakley and Garforth (1985) assert that in agricultural extension, the adoption of new ideas involves farmers, groups of farmers or whole communities. Rogers asserts that the nature of social systems is either heterophilous or homophilous. Heterophily is the tendency of people with unrelated characteristics such as age, education and beliefs to interact. Homophily is the tendency of people with similar characteristics such as age, education, beliefs and social status to interact. Homophily communication is more effective because the two communication parties share a common meaning, have a mutual sub-cultural language and similar personal and social characteristics. Communication is therefore likely to be more rewarding to both parties because they end up gaining more knowledge, have attitude formation and overt behavior change. However, when the communicating parties are totally heterophilous, ineffective communication takes place. The nature of diffusion demands that some degree of heterophily be present between the two communicating parties. For example, they can be homophiluos in education, social status, age, but heterophiluos in their views concerning the innovation.

The structure of a social system can have an influence on the spread of an innovation. It can either deter or facilitate the rate of diffusion and adoption of innovations. A social system also has norms, social status and hierarchy that influence people's behavior (Chi & Yamada, 2002). Hierarchies in every social system ensure that some people or organizations are more influential than others. To gain adoption of an innovation, the change agent should identify the opinion leader (Rogers, 1995). In the field of communication, opinion leaders are viewed as early adopters but not pioneer inventors (Mak, 2008). Characteristics of opinion leaders are that they are well respected and sway adoption decisions in their social system (Rogers, 1995).

Scholars have identified strengths and weaknesses of the diffusion of innovation theory. Ayodele (2012) notes that diffusion of innovation theory has been relevant in the past years and it is most likely to remain so in the future because, new ideas or innovations

occur daily and will continue to be diffused for people to adopt. Wolfe (1994) however, argues that there is limited consideration to characteristics of an innovation and how they change over time. On the other hand, Waterman (2004) notes that Rogers does not consider the likelihood of people rejecting an innovation despite understanding it fully. Based on Waterman's premise, this study was carried out to determine whether there was shared meaning between extension officers and farmers and its effect on adoption of Irish potato farming innovations in Meru County.

Further, the diffusion of innovation theory focuses on the conditions which increase or decrease the likelihood that a new product, idea or practice (innovation) will be adopted by members of a given society (social system). The theory states four elements that are necessary in the diffusion of new ideas which include: Innovation, communication channels, time and social system. In this study, the diffusion of innovation theory will be critical in determining the effect of communication channels, temporal and social context on the adoption of Irish potato farming innovations in Meru County.

2.2.2 Symbolic Interaction Theory

Symbolic interactionism is a terminology coined by Blumer (1969) who was greatly inspired by John Dewey. George Herbert Mead (1934) and Charles Hortan Cooley (1902) however, are believed to be the proponents of the symbolic interaction theory. "Symbolic interactionism is the way people learn to interpret and give meaning to the world through their interactions with others" (Plunkett, n.d.). Similarly, Beebe, Beebe, Redmond, Geerinck and Wiseman (2015) state that human communication is the process by which human beings make sense out of the world they live in and share that sense with others by creating meaning through the use of verbal and nonverbal messages.

Symbolic interactionism looks at society by the meanings that people have given to objects, events and behaviors. The theory suggest that society is based on the interpretations of people because meaning is derived from descriptive beliefs rather than

objective truth. The meanings are as a result of people's interaction with the society and the interactions are subjectively interpreted by them to suit the meaning in accordance with the existing symbols.

Blumer (1969) identifies three core principles of this theory as: Meaning, language and thought. Meaning is the way human beings act towards others and things in accordance to the meanings given to them. Language is made up of symbols. Through the use of language, humans are able to name things and this creates meaning to everything because all things have their own distinct names. The names show distinct features or any other key information about things. Beebe et al. (2015) note that, in order to understand the behavioral patterns of a particular society, people need to understand the existing language symbols. Thought is the interpretations that we give to symbols. Humans think or mentally converse using a particular language about meaning, names and symbols. Through imagination, thought provides an idea to unknown thing based on known knowledge. Mead (1934) also noted that naming was the basis of human society and the existence of knowledge because it assigned meaning to objects and ideas.

Shared meaning is attained if the language and knowledge categories formed by the two communicating parties are understood by them (Tabatabai, 2009). The symbolic interaction theory looks at language as a vehicle of shared meaning and knowledge as a product of meaning. In agricultural extension communication, extension officers and farmers use a language(s) that is familiar to both parties to relay information on adoption of Irish potato farming innovations. Rogers (1995) asserts that diffusion of innovations is difficult when language barriers are present. Thought, according to symbolic interaction theory, is the interpretation that people give to symbols. That is, farmers interpretation of extension messages does influence their decision to either adopt or not adopt Irish potato farming innovations. Based on the symbolic interaction theory, this study investigated if the thought and language create shared meaning between extension officers and farmers and its impact on the adoption of Irish potato farming innovations in Meru County.

2.3 Conceptual Framework

This study looked at four independent variables which were: Communication channels, nature of messages, communication context and noise. The dependent variable in this study was adoption of Irish potato farming innovations as shown on figure 2.1. When appropriate channels, messages, context are observed and noise effects reduced, they lead to high adoption of Irish potato farming innovations. However, if appropriate channels, messages, context are not observed and noise effects not reduced, they lead to low adoption of Irish potato farming innovations.

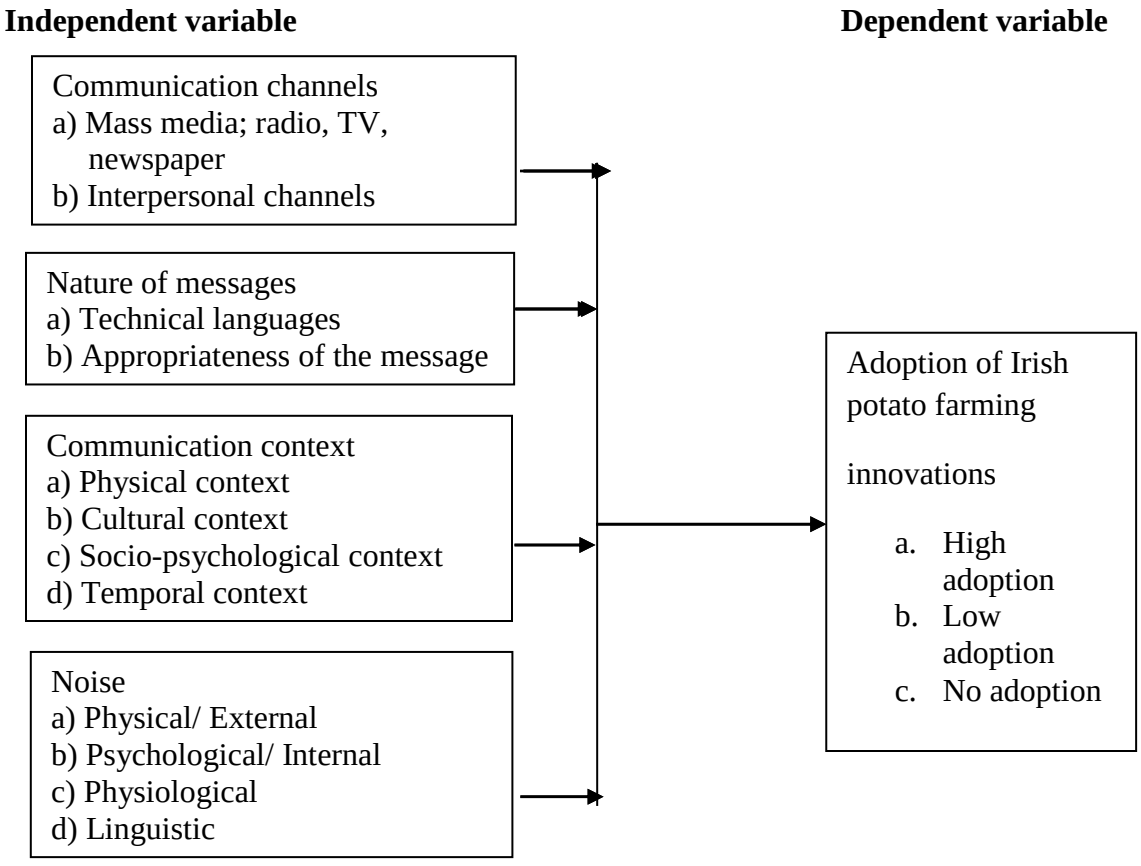

Figure 2.1: Conceptual Framework

2.4 Review of Variables

2.4.1 Communication channels

Communication channels are the means through which messages move from the source to the receiver and vice versa (Age et al., 2012). Early agricultural extension relied on direct communication with famers. However, changes in society have resulted in the use of diverse communication channels (Okwu & Daudu, 2011). Gamble and Gamble (2010) classifies communication channels according to: (1) the senses that carry or receive the message, (2) if the message is verbal or nonverbal or both, and (3) the primary means of communication used to deliver information, whether face-to-face communication, computer-mediated communication, telephone communication and text messaging or mass media. Age et al. (2012) however, categorizes communication channels into physical channels, non-physical channels, technical channels and token of communication channels.

All channels of communication are not equally useful in attaining the same purpose. The channel chosen relies on the total communication situation, that is, the source, the receiver and the message. Different roles are played by different channels of disseminating agricultural information. The roles of channels also vary according to the stages of the adoption process. Mass media channels are important in transmitting information, creating awareness or changing cognition, giving timely advice about the occurrence of disease and pest outbreaks together with urgent advice on what farmers should do. Interpersonal channels on the other hand, bring about attitude change to farmers (Oakley & Garforth, 1985; Rogers & Nichof, 2002). Similarly, Rogers (2003) in the diffusion of innovation theory asserts that interpersonal communication channels are powerful to create and change a person's attitudes. Rogers also notes that communication that takes place through interpersonal communication channels may have the characteristic of being homophilyor heterophily. If the participants are

heterophilous, then it poses problems in diffusion of innovations. Interpersonal channels, according to Dominick (1999), allow immediate feedback whereas delayed feedback is one of the characteristics of mass communication.

According to Bello and Obinne (2012) interpersonal and mass communication are the most used channels of transmitting agricultural information to farmers. Interpersonal communication channels or physical channels include visits, seminars, workshops, exhibitions, advisory village meetings and agricultural shows. Cheboi and Mberia (2014) carried out a study on efficacy of interpersonal communication channels in the diffusion and adoption of zero grazing technology. The study revealed that opinion leaders, churches, family members, peers, field demonstrations, farmers' field days in schools, co-farmers and non-state agencies' farms were the main channels used. Other interpersonal communication channels used were women and youth group meetings, public *barazas*, provincial administrators and experts such as livestock production officers and development agencies like World Vision, Child Fund, and Catholic Justice and Peace Commission (CJPC). Similarly, Ng'ang'a et al. (2003), Okwu and Daudu (2011) and Wafula (2015) found that farmer to farmer, opinion leaders, demonstrations, field days, seminars, field schools, extension visits, trade fairs, mobile phones, group meetings, chief *barazas*, agricultural shows, church and school meetings were interpersonal channels used to communicate agricultural messages.

Mass media or non-physical channels are made up of print and electronic media such as posters, leaflets, circular letters, newspapers, television, radio, audio cassettes and films which play a big role in informing farmers globally about agricultural innovations (Age et al., 2012; Oarkley & Garforth, 1985). However, newspapers, magazines and other print media are used by literate farmers. When literacy in a country is increased, the use of print media which in turn aids in farm decision making is also raised (Ali, 2011). Various studies which were conducted around the world revealed that different mass media are used in agricultural extension communication. Rehman, Muhammad, Ashraf and Hassan (2011) carried out a study on factors affecting the effectiveness of print

media in the dissemination of agricultural information. They found that print media were a major source of information in Punjab province, Pakistan. Print media were ranked 1st followed by fellow farmers who were ranked 2nd, television, extension officers, private sector, radio, NGOs and others were ranked 3rd, 4th, 5th, 6th, 7th and 8th respectively.

It is important that agricultural extension officers use a variety of communication channels when conveying agricultural messages. Different channels of communication appeal to different human senses thus aiding in easy understanding of messages (Age et al., 2012). Successful agricultural extension communication usually involves a combination of mass media, personal contact and group methods. Research reveals that five or more channels of communication used in combination are often necessary to get information through a large number of farmers. This has enough impact to influence significant changes in farming practices and agricultural productivity (Bembridge, 1991). Wafula (2015) carried out a comparative analysis of communication channels used for diffusion and adoption of Quality Protein Maize (QPM) in Kathonzweni and Kirinyaga sub-counties. The results indicated that farmers received information through a wide range of channels including farmer to farmer (84.2%), extension (77.5%), demonstrations (65.5), field days (63.2%), seminars (60.8%), radio (47.4%), field schools (16,7%), television (9.1%), newspapers (7.2%), mobile phone (3.8%), group meetings (3.8%), magazines (3.3%), CARITAS (NGO) (1.0%), chief *barazas* (0.5%), school meetings (0.5%) and church meetings (0.5%).

A single channel cannot be effective and best for all situations in the communication process (Chauhan, 2007). However, sometimes the use of different communication channels is limited due to financial constraints that leave agricultural extension officers with no other choice, but to choose only a few among the many communication channels (Licht & Martin, 2007). Other factors to consider while choosing an appropriate means of communication are: Availability of the communication channel to the communicators, appropriateness of the channel to the receiver, the message and the main purpose of communication (Chauhan, 2007).

There is scanty literature on frequency of mass media and interpersonal communication channels used to disseminate agricultural extension messages. Sison (as cited in Coldevin, 2008) found out that in Philippines in the Masagana 99 program, farm programs were daily aired through the radio. However, Okwu and Daudu (2011) carried out a study on extension communication channels' usage and preference by farmers in Benue State, Nigeria and observed low use of radio, newspapers, television and film shows by farmers in obtaining agricultural information. Low use of mass media was caused by unsteady power supply, network services and financial resources (Adejoh, Edoka & Shaibu, 2016). To increase radio use, Adejoh et al (2016) recommended that radio programmes should be given more time slot to air agricultural information at a time that is convenient to the farmers. Kiptot and Franzel (2015) conducted a study on farmer-to-farmer extension opportunities for enhancing performance of volunteer farmer training in Kenya. They found out that volunteer farmer trainers trained farmers on an average of two hours per day; two to three times per month.

Pertaining to communication channel preferences, Okwu and Daudu (2011) conducted a study on extension communication usage and preference by farmers in Benue State, Nigeria and found that interpersonal communication channels were more available and used by farmers. However, Licht and Martin (2007) conducted a study on communication channel preferences of corn and soyabean producers in Iowa. Findings of the study revealed that producers preferred mass media channels (radio, magazines, internet, newspapers and television) for general information. Interpersonal communication channels (personal consultations, demonstrations, meetings and workshops) were used for specific and applicable information. Familusi and Owoeye (2014) assessed the use of radio and other means of information dissemination among the residents of Ado-Ekiti, Nigeria. Findings of the study revealed that radio was the most important channel in information dissemination because it reached a large number of people irrespective of their location, created awareness on socio-political and economic issues and made it possible to get adequate information about programs and government activities. Ogola (2015) assessed communication channels and the impact of

agricultural information used by farmers in watermelon production in Limbo East Ward, Siaya County and found that radio, fellow farmers, extension officers and telephone calls were farmers preferred channels of receiving agricultural information.

In order to have effective transfer of agricultural innovations from the researchers to the farmers, extension officers need to have knowledge in the use of communication channels for agricultural information dissemination. Akinbile and Otitolaye (2008) assessed extension agents' knowledge in the use of communication channels for agricultural information dissemination in Ogun State, Nigeria. The study revealed that 78.8% of the extension agents had moderate knowledge and 16.8% had high level knowledge in the use of communication channels. The study also revealed that agricultural extension officers who had high level knowledge in the use of communication channels had also attained high levels of education and vice versa.

Selection of a communication channel is very important. This is because there is a relationship between communication channel and communication effectiveness. The transmission of information through a communication channel affects the meaning of the message. Each channel of communication has distinct features which makes it suitable for certain situations and not others (Lengel & Daft, 1988). Guo and Sanchez (2005) also assert that there is symbolic meaning in the choice of a medium of communication beyond the content of the message. "The medium is the message," a statement by Marshall McLuhan means that the choice of channel determines the way the message will be understood (Federman, 2004).

2.4.2 Nature of message

A message is the information conveyed by the sender to the receiver (Oakley & Garforth, 1985). McLuhan however defines a "message" as, "the change of scale or pace or pattern" that an innovation "introduces into human affairs" (Federman, 2004). Messages take various forms made up of several physical components, which may be

words with symbolic meaning or ideas encoded into symbols to which meaning can be derived (Age et al., 2012). Benokraitis (2016) affirms that language, most likely, is the most powerful of all human symbols because it is a system of shared symbols that aid human beings to communicate with each other. The origin of language is thought, that human beings have given meaning. In addition, in the symbolic interaction theory, Blumer (1969) notes that language, which is one of the three core principles of this theory, is made up of symbols. Through the use of language, humans are able to name things and this creates meaning to everything because all things have their own distinct names. The names show distinct features or any other key information about things. Thought is the interpretation that we give to symbols. Humans think or mentally converse using a particular language about meaning, names and symbols. Through imagination, thought provides an idea to an unknown thing based on known knowledge.

Messages are either verbal or nonverbal (DeVito, 2010). Verbal communication consists of spoken and written cues while nonverbal communication surpass written and spoken symbols (Gabbot & Hogg, 2001). Nonverbal communication is defined as the "unspoken dialogue" (Burgoon, Guerrero & Floyd, 2010). Steinberg (2007) asserted that the meaning attached to a message is from two types of information it carries: Content and relational information. Content information refers to the details of the message while relational information is the feelings of the communicators and how the details of the message should be interpreted. DeVito (2015) however, notes that verbal messages can have two kinds of meanings. Connotation is subjective or emotional meaning that people have for words. Denotative meaning on the other hand is the definition of words as agreed upon by a group of people who speak a particular language or the way in which a dictionary defines a word. When the sender's message is appropriately interpreted, communication is said to be effective (Ergen, 2010).

In agricultural communication, message refers to the agricultural information or idea or technology that the source wishes to convey to the end-users (receivers). The general extension approach uses trained extension specialists to provide a range of services to

farmers that include technology transfers, advisory services and human resource development (Aker, 2011). Agricultural extension messages, according to Lawal (2015) and Nisha (2006) cover a wide range of information including improved varieties of crops, livestock control, water management and control of pests, weeds or plant diseases. Agricultural extension messages should be compatible with the existing practices, societal norms, beliefs and culture of the society before it can be accepted or adopted. A message that is relevant is one that is: Technically feasible, economically affordable and socially acceptable by the people in the society (Age et al., 2012). FAO (2003) however, argued that extension agents should communicate extension information in a language that the farmer is accustomed to. Kipkurui (2015) examined the effects of information and communication on the use of organic resource inputs to build soil fertility in the central highlands of Kenya. Findings revealed that Kimeru and Kikuyu languages were used by government extension officers to disseminate information to farmers.

In regard to demand driven agricultural extension, Birner and Anderson (2007) pointed out that it is more responsive to the farmers' needs. Further, decentralization of agricultural extension services from the central to local government has helped farmers to express their demands for agricultural innovation. Bembridge (1991) was of the opinion that researchers need to know the needs of the farmers so as to be able to tailor appropriate messages for their use. In addition, extension officers are change agents who help farmers identify their farming problems and solutions (Anaeto et al., 2012). Through the identification of farmers information needs, extension officers are able to feed researchers with information on daily farming problems, successes and failures of farmers (Soola, 1988). Farmers' information needs are different. A survey conducted by Bachhav (2012) on information needs of the rural farmers in Maharashtra, India, found that majority of the farmers needed information on availability of seeds, crop production, water management, weather, agricultural equipment, insecticide and fertilizer availability. A study on the role of mobile phone technology in improving small farm productivity by Mittal and Tripathi (2009) found that farmers required

information on the crop to plant, seed varieties, weather, best practices for cultivation, prices, demand indicators and logistical details. Farmers are familiar with their problems and aspirations. Therefore, it is important for extension officers to involve them in the development of agricultural extension messages (Ofuoku, 2012).

There is a direct relationship between understanding of extension messages and adoption of agricultural technology by farmers (Ogueri, 2013). Farmers are usually not able to adopt new ideas because they are usually complex, technical and are hardly understood (Anaeto et al., 2012). Oakley and Garforth (1985) note that agricultural extension officers may send messages which they feel are clear and concise but in the long run, the receivers of the messages (farmers) end up interpreting them wrongly. A study by Ogueri (2013) on evaluation of agricultural extension messages that support adoption of improved cassava production technologies revealed lack of clarity of extension messages for improved cassava varieties as one of the constraints extension officers face when they are delivering their services. The researcher suggested that to be able to market agricultural technologies, creative extension messages should be developed in the farmers' dialects. It is the work of agricultural extension officers to collect, organize, interpret and clarify technical information related to farmers' different agricultural activities (Bagi & Bagi, 1989).

For farmers to adopt new agricultural technologies, extension messages conveyed to them should be concise and unambiguous. According to Chauhan (2007), a good message has the following characteristics: Aligned to the objectives to be achieved, clear, appropriate, correct, current and transmitted through the right channel. Extension messages turn out to be relevant to farmers when they are involved in the development and dissemination of information (Ofuoku, 2012). The extension officer should also view what they are doing or saying from the world view of their audience (Agbamu, 2006). Oakley and Garforth (1985) noted that adoption and transfer of agricultural technology will not take place unless farmers share meaning with extension offices on messages transmitted through an appropriate feedback. Asking questions enhances

farmers' comprehension of messages. It reveals to the extension officers, parts of messages farmers find difficult to understand (Hunt, 2006; Ofuoku, 2012).

In order for shared meaning to be attained during agricultural extension communication between extension officers and farmers, appropriate extension messages should be developed. Campbell and Barker (1998) also agree that the performance of extension programs to a large extent depends on the appropriateness of extension messages. Peshin, Vasanthakumar and Kalra (2009) also note that the impact of extension relies on communication of a relevant message through an understandable extension method. Appropriate messages should be tailored to the farmers' context because a message that is suitable for one farmer may not be for another (Campbell & Barker, 1998). Campbell and Barker identify four areas in which message appropriateness should be defined: Technical and economic feasibility, social acceptance, environmental safety and sustainability. Messages that are relevant should also be tailored to the needs and interests of the target audience. Audience analysis enables the communicator to segment the target audience with a view of developing appropriate messages for them in order to satisfy their needs, interests and aspirations (Age et al., 2012).

2.4.3 Communication context

Context is the environment or situation in which the communication process takes place (Steinberg, 2007). Martin and Nakayama (2010) also noted that context is brought about by the physical and social aspects of the situation in which communication takes place. According to DeVito (2010) there are four aspects of communication contexts: (1) physical context, which is the environment in which messages are exchanged, (2) cultural context is the lifestyle, knowledge, beliefs, values, behavior and norms of a group of people, (3) socio-psychological context is the relationship between the sender and the receiver, and (4) temporal context which is appropriateness of a message in a situation.

The four aspects of context interact and affect each other. According to Steinberg (2007) the communication process is affected by time, space, physical properties of the place of information exchange, roles, status and relationship of the communicating parties. Context also affects the meaning, form and content of a message transmitted (DeVito, 2015). This, therefore, makes people communicate differently in different contexts (Martin & Nakayama, 2010).

In agricultural extension, it is important that extension officers ensure that the setting in which they choose to educate the farmers is one that promotes understanding of the information conveyed (Age et al., 2012). In order to attain shared meaning in different contexts of agricultural extension communication, Age et al., assert that: (1) during agricultural extension communication, neither the extension officer nor the farmer should have dominance or control over the communication process but should have a symmetrical relationship, and (2) Change agents should be homophilous, at the level of farmers in terms of knowledge, language, norms, beliefs and culture. Moreover, Oakley and Garforh (1985) posited that agricultural communication should be at a convenient time for both extension officers and farmers; a time that does not clash with other activities and events.

According to Oakley and Garforth (1985) places where farmers usually meet with agricultural extension officers to exchange information are farmers' homes, farms and extension officers' offices. When extension agents meet a famer at home or at the farm, they are able to discuss issues pertaining to farming; giving the farmer information and advice. The atmosphere of meeting at the farmer's farm or home is usually informal and relaxed. In such contexts, the farmer is able to gain from the extension officer's individual attention, thus likely to listen to the advice given. This motivates the farmer to participate in extension activities. Individual meetings between the extension officer and the farmer also help in building both parties' confidence. From time to time, a farmer may visit an agricultural extension officer's office. Such visits are usually a reflection of the confidence a local farmer has in the extension agent and the curiosity the officer may

have aroused in the farmer during their previous interaction(s). Ali, Naseem and Ali (2016) examined farmer's perception regarding extension activities conducted by agricultural extension field staff in Barkhan District of Balochistan before and after decentralization, and found that extension office visits by farmers were informative, beneficial and interesting. However, the Department of Agricultural Extension (DAE) (1999) argued that it is more meaningful that extension officers meet male farmers in the farm to discuss a crop related issue and it's easier to meet women farmers in their homestead. In addition, DAE suggested that extension officers should find venues where women NGOs meet regularly and use them for extension events.

Nevertheless, Aker (2011) and Otter and Theuvsen (2013) argued that information on high yield varieties and timing to plant is important during the planting stage. In the stages of planting and growing, information on fertilizers, pesticides and innovations is crucial. Further, information on appropriate harvesting time, climate and weather help farmers to get high yields. Ndwiga (2014) conducted a study on challenges women farmers face in accessing Agricultural Extension Services (AES) in Kamugere sub-location of Embu County. Findings revealed that 53.4% of the respondents felt that AES were more necessary during harvesting, marketing, selling and dry season while 46.6% felt that AES were needed more during the weeding, planting and wet seasons. Kamal, Khalid, Waheed and Muhammad (2014) investigated the role of agricultural extension agents in enhancing tomato production in Peshawar district, and found that majority of the respondents were visited in their farms once a month while minority indicated they were visited three times a month. In addition, in regard to frequency of visits paid by farmers to the extension office, majority of the farmers reported to have paid one visit per month while a minority paid weekly visits.

The culture of the society to which the farmers belong influences their attitudes and desires (Oakley & Garforth, 1985). In addition, differences in cultural attitudes and unobservable characteristics influence adoption of agricultural innovations (Obayelu, Ajayi, Oluwalana & Oyunmola, 2017). In order to make extension communication and

adoption effective, Oakley and Garforth (1985) posited that extension officers first need to know traditional farming systems before they can gradually introduce farmers to new farming systems. Obayelu et al. (2017) and Lee (2011) further confirmed that features of culture get into the adoption process through network formation and indirect effects such as imitation, peer effects and norm-based diffusion.

Farmers' decisions to adopt new agricultural innovations are influenced by their knowledge, attitudes and perception towards the innovation. Rogers' diffusion of innovation theory notes that the first step in the decision-making process in adoption is the creation of awareness of the innovation. During agricultural extension communication, farmers acquire knowledge about the existence of new agricultural technologies, how to use them, and their outcomes in terms of products, yield, potential environmental benefits, risks and costs. This information forms the basis of the attitudes and perceptions farmers develop towards the agricultural technology (Meijer, Catacutan, Ajayi, Sileshi & Nieuwenhuis, 2015).

Since extension officers have to work with farmers in various ways, they should form close relationships which enables farmers to understand agricultural extension messages (Oakley & Garforth, 1985). Individual and group methods of extension, according to Oakley and Garforh (1985), enable both extension officers and farmers to sensitively developed face-to-face relationships that are of mutual confidence and respect. On the same note, Eltham Training Centre (2001) and Ofuoku (2012) noted that the relationship between the farmer and extension officer should be of mutual trust and that of sharing experiences. A study by Ofuoku (2012) on influence of extension agents' and farmers' communications factors on the effectiveness of poultry production technology messages, showed that farmers had good relationships with extension officers which made them have a feeling of togetherness. There should be a strong link between research-extension-farming. "When a strong connection is established and maintained between all three key partners (researcher-extension officer-farmer), their joint activities can lead to increased and sustainable productivity, increased income and well-being of farm people

and the promotion of national food security and economic growth" (Center for International Agricultural Developmen Cooperation (CINADCO), 2015). Agricultural ministries in developing countries, are however faced with lack of close working relationships among national extension organizations and research institutions, farmers and farm organizations (Swanson, 1998).

A situation determines the suitability of a message; what is suitable for one farm family may not be suitable for another, even if both farm families operate within the same agroecological zone. Similarly, what is suitable for one country may not be suitable for another. It has also been revealed that agricultural technology at the national level can be facilitated by developing suitable technologies (Campbell & Barker, 1998). Adoption of agricultural technologies may involve identification and evaluation of agricultural practices and innovations that increase productivity, food security, resilience in certain agro-ecological areas together with farming systems (United Nations Framework Convention on Climate Change (UNFCCC), 2016).

2.4.4 Noise in Communication

In communication studies, noise appears as though it has been given the least attention even if it affects all the components (source, channel, receiver, message, feedback) of the human communication process (Ifenkwe & Ikpekaogu, 2012). Bello and Obinne (2012) argued that noise, is a notable yet an undesirable element of the communication process. "Noise is any interference en route transmission and reception" (Age et al., 2012). DeVito (2015) defines noise as anything that disrupts the reception of a message. DeVito further classifies noise into four categories which are: Physical, physiological, psychological and semantic noise. Age et al. (2012) however, states that there are three broad categories of noise: Physical, psychological and linguistic noise.

Physical noise is disruption from the environment such as, a loud siren, a disturbing odour or a hot room, loud conversations, side talks at meetings, sound from workmen's

tools, horns from moving vehicles, dog barking and disturbances of other animals (Age et al. 2012; Onasanya et al., 2006). Durgut and Celen (2004), Kluge (2001) and Solecki (1995) noted that external noise occurs in the farms. Psychological noise comes from the psychological makeup, intellectual ability or physical condition of the communicator (Gamble & Gamble, 2010). Psychological and linguistic noise is said to occur within the communicator (Age et al., 2012; DeVito, 2015; Velentzas & Broni, 2014).

The ability to hear is important for participating in farm activities. Farmers and farm workers therefore should be able to hear other people in the farm despite the sounds of animals and machinery, so as to ensure safe working environments (Winters et al., 2005). However, Solecki (1995) affirms that as farmers increasingly adopt mechanical technologies that aid to increase yields, the machines have the disadvantage of producing excessive noise. Noise form tractors, combines, grinders, choppers, elevators, power tools, ban fans etc. is produced in daily work. Sounds from animals in enclosed spaces can reach dangerous levels too. Farmers have therefore higher chances of experiencing hearing loss as a result frequent exposure to high levels of noise as compared to people from other professions (Kluge, 2001). Further, Durgut and Celen (2004) argue that environmental noise can affect people physically and psychologically by making them lose the ability to hear, irritable, angry and interfere with their speech and sleep. Noise also directly affects people's performance by decreasing efficiency and productivity and increasing chances of accidents occurring due to lack of concentration (Saeki et al., 2004).

In the 1980s, agricultural economies worldwide were reconstructed and this resulted to server change pressures on all agricultural sectors in different countries (Ang, 2010). Stress is known to affect decision making (Starcke & Brand, 2012). Stress also has a negative influence on productivity, personal health and safety (Occupational Safety and Health Service, 1998). Psychological noise also results from preconceived notions, such as racial stereotypes, reputations, biases and assumptions that people bring to communication process. When people communicate with ideas about what the other

person is going to say and why, the meaning of the original message can be distorted (Velentzas & Broni, 2014).

Physiological noise usually occurs within the communicator; for example, visual and/or hearing impairment, problems with pronunciation and memory loss (DeVito, 2015). International Center of Insect Physiology and Ecology (ICIPE) (2013) notes that most of the time, intense physical labor in agriculture poses a challenge to disabled farmers. FAO (2003) carried out a study whose objective was to find out the needs of people with physical disabilities (PPD) in the province of Mazandaran, Iran. Findings of the study revealed that challenges faced by farmers who were physically disabled were inability to prepare land, transport heavy inputs and products and perform other heavy farming jobs. The respondents recommended that suitable tools, machinery and special training should be availed, to enable them carry out farming tasks easily.

Linguistic noise is the inability of the communicator to use language correctly and appropriately (Age et al., 2012). Age et al. further sub-divided linguistic noise into grammatical, phonological and semantic noise. Grammatical noise may be caused by use of wrong sentence structure, not following the rule of language use. Phonological noise occurs as a result of wrong articulation of words. Semantic noise is caused by wrong choice of words, use of unfamiliar words or use of familiar words in the wrong way. Ifenkwe and Ikpekaogu (2012) notes that the print media suffers a lot from semantic noise.

> Sources of noise in printed materials include language vis-à-vis targeted audience, colour of printed material, composition or arrangement of message, and presentation pattern. Others are character and size of print (which affect legibility), as well as grammatical and technical accuracy. Although most extension print materials appear quite attractive, some fail to convey intended meaning or produce the desired effect on farmers

because they are poorly edited, and so certain undesirable elements-noise. (Ifenkwe & Ikpekaogu, 2012, p 52)

DeVito (2015) notes that noise cannot be totally overcome, but its effects can be reduced. Ways on how to reduce the effects of noise include: Making language more precise, improving nonverbal communication, listening and feedback skills. On the same note, Age et al. (2012) asserts that noise can be reduced by controlling physical, psychological and linguistic factors. Physical noise can be reduced by moving away from loud noise, maintaining silence and satisfying physiological needs to prevent loss of attention (Age et al. 2012; Durgut & Celen, 2004). Psychological and linguistic noise can be reduced by controlling emotional stress and correct application of grammatical rules, words and pronunciation, respectively (Adebayo, 1997; Age et al., 2012). Ifenkwe and Ikpekaogu (2012) noted that noise should therefore be given considerable attention having been proven as a source of inefficient exchange of extension messages.

2.4.5 Adoption of Irish potato farming innovations

Irish potato is positioned fourth in the world after maize, rice and wheat as a food crop. It is produced and consumed more than the other root crops such as cassava, sweat potato and yams. Its output is about half of the world's produced roots and tubers; thus becoming the largest non-cereal cash crop (Food and Agriculture Organization Corporate Statistical Database (FOASTAT), as cited in Kabungo, 2008). Farming of Irish potatoes in some places ensures food security and gives income to many households through trade (Nyagaka et al., 2009). Similarly Gildemacher (2006) and MoA (2006) (as cited in Nyagaka, et al., 2009) stated that Irish potato farming being labour intensive, creates employment in production, marketing and processing sectors. A study on the potato's contribution to old world population and urbanization by Nunn and Qian (2011) revealed that improved potato productions lead to increase in population numbers in Europe and Napal because potatoes provided more calories and nutrients than other consumed staple foods.

Over the past three decades, the production of Irish potatoes has risen worldwide. In the year 2002 to 2007 the average production was about 1 million tonnes as compared to an average of 245,000 metric tonnes produced in 1960's. This increase in Irish potato production has been attributed to increase in cultivated land rather than increase in produce (MoA, 2006, as cited in Nyagaka et al., 2009). Irish potato yield per unit area is therefore lower than the expected production. Similarly, Abong, Okoth, Imungi and Kabira (2010) state that there has been a steady decrease in the production of a variety of Irish potatoes per unit area in the recent years. This has made research institutions and organizations to breed newer varieties of potatoes which are more resistant to diseases. To address this challenge:

> the Government of Kenya and other stakeholders have undertaken a number of Irish potato development programs such as varietal improvement, seed development, multiplications and distribution to boost production and improve farm incomes. The National Potato Research and Development Program has developed and introduced several technologies which have been passed to farmers through the extension service over the years. (Kinyae et al., as cited in Nyagaka, 2009, p 5)

Despite numerous efforts and resources dedicated to the creation and diffusion of new Irish potato production technologies, the average farm yield has not increased (Nyagaka et al., 2009). Kenya's low yields have been blamed on a failure to use clean seeds, fertilizers, fungicides and irrigation (Wang'ombe & Dijk, 2013). Wang'ombe and Dijk (2013) conducted a study to assess the relative impacts of the adoption of clean seeds, fertilizers, fungicides and irrigation on potato yields in Kenya. The survey was conducted in three counties: Nakuru, Nyandarua and Meru. Findings of the study revealed that adoption of clean seeds had the lowest adoption rate (4.5%), followed by adoption of irrigation which was at 23%. However, there was high adoption of fungicides and fertilizers at 92% and 96%, respectively.

Namwata, Lwelamira and Mzirai (2010) assessed the adoption of improved agricultural technologies for Irish potatoes among farmers in Ilungu ward, Mbeya Rural district, Tanzania. They found that eight of improved agricultural technologies had been disseminated in the area by extension agents. Extent of adoption among farmers varied with the type of technology applied. Seeding rate, timely sowing and fungicide application were the highly adopted technologies with each of them being adopted by at least 80% of surveyed households. Improved varieties and pesticide application were used by 58% and 51% of the surveyed households, respectively and hence moderately adopted technologies. Least adopted technologies were recommended chemical fertilizer application rate, as well as folial or booster fertilizer application, which were used by nearly one- third of surveyed households. Recommended spacing was not used by any of the surveyed households. Results on the overall adoption of technologies disseminated to farmers indicated half of surveyed households to have adopted not more than three out of eight of improved agricultural technologies for Irish potatoes. This reflected poor overall adoption by a significant portion of surveyed households. Study findings also showed that increased household income, being a male or a married woman, high farming experience, access to credit and extension services were positively and significantly associated with overall adoption.

Kiptoo et al., (2016) conducted a study on factors influencing adoption and use of clean certified seed potato tubers among small-scale potato farmers in Koibatek Sub County, Baringo, Kenya. Study findings revealed that farmer education level, frequency of access to agricultural extension services, years of experience in potato farming, the administrative ward of the farmer and farmer's off-farm income influenced the likelihood of adoption and use of clean/certified seed potato tubers for production. Other factors such as use of credit in potato farming, membership to farmer associations, amount of livestock income, type of fertilizer used, gender, household size and the age of the farmer were not of significance to the adoption. Chi and Yamada (2002) study on factors affecting farmers' adoption of technologies in farming system in Omon district,

Can Tho province, Mekong Delta, revealed that progressive, young and educated farmers triggered adoption.

2.5 Empirical Review of Literature Relevant to the Study

Several studies have been done in relation to communication channels used in transmitting agricultural information to farmers. A descriptive study was carried out by Cheboi and Mberia (2014) on efficacy of interpersonal communication channels in the diffusion and adoption of zero grazing technology in Tot Division, Kenya. Purposive sampling technique was used in selecting 40 FGD participants who were farmers and 17 key informants (10 opinion leaders, 1 livestock officer and the only 6 NGO representatives who have training in general agriculture). Findings revealed that opinion leaders, churches, family members, peers, field demonstrations, farmers' field days in schools, co-farmers/early adopters and non-state agencies' farms were the main interpersonal channels used. Other interpersonal channels were women and youth group meetings, public *barazas*, provincial administrators and experts such as livestock production officers and development agencies like World Vision, Child Fund and Catholic Justice and Peace Commission (CJPC). Whereas Cheboi and Mberia (2014) study is different from the present study, there are some parallels in relation to the research method and theoretical framework applied. However, the study only focused on interpersonal communication channel. The present study determined both interpersonal and mass communication channels used between extension officers and farmers on the adoption of Irish potato farming.

Ogueri (2013) conducted a participatory study that evaluated agricultural extension messages that support adoption of improved cassava production technologies in Rivers State, Nigeria. The main objective of the study was to evaluate the technology packages in terms of agricultural extension messages on improved cassava varieties by the public and private systems. Using the participatory research method, the researcher used interviews, focus group discussions and questionnaires to gather data from farmers and

extension officers. Findings of the study revealed that the content of extension messages for improved cassava varieties was not concise but ambiguous, leading to multiple interpretations. Farmers reported to have been left with the burden of handling distorted information from the extension officers. This was one of the constraints farmers faced while communicating with extension officers and it had a negative impact on the adoption of improved cassava production technologies. The researcher suggested that to be able to market agricultural technologies, creative extension messages should be developed in the farmers' dialects. Ogueri's (2013) study is different from the present study for it focuses only on extension messages. The present study goes further to evaluate the effect of other components of communication, that is, agricultural extension messages, communication channels, context and noise, on adoption of Irish potato farming.

Using the survey method, Idowu (2005) conducted a study on farmers' perception on agricultural agents' characteristics as factors for enhancing adult learning in Mezam Division of Northwest Province of Cameroon. The general objective of the study was to determine the factors that enhance learning among farmers in Mezam Division of Cameroon. The target population were 30 farmers who were selected without any definite sampling frame. With the aid of structured questionnaires, findings of the study revealed that farm visits were the most preferred by extension officers at 37.5% followed by home visits at 25.0% and office calls at 12.5%. Preference for farm visits could be attributed to the ability to have the full attention of the extension officer and the opportunity of the agent to identify other problems on the farm. Further, preference for home visits after farm visits could have been as a result of the creation of face-to-face communication which enhanced discussions of not only agricultural related topics but also other subjects that would crop up. Whereas Idowu's (2005) study collected data from farmers only, the present study gathered data from both farmers and extension officers with an aim of determining the context of communication between extension officers and farmers.

Namwata et al. (2010) used cross-sectional survey to assess the adoption of improved agricultural technologies for Irish potatoes among farmers in Ilungu ward Mbeya Rural District, Tanzania. Specific objectives of the study were: (1) identification of improved agricultural technologies for Irish potato farming, (2) determine the extent of adoption of these technologies and (3) identification of factors influencing adoption. Structured questionnaires and in-depth interviews were used to collect data from 60 household heads who were purposely selected and extension officers. Study findings revealed that eight of improved agricultural technologies had been disseminated in the area by extension agents. Extent of adoption among farmers varied with the type of technology employed. Seeding rate, timely sowing and fungicide application were the highly adopted technologies with each of them being adopted by at least 80% of surveyed households. Improved varieties and pesticide application were used by 58% and 51% respectively of the surveyed households and hence moderately adopted technologies. Least adopted technologies were recommended chemical fertilizer application rate as well as folial or booster fertilizer application, which were used by nearly one- third of surveyed households. Recommended spacing was not used by any of the surveyed households. Assessed by the overall adoption of technologies, results indicate, half of surveyed households had adopted not more than three out of eight improved agricultural technologies for Irish potatoes disseminated in the area. This reflected low overall adoption by a significant portion of surveyed households. Results for multiple linear regression analysis indicated that increased household income, being a male or a married woman, increased farming experience, access to credit and extension services were positively and significantly associated with overall adoption. Namwata et al. (2010) study is similar to the present study for they both focus on adoption of Irish potato innovations. However, whereas Namwata et al. study was carried out in Ilungu ward Mbeya Rural District, Tanzania, the present study was conducted in Meru County, Kenya. Further, it is in the interest of the present study to find the effect of shared meaning between extension officers and farmers on the adoption of Irish potato farming innovations in Meru County.

2.6 Critique of the Existing Literature Relevant to the Study

In order to have effective transfer of agricultural innovations from the researchers to the farmers, extension officers need to have knowledge in the use of communication channels for agricultural information dissemination. A study by Akinbile and Otitolaye (2008) on assessment of extension agents' knowledge in the use of communication channels for agricultural information dissemination in Ogun State, Nigeria found that 78.8% of the extension agents had moderate knowledge and 16.8% had high level knowledge. The study also revealed that agricultural extension officers who had high level knowledge in the use of communication channels had also attained high levels of education and vice versa. This study did not reveal if the high knowledge use of communication channels also went along with attainment of shared meaning.

There is a direct relationship between understanding of extension messages and adoption of agricultural technology by farmers (Ogueri, 2003). Chauhan (2007) states that, a good message has the following characteristics: It is aligned to the objectives to be achieved, clear, appropriate, correct, current and transmitted through the right channel. As seen before, farmers are usually not able to adopt new ideas if they are complex, technical and hardly understood (Anaeto et al., 2012). Oakley and Garforth (1985) noted that agricultural extension officers may send messages that they feel are clear and concise but in the long run the receivers of the messages (farmers)end up interpreting them wrongly. A study by Ogueri (2013) on evaluation of agricultural extension messages that support adoption of improved cassava production technologies revealed lack of clarity of extension messages for improved cassava varieties as one of the constraints extension officers faced when they were delivering their services. This study did not reveal in details, exactly what resulted in the extension messages being ambiguous and not concise leading to multiple interpretations.

Campbell and Barker (1998) assert that the performance of extension programs to a large extent depends on the appropriateness of extension messages. Peshin et al. (2009)

also noted that the impact of extension relies on communication of relevant messages through an understandable extension method. A message that is relevant is one that is technically feasible, economically affordable and socially acceptable by people in the society (Age et al., 2012). Similarly, Campbell and Barker (1996) identify four areas in which message appropriateness should be defined: Technical and economic feasibility, social acceptance, environmental safety and sustainability. Message clarity that brings about shared meaning between extension officers and farmers could also be another attribute to appropriate messages.

In agricultural extension, it is important that extension officers make sure that the setting in which they choose to educate the farmers is one that promotes understanding of the information conveyed (Age et al., 2012). According to Oakley and Garforth (1985) places where farmers usually meet with agricultural extension officers to exchange information are farmers' homes, farms and extension officers' offices. When extension agents meet a famer at home or at the farm, they are able to discuss issues pertaining to farming; giving the farmer information and advice. The atmosphere of meeting on the farmer's farm or home is usually informal and relaxed. In such contexts the farmer is able to gain from the extension officer's individual attention, thus likely to listen to the advice given and this motivates the farmer to participate in extension activities. However, Solecki (1995) asserts that as farmers increasingly adopt mechanical technologies that aid to increase yields, the machines have the disadvantage of producing excessive noise. Noise from tractors, combines, grinders, choppers, elevators, power tools, ban fans etc, is produced during daily work. In addition, sounds from animals in enclosed spaces can reach dangerous levels. Despite the farmers' farms or homes being an informal and relaxed setting, shared meaning may not take place between the extension officer and the farmer because of the presence of noise coming from farm machines that are in operation at the time of communication and sounds from the farm animals.

Bello and Obinne (2012) noted that, noise is a notable yet an undesirable element of the communication process. However, there are conflicting numbers of categories of noise. DeVito (2015) classifies noise into four categories which are: Physical, physiological, psychological and semantic noise. Age et al. (2012) however, states that there are three broad categories of noise: Physical, psychological and linguistic noise. Semantic noise according to DeVito's classification of noise falls into linguistic noise as classified by Age et al. Age et al. (2012) have also not included physiological noise into their broad categories of noise, yet ICIPE (2013) notes that most of the times, intense physical labor in agriculture poses a challenge to disabled farmers.

Concerning physical noise, Kluge (2001) notes that farmers have higher chances of experiencing hearing loss as a result of frequent exposure of high levels of noise as compared to people from other professions. Noise also directly affects people's performance by decreasing efficiency and productivity and increasing chances of accidents occurring due to lack of concentration (Saeki et al., 2004). On physiological noise, ICIPE (2013) notes that most of the time, intense physical labor in agriculture poses a challenge to disabled farmers. A study carried out by FAO (2003) to find out the needs of people with physical disabilities (PPD) in the province of Mazandaran, Iran, revealed that challenges faced by such farmers were inability to prepare land, transport heavy inputs and products and perform other heavy farming jobs. These studies do not indicate lack of shared meaning resulting from noise. On the other hand, a study conducted by Ifenkwe and Ikpekaogu (2012) on noise mitigation for effective agricultural extension print message delivery and utilization, revealed that grammatical mistakes and message ambiguity resulted to lack of shared meaning.

2.7 Research Gap

Several studies have found that there has been a steady decrease in the production of Irish potatoes per unit area in the recent years in Kenya (Abong et al., 2010; MoA, 2006, as cited in Nyagaka et al., 2009; Njuguna et al., 2015). Various factors have been

attributed to the decline in adoption of Irish potato technologies. They include: Household size (Kafle & Shash, 2012), perceptions that improve potato varieties are not resistant to blight, access to extension services, family size and access to credit (Njuguna et al., 2015). Further, the Ministry of Agriculture (cited in Kilang'at & Ocholla, 2005) noted that, lack of adequate information support is a constraint in Kenya's agricultural extension. Factors attributed to lack of adequate information support include: Inappropriate agricultural information systems and services, wrong timing, communication of irrelevant agricultural messages and lack of effective linkages among researchers, extension agents and farmers. However, none of these studies investigated effects of shared meaning between extension officers and farmers on the adoption of Irish potato farming. This study, therefore, sought to fill this gap by evaluating the effect of communication channels, nature of messages, communication context and noise in the exchange of agricultural information between extension officers and farmers and on the adoption of Irish potato farming innovations in Meru County.

2.8 Summary

Previous studies, Njuguna et al. (2015), Riungu (2011), Agbamu (2005) and Wang'ombe and Dijk (2013), have focused on other factors other than communication that influence the adoption of Irish potato farming. Factors said to have contributed to low adoption of Irish potato innovations include inappropriate agricultural information systems and services, wrong timing, communication of irrelevant agricultural messages and lack of effective linkages among researchers, extension agents and farmers. From the literature reviewed, it was found that there is a communication gap between extension officers and farmers. Based on the diffusion of innovation theory and symbolic interaction theory, this study had four independent variables: Communication channels, nature of messages, communication context and noise. The four independent variables from which the study objectives were drawn, guided this study in establishing the existence of shared meaning between extension officers and farmers in the adoption of Irish potato farming innovations in Meru County.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

The purpose of this study was to establish the existence of shared meaning between extension officers and farmers in the adoption of Irish potato farming innovations in Meru County. This chapter provides information on research methodology of the study. It explains research design, population, sampling frame, sample and sampling technique, instruments used, data collection methods, instrument piloting and data processing and analysis.

3.2 Research Design

This study used qualitative research design. The design, according to Neergaard, Olesen, Andersen and Sondergaard (2009) and Sullivan-Bolyai, Bovac and Harper (2005) is important and appropriate for research questions focused on finding out the who, what and where of events or experiences and gaining insights from informants regarding a poorly understood phenomenon. It is also easy, quick and cheap to perform because data is collected only once from the respondents (Sedgwick, 2015). However, Sedgwick further asserts that this design may be prone to non-response bias if participants who agree to take part in the study differ from those who do not, resulting in a sample which is not a representative of the population.

Based on the above discussed advantages, disadvantages and assertion that qualitative research keeps the researcher focused on the meaning that participants hold about a problem and not the meaning the researcher brings to the research (Creswell, 2014), the

design is therefore, appropriate in determining the effect of shared meaning between extension officers and farmers on the adoption of Irish potato farming innovations in Meru County.

3.3 Population

The population of this study comprised of all the farmers in Kibirichia Ward in Central Imenti Constituency, Meru County. The total area of Meru County is approximately 6,936 km^2 out of which 1,776km^2 is gazetted forest. According to the national census of 2009, the total population of Meru County was estimated at 1,591,533. There are nine constituencies in this county namely: Igembe Central Constituency with a population of 182,641, Igembe South Constituency with a population of 145,301, Igembe North with a population of 154,814, Buuri Constituency with a population of 109,803, Tigania East Constituency with a population of 157,246, Tigania West Constituency with a population of 135,980, North Imenti Constituency with a population of 149,144, Central Imenti Constituency with population of 141,768 and South Imenti Constituency with a population of 179,604 (IEBC, 2013).

Kibirichia County Assembly Ward covers an area of approximately 105.80 Km^2 with a population of 24,850 persons (IEBC, 2013) and is characterized by annual rainfall ranging between 1400mm and 2600mm and temperature averaging 18℃ (Jaetzold, Schmidt, Hornetz & Shisanya, 2006, as cited in Muthoni et al., 2013). The ward comprises Kimbo, Gathuine, Kiamiogo, Mburugiti, Ntumburi, Barrier, Mboroga and Murinya Sub–Locations (IEBC, 2013). Kimbo has a population of 4149, Gathuine has a population of 645, Kiamongo has a population of 3181, Mburugiti has a population of 3932, Ntumburi has a population of 2847, Barier has a population of 2187, Mboroga has a population of 3347 and Murinya has a population of 4562 (IEBC, 2013).

Table 3.1: Population Distribution of Sub-locations in Kibirichia Ward

Name of sub-location	Population (2009 National Census)	Approximate number of households per sub-location	Kimbo
Gathuine	645	174	
Kiamongo	3181	846	
Mburugiti	3932	1265	
Ntumburi	2847	760	
Barier	2187	594	
Mboroga	3347	877	
Murinya	4562	1202	
TOTAL	**24,850**	**6,760**	

The researcher chose to conduct the study in Kibirichia Ward because of two reasons. Studies by Kaguongo et al., (2008), Kaguongo et al. (2009) and Muthoni et al. (2013) revealed that 1) Kibirichia Ward in Meru County is an area of high potato production in Kenya, and 2) farmers in Meru County, specifically those in Kibirichia Ward have the longest experience in cultivating Irish potatoes. Kaguongo et al., (2008) in their study on farmer practices and adoption of improved potato varieties in Kenya and Uganda, found that Meru was the most intense potato farming region amongst the four major potato producing districts (Meru, Nyandarua, Bale and Kisoro) in Kenya and Uganda. Further, Kaguongo et al. (2009) who conducted a study on seed potato use and projected demand in Kenya, found that Meru district had the longest experience, that is, 19 years of growing potatoes as compared to Keiyo (10 years), Mt. Elgon (9 years), Nakuru (8 years), Narok (10 years), Bomet (8 years), Nyandarua (17 years), Nyeri (17 years), Taita (8 years) and Kiambu (15 years). Kibirichia County Assembly Ward was purposively selected because it is an area of high potato production. Similarly, a study by Muthoni et al. (2013) on potato production in Kenya farming systems and production constraints, found out that farmers in Kibirichia ward had cultivated potatoes for the longest time; an average of 23.3 years. The study also revealed that 100% of the farmers in Kibirichia Ward grew Irish potatoes. In addition, 63.9% of the sampled Irish potato farmers in

Kibirichia stated that they cultivated potatoes because they were high yielding. Apart from the favorable climate and high yields that farmers get, Irish potatoes in Meru County are an important commercial crop that have a well-defined market and a premium price (Kaguongo et al., 2008)

3.3.1 Target population

The target population of the study were three extension officers employed by the national government to disseminate agricultural information to the farmers in Kibirichia Ward and a total of 11,907 area residents (Irish potato farmers) from the four sub–locations (Kimbo, Gathuine, Kiamiogo, Mburugiti) spread across 3,327 households according to the 2009 National Census. The study adopted the target population of farmers from the four sub-locations in Kibirichia Ward considering that every farmer in the selected sub-locations grows potatoes because it is the most productive crop.

Table 3.2: Population Distribution of Four Sub-locations in Kibirichia Ward

Name of sub-location	Population (2009 National Census)	Approximate number of households per sub-location	Sample size of household heads
Kimbo	4,149	1,042	9
Gathuine	645	174	9
Kiamongo	3,181	846	9
Mburugiti	3,932	1,265	9
TOTAL	**11,907**	**3,327**	**36**

3.4 Sampling Frame

The sampling frame for this study was all the households in the four selected Sub-Locations. The 2009 National Census Report was the sampling frame for the households in Kimbo, Gathuine, Kiamiogo and Mburugiti Sub-Locations. Sampling frames for

Agricultural extension officers were the three agricultural officers employed for the above purpose and registered with the Ministry of Agriculture.

3.5 Sample and Sampling Technique

3.5.1 Sample size

A qualitative sample size is best determined by the time allocation, resources available, the objectives of the study, Patton (1990) and data saturation (Fusch & Ness, 2015). Different scholars give varying numbers for participants to be included in the qualitative study. For example, Guest, Bunce and Johnson (2006) assert that six interviews are enough to attain data saturation. However, Hill et al. (2005) recommend 8-15 participants for interviews. For focus groups, the recommended members of a focus group are 6-12 participants (Lasch et al., 2010). Hancock (1998) however, recommends between 6-10 people for focus groups.

In this study, the researcher conducted four focus group discussions (FGDs) of nine members. This was within what both Hill et al and Hancock recommended. Such a group size is small enough to allow all the participants to talk and give their own experiences, and yet large enough to accommodate a diverse group (Lasch et al., 2010). According to the National Government Co-ordination Act No. 1 of 2013 (2013) sub-chiefs are in charge of sub-locations. It was also assumed that each sub-chief knew at least each household head in their sub-location. The assistant chiefs, therefore, assisted in identifying nine household heads from their sub-location to be included in the focus group discussions. Farmers selected in this study were household heads aged 30 years and above because they had enough experience in Irish potato farming and were therefore able to answer the focus group discussion questions. Hancock (1998) noted that a small number of focus groups, as few as three or four, may gain adequate breadth and depth of information. The researcher therefore conducted one focus group from each of the four sub-locations purposively sampled from Kibirichia Ward.

Three in-depth interviews were conducted with the three extension officers who provide extension services to Irish potato farmers in the four selected Sub-Locations in Kibirichia Ward. Considering that the target population of the study was 11, 907 area residents (Irish potato farmers) from the four sub–locations (Kimbo, Gathuine, Kiamiogo, Mburugiti) and three agricultural extension officers, a sample size of 39 respondents was therefore used.

3.5.2 Sampling technique

Focus group discussion respondents were purposively selected from the sampling frame as indicated in Table 3.2. Participating farmers were selected using homogeneous sampling, which is an approach of purposive sampling. Homogeneous sampling was ideal for this study as it describes a particular subgroup in depth, reduces variation, simplifies analysis and facilitates group interviewing (Palinkas et al., 2013; Patton, 1990). The homogeneous sample comprised of farmers who were household heads and were 30 years of age and above. The assistant chief assisted in identifying the farmers.

In-depth interviewees were selected using total population sampling which is a technique of purposive sampling. Total population sampling is used where the number of cases being investigated is relatively small. Consequently, the researcher interviewed all the three extension officers who provide extension services to Irish potato farmers in the four sub-locations in Kibirichia Ward.

3.6 Data Collection Instruments

This study used two data collection tools, that is, in-depth interviews and focus group schedules.

3.6.1 Interviews for agricultural extension officers

For agricultural officers, the researcher used semi structured interviews. The interviews entailed open-ended questions about the topic under study. Additionally, through probing, the interviews provided both the interviewer and interviewee the opportunity for an in-depth discussion. The researcher restricted in-depth interviews to the extension officers in order to get their individual views on effect of communication channels, nature of messages, communication context and noise on the adoption of Irish potato farming innovations in Meru County. The researcher ensured that the questions on the interview schedule were pegged on the research questions in order to obtain data that would meet the objectives of the study. Further, the interviews were conducted in English since all the extension officers were literate.

3.6.2 Focus Group Discussions (FGD)

The researcher prepared a list of open-ended questions to be covered during the FGD (See appendix 3). The questions were discussed with the research assistant prior to the meeting to ensure that they were understood, appropriate and covered the research objectives. The questions were formulated as a series of open-ended discussions requiring explanations, descriptions and narrations on shared meaning in the adoption of Irish potato farming innovations. This enabled the researcher to get adequate information from the respondents. Further, all focus group discussions were conducted in Kimeru because some farmers were illiterate. Further, all the participants preferred discussing the FGD questions in Kimeru since they were more conversant with their mother tongue than other languages. The interview for each group was scheduled at a convenient time and place such as, a social hall or a church premises.

3.7 Data Collection Procedure

The researcher used qualitative research methods in data collection. Qualitative research was appropriate for this study for it uses assumptions, worldviews, theoretical lens and it

studies research problems to find the meaning that individuals give to social or human problems (Creswell, 2007). Among the characteristics of qualitative research identified by Creswell that make it appropriate for this study are: (1) data collection takes place at the site where the respondents experience the issue under study, (2) not one source of data is used but multiple such as interviews and focus group discussions and, (3) researchers focus on the meaning that the respondents have on the problem of study and not the meaning that researchers or writers bring into the study.

3.7.1 In-depth interviews

In depth interviews were exclusively for extension officers and the researcher. In-depth interviews focused on one-on-one interview format in which the researcher interacted with the three key informants one at a time in their offices. Before the interview sessions began, the researcher informed the respondents about the study details and gave them assurance about ethical considerations, such as, confidentiality and anonymity. This gave respondents an idea of what to expect in the exercise and sought their consent. The researcher also strived to build a rapport with the respondents before the interview, to help them relax. Permission was requested from the interviewees for the researcher to use a tape recorder. One of the reasons why tape recording was preferable was that, it enabled the interviewer to concentrate on listening and responding to the interviewee and not get distracted by taking notes of the responses given (Hancock, 1998). The interviews were conducted in the extension officers' offices.

The three extension officers were asked identical open-ended questions in the same sequence without the interviewer influencing the process. If the researcher noticed that the interviewee(s) had difficulty in answering questions or provided only a brief response, cues and prompts were used. This was to encourage the interviewee to consider the questions further. At the end of each interview session, the researcher thanked the respondents and asked them if there was any information that they would have liked to add. This gives respondents an opportunity to bring up issues they

consider as important but not discussed in the interview (Kvale, as cited in Gill, Stewart, Treasure & Chadwick, 2008). Such an opportunity leads to new and unanticipated information (Gill et al., 2008).

3.7.2 Focus group discussion

The researcher relied on assistant chiefs for purposive selection of participant households. The assistant chiefs were requested to select farmers from households that were homogeneous and had the required information with respect to adoption of Irish potato farming innovations. Homogeneous household samples comprised of Irish potato farmers who were residents of the same sub-location with the selected member of the household being over 30 years old.

Introducing the session. The researcher and research assistant (facilitator) introduced themselves to the farmers followed by self-introduction by the participants. The facilitator then explained the purpose of the FGD, the kind of information needed and how the information would be used. Permission was sought from the participants to use a tape recorder during the in-depth interviews and focus group discussions.

Encouraging discussion. The facilitator and researcher were enthusiastic, lively and showed their interest in the groups' ideas. They asked questions and encouraged all the participants to express their views. They also made sure that there was no expression of 'right' or 'wrong' answers and reacted neutrally to both verbal and non-verbal responses. The research assistant and researcher reoriented the discussion when it went 'off the track.' At the end, the main issues were summarized and read back to the group to check whether additional comments were needed. The researcher then thanked the participants and assured them that their ideas were valuable and would be used for the intended research. The researcher together with the facilitators thereafter listened to each and every interview recorded in the tape and took notes. This enabled the researcher to fix mistakes manually and maintain accuracy when the information was still fresh.

3.8 Ethical Considerations

The researcher got an introduction letter from Jomo Kenyatta University of Agriculture and Technology and a government permit which were submitted to the Ward Officers in Kibirichia. These documents informed them of the data gathering from the Irish potato farmers and agricultural extension officers in the four sub-locations. Creating a rapport with the respondents was another way of playing ethical duty for the researcher. The purpose of the FGD and in-depth interviews, the kind of information needed and how the information would be used, was explained to the participants. The researcher did explain the purpose of the study and its usefulness to the respondents so that they can see themselves contributing positively to their wellbeing (Mugenda & Mugenda, 2003).

3.9 Piloting Test

A pilot study is a stage in research in which the researcher gathers a small amount of data so as to test the research procedures, identify possible problems in data collection procedure and prepare for the actual research (Teddlie & Tashakkori, 2009). Pilot studies are conducted for a short period of time, involves few participants, locations and little organization. Pilot tests help determine the actual study location and participants of interest. Further, pilot tests aid the researcher to formulate a rapport with the respondents in order to develop interview skills and find out potential problems that could interfere with data collection. The tests also determine which respondents to include in the actual study and appropriate data collection procedures (Given, 2008). However, Teijlingen and Hundley (2001) identified three limitations of pilot studies as; (1) the possibility of making wrong predictions and assumptions based on pilot data, (2) contamination, that is, results and respondents of the pilot study being included in the main study, and (3) limited funding. In this study, pilot tests were conducted to determine the validity and reliability. Julious (2005) notes that a sample size of 12 respondents for a pilot study is ideal.

The study was pre-tested among 12 respondents who were not included in the final study. The sample size of respondents who took part in the pilot study was determined by data saturation from respondents who were obtained from a church or a village. The pre-test was carried out on the interview and focus group schedules to ascertain correctness of concepts and whether respondents interpreted the meaning of questions appropriately. After the pre-test, slight adjustments were made on the focus group schedule. First, Irrelevant questions that would yield unnecessary data were deleted and relevant ones added. Secondly, the pre-test helped to solidify sentences for flow, clarity hence understanding by the respondents.

3.9.1 Validity

The validity of a research instrument concerns the extent to which the instrument yields the same results on repeated trials and measures the intended construct (Ngechu, 2006). Validity refers to the appropriateness of the instrument in collecting data and the degree to which a test purports to measure. Construct validity is the appropriateness of inferences made on the basis of whether an instrument measures the intended research question (Amin, 2005). Where significant issues were reported, the instrument was modified.

Study tools were presented for correctness and accuracy to a sample of 12 respondents who had similar characteristics with those of the actual study. This ensured that the research instrument used obtained the data required, assessed what the research intended to measure in order to meet the objectives of the study. Questions which were identified as irrelevant were deleted and those considered to relevant were included in the tools. Further, unclear questions that were pointed out by the 12 respondents were revised for easy understanding.

3.9.2 Reliability

"Reliability is a measure of the degree to which a research instrument yields consistent results, or data after repeated trials" (Mugenda & Mugenda, 2003, p95). Kasomo, (2006) proposes that to ensure adequate reliability, the researcher needs to consider the following: (1) the length of a research instrument, (2) how heterogeneous the subjects are, (3) ability of the subjects participating, (4) nature of the variable being measured and (5) clarity of instruments given to respondents. In quantitative research, reliability is viewed differently from qualitative research. In quantitative research, reliability is characterized by the degree to which many researchers involved in similar study using identical procedures arrive at the same results. However, in qualitative research, three indicators often cited of credibility and dependability are; Methodological coherence, researcher responsiveness and audit trails (Given, 2008). Deviation from the true measurements as a result of factors that the researcher did not address adequately is called random error or measurement error. According to Mugenda and Mugenda, factors that cause random errors are: Inaccurate coding, unclear instrument instructions to the respondents, interviewers and interviewees fatigue and bias. To ensure reliability, the researcher in this study pre-tested the instruments for consistency and proper flow of the questions before data collection.

3.10 Data Processing and Analysis

After completion of data collection, the analysis and interpretation process commenced. Qualitative data obtained through in-depth interviews and FGDs was coded and analyzed for themes. There are six steps in analyzing and interpreting qualitative data: (1) organizing and preparing the data for analysis by transcribing data, (2) reading through all the data to get a general sense of the information and reflect on its overall meaning, (3) coding all the data into relevant themes and sub-themes, (4) coding to generate a description of the setting or participants as well as categories and themes of analysis, (5) making a decision on how the descriptions and themes will be presented in

a narrative and, (6) making an interpretation of the results by finding the lessons that have been learnt.

Focus group discussions and in-depth interview data were transcribed manually. That is, the researcher listened to each of the recorded interviews and discussions and recorded them on paper. During the transcription process, the researcher took note of how the respondents expressed their feelings and meanings during the interview sessions and focus group discussions. After transcription, the researcher read and made sense out of the collected data. The data for each question was put together, coded and categorized into relevant themes and sub-themes according to the objectives of the study. Ryan and Bernard (2003) noted that, "Looking for themes in written material typically involves pawing through texts and marking them up with different colored pens." For easy identification and interpretation of themes, the researcher marked key phrases with different colored pens. Consistencies and differences in the data were identified by making systematic comparisons across categories of data. Finally, the researcher made possible and plausible explanations of the findings.

3.11 Summary

This study used the qualitative research design. Qualitative data were collected using focus group discussions and in-depth interviews. Data was collected in Kibirichia Ward in Meru County amongst Irish potato farmers who were area residents from four sub-locations (Kimbo, Gathuine, Kiamiogo, Mburugiti) and all the extension officers involved in the production of Irish potato crop. A sample size of 39 respondents was drawn. Using qualitative methods in data analysis, focus group and interview data was transcribed, coded and categorized into relevant themes and sub-themes and possible and plausible explanations of the findings drawn.

CHAPTER FOUR

FINDINGS AND DISCUSSION

4.1 Introduction

This chapter presents the findings and discussions of the study. It commences by restating the purpose and objectives of the study. The aim of the study was to investigate the effect of shared meaning between extension officers and farmers on the adoption of Irish potato farming innovations in Meru County.

The study had the following objectives: (1) to determine the effect of channels of communication used between extension officers and farmers on the adoption of Irish potato farming innovations in Meru County, (2) to describe the effect of the nature of messages conveyed between the extension officers and farmers on the adoption of Irish potato farming innovations in Meru County, (3) to examine the effect of the context of communication between extension officers and farmers on the adoption of Irish potato farming innovations in Meru County, and (4) to determine the effect of noise on shared meaning between extension officers and farmers on the adoption of Irish potato farming innovations in Meru County. In this chapter, findings from the farmers were first presented, followed by findings from the extension officers, as the discussion of results and linking literature and theory in each item follows.

4.2 Response Rate

Data was collected from farmers and extension officers in four sub-locations of Kibirichia Ward, Meru County. Respondents comprised four groups of farmers with nine farmers per focus group from both genders and three extension officers (one female and two male). The study envisioned conducting four focus group discussions with the

farmers and three in-depth interviews with the extension officers, which the researcher was able to accomplish. The response rate, therefore, was 100%.

4.3 Demographic Information

Most of the farmers in this study ranged between 40-70 years of age. This indicates that most these farmers had many years of experience in Irish potato farming. However, minority were between 20-30 years and one was 80 years old. Though the study had targeted household heads who were over 30 years old, a minority of those selected could not make it for the focus group discussions. To replace the farmers who could not make it for the FGDs, the assistant chiefs selected few farmers who were household heads between 20-30 years old and had experience in Irish potato farming. Female farmers were more than the male in the Focus Group Discussions (FGD). This indicated that many of the households in Kibirichia Ward were headed by women. Majority of the farmers had an experience of 10-19 years in Irish potato farming. Some female participants reported to have been born and brought up in other areas which did not cultivate Irish potatoes and were married in Kibirichia Ward where they practice Irish potato farming. Majority of the farmers had attained secondary school education followed by those with primary school education and a minority were university graduates. Another minority had no formal education.

All the agricultural extension officers in Kibirichia Ward were in age brackets 52-54 years. Two of the officers were males while one was female and they all had 8-10 years of working experience in Kibirichia Ward. All the extension officers were college graduates at different levels, with two having attained a diploma while the third one had a Certificate in Agriculture.

4.4 Communication channels

This section addresses the first objective of the study which determines the effect of channels of communication used between extension officers and farmers on the adoption

of Irish potato farming innovations in Meru County. The sub-sections below present detailed findings.

4.4.1Mass media used to disseminate extension information on Irish potato farming

The study sought to investigate the mass media used to disseminate information on Irish potato farming. Farmers from Kiamiogo stated that information on Irish potato farming innovations was disseminated through posters, letters and leaflets while Gathuine farmers received information through leaflets distributed by the extension officers. For example, one farmer said, *"Extension officers write letters which are distributed and read out to the farmers."* Kimbo farmers however, asserted they had received messages through posters only. One respondent said:

> *When extension officers have planned a one-day farm visit, they put up posters to inform us of the event. For example, when they plan to use Mr. Marangu Kurea's farm to conduct a demonstration, they put up posters to notify the farmers.*

All the farmers, however, were categorical that they did not receive messages on Irish potato farming innovations through newspapers, magazines, radio or television.

Similar to the farmers' responses, extension officers pointed out that they mainly communicated to the farmers using letters, leaflets and posters. *"Actually, we have been using posters and also writing letters through churches and schools in order to reach out to farmers. Letters are normally addressed to the farmers through church chairmen,"* one extension officer said. However, mainstream mass media was also used to communicate to farmers albeit marginally. For instance, one extension officer reported that information on Irish potato farming was also communicated through the radio, television and newspapers especially when the Meru County government occasionally provided finances to support field days for farmers. In such cases, farmers were informed about meetings through the local media channels like the Meru County

newspaper, the Meru Television Stations like Muuga Television Channel, and radio stations such as Muuga FM. The extension officer also reported:

> *When it is our own local meetings, we print advertisements about the meeting on A4 papers. We print the posters ourselves using our office computers... However, for the county meetings, we use big posters that are printed on A2 papers and also announce through the radio.*

This study revealed that posters, leaflets and letters were mass media channels used to disseminate information on adoption of Irish potato farming innovations. These findings concur with Age et al. (2012) who argued that print and electronic media such as television, radio and newspapers, are used globally to inform farmers about agricultural innovations. All the farmers in this study were categorical that they did not receive information on Irish potato farming through the mass media. However, the extension officers reported that electronic media were used only when the Meru County government works jointly with them. Probably, the Meru County government uses mass media to reach a large number of people irrespective of their location within the county. In addition, the Meru County government could be having more funds allocation compared to the Buuri sub-county where Kibirichia Ward falls. This is in agreement with Oarkley and Garforth's (1985) argument that mass media disseminates the same information to a large number of people.

4.4.2 Frequency of mass media use in dissemination of extension messages

Generally, findings of the study revealed that the frequency of mass media use was determined by the situation on the ground, interpersonal communication channels used relied on farmers' needs and desires for agricultural extension information (demand driven). Farmer-based factors were considered when choosing channels of communication, which in turn provided both immediate and delayed feedback.

Farmers from all sub-locations reported that the frequency was determined by the situation on the ground. These situations could be visits by agrochemical companies' representatives, Irish potato planting seasons and disease outbreaks. For example, Kimbo farmers said that messages reached them once every three months and talked of an increased frequency during the Irish potato growing season. *"Communication from the extension officers is more frequent when the Irish potato crops are growing,"* said a farmer in the Kimbo group. In addition, those from Mburugiti asserted that the frequency was determined by an outbreak of Irish potato disease or the need to create awareness on a new Irish potato breed. *"There is a lot of communication between us and the extension officers during planting, weeding, and when there is a disease outbreak,"* said another farmer. Gathuine farmers said they received information from the extension officers two to three times a year. Further, the farmers pointed out that the frequency increased when extension officers partnered with companies that manufacture fertilizers in disseminating information. Contrary to this opinion, one respondent had this to say:

> *Last year, fertilizer companies' representatives who normally give us brochures visited us once. This year, they have not paid us a visit probably due to drought. In addition, few farmers have planted potatoes this year; those who use the irrigation system.*

It was also noted that extension officers paid fewer visits to farmers after the crop had flowered because the crop was about to mature.

Farmers from Kiamongo said they received messages through posters once or twice a year. Another respondent from Gathuine referring to extension officers said, *"I have not received information from these people for a long time." "How have you been getting information on farming your potatoes?"* asked the researcher. *"I have been getting information from my fellow farmers."* replied the farmer. *"Farmers get information more frequently when they seek for it through personal consultations than in groups where they receive it about twice a year,"* said another farmer.

There was also an apparent inconsistency in the responses from the extension officers regarding the frequency of communicating information on adoption of Irish potato farming with the farmers through the mass media. One extension officer gave an approximation of five to fifteen times in a growing season. The officer asserted that the frequency was determined by the number of activities they had to carry out with the farmers, corroborating partners and the urgency of disseminating messages, like during a pest outbreak. Another extension officer reported this regarding the frequency of information dissemination:

> *Most of the time we partner with Kisima Farm over new varieties which they have come up with, so it may be quarterly. We may also get other stakeholders like sometimes we get companies such as Farm Input and Promotions Africa Limited (FIPS), Syngenta Kenya, East Africa Seed Company Limited (EASEED) and Bayer East Africa Limited that want to partner with us.*

A third officer said, *"The estimate of our meetings is about ten times a year. It depends on the number of farmers' groups supported by BIPS project at any one time."*

Results showed that the frequency of mass media use was determined by the situation on the ground. These situations were visits by agrochemical companies' representatives, Irish potato planting seasons and disease outbreaks. Probably the situations on the ground dictated that extension officers pass down information to farmers and not the officers to receive information from farmers as Ndwiga (2014) observed. This study also revealed that the frequency of mass media use was low which is in tandem with Okwu and Daudu (2011) who observed low use of radio, newspapers, television and film shows by farmers in obtaining agricultural information. The low frequency of mass media usage in this study could be attributed to the channels not being considered as important sources for information as interpersonal communication (Tologbonse, Mesini & Tsado, 2006; Yahaya 2002).

4.4.3 Interpersonal channels used to disseminate information on Irish potato farming innovations

Generally, findings revealed that interpersonal communication channels used included meetings or *barazas*, demonstrations, mobile phone calls, Short Message Service (SMS), seminars, field days and workshops. When farmers were asked to name interpersonal channels used to disseminate information on Irish potato farming, farmers in all the FGDs concurred that extension officers used seminars, meetings or *barazas*, home and farm visits, fellow farmers, field days, phone calls and demonstrations to convey messages. For example, a respondent from Kimbo sub-location said:

> *Extension officers use seminars, chiefs' barazas, field days and demonstrations. The officers also visit individual farmers in their homes to discuss farming issues over a cup of tea after which they go to the farm for more discussions. We like home visits because they have a personal touch.*

Another farmer from Kimbo noted that, *"Since the turn up for chiefs' barazas is high, the officers normally request the chief to give them a chance to speak to the farmers."*

Seminars and mobile phone calls were sometimes used by extension officers to disseminate information to group leaders of farmers or to contact farmers who in turn passed across the message(s) to their members. Demonstrations were used to teach good agricultural practices and they were carried out in progressive farmers' farms. For example, one farmer said, *"There is a farmer called Kimaita who is known to be the best farmer in Kimbo, Ncooro area. The officers like using his farm for demonstrations."* Another farmer added, *"Demonstrations are good because we learn by seeing."* Farmers however said that tours were rare.

Asked the same question as the farmers, all the extension officers pointed out that meetings, demonstrations, mobile phone calls, SMS, seminars, field days and workshops were the key interpersonal channels of communication. One extension officer had this to

say, *"We use mobile phone calls, SMS, meetings, seminars, field days and demonstrations. During demonstrations, we teach practically; when I plant, farmers get to see how I am planting. That is what we call demonstration."* In addition, another extension officer said:

> *Demonstrations are one of the methods we use to train farmers. We demonstrate as we explain to the farmers what we are doing. We use demonstrations to teach groups of farmers because currently, we are three extension officers serving 28,000 farmers in Kibirichia Ward. We have therefore, about eighteen groups to attend.*

Findings revealed that meetings or *barazas*, demonstrations, mobile phone calls, SMS, seminars, home and farm visits, fellow farmers, field days and workshops were the interpersonal channels of communication used to disseminate information on adoption of Irish potato farming innovations. These findings are in agreement with Cheboi and Mberia (2014) who found that interpersonal channels used in the diffusion and adoption of zero grazing technology were opinion leaders, churches, family members, peers, demonstrations, field days, meetings and public *barazas*. Other studies (Ng'ang'a et al., 2003; Okwu & Daudu, 2011; Wafula, 2015) found that farmer to farmer, opinion leaders, demonstration, field days, seminars, field schools, extension visits, trade fairs, mobile phones, group meetings, chief *barazas*, agricultural shows, church and school meetings were interpersonal channels used to communicate agricultural messages.

4.4.4 Frequency of interpersonal channels used to disseminate information on Irish potato farming innovations

The respondents were also asked the frequency of using interpersonal channels to transmit information on Irish potato farming innovations. The respondents indicated that the frequency relied on farmers' needs and desires for agricultural extension information (demand driven). However, there were inconsistencies regarding the number of times

extension messages on adoption of Irish potato farming innovations were transmitted to the farmers through interpersonal communication channels. Some of the farmers gave a frequency of two to three times during a single season of Irish potato growing while others gave a frequency of twice to four times a year. Farmers also reported that extension officers met them when they had information to disseminate.

According to the extension officers, meetings were said to be called for about ten times a month, seminars twice a month, demonstrations eight times a month, field days once a month or sometimes three times a year depending on the needs at the time. Further probe by the researcher regarding the frequency of meetings revealed that they depend on the farm activities and urgency, like if there is an outbreak of a pest or disease. *"On the average, we send messages five times but it can rise to fifteen times during the Irish potato growing season depending on the seriousness of the case,"* said one of the extension officers.

This study results showed that the frequency in the use of interpersonal communication channels relied on farmers' needs and demand for agricultural information (demand driven). This finding agrees with Kiptot and Franzel (2015), who found that volunteer farmer trainers, who play the part of trained extension officers, train farmers when called upon. The current study further revealed discrepancies between extension officers and farmers' reports on the frequency of information exchange through interpersonal communication channels. The discrepancy could be due to low extension officers to farmers' ratio in Kibirichia Ward. This is in agreement with Agbamu (2005) who reported that low extension officers to farmers' ratio is prevalent in many developing countries. This makes many farmers not to benefit from agricultural extension services.

4.4.5 Most preferred channels of communicating information on Irish potato innovations

Generally, study respondents indicated that demonstrations, field days, meetings or *barazas* and seminars were predominantly identified as the most preferred channels of communication. When farmers were asked to identify the most preferred channels of communicating information on Irish potato farming and justify their reasons, they mentioned demonstrations, field days, *barazas* and seminars. For instance, all farmers from Mburugiti group asserted that all face-to-face communication channels were good because they were able to ask questions and get instant clarification from the extension officers. One farmer in the group highlighted demonstration as the best while another farmer preferred seminars to tours because seminars were held locally thus making them cheaper as compared to tours.

Gathuine farmers were of the opinion, *"Demonstrations are good because we are able to imitate what we see the officers doing."* Kiamiogo farmers also said, *"Demonstrations are good because during demonstrations, the extension officers come with samples of fertilizers and seeds. They use a small piece of land in one of the farms to show us how to plant and apply fertilizers."* Another farmer said, *"Just as the others have said, demonstrations are the best; I don't like missing them."*

Asked the same question, all extension officers stated demonstrations, training and visits (T&V), phone calls, SMSs, meetings, seminars, field days and home visits as the most preferred channels for transmitting agricultural extension messages on the adoption of Irish potato farming innovations. Demonstrations were preferred because they were practical, enabling farmers to learn visually how to utilize various agricultural innovations. The following information was given by one of the extension officers, *"Demonstrations are attended by very many farmers who get to see for themselves what to do. There is a lot of practical work in demonstrations so the farmers practice what they have learned in their farms."* Reports from the three extension officers indicated

that during demonstrations, farmers turned-up in large numbers because the officers often partner with other stakeholders like seed and agro-chemical companies who had a boosting effect on the dissemination and reception of information on Irish potato farming. Similarly, during training and visits, farmers were able to learn and adopt the agricultural techniques which they were taught on their farms. *"Home visits are good because we are able to give farmers individual attention and this motivates them to adopt what they have learnt faster,"* said another respondent. Findings also revealed that extension officers didn't use only one or two channels of communication but engaged a variety of them:

> *We use a combination of many channels to get the message across to as many farmers as possible. For example, we can use our own mobile phones to communicate to various contact farmers to consult or inform them on when we will be conducting trainings and demonstrations.*

Results indicated that demonstrations, field days, meetings and seminars were the most preferred channels in disseminating information on adoption of Irish potato farming innovations. These study findings support Licht and Martin (2007) who found that personal consultations, demonstrations, meetings and workshops were most preferred. Oakley and Garforth (1985), Rogers (2003) and Rogers and Nichof (2002) reported that the use of interpersonal channels of communication could be attributed to the role they play in creating and changing attitudes towards an innovation which in turn influences the decision to adopt or reject an innovation. Further, the current research revealed differences between farmers' and extension officers' responses on channels of preference. Farmers stated only face-to-face channels while extension officers pointed out both face-to-face and machine-assisted interpersonal communication channels (mobile phone calls and SMS). This finding contradicts that of Ogola (2015) who found that electronic media (radio), interpersonal channels (fellow farmers and extension officers) and machine-assisted interpersonal communication channels (telephone calls) were farmers' preferred channels of receiving agricultural information. The differences

between farmers and extension officers' response on channels of preference could be attributed to the fact that extension officers used different channels because they played various roles in disseminating agricultural information at different stages of the adoption process (Oakley & Garforh, 1985; Rogers, 2003; Rogers & Nichof, 2002). It is important, therefore, that agricultural extension officers use a variety of communication channels, including face-to-face, mass media and machine-assisted interpersonal channels, when conveying agricultural messages to farmers. Bembridge (1991) argued that five or more channels of communication used in combination have enough impact to influence significant changes in farming practices and agricultural productivity.

4.4.6 Factors considered when choosing a communication channel(s)

The factors considered were: Ability to reach many farmers, distance among farmers, farmers' perception levels, and ability to ask questions and give immediate feedback. According to respondents, factors that influenced the farmers' level of perception were their level of education, advancement and experience in Irish potato farming. One extension officer said:

> *There are groups where some members have little education. Groups are not the same. Group composition will determine which language to use. The type of group will also dictate the teaching materials to use, the language to speak and the message to give. For example, I don't give written messages to old people who cannot read and I rarely call ladies using the mobile phone because they often don't move around with them.*

The current study showed that farmer-related factors were of importance while choosing the channel of communication. These findings differ with Chauhan (2007) who observed that channel related factors such as availability of the communication channel to the communicators, appropriateness of the channel to the receiver and message and the main object of communication were more critical. The study finding also contradicts

Oakley and Garforh (1985), Rogers (2003) and Rogers and Nichof (2002) who argued that different channels play different roles in various stages of the adoption process. These researchers asserted that mass media channels are important in transmitting information, creating awareness or changing cognition, giving timely advice about the occurrence of disease and pest outbreaks together with urgent advice on what farmers should do. Interpersonal channels on the other hand, bring about attitude change to farmers so as to adopt agricultural innovations.

4.4.7 Ability to give feedback through communication channels used in exchanging extension information

Generally, results indicated that both immediate and delayed feedback were evident in channels used in communicating information on adoption of Irish potato farming innovations. With regard to feedback, majority of the participants in the four groups stated that they were able to give extension officers immediate feedback. In fact, the participants pointed out that the officers constantly encouraged them to ask questions and seek for clarification in areas they did not understand. One farmer from Kimbo said, *"As long as they give us information in a language that we understand, we are able to give the officers feedback."* A farmer from Gathuine said, *"We are able to have an exchange of ideas during these activities and give feedback on the spot especially during demonstrations, field days, farm visits, seminars and barazas."* Another farmer from Mburugiti added, *"When they ask questions, we try our level best to answer." "They get feedback by seeing the way we farm and through the amount of the crop yields we get from our farm,"* reported another farmer. Minority of the farmers however pointed out that, sometimes there was delayed feedback. That is, at times extension officers were not able to answer some questions asked by farmers due to lack of knowledge on the information sought. In such cases, extension officers assured farmers that they would give them the needed information once they got it.

Extension officers were of the same view with the farmers on the question of feedback. One extension officer claimed that both immediate and delayed feedback existed. Immediate feedback occurred when farmers were given a chance to seek for clarification and ask questions during the meetings. On the other hand, delayed feedback occurred when farmers did not get back to the officers, informing them of their progress. When one of the extension officers was asked if they were able to get feedback from the farmers, the officer said:

> *Yes, we are able to get feedback but remember, we are working with farmers whose education is not advanced. Few of them come back to tell us of their experiences. However, besides what they tell us we also employ our own methods to get feedback. Sometimes as we walk around and meet farmers, we ask them, 'By the way, how did our farm perform?' or 'How is the new variety?' That way we get feedback. However, there is no single best channel for getting feedback. It is important to also note that farmers are very fast in reporting when the crop has not done well. They report faster than when the crop has done well. Let me repeat. When a product or a variety has failed, they are very fast in bringing back the reports than the other way round. Like now, during abnormally dry season, there is a lot of information we are being given by the farmers.*

On the same note, another extension officer said, *"Farmers appreciate us when they get high yields as a result of practicing what we teach them. When they harvest, some of them thank us by giving us a part of their produce while others give us money due to their joy."*

Results indicated that both immediate and delayed feedback were evident in channels used in communicating information on adoption of Irish potato farming innovations. According to the respondents, the occurrence of immediate or delayed feedback was attributed to the time taken by the officers to answer questions and farmer to relay

information regarding their farming progress; not the channels used. These study findings disagree with Dominick (1999) who reported that interpersonal communication channels allow immediate feedback whereas delayed feedback is one of the characteristics of mass communication. Feedback, whether delayed or immediate, helps one to know if the message has been understood or not (Agbamu, 2006; Ofuoku, 2012). Further, Oakley and Garforth (1985) and Onasanyaet et al. (2006) argued that adoption and transfer of agricultural technology will not take place unless farmers understand extension messages transmitted through an appropriate feedback mechanism.

4.4.8 Effect of communication channels on adoption of Irish potato farming innovations

Farmers reported that interpersonal channels led to high adoption as compared to mass media. A farmer from Mburugiti said, *"All the channels used by extension officers to communicate information on Irish potato farming lead to high adoption."* Another farmer form the Mburugiti group added, *"We find demonstrations more effective in disseminating information on Irish potato farming. We are able to put into practice what we are taught by extension officers during practical demonstration."* A Kimbo farmer said, *"Demonstrations, seminars, chief's brazas and field days lead to high adoption of Irish potato farming innovations. However, posters, letters and leaflets have low effects on adoption of Irish potato farming innovations because extension officers use them to create awareness about upcoming meetings or new Irish potato varieties."*

All the extension officers in Kibirichia Ward reported that all channels of communication lead to high adoption of Irish potato farming innovations. One of the extension officers said, *"Both mass media and face-to-face communication channels lead to high adoption of Irish potatoes farming innovations. Whenever we disseminate information on Irish potatoes, farmers are very keen to get the information and practice it because Irish potato is a cash crop in Kibirichia."* Another officer reported that

farmers who had access to communication channels were quick in adopting agricultural innovations on Irish potato farming innovations.

Findings revealed that majority of the farmers reported that all interpersonal channels led to high adoption as compared to mass media. However, extension officers reported that both interpersonal channels and mass media lead to high adoption. These findings agree with those of Cheboi and Mberia (2014) and Nwankwo and Orji (2013) who found that use of mass media and interpersonal channels to communicate extension information lead to the adoption of agricultural innovations. The discrepancy between farmers and extension officers' responses on the effect of mass media of adoption could be attributed to farmers inaccessibility to some channels such as television and newspapers (Adejoh et al., 2016). Moreover, a number of scholars (Oakley & Garforh, 1985; Rogers & Nichof, 2002; Rogers, 2003) argued that the roles of channels vary according to the stages of the adoption process. Mass media channels are important in transmitting information, creating awareness or changing cognition and giving timely advice. Interpersonal channels on the other hand, bring about attitude change. Therefore, for effective diffusion and adoption of innovations to take place, it is important that agricultural extension officers use a variety of communication channels when conveying agricultural messages.

In conclusion, findings of this study reveal that the channels of communication used for information exchange between farmers and extension officers resulted in shared meaning and adoption of Irish potato farming innovations. Farmers reported that they understood extension information disseminated through the mass media and interpersonal communication channels which created an enabling environment for information exchange and feedback. The ability of these channels to relay feedback enhanced farmers understanding and high adoption of agricultural innovations in Irish potato farming.

4.5 Nature of Messages

The second objective was to describe the effect of the nature of messages conveyed between the extension officers and farmers on the adoption of Irish potato farming innovations. The sub-sections below present detailed findings.

4.5.1 Language used in communication information on Irish potato farming innovations

Under the second objective, farmers were first asked to state the languages used to communicate information on adoption of innovations in Irish potato farming. Farmers' responses indicated that Kimeru, Kikuyu, Kiembu, Kiswahili and English were the languages used to communicate information on Irish potato farming. Further, according to all the farmers, Kimeru was predominantly reported as the primary language used, followed by Kiswahili, English, Kiembu and Kikuyu, in that order. Kimeru was most used because majority of the farmers in Kibirichia Ward were Ameru. Kiswahili language was usually used when extension officers communicated with farmers whom they considered to be youths, while English was spoken when stating names of pesticides, fertilizers and crop diseases that had no Kimeru names. Extension officers who did not belong to the Meru ethnic community were said to occasionally use a combination of their mother tongue (Kiembu or Kikuyu) and the little Kimeru they had learnt. This occurred when officers were not conversant with Kimeru names for certain terms.

Asked the same question, the three extension officers were of the same opinion as those of the farmers. Kimeru was predominantly used to disseminate extension information because majority of the farmers were Ameru. Other languages used included Kiswahili, English, Kiembu or Kikuyu respectively. The age and education of the farmers and ethnicity of agricultural extension officers could also determine the type of language to relay messages. For instance, Kiswahili was predominantly used when transmitting

information to more youthful farmers. The two extension officers who were not of Meru ethnicity, said that they delivered messages through a mixture of their mother tongue and Kimeru, particularly when addressing elderly or semi-literate farmers. *"I speak a crafted language between Kiembu and Kimeru. I try to speak more of Kimeru though I am not fluent in it."* said one extension officer. Another extension officer said, *"I mostly use Kikuyu language while speaking to the farmers. Whenever I speak in Kiswahili, the farmers tell me to switch to speaking in Kikuyu."* For lack of alternative, extension officers engaged the English and scientific language when transmitting technical terminologies that had no Kimeru or Kiswahili equivalence.

Findings revealed that Mount Kenya region vernacular languages, that is, Kimeru, Kiembu and Kikuyu, together with the two Kenyan official languages, Kiswahili and English, were used to communicate information on Irish potato farming. These findings resonate with Kipkurui (2015) who while assessing the effects of information and communication on the use of organic resource inputs to build soil fertility in the central highlands of Kenya, found that Kimeru and Kikuyu languages were used by government extension officers to disseminate information to farmers. Rogers (2003) attests to the fact that homophily communication is more effective and rewarding to the communicating parties because they share common meaning, have a mutual sub-cultural language and similar personal and social characteristics. The tendency of people with similar characteristics to interact, enables the two parties to gain more knowledge, have a common attitude formation and overt behavior change (adoption). Ogueri (2013) argued that to be able to market agricultural technologies, creative extension messages should be developed in the farmers' dialects.

4.5.2 Comprehension of the language(s) used in communication information on Irish potato farming innovations

The second question was whether the languages used to communicate information on adoption of Irish potato farming innovations were understood or not. All the farmers

asserted that there was shared meaning. Farmers gave various responses in trying to explain that they understood the languages used in disseminating information. *"We understand because the extension officers take time to explain information,"* said a farmer from Mburugiti. Another farmer from Kiamiogo said, *"Sometimes, the extension officers use a word or two in Kiembu or Kikuyu language and we understand,"* A similar view was expressed by a Kimbo farmer who asserted that farmers were conversant with the extension officers' mother tongue because they were close Bantus from neighboring counties. *"We understand because the extension officers are conversant with Kimeru, English and Kiswahili. The officers communicate in languages that the farmers are conversant with,"* said a farmer from Gathuine.

Similar to the farmers' responses, all the extension officers pointed out that farmers were conversant with the languages used to disseminate extension information. One extension officer said, *"Before I start teaching, I usually ask them (farmers) the language they prefer; that is the first step I take. If they tell me Kimeru, Kiswahili or English, I just use that particular language." "Most of the farmers understand Kiswahili. However, the few who are not conversant with Kiswahili ask farmers who are familiar with the language, to interpret the information conveyed into Kimeru. When we have visitors who are not from Meru, Kiswahili is used,"* said the second extension officer. On the same note, the third extension officer asserted that if majority of farmers understood the language spoken, it was assumed that all comprehended the language. The officer said:

> *To me they understand. Let me explain. If you can speak in a language which 90% or 95% understand, then I think we are home and dry. You can speak in Kiembu but end up with one or two persons who don't understand a thing; not because of the language but may be the person was not keenly listening.*

This study revealed that farmers understood the language(s) used to disseminate information on adoption of innovations in Irish potato farming thus resulting to shared meaning. This supports previous studies that shared meaning is attained if the language

used by the two communicating parties is understood by both of them (Age et al., 2012; Blumer, 1969; Tabatabai, 2009). Further Beebe et al. (2015) notes that in order to understand the behavioral patterns of a particular society, people need to understand the existing language symbols. Rogers (2003) also pointed out that people who share similar characteristics including speaking a common language, share meaning. FAO (2003) argued that extension agents should communicate extension information in a language that the farmer is accustomed to. Further, Lawal (2015) asserted that in order to promote better understanding and adoption of agricultural innovations, indigenous language(s) which farmers in a particular locality are conversant with should be used.

4.5.3 Information on Irish potato farming innovations disseminated to farmers

Farmers reported that a wide range of information was disseminated by extension officers on adoption of Irish potato farming innovations. It included information on soil testing, seed varieties, spacing, weeding, earthing-up, pesticides, fertilizer and manure application, crop rotations, diseases and harvesting. Farmers further explained that they were often advised to do soil testing to determine the amount of various nutrients, alkalinity or acidity of their farm soil. This in turn helped in determining the kind and amount of fertilizers farmers would apply in their farms. *"Extension officers inform us that we should not farm one variety of Irish potato seed more than three consecutive times, since the yields will decrease,"* said one farmer. One of the FGD participants also pointed out that they did not receive information on marketing from extension officers. The farmer said, *"Extension officers don't give us information on marketing. We face problems in getting reliable markets for Irish potatoes."*

Extension officers said that they primarily disseminate information on soil analysis, fertilizer application, crop rotation, seed acquisition and selection, pests and disease control to farmers. Information on farm records, harvesting, storage and marketing was also communicated. For instance, one of the extension officers said:

First, we teach them about seed selection. If they don't have good seeds, we inform them where they will source for seeds; mostly from Kisima Farm or groups of farmers that do seed multiplication. Once they get clean seeds, we make sure they have used the right fertilizers. These days, we emphasize on soil tests so that farmers can know the appropriate fertilizers to apply to specific types of soil. We also recommend the right pesticides because there are those who lose crops to early blight and late blight. Harvesting is also important; farmers must harvest Irish potatoes at the right time and keep them in good stores.

Further, it was revealed that clean seed acquisition was highlighted as a major issue which was discussed because certified seeds are expensive.

This study found out that a wide range of information on adoption of Irish potato farming innovations, from soil testing to marketing, were communicated to farmers. These findings partially support previous research that agricultural extension messages, covers a wide range of information including improved varieties of crops, livestock control, water management and control of pests, weeds or plant diseases (Nisha, 2006; Lawal, 2015). However, it was interesting to note that, whereas extension officers claimed to disseminate information on marketing, farmers confirmed that they were not given such information. This discrepancy could be attributed to the top-down approach used by agricultural extension officers to pass information from research organizations and institutions to the farmers. In this approach, farmers received free extension messages but their information needs were not taken into consideration (Ponniah et al., 2008; WBOED, 1999).

4.5.4 Information on Irish potato farming innovations often sought by farmers from extension officers

Farmers often sought for information on spacing, sowing of seeds, types of pesticides and fertilizers together with their use, crop rotation, use of organic manure and disease identification from extension officers. In addition, majority of the farmers said they requested for information on how to acquire high yielding Irish potato seeds. *"We would like to know if there are good Irish potato seeds that require little rainfall to produce high yields,"* said one of the farmers from Kiamiogo. A farmer from Kimbo said:

> *Some potato varieties take 120 days to mature while others take 90 days. Majority of us prefer to cultivate the quick maturing varieties that can be harvested within 90 days so that we can be able to plant other crops once we have harvested the potatoes; we would like to be given such information.*

Another farmer from Gathuine said:

> *We seek for information on the correct quantity and methods to apply various fertilizers. Sometimes we are advised to measure certain fertilizers at the tip of a spoon and apply them into the soil close to the crop, while others times we are told to broadcast. We get confused in knowing the correct amount and method of fertilizer application.*

When asked the same question as the farmers, one extension officer asserted that the most sought information was on seed varieties to be sown, crop diseases and market for the produce. Another extension officer stated that farmers often sought information on all aspects of crop diseases and market for their produce. *"Farmers seek to know where they can sell their Irish potatoes at a good price when there is a lot of supply in the market,"* said the extension officer. Mix up of fertilizer use by farmers was another issue that was pointed out by the third extension officers who said:

Sometimes the farmers get mixed up with fertilizer application. This is because there are those who use fertilizers meant for other crops other than Irish potatoes. Some of them purchase any fertilizer that is cheap even if it is not meant for Irish potato farming. Some even buy different types of fertilizers which they mix and apply. Others, instead of using planting fertilizers, they apply top dressing fertilizers for planting. You know when they do that, they won't get good yields. So, there they get mixed up and ask us, 'I used this fertilizer. Why did I harvest low yields?' We point out the mistakes and remind them what they are supposed to do.

This study revealed that farmers sought for a wide range of information on innovations in Irish potato farming from extension officers. This includes information on seeds, spacing, sowing, pesticides, fertilizers, crop rotation, organic manure and disease. These findings are in agreement with Bachhav (2012) who conducted a survey on information needs of the rural farmers in Maharashtra, India. Bachhav's study revealed that majority of the farmers needed information on availability of seeds, crop production, water management, weather, agricultural equipment, insecticides and fertilizers availability. On the same note, Mittal and Tripathi (2009) in their study on the role of mobile phone technology in improving small farm productivity found that farmers required information on what to plant, seed varieties, weather, best practices for cultivation, prices, demand indicators and logistical details. Contrary to the farmers' responses, extension officers stated that farmers frequently sought for information on seeds, diseases and market. This observation indicates that perhaps farmers perceived a wider range of information as key to getting high yields (Aker, 2011; Otter & Theuvsen, 2013) as compared to that of the extension officers who considered the three mentioned aspects to be special, inclusive of those factors mentioned by the farmers.

4.5.5 Ability of extension officers to provide information sought from them by farmers on Irish potato farming innovations

All participants from the four focus groups were positive about the ability of the extension officers to provide information sought from them. One farmer from Mburugiti said, *"When a new Irish potato variety has been produced in a farm, the officers rush there to get information which they later pass on to us."* Farmers also pointed out that the extension officers were knowledgeable about Irish potato farming and when they followed the officers' advice, they ended up getting high yields, *"They give us the required information and we are satisfied. We also believe that they are knowledgeable since they are the experts."* A farmer from Kiamiogo however said:

> *The extension officers are knowledgeable but we are unable to follow their advice due to lack of adequate finances. Those who have money are able to adhere to the officers' advice…. Like now, there are farmers who will harvest Irish potatoes while others will not. If you look at this farm where we are seated, which is about 30 acres, no potatoes will be harvested because of low rainfall. The farmer had put into practice what he had been taught by the extension officer. However, the farmer lacked money to purchase and install an irrigation system. There are also those farmers who have money to install water for irrigation but there is no constant water supply. Here in Kibirichia market, which is in Kiamiogo sub-location, water is very scarce.*

All the extension officers reported that they were able to give farmers information on Irish potato farming. One of the extension officers said, *"I know a lot about Irish potatoes because I have cultivated them for many years. There is also a time I grew Irish potatoes in Timau for more than 12 years in partnership with various researchers on Irish potatoes."* However, concerning information that farmers sought on marketing, where and how they could get better prices for their produce, one of the extension officers said, *"I do usually advise them to form groups, marketing groups, so that buyers can come and buy in bulk from the groups. This will also give them bargaining power."*

Findings in this study revealed that the extension officers were able to give farmers the required information because they were knowledgeable and experienced in Irish potato farming processes. These findings are in agreement with Aker (2011) and Ng'ang'a et al. (2013) who argued that the general extension approach uses trained extension specialists to provide a range of services to farmers that include technology transfers, advisory services and human resource development. Ofuoku (2012) in a study to determine the influence of extension agents' and farmers' communication factors on effectiveness of production technology messages, found that extension officers were rated very good in terms of knowledge on innovations. For farmers to develop interest in extension information, Ofuoku further argued that extension officers should disseminate messages with truthfulness and sincerity. Extension officers are change agents who help farmers identify their farming problems and solutions (Anaeto et al., 2012).

4.5.6 Farmers ability to understand extension messages on adoption of Irish potato farming innovations

On the question of whether messages on adoption of Irish potato farming innovations were understood or not, majority farmers indicated that they understood while a minority said they did not. For example, a farmer from Gathuine said, *"We understand what they teach us, therefore shared meaning takes place." "Shared meaning is there but sometimes we lack capital to practice what they teach us,"* said another farmer from Kiamiogo. The main indicator that farmers understood most information communicated to them was the high Irish potato yields obtained at the end of each cropping season. However, for lack of shared meaning which sometimes took place, this one farmer said, *"It is difficult to understand some English words referring to chemicals and diseases and this interferes with shared meaning. Information on soil acidity and fertilizers to improve acidic soil leaves some of us confused."*

Asked the same question, two of the three extension officers said that the farmers understood information disseminated to them thus shared meaning was achieved. For instance, one of the extension officers said:

> *After conducting a demonstration session, we normally ask farmers questions on what we have taught and they are able to answer correctly. In addition, we also visit farmers' farms and we normally observe that they practice that which we have taught.*

However, another extension officer pointed out that some farmers were unable to comprehend information disseminated to them because they were passive participants who did not practice what they were taught.

Findings of this study revealed that majority of the farmers understood information disseminated to them by extension officers on adoption of innovations in Irish potato farming, thus creating shared meaning. This agrees with Birr (2012) who asserted that in order to have effective communication with anyone, both the sender and the receiver of the message must be on the "same page," that is, they should understand or share the meaning of what has been communicated. Farmers ability to understand could be attributed to use of language(s) that the farmer is accustomed to (FAO, 2003), and dissemination of technically feasible, economically affordable and socially acceptable extension messages (Age et al., 2012). Further, Bagi and Bagi (1989) asserted that it is the work of agricultural extension officers to collect, organize, interpret and clarify technical information related to farmers' different agricultural activities. However, this study revealed that a few farmers sometimes didn't understand extension messages. This could be attributed to farmers inability to understand complex and technical new ideas which in turn leads to low adoption of innovations (Anaeto et al., 2012; Ogueri, 2013).

4.5.7 Information on Irish potato farming innovations that farmers had difficulties in understanding

This study revealed that majority of the farmers had difficulties in understanding information on soil analysis, fertilizers, pesticides and diseases. *"Most of the farmers are unable to comprehend when told that their farm soil is acidic. There is also no name for acidity in Kimeru,"* said one farmer from Kiamiogo. In addition, farmers had difficulty in understanding information on the amount and type of fertilizers to use at different stages of crop growth. Different companies also used different labeling names for the same brand of pesticides thus confusing farmers. A farmer from Kimbo said, *"Through spoken messages, extension officers tell us that Ridomile should be applied in a certain way but pesticide instructions on the packaging instruct differently." "We also have difficulty in understanding information of Irish potato crop diseases. Sometimes different diseases have similar symptoms and we are unable to distinguish some crop diseases,"* said another farmer from Gathuine.

The extension officers reported that farmers had difficulty in understanding information on soil analysis, storage and marketing of produce. Two of the extension officers asserted that marketing was an area which farmers had difficulty in understanding. One of them said:

> *For the last 20 years I have worked with Irish potato farmers, they do not comprehend the marketing aspect. They don't understand when I tell them that they are the major decision makers in setting the prices for Irish potatoes in the market.*

On the same note, another extension officer explained, *"The other challenge with marketing is that brokers or middle men get involved making farmers lose heavily to them. The market has also become a challenge because farmers sometimes sell their produce at a lower price than anticipated."* Further, the officer went on to say, *"Storage*

is normally a problem because many farmers cannot afford to build a good store. Some farmers put their yields outside, cover them with dry leaves but later on they end up getting scorched by the sun."

This study revealed that farmers faced difficulties in understanding some technical information on Irish potato farming innovations. Anaeto et al. (2012) corroborated this finding by asserting that farmers are usually not able to adopt new ideas because they are usually complex, technical and hardly understood. Farmers' difficulty in understanding some of the messages on Irish potato farming could be as a result of misinterpretation of extension messages as argued by (Oakley & Garforth, 1985). Farmers in this study expressed having difficulties in understanding information on soils analysis, fertilizers, pesticides and diseases. Extension officers on the other hand reported that farmers had problems with marketing and storage of Irish potatoes, apart from understanding information on soil analysis. The discrepancy between the farmers' and officers' responses could be as a result of farmers having viewed crop cultivation process information as technical as compared to that of post-harvest information. Oakley and Garforth (1985) noted that agricultural extension officers may send messages that they view as clear and concise but in the long run, the receivers of the messages (farmers) end up interpreting them wrongly. For farmers to understand agricultural messages, FAO (2003) argued that extension agents should communicate extension information in a language that the farmer is accustomed to. According to Chauhan (2007), a good message has the following characteristics: aligned to the objectives to be achieved, clear, appropriate, correct, current and transmitted through the right channel, and it is the work of the agricultural extension officers to collect, organize, interpret and clarify technical information related to farmers' different agricultural activities (Bagi & Bagi, 1989). The extension officer should view what he is doing or saying from the world view of his audience (Agbamu, 2006). Oakley and Garforth (1985) and Onasanya et al. (2006) noted that adoption and transfer of agricultural technology will not take place unless farmers share meaning with extension officers on messages transmitted through an appropriate feedback.

4.5.8 Effect of extension messages on adoption of Irish potato farming innovations

Regarding the effect of extension messages on adoption of Irish potato farming innovations, majority of the farmers from the four sub-locations reported that there was increased adoption. For example, a farmer from Kiamiogo said, *"We adopt because we understand extension messages."* A Mburugiti farmer reported, *"Extension officers encourage us to ask questions in areas that we have not understood and it encourages us to adopt Irish potato innovations."*

All the extension officers noted that there was increased adoption of innovations in Irish potato farming. One extension officer, for example, said, *"It has increased because we teach farmers new ideas which they pay attention to and adopt."* In addition, another extension officer said, *"Adoption has increased because we are usually keen to ensure that all farmers understand the information, we give them."*

According to this study, the nature of extension messages led to an increase in the adoption of Irish potato farming innovations in Kibirichia Ward. These findings concur with Oakley and Garforth (1985), Ogueri (2003) and Onasanya et al. (2006) who argued that there is a direct relationship between understanding of extension messages and adoption of agricultural technology by farmers. Farmers are usually not able to adopt new ideas because they are usually complex, technical and hardly understood (Anaeto et al., 2012). It is the work of agricultural extension officers to collect, organize, interpret and clarify technical information related to farmers' different agricultural activities (Bagi & Bagi, 1989).

In conclusion, findings of this study revealed that messages on Irish potato farming innovations were conveyed majorly in Kimeru and in other languages such as Kiswahili, English, Kiembu and Kikuyu depending on the circumstances. The extension messages contained information, ideas and technologies on soil testing, seed varieties, spacing, weeding, earthing-up, pesticides, fertilizer and manure application, crop rotations,

diseases and harvesting. Farmers' comprehension of most extension messages led to the high adoption of innovations in Irish potato farming in Kibirichia Ward. This agrees with Ergen's (2010) assertion that when the sender's message is appropriately interpreted, communication is said to be effective.

4.6 Communication context

The third objective of this study was to examine the effect of the context of communication between extension officers and farmers on the adoption of Irish potato farming innovations in Meru County. The sub-sections below present detailed findings.

4.6.1 The physical context of information exchange on Irish potato farming innovations

When asked which places information on adoption of Irish potato farming innovations was exchanged, farmers pointed out that extension information was disseminated in farms, extension offices, homesteads, chiefs' camps, shopping centers and in cattle dip grounds. However, farmers from Kiamiogo and Kimbo maintained that agricultural extension meetings were not held in churches or schools. For example, one farmer said, *"The Ministry of Education gave a directive that only school meetings should be held in schools." "There are designated places in the shopping centers where farmers hold their meetings with extension officers,"* said another farmer. Some farmers pointed out that when extension officers called for meetings in the chief's camp and the number of farmers in attendance was so high that they did not to fit in the chief camp's hall, the meetings were then held in the chief camp's open grounds.

More or less similar to the farmers' responses, extension officers pointed that information on innovations in Irish potato farming was disseminated in farms, extension offices, homesteads, school grounds, cattle dip grounds, chiefs' camps and in church halls. Farmers who had formed groups were said to often hold their meetings at the chairperson's homestead or in one of the member's farms. Farmers also found it

convenient to visit extension offices for consultations since the officers were few in number. In this regard, one extension officer said, *"Farmers who visit our offices is between 20 and 30 in number. Most of them come when we are about to distribute subsidized fertilizers from the government so that we can register them."*

Results indicate that information on adoption of Irish potato farming innovations was disseminated in farms, extension offices, homesteads, school grounds, cattle dip grounds, chiefs' camps and in church halls. These finding are in agreement with Kamal, et al. (2014) and Oakley and Garforth (1985) who asserted that places where farmers usually meet with agricultural extension officers to exchange information are farmers' homes, farms and extension offices. However, DAE (1999) argued that it is more meaningful that extension officers meet male farmers in the farm to discuss a crop related issue and easier to meet female farmers in the homestead. In addition, DAE suggested that extension officers should find out venues where women in non-governmental organization (NGO) meet regularly and whether they can use the venues for extension events. Farmers in this study also reported that information was not disseminated in church and school grounds and halls, while extension officers said that these places were used. Extension officers also did not mention shopping centers as places where information was disseminated. The discrepancy between extension officers' and farmers responses regarding meeting venues probably was as a result of extension officers' reference to the past years, when agricultural extension was under the central government and farmers referring to present time, when many countries have taken the trend of decentralizing agricultural extension to the local governments (Agricultural Knowledge and Information Systems (AKIS), 2000).

4.6.2 Frequency of meeting at the physical context(s) of information exchange on Irish potato farming innovations

With regard to frequency of meeting at the above stated places, majority of the farmers indicated that meetings were demand driven and according to the activities in the farms

at the time. *"I am unable to state the frequency because it depends on whether there is need for a meeting to be called for,"* said one Mburugiti farmer. Another farmer from Kiamiogo who was of a similar opinion said, *"Meetings are held when there is information to be passed."* One of the farmers from Kiamiogo was of the view that the frequency of meeting in the earlier on mentioned physical contexts was dictated by activities in the farms. He said, *"We meet during planting, weeding, spraying of pesticides…."* Similarly, one farmer from Kimbo explained, *"We meet in demonstration farms during sowing, germination, top dressing, weeding and harvesting of Irish potatoes. Throughout the Irish potato growing season the officers have a timetable."* Findings of this study however, revealed that some farmers gave varying frequencies on the number of times extension officers met them in the physical contexts of communication. Some farmers gave a frequency of once to four times a year while others stated a frequency of three to four times during the Irish potato growing season.

Similar to the responses of majority of farmers, all the extension officers generally agreed that the frequency of meeting at the stated places of Irish potato information dissemination was demand driven. One of the extension officers said, *"Our meetings are usually demand driven."* Similarly, another extension officer said, *"It depends on when we have particular activities."*

Findings revealed that the frequency of meetings in the various venues, for information exchange between extension officers and farmers was demand driven. The frequency of meetings in the various venues was demand driven probably because of the poor extension officers to farmers' ratio that is prevalent in developing countries (Agbamu, 2005; Rivera et al., 2001). These findings contradict Kamal, et al. (2014) who found that most respondents (farmers) were visited once a month in their farms, while minority were visited thrice a month. Kamal et al. also reported that majority of the farmers paid one visit per month to the extension offices while a minority paid weekly visits. Ofuoku (2012) asserted that the frequency of extension contact with farmers and availability to

farmers are very important as they enhance better understanding and adoption of agricultural technology messages.

4.6.3 Comprehension of extension messages on adoption of Irish potato farming innovations in the physical contexts of communication

Asked if they understood messages in the venues of information exchange, farmers reported that they were able to understand. One farmer from Gathuine said, *"We understand extension information because the officers encourage us to seek for clarification."* Similarly, a Mburugiti farmer said, *"We understand because the extension officers take time to explain and clarify information."* Farmers from the four sub-locations also asserted that shared meaning took place because they were practically taught good farming practices through demonstrations.

All the extension officers concurred that farmers understood extension information disseminated to them in the physical environment where communication took place. The farmers' ability to follow the officers' advice was evident from high potato yields farmers harvested. For example, one extension officer said, *"Yes, farmers understand. Like I told you earlier on, those farmers who follow our teaching get high yields."* Similarly, another officer said, *"They understand. Actually, we get to know that they understand through follow ups. We carry out follow-up visits after holding a seminar or a baraza to see whether they have been implementing what we teach them."*

Results of the study revealed that farmers understood information disseminated to them in the physical context of communication. These findings are in tandem with Ali et al. (2016) who found that extension office visits paid to farmers were informative, beneficial and interesting. Probably farmers understood information disseminated to them because in agricultural extension as asserted by Age et al. (2012), it is important extension officers make sure that the setting in which they choose to educate the farmers is one that promotes understanding of the information conveyed.

4.6.4 The cultural context of information exchange on adoption of Irish potato farming innovations

On the question as to whether the farmers were from the same cultural background as the extension officers or not, farmers revealed that they were all from the same culture, Meru, while the extension officers were from three different cultural backgrounds; Embu, Meru and Kikuyu. A farmer from Gathuine gave the main reason as to why most of the extension officers were from different cultures from those of the farmers, *"It depends on where the government posts them."*

When the officers were asked if they were from the same cultural background as the farmers, one of the extension officers said, *"Not really, because I am from Embu although Embu culture is not very much different from that of the Meru community."* Another officer said, *"No, because I come from Nyeri and was deployed in Meru County. I believe there are some cultural differences between the two communities."* The third extension officer gave a different response by saying, *"I was born and brought up in Meru County and therefore share cultural values with the farmers."*

Results of the present study revealed that farmers and extension officers were from close cultural backgrounds, Bantus who originate from the Mt. Kenya region, which made them homophilous. These findings are in tandem with Rogers (2003) argument that people with similar characteristics such as age, education, beliefs and social status are homophilous. Further, Oakley and Garforh (1985) asserted that farmers are members of the society they live in and every society has acceptable ways of doing things including farming methods. For example, if it is customary for a farmer to scatter seeds and plough them in the soil, then the farmer will grow up believing that is the best way of planting seeds. Oakley and Garforh argued that extension officers will be more effective if they understand the farming cultural practices of the farmers with whom they work with in order to offer agricultural advice based on the farmers culture.

4.6.5 The socio-psychological context of information exchange on adoption of Irish potato farming innovations

Farmers stated that their relationship with extension officers was good. The relationship was good because information was appropriately relayed and farmers understood and practiced what they were taught. Further, farmers enjoyed being taught by the officers and the officers enjoyed working with farmers. For instance, one farmer from Gathuine said, *"The relationship between extension officers and farmers is good because the officers always strive to make sure that farmers understand the information they are disseminating." "Our relationship with the extension officers is good but our major problem is lack of money,"* said a farmer from Kiamiogo. A farmer from Mburugiti said, *"The relationship is not bad because when we invite them to visit our farms, they honor our invitations. However, whenever they are unable to honor our invitations, they inform us early enough."* Contrary to what other farmers said, a Kimbo farmer said:

> *We have taken note that each extension officer has weaknesses. For example, we have observed that there are good officers whom when called upon by farmers take a short duration before meeting them. However, there are those officers whom we call and they take a long time to meet us. They are all different and no extension officer is similar to the other. Generally, we can say they are all good.*

Asked how their relationship was with farmers, two of the extension officers reported that their relationship with farmers was good. One of the officers who asserted that the relationship was good said, *"Well, the reason for saying that the relationship is good is because after training them, I conduct follow up and find that most of them have practiced what I taught them."* Another officer said:

> *You know, a very good relationship means that we are, for example, able to meet all those farmers who demand for our services. However, this is not possible*

because the government doesn't facilitate us with transport. This therefore, is a barrier that prevents us from reaching all of them.

In contradiction with the views of the other two extension officers, the third officer asserted that his relationship with farmers who sought for extension services was very good as compared to those who did not seek for the services. The officer said:

Nowadays, agricultural extension is demand driven and more than half of the farmers are interested in learning, especially the ones in groups have no problem. The relationship with farmers who are interested in learning is very good. However, for farmers who don't seek for extension information but only wait for us to go to their farms, the relationship is very bad. Also, the relationship with farmers in groups is very good. There are serious farmers who come to the office to take fertilizers from the government; the relationship also is very good.

This study revealed a good working relationship between the farmers and the extension officers. Farmers put into practice the officers' advice because they trusted them. This finding is in tandem with that of Ofuoku (2012) who found that farmers had very good relationship with extension officers which made them have a feeling of togetherness. The feeling of togetherness creates the feeling of oneness in the farmers and extension officers. This in turn creates openness and confidence in the farmer so that they do not hide their problems and aspirations from the extension agents (Eltham Training Centre, 2001; Ofuoku, 2012). The good relationship could initially be attributed to the officers use of individual and group methods of extension which create face-to-face relationships that are sensitively developed, out of mutual confidence and respect (Oakley & Garforh, 1985).

4.6.6 Influence of the socio-psychological context on shared meaning

Farmers in this study were in consensus that there was shared meaning as a result of the good relationship they had with the officers. A farmer from Kimbo said, *"If the extension officers have a good relationship with the farmers, they will listen, understand and practice what they learn from them." "Farmers have the confidence to seek for clarification from the officers because their relationship is good,"* said one Gathuine farmer.

Similarly, all the extension officers reported that the good relationship they had with farmers brought about shared meaning. One of the extension officers said, *"Farmers who seek for information from us, are the farmers whom we have a good relationship with. They understand the information that we give them because they always attend meetings." "They understand when I teach them; they accurately grasp most of what l teach,"* said another officer. Further, the third extension officer said, *"Of course, if we are not in good terms with the farmers, they will not understand and practice what we teach them. When we teach and observe that they have adopted what we teach them, we get to know that we are together."*

Findings of this study reveal that the good relationship that existed between the extension officers and farmers had contributed to shared meaning. These findings are in tandem with Oakley and Garforth (1985) who argued that since extension officers have to work with farmers in various ways, they form close relationships which enable farmers to understand. Similarly, Ali et al. (2016) found that extension office visits paid by farmers resulted to shared meaning because the visits were informative, beneficial and interesting. Probably, the existing cordial working relationship between farmers and extension officers is a long-term effect of truthfulness and sincerity among themselves (Ofuoku, 2012).

4.6.7 The temporal context of information exchange on adoption of Irish potato farming innovations

Asked which situations agricultural extension messages on adoption of Irish potato farming innovations were exchanged, farmers in this study were in consensus that information was mostly disseminated before farmers sow seeds, during planting, weeding, applications of fertilizers and pesticides and harvesting of Irish potatoes. Further, study results revealed that the transmission of information between extension officers and farmers took place between 9.00 am to 1.00 pm. or from 2.00 pm to 4.00 pm. Sharing of information between the officers and farmers did not begin at 8.00 am because farmers were engaged in household chores such as feeding livestock, cooking lunch and milking cows. It was noted that extension trainings often lasted for two to three hours to enable farmers to have enough time to attend to other duties. One farmer however pointed out that some meetings, though rarely held, began at 9.00 am and adjourned at 4.00 pm or 5.00 pm. Farmers from the four sub-locations also asserted that apart from chief's *barazas,* information on innovations in Irish potato farming was not disseminated during other formal village meetings such as weddings, naming and funeral ceremonies.

Extension officers asserted that information on adoption of Irish potato farming innovations were disseminated in various situations. These included: During land preparation, when there was a crop disease or pest outbreak, after incorrect information on Irish potato farming had been disseminated to farmers and when a field day was about to be held. For instance, one extension officer said:

> *When wrong information about Irish potato farming is given to the farmers through the mass media, I contact group leaders of Irish potato farmers and give them the right information to disseminate to their members. For example, there was a time when it had been reported through Muuga FM that Trianam is used to cure bacterial wilt, which is not true.*

Similar to the farmers' responses, extension officers reported that information on Irish potato farming was not communicated during weddings, naming, political rallies and funeral ceremonies.

A number of findings were revealed when both farmers and extension officers were asked to name the situations in which agricultural extension messages on adoption of innovations in Irish potato farming were exchanged. While farmers reported that extension information was mostly disseminated during land preparation, planting, weeding, applications of fertilizers and pesticides and harvesting of Irish potatoes; extension officers on the other hand reported that information was communicated during land preparation, when there was a crop disease or pest outbreak, incorrect information on Irish potato farming had been disseminated to farmers and when a field day was about to be held. These findings corroborate with Aker (2011) and Otter and Theuvsen (2013) who asserted that agricultural information is disseminated in the stages of planting, growing and harvesting. The discrepancy between farmers and extension officers' responses on situations messages are exchanged could be as a result of the multitude of different extension information exchanged (Otter & Theuvsen, 2013).

It was further revealed that agricultural extension meetings did not begin at 8.00 am but took place from 9.00 am to 1.00 pm or from 2.00 pm to 4.00 pm. From 6.00 am to 8.00 am, most farmers were engaged in carrying out household chores such as feeding livestock, cooking lunch and milking cows. This indicates that farmers have other responsibilities besides attending extension meetings. It is important for extension officers to make sure they communicate timely information as Anaeto et al. (2012) argued. This should be at a time convenient for the officers and for the farmers that does not clash with other activities and events (Oakley & Garforh, 1985).

In addition, findings revealed that communication between extension officers and farmers often lasted two to three hours to enable farmers to have enough time to attend to other duties. This could be as a result of the farmers having tight schedules. These

findings are in agreement with Kiptot and Franzel (2015) who conducted a study on, Farmer-to-farmer extension: Opportunities for enhancing performance of volunteer farmer training in Kenya. Kiptot and Franzel found out that volunteer farmer trainers trained farmers on an average of two hours per day.

Lastly, results showed that apart from the chief's *barazas,* information on Irish potato farming innovations was not disseminated during other formal village meetings such as weddings, naming and funeral ceremonies. This finding is contrary to Lukuyu, Place, Franzel and Kiptot (2012) findings that revealed farmer trainers used funerals among other channels to disseminate information. It is cautioned that ceremonies and festivals are a central feature of culture, therefore, extension officers should disseminate information in appropriate contexts. Oakley and Garforh (1985) equally argued that extension officers need to know when ceremonies and festivals take place so that they can plan their activities with the occasions in mind.

4.6.8 Extension messages on adoption of Irish potato farming innovations communicated in the temporal context of communication

Regarding the question on which agricultural messages on adoption of Irish potato farming innovations were communicated in various situations, farmers generally said that they received information on new seeds, planting, spacing, weeding, diseases, pests, fertilizers and pesticides. In addition, farmers also pointed out that the different stages of Irish potato cultivation dictated the kind of information they received from extension officers. In this regard, a farmer from Gathuine said, *"Before we plant seeds in our farms, the officers inform us on new Irish potato seeds and fertilizers that we should adopt."* A farmer from Kimbo had similar views:

> *If extension officers call for meetings at a time when farmers are planting, we receive information on spacing. When the potato crop has sprouted, the officers inform us which fertilizers to apply. When it is time for spraying pesticides, they*

inform us which pesticides to use. They come when the necessary information is needed. (Sic)

Similar to the farmers' responses, the extension officers asserted that messages on crop diseases, pests and disease control were mainly communicated. In addition, the officers also pointed out that the content of messages was determined by the stage of growth the crops were in. For instance, one extension officer said, *"We advise farmers on the pesticides to use once they spot and report an Irish potato disease."* Likewise, another extension officer said:

Actually, that will depend on the stage the crop is in. If the crop requires fertilizer application, we just teach them on fertilizer application. If it is, may be, pest control and application of pesticides, we teach them on that. If it is earthing-up, the same. That is what we do. (Sic)

Results revealed that appropriate information on Irish potato farming innovations was communicated between farmers and extension officers. The different stages of Irish potato cultivation that is, land preparation, planting, weeding, fertilizer and pesticide application, harvesting and marketing dictated the kind of information farmers received from the officers. These study findings were corroborated by Aker (2011) and Otter and Theuvsen (2013) who argued that in the stages of planting and growing, information on high yield varieties, timing to plant, fertilizer, pesticides and innovations is important. Ndwiga (2014) also found that 53.4% of the respondents felt that Agricultural Extension Services (AES) were more necessary during harvesting, marketing, selling and dry season, while 46.6% felt that AES were needed more during the weeding, planting and wet seasons. However, in order to make extension communication and adoption effective, Oakley and Garforth (1985) affirmed that extension officers first need to know local farming systems before they can gradually introduce farmers to new farming systems.

4.6.9 Ability of farmers to understand extension messages on adoption of Irish potato farming innovations in the temporal context of communication

Asked if they understood messages on adoption of Irish potato farming innovations in situations of information exchange, farmers' responses were varied. Majority of the farmers stated that they understood extension messages while a minority did not. Some of the farmers who claimed to have understood reported that they were usually attentive to get the new information. *"We understand because we purpose to attend the meetings and pay attention to information disseminated,"* said another farmer. In addition, a farmer from Kimbo said:

> *We understand…. We all understand and are happy when being taught. However, once meetings come to an end, some farmers immediately forget what they have been taught. Farmers who are able to grasp extension information, cultivate well. As for me, I have grown potatoes for a long time and I like following the extension officers' advice.*

With regard to not understanding extension messages, a Kiamiogo farmer reported that if a meeting begun in the morning and extended beyond lunch time, he would not understand information disseminated. The farmer said, *"I won't understand if I am hungry. I first have to eat to be able to understand."* In contradiction, another farmer from the same sub-location said, *"The rest of us understand. We don't mind the hunger pangs we get during the meetings."*

More or less similar to the farmers' responses, all the extension officers concurred that farmers understood extension information relayed in the above stated situations. For example, one extension officer said, *"Yes, they understand because they get high yields."* Another officer said, *"Yes, they do understand because we tackle particular topics depending on the stage of Irish potato cultivation."*

This study reveals that majority of the farmers understood extension messages in situations which they were communicated. This shows probably once a situation of information exchange was identified, extension officers first ensured that they had suitable messages for it. This is in tandem with Age et al. (2012) who asserted that in agricultural extension, it is important that extension officers make sure that the situation in which they choose to educate the farmers is one that promotes understanding of the information conveyed. Further, Oakley and Garforth (1985), Ogueri (2003) and Onasanya et al. (2006) argued that there is a direct relationship between understanding of extension messages and adoption of agricultural technology by farmers.

4.6.10 Effect of communication context on adoption of Irish potato farming innovations

Farmers revealed that physical, socio-psychological and temporal contexts of communication, as referred earlier, lead to high adoption of Irish potato farming innovations. However, when farmers were asked if their culture influenced adoption of Irish potato farming innovations, all the farmers maintained that it did not. For example, a Gathuine farmer said, *"Culture doesn't influence adoption. Farmers are more interested in the information extension officers have and not the different cultural beliefs, attitudes, practices, values and norms."* A farmer from Kiamiogo said, *"There is high adoption of Irish potato innovations because we understand information disseminated to us in the chief's camps, demonstration farmers and extension offices."* A farmer from Gathuine said, *"Since our relationship with extension officers is good, we adopt innovations. For example, Asante potato breed was introduced to us and we have quickly adopted it."* A farmer from Kiamiogo said, *"The trust that we have in the extension officers make us heed to their advice."*

Extension officers also reported that physical, socio-psychological and temporal contexts influenced adoption of Irish potato farming innovations but culture did not. The extension officer from Meru asserted that her knowledge of the Meru culture enabled her

to avoid cultural pitfalls when passing information to farmers. The officer also said, *"The farmers are more interested in extension information which when put into practice will make them adopt innovations in Irish potato farming."* Similarly, all the extension officers reported that the good relationship they had with farmers has a positive influence on adoption of Irish potato farming innovations. An extension officer said, *"Adoption is very high among farmers whose relationship with extension officers is good and low among farmers whose relationship with extension officers is not very good."* When the officer was requested to explain further what he had just stated, he said, *"Such a person will not know where to get good seed. The farmer will therefore harvest low yields."*

Findings revealed that apart from culture, other aspects of communication context (physical, socio-psychological and temporal) increased adoption of Irish potato farming innovations. These findings concur with several scholars (Eltham Training Centre, 2001; Ofuoku, 2012; Swanson, 1998) who argued that when there is a close working relationship between extension agents and farmers, innovations have a probability of being adopted. Possibly, attributes of truthfulness and sincerity between farmers and extension officers resulted in good relationships and adoption of innovations (Ofuoku, 2012).

In conclusion, findings of this study revealed that the physical, cultural, socio-psychological and temporal contexts of communication, positively influenced shared meaning between farmers and extension officers on adoption of innovations in Irish potato farming. Whereas physical, socio-psychological and temporal contexts of communication had direct effect on high adoption of Irish potato farming innovations, the cultural context did not.

4.7 Noise in communication

The fourth objective was to determine the effect of noise on shared meaning between extension officers and farmers on the adoption of Irish potato farming innovations in Kibirichia Ward. The sub-sections below present detailed findings.

4.7.1 Types of noise that occur during information exchange on adoption of Irish potato farming innovations

In order to determine the effect of noise on shared meaning between extension officers and farmers on the adoption of Irish potato farming innovations in Kibirichia Ward, farmers were first asked to state types of noise that occurred during communication. Farmers' responses revealed that there were external, physiological, semantic and psychological noises. External noise was said to result from braying donkeys, passing vehicles, people consulting the chief as meetings went on, power saws logging trees, barking dogs etc. Farmers with visual and hearing impairment experienced physiological noise. Semantic noise occurred when complex terminologies which were unfamiliar to farmers were used, during information exchange. Hunger, illnesses and tiredness were stated as some of the causes of psychological noise. For example, one farmer from Kiamiogo said, *"When extension officers extend meetings beyond lunch time, we are usually unable to concentrate because of hunger pangs."*

Extension officers however, pointed out that noise was not a major deterrent in the communication process. For instance, one of the extension officers maintained that external noise was not a major issue in Kibirichia ward because it is in a rural setting. Similarly, the officers reported that types of noise which occurred during communication of messages on adoption of Irish potato farming innovations were external, physiological, semantic and psychological noise. Extension officers pointed out that external noise resulted from children playing in the homesteads during the school

holidays or weekends, animals in the farm and homesteads and vehicles passing. However, one of the extension officers said:

> *Very few cars or none at all pass near the places we meet with farmers. Children are mostly in school. As for animals, once they are well fed in the morning, they cease making noise; unless they are in danger.*

While physiological noise was experienced by farmers who were partially blind or deaf, semantic noise occurred when technical words were used which farmers could not comprehend. Farmers who were unable to understand extension messages due to mental disturbances resulted in psychological noise. Psychological noise was also caused by stress, frustration, irritation, illnesses and wondering thoughts that farmers had during information exchange. For example, an extension officer noted that:

> *Last year, we were given clean Irish potato seeds by donors to distribute to the farmers. However, only half of the farmers got the seeds because the seeds were few. During one of the meetings, farmers who did not get the clean seeds kept on asking when they would get their share of clean seed. Such farmers were unable to concentrate on the topic of discussion due to their annoyance.*

Findings revealed that noise was present during the communication of information on adoption of Irish potato farming innovations. Noise resulted from braying donkeys, passing vehicles, power saws logging trees, barking dogs, visual and hearing impairment, complex terminologies which were unfamiliar to farmers, hunger, stress, frustration, irritation, illnesses, wondering thoughts and tiredness. These findings agree with several scholars (Age et al., 2012; DeVito, 2015; Gamble & Gamble, 2010; Onasanya et al., 2006; Solecki, 1995; Winters et al., 2005). These scholars indicated that noise comes from loud conversations, side talks at meetings, sound from workmen's tools, horns from moving vehicles, dog barking and disturbances from other animals, poor mental attitudes or emotional stress and inability to use that language of

communication correctly. Durgut and Celen (2004) argued that environmental noise can affect people physically and psychologically by making them lose the ability to hear, irritable, angry, interfere with speech and sleep. Again, findings revealed that while discussing physiological noise, respondents in this study did not mention farmers who were completely deaf or blind but rather those who are partially deaf or blind. This indicates that perhaps completely blind and deaf people in Kibirichia Ward did not engage themselves in farming activities and thus had no need of attending agricultural extension meetings due to the challenges they faced from their handicap conditions (ICIPE, 2013).

4.7.2 The place and time noise occurred during information exchange between extension officers and farmers

Asked when and where the above stated types of noise occurred, farmers said that noise occurred whenever and wherever information was communicated. In Kiamiogo, for example, one farmer said that noise occurred in all their meeting places. *"During demonstrations, people have side talks,"* a Mburugiti farmer said. In addition, another Mburugiti farmer said, *"People cannot avoid coughing and sneezing during the meetings."* A farmer from Kimbo explained, *"Farmers that have cows and donkeys in their farms experience external noise. Similarly, farms which are by the road side, encounter noise from passing vehicles."*

Two varying responses were given by the three extension officers on when and where noise took place during communication of information on adoption of Irish potato farming innovations. Majority of the extension officers believed that the occurrence of noise was evident whenever and wherever information on adoption of innovations in Irish potato farming was disseminated. The other extension officer, however, said that it depended on the venue and time of a meeting. The extension officer said, *"It depends on the locality of that particular meeting. As for time, it can be in the morning or in the afternoon."*

Findings revealed that noise occurred whenever there was communication of information on adoption of Irish potato farming innovations. These findings are more or less similar to those of Durgut and Celen (2004), Kluge (2001) and Solecki (1995) who noted that external noise occurs in the farms, while psychological, physiological and linguistic noise is said to occur within the communicator (Age et al., 2012; DeVito, 2015; Velentzas & Broni, 2014). Further, Durgut and Celen (2004) argued that external noise leads to hearing loss (physiological noise), irritability and anger (psychological) and interference with speech (semantic noise).

4.7.3 Ways in which noise was reduced

Asked by the researcher how various types of noise were reduced, responses were varied. Farmers, who murmured while the communication process was going on, were requested to keep quiet. However, it was also noted that in some situations, the communicating parties made great effort to listen in the midst of external noise. *"If we are holding a meeting near a road, we strive to listen to the extension officers in the midst of the noise produced by cars on the move,"* said one farmer. Farmers who were partially deaf or blind, were usually requested to move closer to the extension officer and encouraged to seek for clarification.

Extension officers reduced semantic noise by making an effort to speak in Kimeru. It was reported that some diseases, seed varieties and other technologies had acquired Kimeru names from the farmers, which were used for reference. Extension officers asserted that whenever they noted a farmer(s) was absent minded, they tried to draw their attention and counsel them. For instance, one extension officer said, *"When farmers who attend our meetings complain that they had not received clean seeds, we record their names and assure them that the next time clean seeds will be distributed, they will be the first to be considered."*

The study revealed that respondents used a number of ways to reduce various types of noise that were present during exchange of extension messages. This finding is in tandem with that of Age et al. (2012) who recorded that noise can be reduced by controlling physical, psychological and linguistic factors. Age et al. and Durgut and Celen (2004) stated that physical noise can be avoided and reduced by moving away from loud noise, maintaining silence and satisfying physiological needs to prevent loss of attention. Psychological noise can be reduced by controlling emotional stress (Age et al., 2012) while linguistic noise can be decreased by writing the same message in different forms but with the same meaning, correct application of grammatical rules, words and pronunciation (Age et al., 2012; Adebayo, 1997). Bello eta al. (2014) and Ifenkwe and Ikpekaogu (2012) reported that noise can be reduced and not totally eradicated because it affects all the components (source, channel, receiver, message, feedback) of the human communication process.

4.7.4 Other barriers other than noise that caused miscommunication between extension officers and farmers

Disparity in educational level, different levels of understanding, poor communication skills and experiential superiority were other barriers other than noise, cited by farmers that caused miscommunication. For example, a Kiamiogo farmer said, *"People are created differently. There are those who are fast in understanding information and those that are slow."* With regard to poor communication skills, another farmer said, *"There are extension officers who are unable to relay or clarify information well."* Farmers reported that some of them who had cultivated Irish potatoes for many years, failed to listen to extension messages because they believed they possess all the knowledge on Irish potato farming. One farmer from Mburugiti however said, *"There is no farmer who knows everything about Irish potato farming. It doesn't matter the number of years they have cultivated Irish potatoes."*

According to the extension officers, other barriers other than noise that created lack of sharing meaning between them and farmers included prolonged meetings, different levels of understanding, disparity in education and handout mentality (negative attitude). For instance, one extension officer noted that when meetings that began in the morning were prolonged beyond 2.00 pm, farmers started complaining of hunger pangs and ceased to listen to extension messages. Another officer who identified farmers' handout mentality as a barrier said:

> *In every group of farmers there are those who are normally not serious. There are farmers who join groups by virtue of thinking that once they become members, there will get a lot of benefits. Such farmers join the groups with different agendas or interests other than the main interest of the group. They join groups with the sole purpose of getting free innovations. To me, that is one of the major problems farmers groups face.*

Findings of this study revealed that common barriers other than noise that deterred shared meaning between extension officers and farmers were prolonged meetings, farmers' handout mentality, poor communication skills, experiential superiority, disparity in education and different levels of understanding. It was further revealed that while farmers reported poor communication skills and experiential superiority as other barriers, extension officers reported prolonged meetings and the handout mentality. These findings are in agreement with Age et al. (2012) and Duta (2015) who indicated that barriers to effective communication are cognitive dissonance, ethnocentrism, information overload/fatigue, delayed/lack of feedback, feed forward, shortage of material inputs and information sensitivity.

4.7.5 Strategies used to overcome barriers which deterred shared meaning between extension officers and farmers

Focus group discussions with the farmers showed that a number of ways were used to overcome the above stated barriers which deterred shared meaning from occurring. In order to improve farmers' comprehension, extension officers carried out follow-up visits with individual farmers to monitor their farming progress. Further, they used pictures and specimen while training farmers to improve their comprehension. In addition, a Mburugiti farmer said, *"Farmers who do not understand extension messages, seek for clarification from others. These farmers also learn by observing and imitating good agricultural practices from prosperous farmers."* Farmers suggested that extension officers should make communication enjoyable in order to overcome experiential superiority. Poor communication skills would be improved by ensuring that extension messages were clear.

Extension officers reported that the instances they needed to hold long extension meetings with farmers, they usually collaborated with sponsors who provided lunch. Pictures and demonstrations were usually used to teach farmers who had difficulties in understanding extension information. In addition, farmers were encouraged to seek for clarification from the officers and other farmers on information which they did not understand. *"A farmer may also invite fellow farmers in their farm to verify the facts taught. For example, to see the disease the extension officer was talking about,"* said one of the officers. With regard to overcoming farmers' handout mentality, one extension officer said, *"When some farmers attend meetings with a handout mentality, I try to talk them out of it and instead I inform them on the new farming practices."*

This study revealed that follow-up visits, the use of teaching aids, seeking clarification by the farmers, making communication enjoyable were methods used by the respondents to overcome barriers that deterred shared meaning on adoption of Irish potato farming innovations. These findings are in agreement with Ogueri (2013) and Onasanya et al.

(2006) argument that state that extension agents' should use teaching aids in the teaching-learning situation and developed creative extension messages. Further, Ofuoku (2012) indicated that communication becomes enjoyable when farmers are involved in the process of disseminating messages while extension messages turn out to be relevant to farmers when they are involved in the development of information to be disseminated. Again, the results concur with Hunt (2006) and Ofuoku (2012) who argued that asking questions enhances farmers' comprehension of messages and reveals to the extension officers, parts of messages that were not well understood by learners.

4.7.6 Effect of noise on adoption of Irish potato farming innovations

Among the farmers, there was consensus that the presence of noise during agricultural extension communication resulted in low adoption of innovations in Irish potato farming in Kibirichia Ward. For example, one farmer from Kiamiogo said, *"When extension officers hold long extension meetings with us, we are usually unable to concentrate on what they tell us because of hunger pangs. This results in low adoption of innovations."* A Gathuine farmer said, *"Farmers who are mentally distracted easily are unable to listen to advice from extension officers and put into practice what the officers have communicated. Such farmers experience low adoption of agricultural innovations."*

Extension officers also reported that the presence of noise led to low adoption of innovations in Irish potato farming. For example, one extension officer said, *"When farmers get distracted and they stop listening to what we are telling them, adoption for such farmers is low."* Another extension officer said, *"When there is noise, farmers fail to understand extension messages and this results in low adoption of Irish potato farming innovations."*

Findings revealed that noise led to low adoption of Irish potato farming innovations in Kibirichia Ward. These findings agree with a number of researchers (FAO 2003; Occupational Safety and Health Service, 1998; Saeki et al., 2004) who found that noise

directly affects farmers performance such as, decreased efficiency and productivity due to lack of concentration. However, noise can be reduced and not totally eradicated because it affects all the components (source, channel, receiver, message, feedback) of the human communication process (Bello eta al., 2014; Ifenkwe & Ikpekaogu, 2012).

In conclusion, this study revealed that the physical, physiological, linguistic and psychological noise were present during information exchange between farmers and extension officers. In addition, findings showed that there were other factors other than noise that influenced farmers' understanding. The reduction of noise led to shared meaning and high adoption of Irish potato farming innovations in Kibirichia Ward.

4.8 Adoption of Irish Potato Farming Innovations

The fourth section of both the in-depth interview and focus group discussions guide was based on the dependent variable which focused on adoption of Irish potato farming innovations. The sub-sections below present detailed findings.

4.8.1 Effect of extension communication on adoption of Irish potato farming innovations

In response to the effect that agricultural extension communication had on adoption of Irish potato farming innovations, majority of the farmers from the four sub-locations asserted that there was increased adoption. For example, a farmer from Kiamiogo said, *"We have to keep up with change and technology."* A Mburugiti farmer reported, *"Adoption has increased because different varieties of Irish potatoes are planted all the time,"* while a farmer from Kimbo who was of a different opinion said, *"It is moderate. It is neither low nor high; it is in the middle."* This view was justified by another farmer who said, *"We adopt but not all of us are quick in adopting. Only few farmers are fast in adopting and the rest of us wait and see how those who have adopted are faring on."*

Asked the same question, all the extension officers noted that there was increased adoption of Irish potato farming innovations. One extension officer, for example, said, *"It has increased because we teach farmers new information which they pay attention to and adopt."* In addition, another extension officer said:

> *Actually, the production has really increased because we have taught them good agricultural practices. We have taught them to use certified seeds from Kisima Farm. We have also taught them how to space seeds during planting because spacing was initially a problem. We have been teaching them about crop rotation, pests and diseases control.* (Sic)

In the same way, the third officer explained:

> *Adoption is going up because currently, three quarters of the farmers at least use clean or certified seeds. Some years back, only a few isolated farmers adopting new seeds. Actually, we could count, 'so and so, are the ones who have certified seeds.' Now, we cannot visit ten homes and not find half of the farmers having planted certified seeds. To me that is adoption. The problem we are facing now is not adoption but availability of good seeds. Ninety percent of our farmers today are looking for clean or certified seeds.* (Sic)

According to this study there was an increase in the adoption of Irish potato farming innovations in Kibirichia Ward. This finding contradicts Muthoni and Nyamongo (2009) and Nyagaka et al. (2009) argument that despite numerous efforts and resources dedicated to the creation and diffusion of new Irish potato production technologies, the average farm production has not yet increased. The increase in adoption of innovations in Irish potato farming could be attributed to the fact that Irish potatoes are an important source of food, employment and income in developing countries (FAO, 2008; Kabungo, 2008).

4.8.2 Other factors other than shared meaning that influence adoption of Irish potato farming innovations

Farmers were asked to identify other factors, other than shared meaning, that influence adoption of Irish potato farming innovations in Kibirichia Ward. Farmers stated presence of reliable markets, prices for produce, ability of the potato seeds to produce high yields, farmers' purchasing power, weather patterns, access to water for irrigation, size of farm, disease resistant crops, palatable and good tasting potatoes and crops that took a short time to mature. Further, Irish potatoes could be stored over a long duration of time after harvest.

Extension officers stated that demand for potatoes in urban areas, availability of subsidized fertilizers and affordability of clean seeds influence the adoption of Irish potato farming innovations. Lack of an alternative crop to cultivate was also cited by one of the extension officers. The officer said:

> *Farmers used to cultivate French peas but they stopped because they could not fetch good market prices. Unlike Irish potatoes, French peas cannot be stored for a long time. Farms are also becoming smaller thus making farmers to be unable to cultivate wheat.*

The key findings revealed that, apart from shared meaning, other factors such as presence of reliable markets, prices for produce, ability of the potato seeds to produce high yields, farmers' purchasing power, weather patterns, access to water for irrigation, size of farm, disease resistant crops, palatable and good tasting potatoes influenced adoption of Irish potato farming innovations in Kibirichia Ward. Other factors taken into consideration were quick maturing crops whose yield can be stored over a long duration of time after harvest. These findings are in contradiction to Kiptoo et al. (2016) who found that factors influencing adoption and use of clean certified seed potato tubers were: Farmer education level, frequency of access to agricultural extension services,

years of experience in potato farming, the administrative ward of the farmer and farmer's off-farm income. Chi and Yamada (2002) found progressive, young and educated farmers to be a trigger to adoption. The five characteristics of innovations, according to Rogers (2003) influence adoption. The characteristics are relative advantage, compatibility, complexity, triability and observability.

4.8.3 Farmers rate of adopting Irish potato farming innovations

Regarding farmers' rate of adoption of innovations in Irish potato farming, farmers revealed that the rate varied from one individual farmer to another. There were farmers who were quick to adopt while others were slow. Majority of the farmers from the four sub-locations, however, asserted that when an innovation was introduced to them, they initially did not adopt but first observed how the innovation worked for the early adopters. *"We wait and see the effect the new technology has on increasing crop production, from those who are very fast in adopting,"* said a farmer from Kiamiogo.

Two of the extension officers were of the opinion that farmers in Kibirichia Ward were very fast in adopting since the Irish potato crop was a cash as well as food crop. The third extension officer, however, noted that the adoption rate differed among farmers in different sub-locations in Kibirichia ward. The officer said, *"Farmers in Kimbo and Gathuine are very fast in adopting innovations because they have reliable rainfall and adequate water for irrigation as compared to those in Mburugiti and Kiamiogo."*

Findings revealed that rate of Irish potato adoption varied among farmers and sub-locations in Kibirichia ward. These findings contradict those of Wang'ombe and Dijk (2013) and Namwata et al. (2010) who found that the extent of adoption among farmers varied with the type of technology. Further, this study results revealed that majority of the farmers were not quick to adopt innovations but first observed how the innovations worked and their effect on increasing crop production from those who were quick in adopting. This finding is in tandem with Rogers (2003) who argued that time is involved

in innovation decision making which is a mental process through which an individual(s) goes through from the initial knowledge about the innovation, to forming an attitude, making a decision to accept or reject, implementation and confirmation of the decision. Farmers' slow rate of adoption could be attributed to the complexity, technicality and difficulty of understanding new ideas by most of the farmers (Anaeto et al., 2012). On the other hand, Rogers (2003) noted that innovations that are perceived to have greater relative advantage, compatibility, triability and observability and less complexity are rapidly adopted than other innovations.

4.8.4 Ways to further improve shared meaning between extension officers and farmers

Farmers gave a number of suggestions on ways to improve shared meaning between them and extension officers. The farmers said there should be an increase in the number of extension officers in Kibirichia Ward, follow ups, demonstrations and use of radio to disseminate information. In addition, farmers from Kiamogo said, *"Information on new Irish potato seeds should be communicated to farmers before the planting season and agricultural information through the mass media should be disseminated by experts."* Another farmer from Kimbo said, *"Extension officers should increase the frequency of farm and follow-up visits after trainings."* A farmer from Mburugiti was of the opinion that, more demonstrations to teach farmers on various aspects of Irish potato farming should be carried out by the extension officers.

Extension officers, on the other hand, recommended that the national government should increase resources allocated for local extension activities including facilitation to air extension radio programmes that are tailored to meet farmers' needs in various sub-locations in Kibirichia Ward. An increase of farmers' educational tours and presence of a reliable market for produce were other suggestions given by the officers.

Suggestions to increase the number of extension officers in Kibirichia Ward, follow ups, demonstrations and use of radio are in tandem with those of Bello et al. (2014) and Onasanya et al. (2006) that the government should train and employ more extension officers in addition to giving already employed extension officers more financial support. Extension officers should be available to the farmers anytime of the day, especially when the farmers have crucial farming problems that need to be resolved (Kamal et al., 2014). Further, Kiptoo et al. (2016) argued that farmers' access to agricultural extension services leads to adoption of innovations.

In conclusion, farmers' adoption of innovations in Irish potato farming was high. However, adoption varied from one individual farmer to another. Majority of the farmers first observed the effectiveness of an innovation from early adopters before they adopted. To improve shared meaning between farmers and extension officers, study respondents recommended the government to employ more extension officers in Kibirichia Ward and the frequency of follow ups, demonstrations and use of radio increased.

4.9 Implications of Results from Diffusion of Innovation Theory

This study was drawn from the diffusion of innovation theory which looks at how a new idea or a product spreads and is taken by a specific population. This theory was valuable to the study because it aided in the investigation on the effect of shared meaning between extension officers and farmers on the adoption of Irish potato farming innovations in Meru County. There was evidence in the study findings that the four main elements (innovation, communication channels, time and social system) in the diffusion of new ideas were important for shared meaning to occur between extension officers and farmers on the adoption of Irish potato farming innovations.

4.10 Summary of the Chapter

This study revealed that the channels of communication used for information exchange between farmers and extension officers resulted in shared meaning which in turn led to high adoption of Irish potato farming innovations. In addition, farmers' comprehension of most extension messages which were in form of information, ideas and technology led to the high adoption of Irish potato farming innovations in Kibirichia Ward. However, whereas physical, socio-psychological and temporal contexts of communication positively influenced shared meaning and adoption of Irish potato farming, cultural context did not have an effect on adoption but only influenced shared meaning. Noise was not a major factor affecting shared meaning between farmers and extension officers. Its effects when reduced resulted to attainment of shared meaning and high adoption of Irish potato farming innovations in Kibirichia Ward.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter summarizes, concludes and makes recommendations of the study. The purpose of the study was to investigate the effect of shared meaning between extension officers and farmers on the adoption of Irish potato farming innovations in Meru County. The study sought to achieve the following objectives: (1) to determine the effect of channels of communication used between extension officers and farmers on the adoption of Irish potato farming innovations in Meru County, (2) to describe the effect of the nature of messages conveyed between the extension officers and farmers on the adoption of Irish potato farming innovations in Meru County, (3) to examine the effect of the context of communication between extension officers and farmers on the adoption of Irish potato farming innovations in Meru County, and (4) to determine the effect of noise on shared meaning between extension officers and farmers on the adoption of Irish potato farming innovations in Meru County.

5.2 Summary of Study Findings

The summary is organized according to the four objectives which guided the study as follows.

5.2.1 The effect of channels of communication used between extension officers and farmers on the adoption of Irish potato farming innovations in Meru County

The first objective was to determine the effect of channels of communication used between extension officers and farmers on the adoption of Irish potato farming innovations in Meru County. Findings of this study revealed that the mass media and interpersonal channels of communication used for information exchange between

farmers and extension officers enhanced adoption of innovations for Irish potato farming. Frequency of mass media use was determined by the extension officers' need to disseminate information to farmers while interpersonal communication channels were mostly demand driven by the farmers needs to get specific information from the extension officers. The mass media used were posters, leaflets and letters while interpersonal communication channels included meetings or *barazas*, demonstrations, mobile phone calls, SMS, seminars, field days and workshops. These findings are in tandem with Bello and Obinne (2012) argument that both interpersonal and mass communication channels are used in transmitting agricultural information to farmers. Further, in this study, farmers reported that they understood extension information disseminated through the communication channels because they created an enabling environment for information exchange (feedback). This finding is supported by Oakley and Garforth (1985) and Onasanya et al. (2006) who asserted that adoption and transfer of agricultural technology will not take place unless farmers understand extension messages transmitted through an appropriate feedback mechanism.

5.2.2 The effect of the nature of messages conveyed between the extension officers and farmers on the adoption of Irish potato farming innovations in Meru County

The second objective was to describe the effect of the nature of messages conveyed between the extension officers and farmers on the adoption of Irish potato farming innovations in Meru County. Findings of this study revealed that extension messages communicated between extension officers and farmers resulted in shared meaning and high adoption of Irish potato farming innovations in Kibirichia Ward. Messages on Irish potato farming were conveyed in Kimeru, Kiswahili, English, Kiembu and Kikuyu. In addition, extension messages contained information, ideas and technologies on soil testing, seed varieties, spacing, weeding, earthing-up, pesticides, fertilizer and manure application, crop rotations, diseases and harvesting. Comprehension of Irish potato farming information communicated between extension officers and farmers led to high adoption rate. These findings concur with Age et al. (2012) and FAO (2003) who argued

that farmers' ability to understand extension messages could be attributed to use of language(s) that the farmer is accustomed to, dissemination of technically feasible, economically affordable and socially acceptable information. In addition, Oakley and Garforth (1985) and Onasanya et al. (2006) noted that adoption and transfer of agricultural technology will not take place unless farmers share meaning with extension officers on messages transmitted through an appropriate feedback.

5.2.3 The effect of the context of communication between extension officers and farmers on the adoption of Irish potato farming innovations in Meru County

The third objective was to examine the effect of the context of communication between extension officers and farmers on the adoption of Irish potato farming innovations in Meru County. Findings of this study revealed that whereas physical, socio-psychological and temporal contexts of communication positively influenced shared meaning and adoption of innovations in Irish potato farming, cultural context did not have an effect on adoption but only influenced shared meaning. Further, while the physical context of communication comprised of farms, extension offices, homesteads, chiefs' camps, shopping centers and cattle dip grounds, the cultural context was the ethnic background of the communicating parties. The socio-psychological context was the good relationship between the extension officers and the farmers. The appropriateness of extension messages in communication situations (such as Irish potato growth stages, time of communication and events) was the temporal context. These findings are in agreement with Abayule et al. (2017) and De Vito (2014) who posited that the communication context affects the meaning of a message and adoption of agricultural innovations.

5.2.4 The effect of noise on shared meaning between extension officers and farmers on the adoption of Irish potato farming innovations in Meru County

The fourth objective was to determine the effect of noise on shared meaning between extension officers and farmers on the adoption of Irish potato farming innovations in Meru County. Findings of this study revealed noise deterred shared meaning between extension officers and farmers. Further, noise resulted in low adoption of Irish potato farming innovations in Meru County. These findings agree with a number of researchers (FAO, 2002; Occupational Safety and Health Service, 1998; Saeki et al., 2004) who found that noise directly affects farmers performance such as, decreased efficiency and productivity due to lack of concentration. Types of noise that occurred during information exchange were external, physiological, semantic and psychological noise. External noise was said to result from braying donkeys, passing vehicles, people consulting the chief as meetings went on, power saws logging trees and barking dogs. Farmers who had visual and hearing impairment experienced physiological noise. Semantic noise occurred when complex terminologies, which were unfamiliar to farmers were used, during information exchange. Hunger, illnesses and tiredness were stated as some of the causes of psychological noise. To increase shared meaning and adoption, effects of noise were reduced in different ways. For example, whereas physical noise was avoided by moving away from loud noise, maintaining silence, psychological and linguistic noise were reduced by controlling emotional stress and correct application of grammatical rules, words and pronunciation. Further, other barriers apart from noise that deterred shared meaning were farmers' different levels of education and understanding. To improve farmers' comprehension, extension officers carried out follow-up visits to monitor individual farmers' farming progress and used pictures together with specimen while training farmers.

5.3 Conclusions

The study concludes that the channels of communication used for information exchange between farmers and extension officers result in shared meaning and high adoption of Irish potato farming innovations in Meru County. Information is disseminated through Mass media and interpersonal communication channels. Mass media employed are leaflets, letters and posters. Meetings or *barazas*, demonstrations, mobile phone calls, SMS, seminars, field days and workshops constitute interpersonal communication channels. Farmers understand extension information disseminated through mass media and interpersonal communication channels which create an enabling environment for information exchange and feedback. Consequently, this means that extension officers and farmers use the right communication channels effectively.

Secondly, the nature of messages (information, ideas and technologies) communicated between extension officers and farmers result in shared meaning and high adoption of Irish potato farming innovations in Meru County. Extension messages contain information, ideas and technologies on soil testing, seed varieties, spacing, weeding, earthing-up, pesticides, fertilizer and manure application, crop rotations, diseases and harvesting. Farmers are keen to understand messages and adhere to extension officers' advice in order to maximize production. This means that information, ideas and technologies conveyed are appropriately interpreted thus making communication effective.

Thirdly, whereas physical, socio-psychological and temporal contexts of communication positively influence shared meaning and adoption of innovations in Irish potato farming, cultural context does not have an effect on adoption but only influences shared meaning. The farmers' cultural differences from those of the two extension officers does not deter them from sharing meaning. Probably this is as a result of all the extension officers originating from the larger Mount Kenya region who share a common cultural background with the Meru.

Lastly, noise deters shared meaning from taking place between extension officers and farmers and lowers adoption of Irish potato farming innovations in Meru County. Other factors other than noise that influence farmers' understanding of extension messages are disparity in educational level, different levels of understanding, poor communication skills, experiential superiority, prolonged meetings and handout mentality (negative attitude). To increase shared meaning and adoption, effects of noise are reduced and not totally overcome because noise is a component of the human communication process.

5.4 Recommendations

Based on the summary and conclusions, this study makes the following recommendations.

5.4.1 Recommendations for agricultural extension officers

Agricultural extension officers should establish more communication campaigns and use them together with mass media and interpersonal communication channels to disseminate information on Irish potato farming innovations. Consequently, extension officers should recommend the government to employ development communication experts who can create appropriate communication campaigns to promote effective dissemination of extension information to farmers and improve adoption of innovations in Irish potato farming.

5.4.2 Recommendations for the government

The government should employ more extension officers considering that presently there are only three officers serving 3,327 households in Kimbo, Gathuine, Kiamiogo and Mburugiti sub-locations, in Kibirichia Ward. This will increase frequency of information exchange on Irish potato farming innovations between farmers and extension officers hence enhance productivity of a crop that has the potential to help Kenya fight perennial food insecurity.

5.4.3 Recommendations for farmers

Since agricultural extension officers in Kibirichia Ward are few, group approach in training farmers is predominantly used. Farmers with the help of extension officers should form extension groups which consist of members who share the same interest and problems. Groups create a supportive environment to individual farmers enabling them make decisions and determine a course of action. The group method of extension could also enable extension officers to achieve greater coverage in less time and cost.

5.4.4 Recommendations for agricultural research institutions

As agricultural extension officers in the whole of Kibirichia Ward are few, agricultural research institutions should avail information on agricultural innovations through mobile phone services. This will enable farmers to interact, obtain knowledge and information from researchers and extension officers about agricultural issues and problems. phone calls and short message service (SMS) are easy, fast and convenient ways for farmers to communicate and get prompt answers to respective agricultural problems.

5.5 Further Research

The study makes the following suggestions for further research. First, since the present study focused on interpersonal and mass communication channels, there is need to determine the role of social media on adoption on Irish potato farming innovations in Meru County. Secondly, since this study has focused on Meru County, further comparative studies that focus on shared meaning between extension officers and farmers, could be conducted in other counties in Kenya that cultivate Irish potatoes.

REFERENCES

Abong, G. O., Okoth, M. W., Imungi, J. K., & Kabira, J. N. (2010). Evaluation of selected Kenyan potato cultivars for processing into potato crisps. *Agriculture and Biology Journal of North America, 1*(5), 886–893. https://doi.org/10.5251/abjna.2010.1.5.886.893

Adebayo, K. (1997). *Communication in agriculture.* Abeokuta: Greenlinks International.

Adejoh, S. O., Edoka, M. H., & Shaibu, U. M. (2016). Assessing the availability, accessibility and use of media channels for sourcing agricultural information by urban and rural farmers in Kogi State, Nigeria. *Asian Journal of Agricultural Extension, Economics & Sociology 14*(2), 1-8.

Agbamu, J. U. (2005). Problems and prospects of agricultural extension service in developing countries. In S. F. Afolayan (Ed.), *Agricultural Extension in Nigeria* (pp159 – 169). Ilorin ESON.

Agbamu, J. U. (2006). *Essentials of agricultural communication in Nigeria*. Lagos: Malthouse Press Ltd.

Age, A. I., Obinne, C. P. O., & Demenongu, T. S. (2012). Communication for sustainable rural and agricultural development in Benue State, Nigeria. *Sustainable Agriculture Research, 1*(1), 118–129. https://doi.org/10.5539/sar.v1n1p118

Agricultural Knowledge and Information Systems (AKIS). (2000). *Decentralizing agricultural extension: Lessons and good practice.* Wachington, D. C.: The World Bank.Retrieved from http://siteresources.worldbank.org/INTARD/825826-1111063678817/20431788/Decentralization.pdf

Agwu, A. E., Ekwueme, J. N., & Anyanwu, A. C. (2008). Adoption of improved agricultural technologies disseminated via radio farmer programme by farmers in Enugu State, Nigeria. *African Journal of Biotechnology, 7*(9), 1277-1286. Retrieved from https://www.ajol.info/index.php/ajb/article/viewFile/58662/46990

Aker, J. C. (2011). Dial "A" for agriculture: A review of information and communication technologies for agricultural extension in developing countries. *Agricultural Economics*, *42*(6), 631–647. https://doi.org/10.1111/j.1574-0862.2011.00545.x

Akinbile, L. A., & Otitolaye, O. O. (2008). Assessment of extension agents' knowledge in the use of communication channels for agricultural information dissemination in Ogun State, Nigeria. *Journal of Agricultural and Food Information*, *9*(4), 341–353. https://doi.org/10.1080/10496500802451426

Ali, J. (2011). Adoption of mass media information for decision-making among vegetable growers in Uttar Pradesh. *Indian Journal of Agricultural Economics*, *66*(2), 241–254.Retrieved from http://ageconsearch.umn.edu/bitstream/204748/2/07-JABIR%20ALI.pdf

Ali, J., Naseem, B., & Ali, A. (2016). Farmer's perception regarding extension activities conducted by agricultural extension field staff in Barkhan District of Balochistan before and after decentralization. *International Journal of Advanced Research in Biological Sciences, 3*(4), 176-182.

Amin, M. E. (2005). *Social science research: Conception, methodology and analysis.* Kampala: Makerere University Press.

Anaeto, F. C., Asiabaka, C. C., Nnadi, F. N., Ajaero, J. O., Aja, O. O., Ugwoke, F. O., … Onweagba, A. E. (2012). The role of extension officers and extension services in the development of agriculture in Nigeria. *Wudpecker Journal of Agricultural Research*, *1*(6), 180–185. Retrieved from http://pdoaj.com/pdf-files/agr/194/180-185 Vol 1 issue 6 July 2012.pdf

Ang, H. B. (2010). Occupational stress among New Zealand farmers-A review. *Labour, Employment and Work in New Zealand*. Retrieved from http://ojs.victoria.ac.nz/LEW/article/view/1708

Antholt, C. H. (1994). *Getting ready for the twenty-first century: Technical change and institutional mordernization in Agriculture.* Washington, D. C.: The World Bank.

Ayodele, A. E. (2012). A critical analysis of Diffusion of Innovation Theory. Retrieved

from https://odinakadotnet.wordpress.com/tag/mass-communication-theory/

Bachhav, N. B. (2012). Information needs of the rural farmers: A study from Maharashtra, India: A survey. *Library Philosophy and Practice*, *866*. Retrieved from http://digitalcommons.unl.edu/libphilprac/866 [Accessed July 20, 2013].

Bagi, F. S., & Bagi, S. K. (1989). A model of farm-level demand for extension information. *North Central Journal of Agricultural Economics*, *11*(2), 297–307.

Baig, M. B., Shayaa Al-Shay, M., & Straquadine, G. S. (2012). Agricultural extension in the kingdom of Saudi Arabia: Difficult present and demanding future. *Journal of Animal and Plant Sciences*, *22*(1), 239–246. Retrieved from http://www.thejaps.org.pk/docs/v-22-1/12.pdf

Bankay, V. (2012). *Examining the communication gaps that exist between farmers and extension officers in the agricultural sector of Changuanas*. The University of the West Indies. Retrieved from https://prezi.com/1-01cbilpcpl/examining-the-communication-gaps-that-exist-between-farmers-and-extension-officers-in-the-agricultural-sector/

Bardsly, J. (1982). Farmer's assessment of information and its source. In Nwuzor, B. (2000). *Nature and role of agricultural extension in economic development*. Enugu, Econus Publishing Company, p. 48.

Becker, H. (1991). Theory: The necessary evil. In *The Annual meeting of the American Educational Research Association*. Chicago.

Beebe, S. A., Beebe, S. J., Redmond, M. V., Geerinck, T. M., & Wiseman, L. S. (2015). *Interpersonal communication: Relating to others*. (M. Sartor & D. LeGallais, Eds.) (5th ed.). New Jersey: Pearson Education. Retrieved from http://www.pearsoncanada.ca/media/highered-showcase/multi-product-showcase/beebe-preface.pdf

Bello, M., & Obinne, C. (2012). Problems and prospects of agricultural information sources utilization by small scale farmers: A case from Nasarawa State of Nigeria. *Journal of Communication, 3*(2).

Bello, M., & Obinne, C. P., & Bako, S. A. (2014). Challenges of utilizing agricultural

information sources by small scale farmers in Nasarawa State, Nigeria. *Journal of Biology, Agriculture and Healthcare, 4*(26).

Bembridge, T. J. (1991). *The practice of agricultural extension: A training manual.* Development Bank of Southern Africa: Halfway House.

Benokraitis, N. V. (2016). *Introduction to Sociology.* (4th ed.). Boston, MA: Cengage Learning.

Birner, R., & Anderson, J. R. (2007). How to make agricultural extension demand-driven? The Case of India's agricultural extension policy. *IFPRI Discussion Paper 00729*, (November).

Birr, T. (2012). Communication: The process of creating shared meaning. Retrieved from https://thefoxyfiveexplainsitall.wordpress.com/2012/09/14/communicationthe-process-of-creating-shared-meaning/

Blumer, H. (1969). *Symbolic Interactionism: Perspective and Method.* Berkeley: University of California Press.

Burgoon, J. K., Guerrero, L. K., & Floyd, K. (2010). *Nonverbal communication*. New York: Pearson Education Inc.

Campbell, D. A., & Barker, S. C. (1998). Selecting appropriate content and methods in programme delivery. In B. E. Swanson, R. P. Bentz, & A. J. Sofranko (Eds.), *Improving agricultural extension. A reference manual* (2nd ed.). Rome.

Chauhan, J. (2007). *Agriculture extension education, communication in agriculture.* Raja Balwant Singh College, India, p. 14-16.

Cheboi, S., & Mberia, H. (2014). Efficacy of interpersonal communication channels in the diffusion and adoption of zero grazing technology. *International Journal of Academic Research in Business and Social Sciences*, *4*(9), 352–368. https://doi.org/10.6007/IJARBSS/v4-i9/1164

Chi, T., & Yamada, R. (2002). Factors affecting farmers' adoption of technologies in farming system: A case study in Omon district, Can Tho province, Mekong Delta. *Omonrice, 10,* 94–100. Retrieved from

https://pdfs.semanticscholar.org/f62f/b7147568c61610d4ad6b6de48f14a73f6f83.pdf

Center for International Agricultural Developmen Cooperation (CINADCO). (2015). *The Integration between Research, Extension and Applied Agriculture.* Washington, D. C.

Coldevin, G. (2008). Making a difference through development communication: Some evidence-based results from FAO field projects. In J. Servaes (Ed.), *Communication for Development and Social Change*(pp.14-429). India: Sage Publications India Pvt Ltd.

Cooley, C. H. (1902). Human nature and the social order. New York: Charles Scribners.

Coughlan, M. Cronin, P. & Ryan, F. (2007). Step by step guide to criticing literature. Part 1: qualitative research. *British Journal of Nursing, 16*(11), 14-27. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/17577184

Creswell, J. W. (2007). *Qualitative inquiry and research design: Choosing among five approches.* (2nd ed.). California: Sage Publications Ltd.

Creswell, J. W. (2014). *Research design: Qualitative, quantitative and mixed methods approaches*. U.S.A.: Sage Publications, Inc.

Department of Agricultural Extension (DAE). (1999). *Agricultural extension manual.* Ministry of Agriculture: Government of the People's Republic of Bangladesh.

DeVito, J. A. (2010). *Essentials of Human communication* (7th ed.). New York: Person Education.

DeVito, J. A. (2015). *Human communication: The basic course* (13th ed.). Harlow: Pearson Education Limited.

Dominick, J. R. (1999). *The dynamics of mass communication* (5th ed.). Boston: MacGraw-Hill.

Durgut, M. R., & Celen, I. H. (2004). Noise levels of various agricultural machineries. *PakistanJournal of Biological Sciences, 7*(6), 895-901.Retrieved from http://www.docsdrive.com/pdfs/ansinet/pjbs/2004/895-901.pdf

Duta, N. (2015). From theory to practice: The barriers to efficient communication in

teacher-student relationship. *Procedia-Social and Behavioral Sciences, 187,* 625-630. Retrieved from https://ac.els-cdn.com/S1877042815019096/1-s2.0-S1877042815019096-main.pdf

Eisenhart, M. (1991). Conceptual frameworks for research circa 1991: Ideas from a cultural anthropologist; Implications for Mathematics education researchers. In G. U. Robert (Ed.), *Thirteenth Annual Meeting North American Chapter of the International Group for the Psychology of Mathematics Education*. Virginia: Christianburg Printing Company, Inc. Retrieved from http://www.colorado.edu/physics/phys4810/phys4810_fa06/4810_readings/Eisenhart_conceptual_framework.pdf

Eltham Training Centre (2001). Rural Agricultural Development Authority (RADA) Training Course. In *Reflections on agriculture in Jamaica*. Jamaica: Inter-American Institute for Cooperation on Agriculture.

Ergen, E. (2010). *Workplace Communication : A case study on informal communication network within an organization,* (November), 1–14. Retrieved from http://www.ergen.gr/files/WorkplaceCommunicationInformalCommunicationFramework.pdf

Fallding, H. (1959). The contribution of Sociology to effective agricultural extension II. *Australian Journal of Agricultural Economics, 3*(1), 35–45. Retrieved from http://purl.umn.edu/22307

Familusi, E. B., & Owoeye, P. O. (2014). *An assessment of the use of radio and other means of information dissemination by the resodents of Ado-Ekiti, Ekiti State, Nigeria.* University of Nebraska, Lincoln. Retrieved from https://digitalcommons.unl.edu

FAO. (2003). *Addressing extension and training needs of farmers with physical disabilities: A case study of the Islamic Republic of Iran*. Rome.Retrieved from http://www.fao.org/tempref/GI/Reserved/FTP_FaoRlc/old/prior/desrural/extension/pdf/iran1.pdf

FAO. (2008). *International year of the potato 2008: New light on a hidden treasure.*

Rome.Retrieved from http://www.fao.org/potato-2008/pdf/IYPbook-en.pdf

FAOSTAT. (2004). Agricultural data. Provisional 2003 production and indices data crop primary. In Kabungo, C. V. D. (2008). *Evaluation of Irish potato production and marketing performance: A case study of Mbeya rural district, Mbeya region, Tanzania* (Master's thesis, Sokoine University of Agriculture). Retrieved from http://suaire.suanet.ac.tz:8080/xmlui/bitstream/handle/123456789/122/CATHERINE V. D. KABUNGO 2008.pdf

Federman, M. (2004). What is the Meaning of the Medium is the Message? Retrieved from http://individual.utoronto.ca/markfederman/article_mediumisthemessage.htm

Fu, X., & Akter, S. (2012). *The impact of ICT on agricultural extension services delivery: Evidence from the rural e-service project in India* (TMD Working Paper No. 046). Retrieved from https://pdfs.semanticscholar.org/0610/637ee553b94236d6ee9fc8ed0fc758e105bc.pdf

Fusch, P. I., & Ness, L. R. (2015). Are we there yet? Data saturation in qualitative research. *The Qualitative Report*, *20*(9), 1408–1416. Retrieved from https://cpb-us-east-1-juc1ugur1qwqqqo4.stackpathdns.com/sites.nova.edu/dist/a/4/files/2015/09/fusch1.pdf

Gabbott, M., & Hogg, G. (2001). The role of nonverbal communication in service encounters: A conceptual framework. *Journal of Marketing and Management*, *17*(1–2), 5–26. https://doi.org/10.1362/026725701257140

Gamble, T. K., & Gamble, M. (2010). *Communication works*. New York: McGraw-Hill Companies, Inc.

Gildemacher, P. (2006). *Poverty impact for smallholder potato farmers in Kenya through concurrent market and technical innovation*. Nairobi: International Potato Center. Retrieved from http://www.cgiar.org/www-archive/www.cgiar.org/pdf/114_CN.pdf

Gildemacher, P. R., Kaguongo, W., Ortiz, O., Tesfaye, A., Woldegiorgis, G., Wagoire, W. W., … Leeuwis, C. (2009). Improving potato production in Kenya, Uganda and Ethiopia: A system diagnosis.*American Journal of Potato Research, 86*: 373-382.

Given, L. M. (Ed.). (2008). *The Sage encyclopedia of qualitative research methods*. (Volume 1 & 2). Los Angeles: Sage Publications, Inc.Retrieved from http://www.yanchukvladimir.com/docs/Library/Sage%20Encyclopedia%20of%20Qualitative%20Research%20Methods-%202008.pdf

Government of Kenya. (2010). *Agricultural sector development strategy 2010-2020.* Nairobi.Retrieved from http://www.gafspfund.org/sites/gafspfund.org/files/Documents/5.%20Kenya_strategy.pdf

Guest, G., Bunce, A., & Johnson, L. (2006). How many interviews are enough ? An experiment with data saturation and variability. *Field Methods*, *18*(1), 59–82. https://doi.org/10.1177/1525822X05279903

Guo, K. L., & Sanchez, Y. (2005). Workplace communication. In N. Borkowski (Ed.), *Organizational behaviour in health care* (2nd ed., pp. 77–109). Canada: Jones and Bartlett Publishers. Retrieved from http://tawanmandi.org.af/knowledge-portal/Media/Workplace_communication_chapter_in_communications.pdf

Gupta, H., & Shinde, S. (2013). Agricultural extension in India. *International Journal of Management and Social Sciences Research (IJMSSR)*, *2*(11), 6–16.Retrieved from http://www.academia.edu/5370429/Agricultural_Extension_in_India

Hancock, B. (1998). *Trent focus for research and development in primary health care: An introduction to qualitative research*. Trent Focus Group. Retrieved from https://bcps.org/offices/lis/researchcourse/images/Another_text_book_chapter_IntroQualitativeResearch.pdf

Hill, C. E., Knox, S., Thompson, B. J., Williams, E. N., Hess, S. A., & Ladany, N. (2005). Consensual qualitative research: An update. *Journal of Counseling Psychology*, *52*(2), 196–205. Retrieved from https://epublications.marquette.edu

Hubbard, G. W., & Sandmann, L. R. (2007). Using diffusion of innovation concepts for improved program evaluation. *Journal of Extension*, *45*(5).Retrieved from https://joe.org/joe/2007october/a1.php

Hunt, J. U. (2006). *Defining effective message.* Technical Assistance Bulletin. Washington. D.C. Centre for Sustainable Agricultural Policy(CSAP).

ICIPE. (2013). *Push-pull and physically disabled farmers: An appropriate agricultural technology for improving livelihoods*.Retrieved from http://www.push-pull.net/Disabled-push-pull-farmers.pdf

Idowu, O. O. (2005). Farmers' perception of agricultural extension agents' characteristics as

factors for enhancing adult learning in Mezam division of Northwest Province of Cameroon. *Australian Journal of Adult Learning*, *45*(2).Retrieved from https://files.eric.ed.gov/fulltext/EJ797630.pdf

Idrisa, Y. L., Ogunbameru, B. O., & Shehu, H. (2013). Use of Information and Communication Technology (ICT) among extension workers in Borno State, Nigeria. *Journal of Agricultural Extension*, *17*(1).

IEBC. (2013). Central Imenti Constituency. Retrieved from http://www.infotrackea.co.ke/services/leadership/constituencyinfo.php?cinf=wards&t=58

Ifenkwe, G. E., & Ikpekaogu, F. (2012). Noise mitigation for effective agricultural extension print message delivery and utilization. Journal of Agricultural Extension and Rural Development *4*(2), 51–56. Retrieved from http://www.academicjournals.org/article/article1379513279_Ifenkwe%20and%20Ikpekaogu.pdf

IUCN Inter-Commission Task Force on Indigenous Peoples. (1997). *Indigenous peoples and sustainablity: Cases and actions*. University of Minnesota: International Books.

Jaetzold, R., Schmidt, H., Hornetz, B., & Shisanya, C. (2006). *Farm management handbook of Kenya (Vol 2). Natural conditions and farm management*

information (2nd ed.). Nairobi: Ministry of Agriculture, Kenya. Retrieved fromhttp://www2.giz.de/dokumente/bib/07-1282.pdf

Jiyawan, R., Jirli, B., & Singh, M. (2009). Farmers' view on privatization of agricultural extension services. *Journal of Extension Education*, *9*(3), 63–67.

Julious, S. A. (2005). Sample size of 12 per group rule of thumb for a pilot study. *The Journal of Applied Statistics in thePharmaceutical Industry*, *4*(4), 287–291.

Jwanya, B. A., Dawang, N. C., Zarmai, D. U. & Mashat I. M. (2014). Economic analysis of irrigated Irish potato production in Plateau State. *Developing Country Studies, 4*(12). Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.885.3586&rep=rep1&type=pdf

Kaguongo, W., Gildemacher, P., Demo, P., Wagoire, W., Kinyae, P., Andrade, J., … Thiele, G. (2008). *Farmer practices and adoption of improved potato varieties in kenya and uganda*. *Social Sciences working paper No 5*. International Potato Center (CIP), Lima.

Kaguongo, W. Ng'ang'a, N., & Landeo, J. (2009). *Seed potato use and projected demand in Kenya.* Preliminary report. Retrieved from http://npck.org/Books/SeedpotatousenadprojecteddemandSeedstudy.pdf

Kaguongo, W., Ng'ang'a, N. & Landes, J. (2009). Seed potato use and projected demand in Kenya. Preliminary report. Retrieved from file://npck.org/SeedpotatousenadprojecteddemandSeedstudy.pdf

Kamal, T., Nawab, K., Ullah, W., & Khan, M. U. (2014). Role of agricultural extension agents in enhancing tomato production in District Peshawar. *Journal of Economics and Sustainable Development*, *5*(27), 52–60. Retrieved from www.iiste.org/Journals/index.php/JEDS/article/download/.../18814

Kanwat, M., Meena, M. S., Kumar, P. S., Choudhary, V. ., & Bhagawati, R. (2012). Measurement of attitude towards the adoption of back yard poultry farming in Arunachal Pradesh. *Journal of Agricultural Science*, *4*(3), 131–136.

https://doi.org/10.5539/jas.v4n3p131

Kasomo, D. (2006). *Research methods in humanities and education*. Eldoret: LAP Lambert Academic Publishing.

Kavele, S. (1996). Interviews. In Gill, P., Stewart, K., Treasure, E., & Chadwick, B. (2008). Methods of data collection in qualitative research: Interviews and focus groups. *British Dental Journal*, *204*, 291–298. Retrieved from http://www.academia.edu/746649/Methods_of_data_collection_in_qualitative_research_interviews_and_focus_groups

Kinyae, P. M., Lung'aho, C., Njenga, D. N., & Kabira, J. N. (1996). Adoption of potato production technologies in Nyandarua District, Kenya. In Nyagaka, D. O. (2009). Analysis of production efficiency in Irish potato production in Kenya: The case of Nyandarua North District (Master's thesis, Egerton University). Retrieved from

http://ir-library.egerton.ac.ke/bitstream/handle/123456789/1086/

Kipkurui, W. (2015). *Assessing the effects of information and communication on the use of organic resource inputs to build soil fertility in the Central Highlands of Kenya* (Master's thesis). Retrieved from https://journalism.uonbi.ac.ke/sites/default/files/chss/journalism/journalism/M.A. PROJECT - LANGAT, WALTER KIPKURUI.pdf

Kiplang'at, J., & Ocholla, D. (2005). Diffusion of information and communication technologies (ICTs) in communication of agricultural information among agricultural researchers and extension workers in Kenya. *South African Journal of Library and Information Science, 71*(3), 234–246. https://doi.org/10.7553/71-3-591

Kiptoo, K. W., Xia, X., Mchomvu, F. E., Ali, B. Z., & Rehama, H. M. (2016). Factors influencing adoption and use of clean certified seed potato tubers among small-scale potato farmers: Evidence from Koibatek Sub County, Baringo, Kenya. *African Journal of Agriculture andEnvironment, 1*(1), 1-7.

Kiptot, E., & Franzel, S. (2015). Farmer-to-farmer extension: Opportunities for enhancing performance of volunteer farmer trainers in Kenya. *Development in Practice*, *25*(4), 503–517. http://www.tandfonline.com/doi/full/10.1080/09614524.2015.1029438

Kluge, L. M. (2001). *Hearing conservation on the farm*. Partners in Agricultural Health (Module III). Retrieved from http://worh.org/files/AgHealth/hear.pdf

Kobzev, A., & Borodina, O. (2001). Developing sustainable agricultural extension services: conceptual issues and policy implications for Ukraine. In S. Taubadel, S. Zorya, & L. Striewe (Eds.), *Policies and agricultural development in Ukraine* (pp. 240–259). Germany: Shaker Verlag.

Laititi, M. S. (2014). Potato market survey in Kenya: An agricultural product value chain approach. *International Journal of Business and Management Review*, *2*(6), 59-87.Retrieved from http://www.eajournals.org/wp-content/uploads/Potato-Market-Survey-In-Kenya-An-Agricultural-Product-Value-Chain-Approach.pdf

Lasch, K. E., Marquis, P., Vigneux, M., Abetz, L., Arnould, B., Bayliss, … Rosa, K. (2010). PRO development: Rigorous qualitative research as the crucial foundation. *Quality of Life Research*, *19*(8), 1087–1096. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2940042/

Lawal, O. A. (2015). Indigenous languages as tools for effective communication of science and technology for food production in Nigeria. *Theory and practice in language studies*, *5*(3), 463-468.Retrieved from file:///C:/Users/comp12/AppData/Local/Temp/126-487-1-PB.pdf

Lee, K. (2011). *The role of culture in agricultural technology diffusion in Ghana.*(MMSS Senior thesis).Retrieved from http://mmss.wcas.northwestern.edu/thesis/articles/get/765/Lee2011.pdf

Lengel, R. H., & Daft R. L. (1988). The Selection of Communication Media as an Executive Skill. *The Academy of Management Executive (Vol II)*, 225–

232.Retrieved from https://blogs.commons.georgetown.edu/cctp-505-fall2008/files/2008/09/selectionofcommunicationmedia.pdf

Licht, M. A., & Martin, R. A. (2007). Communication channel preferences of corn and soybean producers. *Journal of Extension*, *45*(6), 1–11. Retrieved from http://www.joe.org/joe/2007december/rb2.php

Lukuyu, B., F. Place, S. Franzel, & Kiptot, E. (2012). "Disseminating improved practices: Are volunteer farmer trainers effective?" *Journal of Agricultural Education and Extension, 18* (5), 525–540.Retrieved from http://blog.worldagroforestry.org/wp-content/uploads/2012/10/Lukuyu.pdf

Mak, V. (2008). *The Emergence of Opinion Leaders in Social Networks.* Department of Marketing, The Hong Kong University of Science and Technology. Retrieved from https://pdfs.semanticscholar.org/4fea/0a82b3fa760989496def1ed447e028cca9db.pdf

Martin, J. N., & Nakayama, T. K. (2010). *Intercultural communication in contexts*. New York: The McGraw-Hill Companies, Inc.

Mbogoh, S. G. (1976). The economics of production and marketing of potatoes in Meru District, Kenya (Masters thesis, University of Nairobi). Retrieved from http://erepository.uonbi.ac.ke/bitstream/handle/11295/26537/

McLean, S. (2005). *The basics of interpersonal communication.* Boston, MA: Allyn & Bacon.

Mead, G. H. (1934). Mind, self and society from the standpoint of a social behaviorist. Chicago: University of Chicago Press.

Meijer, S. S., Catacutan, D., Ajayi, O. C., Sileshi, G. W., & Nieuwenhuis, M. (2015). The role of knowledge, attitudes and perceptions in the uptake of agricultural and agroforestry innovations among smallholder farmers in sub-Saharan Africa. *International Journal of Agricultural Sustainability*, *13*(1), 40–54. https://www.tandfonline.com/doi/pdf/10.1080/14735903.2014.912493

Melkote, S. R. (1988a). Agricultural Extension and the Small Farmer: Revealing the

Communication Gap in an Extension Project in Kenya. *The Journal of Developing Areas, 22*(2), 239–252. Retrieved from http://www.jstor.org/stable/4191648

Melkote, S. R. (1988b). *Revealing communication constraints in extension communication strategies: A case of a project under the World Bank's T and V system, India.* Retrieved from http://files.eric.ed.gov/fulltext/ED300846.pdf

Memon, I., Panhwar, K. N., Chandio, R. A., Bhutto, A. L. & Khooharo, A. A. (2014). Role of mass media in dissemination of agricultural technology among the farmers of Jaffarabad district of Bolochistan. *Journal of Basic & Applied Sciences, 10,* 525-531.Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.868.9539&rep=rep1&type=pdf

Ministry of Agriculture (MOA). (2006). National policy on potato industry.Policy and reforms in the industry to improve production, research, marketing and regulatory framework. In Nyagaka, D. O., Obare, G. A., & Nguyo, W. (2009). *Economic efficiency of smallholder Irish potato producers in Kenya : A case of Nyandarua North District.*Paper presented at the International Association of Agricultural Economists' Conference, 16 to 22 August 2009, Beijing, China. Retrieved from http://ageconsearch.umn.edu/bitstream/49917/2/CCONTRIBUTED_PAPER_98.pdf

Mittal, S. & Tripathi, G. (2009). Role of mobile phone technology in improving small farm productivity. *Agricultural Economics Research Review, 22, 451-459.*Retrieved from *https://ageconsearch.umn.edu/bitstream/57502/2/15-S-Mittal.pdf*

Mugenda, O. M., & Mugenda, A. G. (2003). *Research Methods: Qualitative and Quantitative Approaches.* Nairobi: Acts Press.

Muthoni, J., & Nyamongo, D. O. (2009). A review of constraints to ware Irish potatoes production in Kenya. *Journal of Horticulture and Forestry, 1*(7), 98–102.

Retrieved from http://www.academicjournals.org/article/article1379686338_Muthoni and Nyamongo.pdf

Namwata, B. M., Lwelamira, J., & Mzirai, O. B. (2010). Adoption of improved agricultural technologies for Irish potatoes (Solanum tuberosum) among farmers in Mbeya Rural district, Tanzania: A case of Ilungu ward. *Journal of Animal & Plant Sciences*, *8*(1), 927–935. Retrieved from http://www.m.elewa.org/JAPS/2010/8.1/4.pdf

Ndilowe, U. M. (2013). *An investigation of the role of communication in the Malawi agriculture sector wide approach-special project (ASWAp- SP), a closer look at conservation agriculture: The case of Mitundu Extension Planning Area (EPA) in Chisamba village.* (Master's thesis, University of Oslo). Retrieved from https://www.duo.uio.no/bitstream/handle/10852/35874/NdilowexUpilexMasterxthesis[1].pdf

Ndwiga, J. N. (2014). *Challenges women farmers face in accessing agricultural extension services in Kamugere sub-location of Embu County* (Master's theis).Retrieved from http://erepository.uonbi.ac.ke/bitstream/handle/11295/76922/Ndwiga_Challenges%20women%20farmers%20face%20in%20accessing%20agricultural%20extension%20services.pdf

Neergaard, M. A., Olesen, F., Andersen, R. S., & Sondergaard, J. (2009). Qualitative description- the poor cousin of health research? *BMC Medical Research Methodology, 9: 52*

Ng'ang'a, N. M., Kinyae, P. M., Walingo, A., Wakahiu, M. W., Kipkoech, D., Muhonja, L., & Kabira, J. N. (2003). Potato production and technology dissemination in Kenya. Unpublished Report

Ngechu, M. (2006). *Understanding the research process and methods: An introduction.* Nairobi: University of Nairobi.

Nisha, M. (2006). *Understanding extension education*. Delhi: Kalpaz Publication.

Njuguna, I. M., Munyua, C. N., & Makal, S. K. (2015). Influence of demographic characteristics on adoption of improved potato varieties by smallholder farmers in Mumberes Division, Baringo County, Kenya. *Journal of Agricultural Extension and Rural Develoment, 7*(4), 114-121. Retrieved from http://www.academicjournals.org/journal/JAERD/article-full-text-pdf

Nunn, N., & Qian, N. (2011). The potato's contribution to population and urbanization: Evidence from a historical experiment. *Quarterly Journal of Economics, 126*(2), 593–650. https://doi.org/10.1093/qje/qjr009

Nwankwo, O. O. & Orji, O. (2013). Assessment of mass media contributions to agricultural technology adoption in Owerri agricultural zone of Imo State, Nigeria. *Global Advanced Research Journal of Management & Business Studies, 2*(7), 389-394.

Nyagaka, D. O. (2009). *Analysis of production efficiency in Irish potato production in Kenya: The case of Nyandarua North District* (Master's thesis). Retrieved form http://ir-library.egerton.ac.ke/bitstream/handle/123456789/1086/

Nyagaka, D. O., Obare, G. A., & Nguyo, W. (2009). *Economic efficiency of smallholder Irish potato producers in Kenya : A case of Nyandarua North District.*Paper presented at the International Association of Agricultural Economists' Conference, 16 to 22 August 2009, Beijing, China. Retrieved from http://ageconsearch.umn.edu/bitstream/49917/2/CCONTRIBUTED_PAPER_98.pdf

Oakley, P., & Garforth, C. (1985). *Guide to extension training*. Rome: Food and Agriculture Organization of the United Nations. Retrieved from http://www.fao.org/3/a-t0060e.pdf

Obayelu, A. E., Ajayi, O. D., Oluwalana, E. O., & Ogunmola, O. O. (2017). What does literature say about the determinants of adoption of agricultural technologies by smallholders farmers? *Agricultural Research & Technology Open Access Journal 6(1).*Retrieved from *https://juniperpublishers.com/artoaj/pdf/ARTOAJ.MS.ID.555676.pdf*

Obidike, N. A. (2011). Rural farmers' problems accessing agricultural information: a case study of Nsukka local government area of Enugu State, Nigeria. *Library Philosophy and Practice*.

Retrieved from https://digitalcommons.unl.edu/libphilprac/660/

Occupational Safety and Health Service. (1998). *Stress and fatigue: Their impact on health and safety in the workplace*. Wellington: New Zealand.

Ofuoku, A. U. (2012). Influence of extension agents' and farmers' communications factors on the effectiveness poultry technology messages. *Tropical Agricultural Research & Extension, 15*(1). Retrieved from https://www.google.com/#q=Ofuoku,+A.+U.+(2012).+INFLUENCE+OF+EXTENSION+AGENTS'+AND+FARMERS'+COMMUNICATIONS+FACTORS+ON+THE+EFFECTIVENESS+POULTRY+TECHNOLOGY+MESSAGES.+Tropical+Agricultural+Research+&+Extension+15(1):+2012

Ogola, P. A. (2015). *Assessing communication channels and the impact of agricultural information used by farmers in watermelon production in Limbo East Ward, Siaya County*. (Unpublished master's thesis). University of Nairobi, Nairobi.

Ogueri, E. I. (2013). Evaluation of agricultural extension messages that support adoption of improved cassava production technologies: A case of public and private sector extension in Rivers State, Nigeria. *International Journal of Sustainable Development, 6*(4), 11–24. Retrieved from http://www.ssrn.com/link/OIDA-Intl-Journal-Sustainable-Dev.html

Okali, C.,& Schambram, K. (2010). A guide to conducting a systematic literature review of information systems research.*Papers on Information Systems, 10*(26). Retrieved from https://www.researchgate.net/publication/228276975_A_Guide_to_Conducting_a_Systematic_Literature_Review_of_Information_Systems_Research

Okoedo-Okojie, D. U., & Aphunu, A. (2011). Assessment of farmers' attitude towards the use of chemical fertilizers in northern agricultural zone of Delta State, Nigeria. *Archives of Applied Science Research, 3*(1), 363–369. Retrieved from

http://scholarsresearchlibrary.com/archive.html

Okuthe, I. K., Kioli, F., & Abuom, P. (2013). Socio cultural determinants of the adoption of integrated natural resource management technologies by small scale farmers in Ndhiwa Division, Kenya. *Current Research Journal of Social Sciences*, *5*(6), 203–218.Retrieved from http://maxwellsci.com/print/crjss/v5-203-218.pdf

Okwu, O. J., & Daudu, S. (2011). Extension communication channels' usage and preference by farmers in Benue State, Nigeria. *Journal of Agricultural Extension and Rural Development*, *3*(5), 88–94. Retrieved from http://www.academicjournals.org/article/article1379429919_Okwu and Daudu.pdf

Olsen, C.,& St. George, D. M. (2004). *Cross-sectional study design and data analysis*. College Entrance Examination Board, New York.

Omiti, J. M.,& Laibuni, N. M. (2014). *Market Structure and Price: An empirical analysis of Irish potato markets in Kenya*.Future Agricultures Consortium, Brighton, UK.

Onasanya, A. S., Adedoyin, S. F., & Onasanya, O. A. (2006). Communication factors affecting the adoption of innovation at the grassroots level in Ogun State , Nigeria. *Journal of Central European Agriculture*, *7*(4), 601–608. Retrieved from file:///C:/Users/comp12/AppData/Local/Temp/jcea74_1.pdf

Otter, V., & Theuvsen, L. (2013). *ICT and farm productivity: Evidence from the Chilean agricultural export sector.* Contributed paper accepted for poster presentation at the 34. GIL-Jahrestagung – IT-Standards in der Agrar- und Ernährungswirtschaft. Bonn, Germany, February 24-25, 2014.

Oyugi, Z. (2018, August 14). National government to provide Meru farmers with certified potato seeds (Blog post). Retrieved from http://farmbizafrica.com/high-yield/2205-national-government-to-provide-meru-farmers-with-certified-potato-seeds

Palinkas, L. A., Horwitz, S. M., Green, C. A., Wisdom, J. P., Duan, N., & Hoagwood, K.

(2013). Purposeful sampling for qualitative data collection and analysis in mixed method implementation research. *Adm Policy Ment Health*, *42*(5), 533–544. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4012002/

Patton, M. (1990). *Qualitative evaluation and research methods.* Beverly Hill, CA: Sage.

Pearson, J.C.,& Nelson, P. E. (2000). *An introduction to human communication: Understanding and sharing.* (8th ed.). Boston, MA: McGraw Hill Higher Education.

Peshin, R., Vasanthakumar, J., & Kalra, R. (2009). Diffusion of innovation theory and integrated pest management. In Peshin, R. & Dhawan, A. (Eds.) Vol 2. *Integrated Pest Management: Dissemination and Impact*. Springer, Dordrecht, 1–29. Retrieved from

http://gtu.ge/Agro-Lib/Books/Integrated_Pest.pdf

Plunkett, S. (n.d.). *Symbolic interactionism theory.* Retrieved from http://mrdresherssociologyclass.weebly.com/uploads/2/3/0/7/23071366/symbolic_interactionism_bulleted_summary.pdf

Ponniah, A., Puskur, R., Workneh, S.,& Hoekstra, D. (2008). *Concepts and practices in agricultural extension in developing countries: A source book*. Ethiopia: International Livestock Research Institute.Retrieved from https://cgspace.cgiar.org/bitstream/handle/10568/99/Source_book.pdf

Qamar, M. K. (2005). *Modernizing national agricultural extension systems: A practical guide for policy-makers of developing countries.* Rome: Food and Agriculture Organization of the United Nations. Retrieved from http://www.fao.org/docrep/008/a0219e/a0219e00.htm#Contents

Rehman, F., Muhammad, S., Ashraf, I., & Hassan, S. (2011). Factors affecting the effectiveness of print media in the dissemination of agricultural information. *Sarhad Journal of Agriculture*, *27*(1), 119–124. Retrieved from http://www.aup.edu.pk/sj_pdf/FACTORS%20AFFECTING%20THE%20EFFECTIVENESS%20OF%20PRINT%20MEDIA.pdf

Rivera, W. M, Qamar, M. K., & Crowder, L. V. (2001). *Agricultural and rural extension worldwide: Options for institutional reform in the developing countries.* Rome: FAO.Retrieved from http://www.fao.org/docrep/004/y2709e/y2709e00.htm

Rogers, E. M. (1995). *Diffusion of innovations* (4 th ed.). New York: The Free Press.

Rogers, E. M. (2003). *Diffusion of innovation* (5th ed.). New York: The Free Press.

Rogers, L., & Nichof, G. (2002). The communication of agricultural research to farmers in Africa. In *Proceedings of the 2nd General Conference on Making Agriculture More Meaningful to Farmers.* Dakar, Senegal, March 24-28.

Ryan, G. W., & Bernard, H. R. (2003). Techniques to Identify Themes. *Field Methods*, *15*(1), 85–109. Retrieved from http://qualquant.org/wp-content/uploads/text/Ryan%20&%20Bernard%202003.pdf

Saeki, T., Fujii, T., Yamaguchi, S., & Harima, S. (2004). Effects of acoustical noise on annoyance, performance and fatigue during mental memory task. *Applied Acoustics*, *65*, 913–921.

Sakib, H., Safiul, I., & Ali, M. (2015). Information source preference of farmers regarding modern aquaculture technologies in Bogra District of Bangladesh. *International Journal of Agricultural Extension*, *3*(1), 1–5. Retrieved from https://www.researchgate.net/profile/Md_Hashmi_Sakib2/publication/277816819

Santucci, F. M., Alrefae, A. H. E., Nassour, G., Saker, S. E., Othman, S., & Hamzah, W. (2002). Farmers' opinion about agricultural extension service in Syria. *New Medit*, *1*(1), 56–61. Retrieved from http://www.iamb.it/share/img_new_medit_articoli/355_56santucci.pdf

Sedgwick, P. (2015). Bias in observational study designs: Cross-sectional studies. BMJ Publishing Group Ltd.

Simpson, S. D. (2016). Top agricultual producing countries. *Investopedia*. Retrieved from http://www.investopedia.com/financial-edge/0712/top-agricultural-producing-countries.aspx

Singh, R. B. (2002). *Science and technology for sustainable food security, nutritional*

adequacy and poverty alleviation in the Asia-Pacific region. Bangkok: FAO Regional Office for Asia and the Pacific. Retrieved fromhttp://www.fao.org/tempref/docrep/fao/005/AC483e/ac483e00.pdf

Sinja, J., Karugia, J. T., Baltenweck, I., Waithaka, M. M., Miano, M. D.,Nyikal, R. A. & Romney, D. (2004). Farmer perception of technology and its impact on technology uptake: The case of fodder legume in Central Kenya highlands. In *African Association of Agricultural Economists. Shaping the future of african agriculture for development: The role of social scientists. Proceedings of the Inaugural Symposium, 6 to 8 December 2004, Grand Regency Hotel, Nairobi, Kenya* (pp. 1–19). Nairobi. Retrieved from http://ageconsearch.umn.edu/bitstream/9543/1/cp04si01.pdf

Solecki, L. (1995). Evaluation of occupational exposure to noise among operators of tractors and self-propelled machines. *Aminals of Agricultural and Environmental Medicine*, *2*(2), 135–138.

Soola, E. (1988). Agricultural communication and the African non-literate farmer: The Nigerian experience. *Africa Media Review*, *2*(3), 75–91. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/12342253%5Cnhttp://archive.lib.msu.edu/DMC/African Journals/pdfs/africa media review/vol2no3/jamr002003006.pdf

Starcke, K., & Brand, M. (2012). Decision making under stress: A selective review. *Neuroscience and Biobehavioral Reviews*, *36*(4), 1228–1248.

Steinberg, S. L. (2007). *An introduction to communication studies*. Cape Town: Juta & Co. Ltd.

Sullivar-Bolyai, S., Bovac, C., &Harper, D. (2005). Developing and refraining interventions in persons with health disperities: the use of qualitative description. *Nursing Outlook, 53(3),* 127-133.

Swanson, B. E. (1998). Strengthening research-extension-farmer linkages. In B. E. Swanson, R. P. Bentz, & A. J. Sofranko (Eds.), *Improving agricultural extension. A reference manual*. Rome: Food and Agriculture Organization of the United Nations.

Syngenta Foundation for Sustainable Agriculture. (2016). *Agricultural Extension*. Syngenta Foundation for Sustainable Agriculture. Retrieved from http://www.syngentafoundation.org/index.cfm?pageID=594

Tabatabai, M. R. (2009). *The process of communication between people with categorical knowledge: An exploratory study* (Master's thesis). Retrieved from https://uwspace.uwaterloo.ca/bitstream/handle/10012/4764/Thesis submission-Rohani.pdf?sequence=1&isAllowed=y

Teddlie, C., & Tashakkori, A. (2009). *Foundations of mixed methods research: Intergrating quantitative and qualitative approaches in the social and behavioral sciences.* U.S.A.: Sage Publications, Inc.

Teijlingen, E. R., & Hundley, V. (2001). The improtance of pilot studies. *The Social Research Update,* 35. Retrieved from http://sru.soc.surrey.ac.uk/SRU35.html

The Republic of Kenya (2013). National Government Co-ordination Act No 1. of 2013. National Councile of Law Reporting.

Tologbonse, E. B., Mesini, O., & Tsado, J. H. (2006). Farmers' perception of sources of information in relation to adoption of improved technology by farmers in inland valley swamps of middle-belt zone of Nigeria. *Journal of Agricultural Extension, 9*,63-73

UN. (2008). *The milleniun development goals report*. United Nations. Retrieved from http://www.un.org/millenniumgoals/2008highlevel/pdf/newsroom/mdg%20reports/MDG_Report_2008_ENGLISH.pdf

UNFCCC. (2016). Views on issues relating to agriculture. In *Subsidiary Body for Scientific and Technological Advice. Forty-fourth session Bonn, 16–26 May 2016*. Retrieved from http://unfccc.int/resource/docs/2016/sbsta/eng/misc01.pdf

Velentzas, J., & Broni, G. (2014). Communication cycle : Definition , process , models and examples. In *Proceedings of the 5th International Conference on Finance, Accounting and Law (ICFA '14)* (pp. 117–131). Retrieved from http://www.wseas.us/e-library/conferences/2014/Istanbul/FINANCE/FINANCE-00.pdf

Wafula, C. K. (2015). *Comparative analysis of communication channels for diffusion and adoption of quality protein maize: The case if Kathonzweni and Kirinyaga, Kenya* (Master's thesis). Retrieved from http://erepository.uonbi.ac.ke/bitstream/handle/11295/94023/Wafula_Comparative%20Analysis%20Of%20Communication%20Channels%20For%20Diffusion.pdf?sequence=4&isAllowed=y

Wang'ombe, J. G., & Dijk, M. P. (2013). Low potato yields in Kenya: Do conventional input innovations account for the yields disparity? *Agriculture & Food Security, 2*(14). https://doi.org/10.1186/2048-7010-2-14

Waterman, A. (2004). Diffusion of innovations (Commentary). Retrieved from http://web.stanford.edu/class/symbsys205/Commentary-RogersDiffusionInnovations.html

Winters, M., MacIntyre, E., Peters, C., Thom, J., T., Teschke, K., & Davies, H. (2005). *Noise and hearing loss in farming*. Langley. Retrieved from https://open.library.ubc.ca/cIRcle/collections/facultyresearchandpublications/304/items/1.0048187

Wolfe, A. (1994). Organizational innovation; Review, critique and suggested research directions. *Journal of Management Studies, 31*(3), 405–431.

World Bank Operations Evaluation Department (WBOED). (1999). *Agricultural extension: The Kenya experience.* Pre'cisWinter 1999, No 198i. Retrieved from http://lnweb90.worldbank.org/oed/oeddoclib.nsf/docunidviewforjavasearch/b728d887fc2b754d852568bd005a8c19/$file/198precis.pdf

Yahaya, M. K. (2002). *Gender and communication variables in agricultural information dissemination in two agro-ecological zones of Nigeria.* Research Monograph. Ibadan: Corporate Graphics Ltd.

Zhou, Y. (2010). Smallholder agriculture, Sustainability and the Syngenta Foundation. *Syngenta Foundation Foundation for Sustainable Agriculture,* 1–15.Retrieved from https://pdfs.semanticscholar.org/b6b9/3f6cdeffc8b92278df329c4a2662b80a1bbb.

pdf

APPENDICES

App**endix 1: Letter of Introduction**

Kinya Kathure Kigatiira,

Jomo Kenyatta University of Agriculture and Technology,

Department of Media Technology and Applied Communication,

P.O. Box 62000-00200,

Nairobi.

TO WHOM IT MAY CONCERN

Dear Sir/ Madam

RE: RESEARCH DATA COLLECTION

I am a doctoral student in the Doctorate in Mass Communication program at the Jomo Kenyatta University of Agriculture and Technology. I am in the process of writing my doctoral dissertation and I am collecting data for that purpose. For my doctoral dissertation I am interested in exploring the effect of shared meaning between extension officers and farmers on the adoption of Irish potato farming in Meru County.

I would appreciate the opportunity to meet with you and discuss the practice of your specialty. Any further insights you have would be greatly appreciated. The information

that you give will be confidential and will be used exclusively for writing my dissertation. Your co-operation will be highly appreciated.

Yours Sincerely,

Kinya K. Kigatiira

Appendix 2: Interview Guide for Extension Officers

1. Respondents demographics

a) How old are you? _____
b) What is your gender? _____
c) Which is your highest educational level? _____
d) How many years have you worked as an agricultural extension officer? _____

2. Main interview guidelines

i. Communication channels used to disseminate information on adoption of Irish potato farming

a) Which mass media channels do you use to communicate Irish potato technologies to farmers? Probe: radio, television, newspapers, audio tapes, posters, magazines, newsletters etc. Why?
b) How often do you send agricultural extension messages on the adoption of Irish potato farming through mass media channels?

c) Which interpersonal communication channels do you use to communicate messages on adoption of Irish potato farming to the farmers? Probe: group discussions/ meetings, seminars, workshops, visits, exhibitions/agricultural shows, others.
d) How often do you send agricultural extension messages on the adoption of Irish potato farming through interpersonal channels?
e) Which channels do you prefer sending agricultural extension messages on the adoption of Irish potato farming? Explain.
f) Which factors do you consider when choosing a channel of communicating information on adoption of Irish potato farming?
g) Are you able to get the farmers feedback once you communicate to them? Explain.
h) Is the feedback immediate or delayed? Explain.
i) What is the effect of communication channels on adoption of Irish potato farming?

ii) Nature of extension messages

a) Which language(s) do you use to communicate to the farmers about adoption of Irish potato farming? Which language is most used, followed by which and why?
b) Do the farmers understand the language(s) you use to communicate to them? How do you know?
c) Which information do you communicate to farmers on the adoption of Irish potato farming? Probe: crop diseases, fertilizers, pesticides, new potato varieties, others.
d) Which information do farmers mostly ask for regarding the adoption of Irish potato farming, during agricultural extension communication?
e) Are you able to give information in subject areas where farmers seek information?
f) Do farmers comprehend Irish potato farming messages that you share with them? Explain?
g) Which information on adoption of Irish potato farming do farmers find difficult in understanding? What is the reason(s)?

h) What is the effect of the nature of extension messages on the adoption of Irish potato farming?

iii) Communication context

a) Where do you exchange extension information with farmers? Probe: Farm, homestead, office, hall. Why?
b) How often do you meet with the farmers at the stated place to disseminate agricultural information?
c) Do farmers understand the extension information at the place where you communicate? Explain?
d) Are you from the same cultural background as the farmers? Explain.
e) How is your relationship with the famers? Explain?
f) How does your relationship with the farmers affect shared meaning on adoption of Irish potato farming information?
g) When/ in which situations do you send agricultural extension messages on adoption of Irish potato farming? Probe: in village meetings, during campaigns.
h) Which agricultural messages on the adoption of Irish potato farming, do you send in the above stated situations? Why?
i) Do the farmers understand the information on adoption of Irish potato farming that you convey to them in the above stated situations? Explain.
j) What is the effect of communication context on the adoption of Irish potato farming?

iv) Noise

a) Which types of noise deter you from effectively transmitting agricultural extension messages? Explain? Probe: physical, psychological, linguistic, cultural, mechanical and physiological noise.
b) When and where do the above types of noise that you have stated often occur?
c) How do you reduce the various types of noise when they occur?

d) Apart from noise, state other barriers that deter you from sharing meaning with farmers on the adoption of Irish potato farming?
e) How do you overcome the above stated barriers that deter you from sharing meaning with farmers on the adoption of Irish potato farming?
f) What effect does noise have on the adoption of Irish potato farming?

v) Adoption of Irish Potato Farming

a) How has agricultural extension communication affected the adoption of Irish potato farming? Probe: Increased, decreased or no change.

b) What other factors other than communication influence the adoption of Irish potato farming? Probe: reduced land size for growing Irish potatoes, farmers cultivating other crops, low market prices for produce, others. Explain.

c) How do you rate farmers' adoption of Irish potato farming technologies? Probe: innovators, early adopters, early majority, late adopters and laggards?

v) Concluding question

a) Suggest ways of improving shared meaning between extension officers and farmers on the adoption of Irish potato farming.

Appendix 3: Introduction and Instructions for Focus Group Discussion

Welcome and thank you for volunteering to take part in this focus group. You have been asked to participate as your point of view is important. I realize you are busy and I appreciate your time.

Introduction: This focus group discussion is designed to determine the effect of shared meaning between extension officers and farmers on the adoption of Irish potato farming. The focus group discussion will take no more than two hours. May I tape the discussion to facilitate its recollection? (If yes, switch in the recorder).

Anonymity: Despite being taped, I would like to assure you that the discussion will be anonymous. The transcribed notes of the focus group discussion will contain no information that would allow individual subjects to be linked to specific statements. You should try to answer and comment as accurately and truthfully as possible. The other focus group participants and I would appreciate it if you would refrain from discussing the comments of other group members outside the focus group. If there are any questions or discussions that you do not wish to answer or participate in, you do not have to do so. However, please try to answer and be as involved as possible.

Ground rules

Only one person speaks at a time.

There are no right or wrong answers.

You do not have to speak in any particular order.

When you have something to say, please do so.

You do not have to agree with the views of other people in the group.

Appendix 4: Focus Group Discussions Guide

Interview Guide for Farmers

A. Respondents demographics

Can each one of you please tell us you name, age, number of years you have farmed Irish potatoes and your highest level of education.

B. Main interview guidelines

i) Communication channels used to disseminate information on adoption of Irish potato farming

a) Which mass media communication channels do you receive information on Irish potato technologies from agricultural extension officers? Probe: radio, television, newspapers, magazines, newsletters, audio tapes, posters etc
b) How often do you receive agricultural extension messages on the adoption of Irish potato farming through mass media channels?
c) Which interpersonal communication channels do you receive information on Irish potato technologies from agricultural extension officers? Probe: group discussions/ meetings, seminars, workshops, visits, exhibitions/agricultural shows, others.
d) How often do you receive agricultural extension messages on the adoption of Irish potato farming through interpersonal channels?
e) Which channels do you prefer for receiving agricultural extension messages on adoption of Irish potato farming? Why?
f) Are you able to give the extension officer(s) feedback once you receive agricultural information through the channel(s) that you have stated?
g) What is the effect of communication channels on adoption of Irish potato farming?

ii) Nature of extension messages

a) Which language(s) do extension officer(s) use to disseminate information on Irish potato farming? Which language is most used, followed by which and why?
b) Do you understand the language(s) used by the extension officer(s) to disseminate information on the adoption of Irish potato farming?
c) Which information is communicated to you by the extension officers on the adoption of Irish potato farming? Probe: crop diseases, fertilizers, pesticides, new potato varieties, others.
d) Which information on adoption of Irish potato farming do you often seek from the extension officers?

e) Are the extension officers able to give you the required information in subject areas where you seek information? Explain.
f) Do you understand the information on Irish potato farming that is communicated to you by the extension officer? Explain.
g) Which information on adoption of Irish potato do you find difficult in understanding? What is the reason(s)?
h) What is the effect of the nature of extension messages on the adoption of Irish potato farming?

iii) Communication context

a) Where do you exchange Irish potato farming information with extension officers? Probe: Farms, homesteads, agricultural shows/exhibitions, offices, halls, *baraza*, others. Why?
b) How often do you meet with the extension officers at the above stated place(s) to exchange Irish potato farming information?
c) Do you understand Irish potato farming information at the place where communication takes place?
d) Are you from the same cultural background as the extension officers? Explain.
e) How is your relationship with the extension officers? Explain.
f) How does your relationship with the extension officers affect shared meaning on adoption of Irish potato farming?
g) When/ in which situations do you receive agricultural extension messages on adoption of Irish potato farming from the extension officers? Probe: in village meetings, during campaigns.
h) Which agricultural messages on the adoption of Irish potato farming, do you receive in the above stated situations? Why?
i) Do you understand the information on adoption of Irish potato farming that you receive in the above stated situations? Explain.

j) What is the effect of communication context on the adoption of Irish potato farming?

iv) Noise

a) Which types of noise would you say you encounter when you are communicating with extension officers?
b) When and where do the above types of noise that you have stated often occur?
c) How do you reduce the various types of noise when they occur?
d) Apart from noise, state other barriers that deter you from sharing meaning with extension officers on the adoption of Irish potato farming?
e) How do you overcome the above stated barriers that deter you from sharing meaning with extension officers on the adoption of Irish potato farming?
f) What effect does noise have on adoption of Irish potato farming?

v) Adoption of Irish potato farming

a) What effect does agricultural extension communication have on the adoption of Irish potato farming? Probe: High, low, no adoption.
b) What other factors other than communication influence your adoption of Irish potato farming?
c) How do you rate your adoption of Irish potato farming technologies? Probe: innovators, early adopters, early majority, late majority and laggards?

vi) Concluding question

a) Suggest ways of improving shared meaning between extension officers and farmers on the adoption of Irish potato farming.

Conclusion

Thank you for participating.

Your opinions will be a valuable asset to the study.

I would like to remind you that your comments will be anonymous.

Appendix 5: Reasearch Permit

NATIONAL COMMISSION FORSCIENCE, TECHNOLOGY ANDINNOVATION

Telephone:+254-20-2213471,
2241349,3310571,2219420
Fax: +254-20-318245,318249
Email: dg@nacosti.go.ke
Website: www.nacosti.go.ke
When replying please quote

9th Floor, Utalii House
Uhuru Highway
P.O. Box 30623-00100
NAIROBI-KENYA

Ref: No. **NACOSTI/P/17/36208/18624**

Date: **16th August, 2017**

Kinya Kathure Kigatiira
Jomo Kenyatta University of
Agriculture and Technology
P.O. Box 62000-00200
NAIROBI.