COMPARATIVE ANALYSIS OF COMMUNICATION CHANNELS FOR DIFFUSION AND ADOPTION OF QUALITY PROTEIN MAIZE: THE CASE OF KATHONZWENI AND KIRINYAGA, KENYA

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DECLARATION AND APPROVAL

I, Carolyne Khalayi Wafula, declare that this thesis is my original work and has not been presented for a degree in any other university or any other award.

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DEDICATION

This work is dedicated to my loving son Brian, for his love, concern and prayers while undertaking my studies and journey mercies when traveling to the university. May the Good Lord grant him the wisdom of knowledge as he climbs the academic ladder.

Secondly, to my dear parents, mum Naliaka and dad Benson for their prayers towards my success and achievement. May the almighty God keep watching over them. Finally but not the most least, to my loving brother Felix and his family for their encouragement in every academic step I took. May the Good Lord bless you.

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ABSTRACT

Despite the use of various communication strategies in Kenya, access and use of agricultural information by rural farming communities and other actors along the agricultural information chain is inadequate to cope with challenges in crop production leading to high levels of poverty. In Kirinyaga and Makueni counties, poverty levels of people living in urban areas are 26 % and 35% respectively, with about 67% of the rural populations living below the poverty line. This study, therefore, investigated how different communication channels used in disseminating new or proven agricultural technologies in Africa by the DONATA project among the smallholder farmers in Kirinyaga in Central and Kathonzweni in Eastern counties of Kenya have influenced the farmers decision to adopt quality protein maize (QPM).

Random sampling technique was used to select respondents for the survey and primary data collected using structured questionnaires which involved 210 farmers, comprising of 110 from Kathonzweni and from 100 Kirinyaga. Descriptive statistics, covariance analysis and binary logistic regression were applied through SPSS application to ascertain the factors contributing to diffusion and adoption of QPM technologies.

The levels of quality protein maize awareness in Kathonzweni were much higher 100% compared to Kirinyaga 98%. Farmer to farmer and farmer groups in Kirinyaga and extension services in Kathonzweni play a major role in farmer awareness of quality protein maize technologies. The results from the binary logistic regression indicates socio economic characteristics in Kathonzweni and Kirinyaga such as age and marital status play a big role in diffusion and adoption of quality protein maize. Field days in both study regions contributed significantly to increased QPM adoption. Farming was found to be the main source of income with 97.3% in Kathonzweni and 98% Kirinyaga. Lack of seed and climate change were major constraints affecting agricultural production in the study areas.

It is therefore recommended that farmer field days, demonstrations, farmer field schools, farmer to farmer and group meetings continue being promoted through increased extension visits, and investing in farmer education via seminars, as vehicles of disseminating agricultural innovations. Information and communication technologies like radio, mobile

phone and television should be used to complement the conventional channels which promote access to quality protein maize information. This will increase adoption, hence increased production and high yields which will be part of the solution to food insecurity and raising poverty levels in the country.

Keywords: Adoption process, Communication, Diffusion, Diffusion process, Quality protein maize.

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ABBREVIATIONS AND ACRONYMS

ANOVA	Analysis of variance
CBOs	Community-based organizations
DONATA	Dissemination of New or Proven Agricultural Technologies in Africa
FARA	Forum for Agricultural Research in Africa
KARI	Kenya Agricultural Research Institute
QPM	Quality Protein Maize
ICT	Information Communication Technology
GoK	Government of Kenya
SSA	Sub-Saharan Africa
FAO	Food Agricultural Organization
NGO	Non-Governmental Organizations

CHAPTER ONE

INTRODUCTION

1.1 Background Information

Agriculture is the backbone of the economies of most Sub Saharan Africa (SSA) countries and constitutes about 60% of the total labour force, 20% of the total exports and accounts for 17% of the Gross Domestic Product (Asaba *et.al.,* 2006). In Kenya, the agriculture sector is the mainstay of the economy and a major driver of community livelihoods (GoK, 2009). It is classified as a priority sector by the Government of Kenya because of its significant contribution towards the national economy, food security, employment creation, poverty reduction, and overall enhancement of rural livelihoods. The sector provides livelihood support to about 70 per cent of rural communities and contributes on annual basis approximately 24% of the national GDP. The sector accounts for 65 percent of Kenya's total exports and provides more than 60 percent of informal employment in the rural areas. In Kenya, smallholder farmers, including agro-pastoralists and pastoralists contribute approximately 12% to the country's gross domestic product (FAO, 2005), with the livestock sector providing an estimated 90% of all employment opportunities and more than 95% of the household incomes in the ASALs (Kaimba *et al*. 2011). In addition, the agricultural sector also provides the basis for development of other agricultural related socio-economic sectors including trade, industry, livestock, and horticulture among others (GoK, 2002).

Maize, although one of the world's most important food crops has a restricted nutritional value for humans and other monogastric animals, since it is deficient in essential amino acids, especially lysine (Nelson 1969). According to Nuss and. Tanumihardjo (2011), maize provides macro- and micronutrients required for humans and lacks adequate amounts of the essential amino acids such as lysine and tryptophan. For those consuming >50% of their daily energy from maize, pandemic protein malnutrition may exist. Severe protein and energy malnutrition increases susceptibility to life-threatening diseases such as tuberculosis and gastroenteritis Nuss and Tanumihardjo (2011).

Various efforts and initiatives towards development of agricultural technologies have been put in place to enhance and stabilize agricultural production in Kenya but with unsatisfactory anticipated outcomes. For example, the low adoption of quality protein maize production is partly due to limited uptake of appropriate technologies as a result of the poor economic bases of the majority of farming communities, and mainly due to lack of the requisite knowledge and information for driving the anticipated transformation. The poor linkage between agricultural research and advisory services also exacerbates the low and slow adoption of new agricultural technologies and practices by farmers. In the majority of cases, research undertaken does not address the actual needs of farmers.

Effective communication is crucial for the transfer of requisite information and knowledge in agriculture (Deane, 2007). Communication has been described as the key to changing the unsustainable situations of conventional agriculture (Servaes and Malikhao, 2007; Shea and Montillaud-Joyel, 2005). However, skills in communication have technical, structural and methodological aspects, as well as a "soft" facet concerning the attitudes, culture and behavior of the actors (FAO and GTZ, 2006).

Behavioral change in particular, though neither easy, nor fast, is an essential step towards transformation leading to knowledge and information driven agricultural practices that could assure commercialization of the sector. This calls for clear understanding of communication needs of all actors, the requisite capacities and related information content as well as the requisite skills and channels needed for efficient transmission of information in a manner that removes misunderstandings in messaging, wastage and inadequacy in language and content. The "traditional" linear, top-down model for communication is still very much strong in the minds of the actors and guides their behavior, even though there is little or no evidence of the success of this approach (FAO and GTZ, 2006).

In Kenya, maize is the main staple food for a large proportion being produced by over 90% of national households in areas where it is grown with population living in both urban and rural areas (GoK, 2007). Its consumption is estimated at 98 kilograms per person per year, which translates to roughly 30 to 34 million bags (2.7 to 3.1 million metric tons) per year. Maize is also important in Kenya's crop production patterns, accounting for approximately 28 percent of gross farm output from the small-scale farming sector (Jayne *et al.*,2001).

Nearly half Kenya's 40 million people are poor, and unable to meet their daily nutritional requirements (IFAD, 2013). The vast majority of these people lives in rural areas and is mainly comprised of smallholder subsistence farmers.

Despite improvement in living conditions since the early 1980s, the poverty level has remained steady at about 48 per cent (MDG, 2012). The rural economy depends mainly on smallholder subsistence agriculture, which produces 75 per cent of total agricultural output (IFAD, 2013).

One of the recent advances in agricultural technology in Kenya is the development of the quality protein maize (QPM) crop variety for food security enhancement. QPM produces 70-100% more of lysine and tryptophan than the most modern varieties of tropical maize. These two amino acids allow the body to manufacture complete proteins, thereby eliminating wet-malnutrition. Kwashiorkor, also called wet protein-energy malnutrition, is a form of Protein-energy a potentially fatal body-depletion disorder characterized primarily by protein deficiency. It is the leading cause of death in children in developing countries. This condition usually appears at about the age of 12 months when breast-feeding is discontinued, but it can develop at any time during a child's formative years. It causes fluid retention (edema); dry, peeling skin; and hair discoloration. In addition, tryptophan can be converted in the body to Niacin, which theoretically reduces the incidence of Pellagra (Nigussie, *et al*, 2001).

Babies and adults consuming quality protein maize are healthier and at lower risk for malnutrition related disorders such as marasmus and kwashiorkor. Data from Latin America and Africa show the grain's role in reversing the effects of malnutrition among those already affected (Nigussie, *et al*, 2001). Quality protein maize offers an equivalent of 90% of the nutritional value of skim milk, the standard for adequate nutrition value. In addition, pigs fed on QPM experience rapid weight gain and are ready for market sooner or can provide an additional quality protein source for small farm families (Nigussie, *et al*, 2001).

QPM hybrids have been developed and tested for varying climatic and growing conditions. QPM varieties are grown on roughly 9 million acres (36,000 km²) worldwide. Meanwhile, QPM research and development have spread from Mexico to throughout Latin America and

to Africa, Europe, and Asia. In total, the QPM germplasm has grown to contribute over $1 billion annually to the economies of developing countries (Kataki and Babu, 2003).

In Kenya, there have been several initiatives, though at project level, aimed at testing various communication strategies that could enhance information dissemination and uptake of new innovations by farmers. One notable example is the ongoing project entitled "Dissemination of New or Proven Agricultural Technologies in Africa (DONATA)" being conducted in Kathonzweni and Kirinyaga sub- counties. This project has been faced with several constraints during the out scaling and upscaling phases of QPM technologies and innovations. One of the biggest challenges is the lack of knowledge by farmers which could be as a result of inappropriate packaging of information, lack of clarity in messages and inappropriate communication channels for disseminating the QPM technologies and practices among others.

1.2 Statement of the Problem

Low agricultural production has been attributed, among other factors, to poor linkages among Research-Advisory Service-Farmers and to ineffective technology delivery systems, including poor information packaging, inadequate communication systems and poor ways of farming (FAO and GTZ, 2006). In Kenya, today, critical gaps exist in the use of recommended technologies and the actual outputs of the technology used at farm level. This is occasioned by a range of factors that include lack of appropriate communication structures, methodologies and tools, poor identification of farmers' needs and priorities, inappropriate research programs, poor or irrelevant extension information and technologies and the low capacities of farmers' technological innovations uptake. The purpose of agricultural research is to increase production through technologies, practices and information, which can be achieved if the technology generated is widely adopted by farmers. Akinola, (2004) pointed out that channels through which agricultural technologies are being communicated to farmers are inefficient and ineffective in spearheading adoption of the recent technologies and practices. Indeed, despite the efforts made by the quality protein maize (QPM) research project in Kenya, there remains a big adoption and production differential of quality protein maize across study areas. The diffusion of information on quality protein maize has proved challenging as transfer of knowledge, technology and practices to farmers

has been difficult, thereby creating communication gaps between researchers and farmers. However, some scanty information exists from the on-going project activities in the selected study regions but this is not easily available. Consequently, knowledge of the importance and production of quality protein maize has not been well diffused to farmers.

Rees *et.al.*, (2000) noted that poor communication is a result of uncoordinated channels of information delivery to farmers which has been a major hindrance to information flow between researchers and farmers. Existing channels have not been used in context with social system through which quality protein maize is supposed to diffuse or spread thus rendering them in-effective. The channels have also not been carefully assessed for strengths and weaknesses so that they are more appropriately utilized. This has contributed to the low farmer awareness of quality protein maize production which might be one of the major causes of poverty and the recurrent food insecurity.

This study, therefore, sought to analyse the influence of different communication channels used in diffusing innovations on farmers' decision to adopt Quality Protein Maize (QPM) in Kathonzweni and Kirinyaga sub- counties.

1.3 Study Objectives

1.3.1 Overall Objective

The overall objective of this study was to analyze the influence of existing communication channels being used by the Dissemination of New or Proven Agricultural Technologies in Africa (DONATA) project on farmers' decisions to adopt quality protein maize technologies in Kirinyaga and Kathonzweni Sub counties.

1.3.2 Specific Objectives

The specific objectives of the study were:

a) To determine the level of awareness on the QPM technology among farmers in Kathonzweni and Kirinyaga Sub counties
b) To identify the existing communication channels used in the dissemination of technologies and practices for production of quality protein maize in Kathonzweni and Kirinyaga Sub counties.

c) To assess the influence of the communication channels in (b) above on the uptake of quality protein maize technologies and practices by farmers.
d) To determine the socio-economic factors that influence preference of communication channels.
e) To compare the effectiveness of mass media and interpersonal channels in disseminating information, technologies and practices for quality protein maize production to farmers.

1.4 Research Hypotheses

The following hypotheses were tested:

a. Communication channels determine the rate of adoption of quality protein maize.
b. Farmers' socio-economic conditions do not influence access to and use of available communication channels.

1.5 Significance of the Study

The results from this study provide valuable information to agricultural researchers, extension officers and policy makers in the country on how to implement effective agricultural communication strategies. The study has also provided feedback from farmers that are helpful in refining the technology generation and identified appropriate communication channels with great potential to influence rapid adoption of an agricultural innovation through the diffusion process. Finally, this study provides mechanisms for bridging the knowledge capacity and communication gaps between farmers in both Kirinyaga and Kathonzweni sub counties and research institutions, extension and other stakeholders that will go a long way to addressing the nutritional, food security and poverty challenges afflicting farming communities through quality protein maize production.

1.6 The study area

The maize growing areas in Kenya are distributed over six Agro Ecological Zones (AEZs) defined by Hassan (1998). This study was conducted in two sites, namely, Kirinyaga County and Kathonzweni Sub County under the medium mid altitude (MM) and the dry medium altitude (DM) agro-ecological zones respectively.

1.6.2 Kathonzweni Sub County

Kathonzweni Sub County is located in Makueni County of eastern Kenya lying between Latitude 1^0 35´ and 3^0 00 South and Longitude $37^0$10´ and 38^0 30´East. Figure 1 presents a map showing the location of the study area.

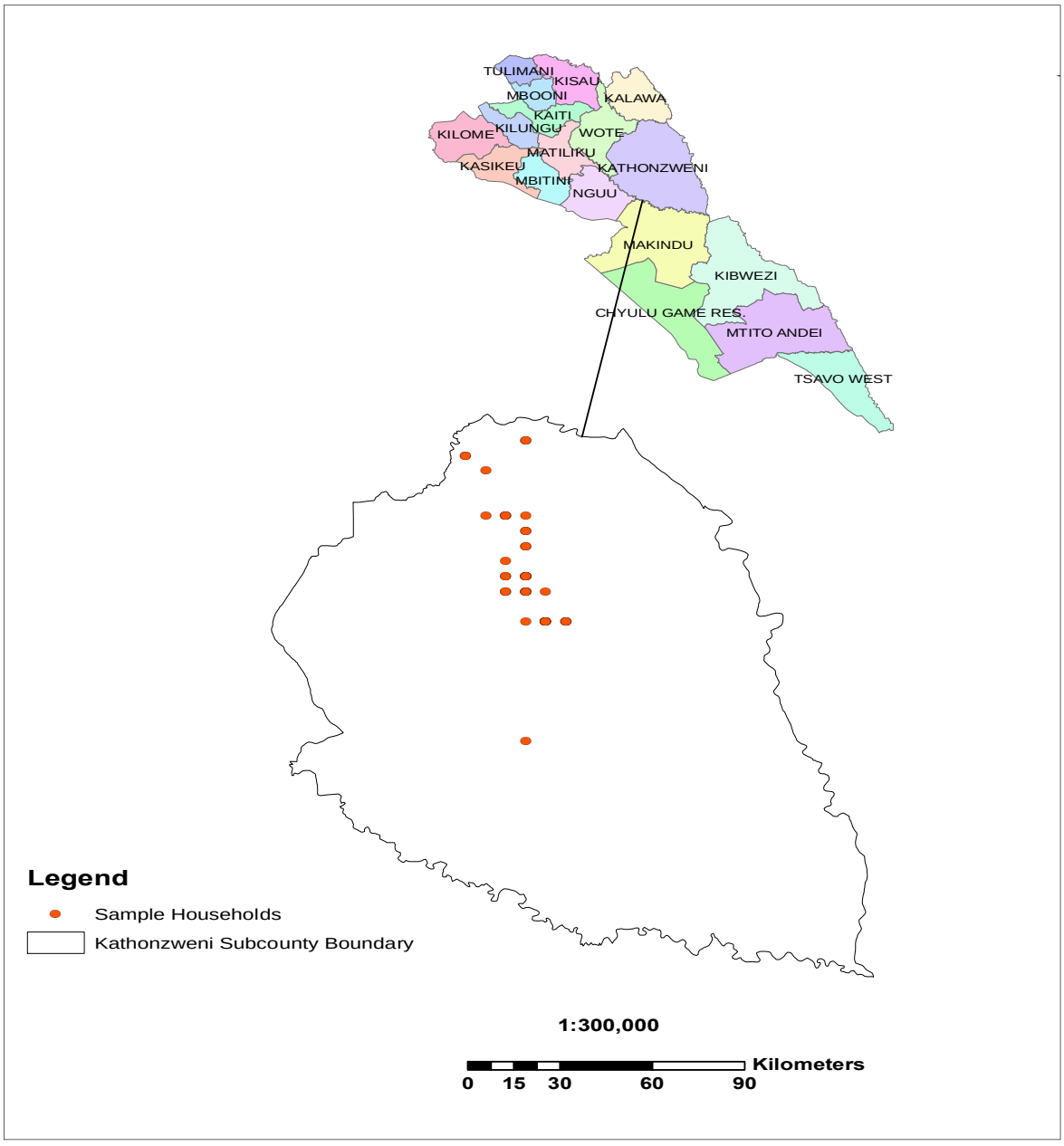


Figure 1: Location of Study Area Showing Sample Households in Kathonzweni Sub-County in Makueni County

The climate of Kathonzweni area is characterized by a generally erratic bimodal rainfall regime comprising of the long (March to May) and short (October to December) rainy seasons. Annual rainfall totals vary from 1000 mm to slightly below 500mm. The sub-county falls within the Upper Midland 2 (UM2) agro-ecological zone and is generally covered by deep sandy alluvium and red sandy soils in addition to patches of black cotton soils. Livestock farming especially keeping of goats is a major economic activity while crop farming is practiced for subsistence purposes (GoK, 1994-1996: 1997-2001).

The quality protein maize varieties available to farmers in these regions are, KH631Q, KH500Q and WS104Q. The first two varieties are bred for moist mid altitude and moist transitional areas. The latter, is bred for dry mid altitude, dry transitional and lowland tropics (Charles Bett *et al* 2012). The decision by farmers in Kathonzweni was inclined more towards the western seed variety WS104Q and KH 500Q as opposed KH 631Q and KH500Q. This is an indication of some degree of information dissemination on the different varieties on the farmers' part and their agro ecological zone suitability.

The sub county has a total population of 884,527 with a total of 186,478 households and covers an area of 8008.8 km^2. The Population density is 110.4 people per km2 and 50.5% of the populations live below the poverty line (Makueni County Integrated Development Plan, 2013).

Accessibility in Kathonzweni is relatively good during dry seasons but the roads are usually impassable during the rainy season thus poor road infrastructure.

1.6.2 Kirinyaga County

Kirinyaga County is located in central Kenya and lies within latitudes 00°10'S and longitudes 37°18'E. The county lies between 1,158 metres and 5,380 metres above sea level in the South and at the Peak of Mt. Kenya respectively. The total area coverage of the sub county is 1,479.1 Km^2 and has a total of 154,220 households. Figure 2 shows the location of the study area.

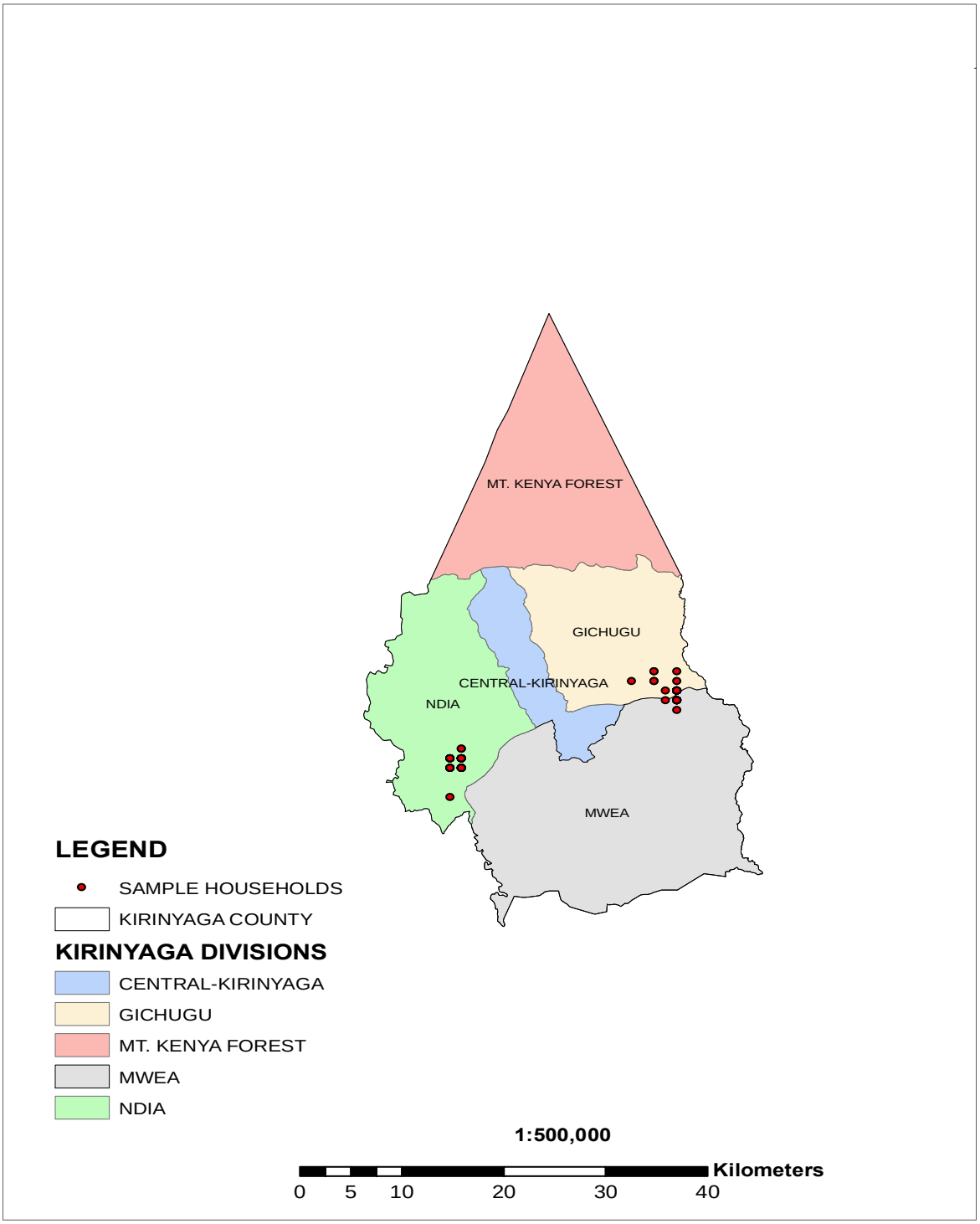


Figure 2: Location of Study Area showing Sample Households and Kirinyaga County

The climate of the county is characterized by a bimodal rainfall distribution with long rainy season being experienced in March to May and the short rainy season occurring in October to December. The rainfall ranges between 1,100mm and 1,250mm per annum. Air temperatures range from a minimum of 12°C to a maximum of 26°C with an average of 20°C.

The region is the most densely populated County with 309 persons/Km^2). Some strengths of the County include natural resources such as Mt. Kenya, forests, hills, rivers, arable land, and tourist attractions like Mt. Kenya. The main economic activities of the sub county include horticulture, tea and coffee farming, fishing, and commercial businesses. Kirinyaga is one of the wettest counties in central Kenya.

1.7 Scope and Limitations of the Study

The study covered two regions of Kenya, namely Kirinyaga County and Kathonzweni Sub County purposely selected from the wider dissemination of New or Proven Agricultural Technologies in Africa (DONATA) project areas in Kenya. One limitation however, was the small number of farmers selected from the wide regions of Kathonzweni and Kirinyaga due to the limited number of farmers who were already participating under the DONATA project. Further, the expansive areas of the study regions could not be fully covered by this study due to limited financial resources and time constraints.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter commences by giving an overview of quality protein maize followed by a description of the communication and dissemination channels, diffusion research, adoption, adopter categories, and a detailed explanation of the Socio-economic factors that influence dissemination channels utilized by farmers in adopting agricultural innovations. The traditional approaches for disseminating agricultural technologies and information to farmers have also been covered. The Conceptual framework underpinning this study is presented in the last section of this chapter.

2.1 Overview of Quality Protein Maize

A nutritionally superior maize cultivar named quality protein maize (QPM) represents nearly one-half century of research dedicated to malnutrition eradication. Compared with traditional maize types, QPM has twice the amount of lysine and tryptophan, as well as protein bioavailability that rivals milk casein. Animal and human studies suggest that substituting QPM for common maize results in improved health (Emily and Tanumihardjo, 2011). Mertz *et al*. (1964) pointed out that the mutation opaque-2 (02) practically doubled the lysine content in the maize endosperm. However, the negative effects brought on the physical properties of the endosperm and other important agronomic traits have limited its wide-spread use in the development of better nutritional quality maize. The identification of modifier genes able to overcome the negative effects of the opaque-2 mutation Paez *et al*. (1969), gave rise to the development of opaque-2 modified genotypes, designated as Quality Protein Maize or simply QPM (Gevers and Lake (1992), Villegas *et al.* (1992). QPM grains present the hardness and the vitrosity of normal genotypes, while the high lysine content of the opaque-2mutants is maintained.

Quality Protein Maize (QPM) was developed by Dr. Surinder Vasal and Dr. Evangelina Villegas at the International Maize and Wheat Improvement Center (CIMMYT) in the late 1990s. For their achievement, they won the 2000 World Food Prize, (Palit and Suresh, 2003).

QPM contains nearly twice as much usable protein as other maize (or corn) grown in the tropics and yields 10% more grain than traditional varieties of maize. However, there has been lack of awareness particularly among smallholder farmers on nutritional value of the quality protein maize, which has long affected the livelihoods of smallholder farmers in Africa. It is hoped that this constraint could be overcome through increased farmer awareness which will increase adoption and hence production of quality protein maize.

In Central and South America, Africa, and Asia, several hundred million people rely on maize as their principal daily food, for weaning babies, and for feeding livestock. Unfortunately maize (corn) has two significant flaws; it lacks the full range of amino acids, namely lysine and tryptophan, needed to produce proteins, and has its niacin (vitamin B_3) bound in an indigestible complex. The Mayans and Aztecs used to boil maize in the alkaline limewater which broke down the complex so that the Niacin became available. The Aztec and Mayans are among the most dominant and advanced civilizations that developed in the Americas prior to the arrival of the Europeans. However in the main, this practice did not transfer to the Old World or settlers in the "New World" which resulted in epidemics of Pellagra from the 16th century onwards (Palit and Suresh, 2003). In addition diets high in corn produce a condition known as wet-malnutrition in which a person receives sufficient calories, but the body malfunctions due to lack of protein. A chronic lack of protein in the diet leads to kwashiorkor.

Some of the main challenges of Quality Protein Maize (QPM) production in Kenya include lack of knowledge and information by farmers. However, various approaches used in Kathonzweni to reach out to farmers include agricultural shows, field days and World Food Days. These forums are used by the project to share knowledge on QPM technologies and innovations. During the field days, shows and world food fairs, dissemination is done through actual training and demonstrations. This is supplemented with the use of leaflets, posters and actual parading of QPM products.

Modified maize with higher protein content dates back to the 1920s, and the “opaque-2” variety was developed in 1963. While its lysine and tryptophan levels were better than those of conventional maize, opaque-2 had lower yields and a soft, chalky kernel, which made it more susceptible to ear rot and insect damage. Moreover, the taste and kernel

appearance dissatisfied consumers, who ultimately rejected the enhanced-protein varieties in the market (Mandefro and Twumasi-Afriyie, 2001).

2.2 Quality Protein Maize Communication and Dissemination Channels

Ewhrudjakpor (1989) defined communication simply as a dynamic process of sharing information between individuals. Adebayo (1997) conceptualized communication as a process of information flow by which ideas are transferred from a source to a receiver with the intent to change his/her knowledge, attitude and/or skills. The source in the agricultural sector is the research or an extension officer who takes the new technology to a farmer in order to change the farmers knowledge, attitude and skills of farming.

Several communication channels have been used to disseminate the Knowledge and information on quality protein maize to farmers. This has been done through various activities at the innovation platforms. The activities include use of group or satellite demonstration plots, training (both formal and informal), shows (agricultural shows and World Food days), use of leaflets and electronic media. Farmers established group demonstration plots popularly known as satellite plots for training group members and scaling out QPM technologies and innovations.

Electronic media has not been widely used, except in Kirinyaga County which has been using Radio Maria for disseminating QPM technologies through regular radio programmes. The availability of new information technologies and media, like the internet, rural radio, mobile phones and TV, open more channels for communication and give the chance for wide access to information and to a limited extent also to interactive communication (FAO and GTZ, 2006). So far, little attention has been given to farmer preference for certain channels of receiving Quality protein maize information and knowledge, and socio-economic factors influencing access to information. Yet this is important if these farmers are to be empowered to make their own choices and decisions in relation to the adoption and use of quality protein maize.

Two levels of capacity building in terms of training have been carried out to share Quality Protein Maize (QPM) knowledge among farmers. The first level of training was carried out for the extension, other stakeholders and farmers referred to as training of trainers (TOTs).

Kirinyaga and Kathonzweni including other regions benefited from an important knowledge sharing forum that covered the entire QPM value chain.

Agricultural shows, field days and World Food Days are other avenues where knowledge has been shared and QPM technologies and innovations disseminated. Although agricultural shows are rarely used, field days and world food were popular avenues where QPM technologies are showcased. During the field days, shows and world food fairs dissemination is done through actual training, demonstrations and this is supplemented with the use of leaflets, posters and actual parading of QPM products.

Adebayo (1997) pointed out that communication is a key process in information dissemination in agriculture. The development of agriculture requires, among others, a timely and systematic transmission of useful and relevant agricultural information from the technology generation system (source) via various communication changes to the intended audience (receiver). It is expected that the client's changes in behaviour as a result of the message received (effect) be passed back to the source (feedback) for the communication process to be complete.

According to Rogers (2003), Mass Media is a major influence on the public's awareness of new innovations. The people we interact with on a regular basis are another avenue of influence. Others are much closer to us friends, family, and co-workers. Our technology choices are influenced by their choices and recommendations. Thus, understanding the diffusion of an innovation is greatly facilitated by understanding the communication channels and social networks involved. As such, many diffusion studies identify who talks to who and how adoption spreads through the identified social network. Some individuals are more influential than others. For example, Extension Officers are often highly connected within the network with farmers. They may decide to adopt or reject a technology of which farmers are likely to follow suit.

Jonassen and Reeves (1996) explained two major approaches to using media and technology in agriculture where farmers can learn "from" media and technology, and they can learn "with" media and technology. Learning "from" media and technology is often referred to in terms of instructional television, computer-based instruction, or integrated learning systems (Hannafin, *et al* 1996).

According to Lasswell and Harold (1948) communication can only be understood if, you know who says what, in which channel, to whom and with what effect. Lasswell stated, the "Who" referred to "control analysis," the "Says What" referred to "content analysis," the "In Which Channel" referred to "media analysis," the "To Whom" referred to "audience analysis," and the "With What Effect" referred to "effect analysis."

2.3 Diffusion Research

An influential study of diffusion was carried out by Ryan and Gross (1943) on seed corn in Iowa communities in the United States. The adoption of hybrid corn meant that Iowa farmers had to make important changes in the corn-growing behavior. The nature of networks and the roles opinion leaders (researchers and extension agencies) play in them determine the likelihood that the innovation will be adopted. Innovation diffusion research has attempted to explain the variables that influence how and why users adopt a new information medium, such as the Internet use among opinion leaders and other respondents. Rather, opinion leaders are the natural preference for farm information Rogers (1995).

Rogers (1962) described diffusion of innovations as a theory that seeks to explain how, why, and at what rate new ideas and technology spread through cultures. In the agricultural sector, it could very well be embedded in the dissemination of variety of technologies to other identified communication channels. It also explains how farmers practice some technologies, why they prefer some and at what rate they incorporate new ideas into their practice.

Diffusion approach has realistic appeal in getting research results as it provides solutions to individuals and research organizations with vested interest in search of some topic and seeks to get the scientific findings utilized. It also assists those who want to use the research results to solve particular social problem or fulfill a need. In addition, diffusion approach helps connect research based innovations including agricultural innovation such as the Quality Protein Maize (QPM), with the potential users of such innovations in a knowledge utilization process.

2.4 Adoption of Agricultural Innovations

The rate of adoption is defined as the relative speed with which members of a social system adopt an innovation. Rate is usually measured by the length of time required for a certain percentage of members of a social system to adopt an innovation (Rogers, 1962:134). Same innovation such as QPM could be adopted more rapidly in certain systems than it is in the others. He defines an innovation as "an idea, practice, or object that is perceived as new by an individual or other unit of adoption". In this study, QPM is a new idea and adoption being production technologies practiced by farmers. A communication channel is "the means by which messages get from one individual to another". The channels for example might be radio, extension, farmer groups, television, demonstration etc. The innovation-decision period is the length of time required to pass through the innovation-decision process". "Rate of adoption" is the relative speed with which an innovation is adopted by members of a social system". "Social system is defined as a set of interrelated units that are engaged in joint problem solving to accomplish a common goal". The members of the social system in this study refers to opinion leaders such as chiefs, church leaders, group leaders, extension and researchers who play a crucial role in influencing the farmers decision whether to adopt the quality protein maize.

Adoption of a technology may be measured by both the timing and extent of new technology utilization by individuals (Sunding and Zilberman, 2001:229). Different communication channels play different roles at various stages in the innovation-decision process. An individual (farmer) passes through different stages (knowing and persuasion, for example) in the process of adopting a new idea such as the quality protein maize. The research offer useful means of gaining understanding of change as innovations are a type of communication message whose effects are easy to isolate.

2.5 Adopter Category

Adopter categories are the classifications of members of a social system on the basis of innovativeness including innovators, early adopters, early majority, late majority and lastly laggards (Rogers, 2003). Innovativeness is the degree to which a farmer adopts an

agricultural innovation (QPM) as a new idea earlier than other farmers. Innovators are the first farmers to adopt the QPM, (appendix 3).

2.6 Theories Guiding the Study

This study was guided by three theories: diffusion of innovations theory, adoption theory, and the uses and gratification theory. The understanding of farmers' information use habits and preferences as well as the process of adoption of an innovation and its diffusion in a social system is well elaborated from the three theories.

Ryan and Gross (1943) first drew attention to the existence of a sequence of stages in the process of adoption by farmers: (1) "awareness" of the existence of an innovation (2) "conviction" of its usefulness, (3) "acceptance" in the sense of willingness to try the innovation which is followed by its (4) "complete adoption". The existence of an adoption process involving four interrelated stages was also outlined by Wilkening (1953). He described the adoption of innovation as a process composed of learning, deciding and acting over a period of time. He identified four adoption stages, namely, awareness, obtaining information, conviction, and trial and adoption.

Diffusion of innovation theory predicts that media as well as interpersonal contacts provide information and influence opinion and judgment. Diffusion research centers on the conditions which increase or decrease the likelihood that a new idea such as the introduction of quality protein maize, production, or practice will be adopted by members of a given cultural setting. Five adopter categories have been identified as (1) innovators, (2) early adopters, (3) early majority, (4) late majority, and (5) laggards (Rogers, 2003) see appendix 2.

An innovation within a social system takes place through its adoption by individual farmers or groups. Adoption is a decision to make full use of an innovation as the best course of action available. The decision to adopt an innovation, however, "is not normally a single, instantaneous act" but a process. . The "adoption process" is a decision-making process that goes through a number of mental stages before making a final decision to adopt an innovation.

In reference to Straub (2009), adoption theory examines the individual and the choices an individual makes to accept or reject a particular innovation and is a micro-perspective on change, focusing not on the whole but rather on the pieces that make up the whole. Information reduces uncertainty and hence is critical in the decision a person may take in choosing to accept or reject an innovation. Conversely, the diffusion of innovation theory takes a macro-perspective on the spread of an innovation across time as it describes how an innovation spreads through a population.

The gratification theory approach focuses on *why* people use particular media rather than on content. The uses and gratifications theory originated from the functionalist perspective on mass media communication and was first developed in research on the effectiveness of the radio medium in the 1940s (Luo, 2002). Its approach is informed by the function. This implies that peoples' needs influence what media they would choose, how they use certain media and what gratifications the media gives them. This theory will therefore bring an understanding of why farmers might prefer one media (channel) choice as opposed to the other.

2.7 Socio-Economic Factors Influencing Utilization of Dissemination Channels by Farmers in Adopting Agricultural Innovations

Socioeconomic factors such as educational level, experience in farming (years), age, farm size, gender and level of income have major roles to play in determining the communication dissemination channel through which a farmer can choose to receive information. For instance, a poor farmer who cannot afford to purchase a radio, mobile phone or television set cannot fully benefit from agricultural radio and television programmes and documentaries being broadcasted.

According to a research carried out by Mamudu *et al.* (2012), the factors that influence the adoption of modern agricultural production technologies are broadly categorised into economic factors, social factors and institutional factors. Economic factors include farm size, cost of technology or modernization, expected benefits from adoption of the technology, and off-farm activities. The social factors that influence probability of adoption of modern agricultural production technologies by farm households include age, level of education and

gender. All these social factors are found to significantly influence the decisions of farm households to adopt modern agricultural production technologies. Institutional factors including access to information and extension services were found to significantly influence farm households' probability of adopting modern agricultural production Mamudu *et al.* (2012).

Studies by Nsabimana and Masabo (2005) found that lack of formal and non-formal education could be considered as the main factor for the non-adoption of innovations. They also concluded that factors which promote adoption of agricultural technologies include sensitization on advantages of the technology, literacy, age, technical information and exposure to technology. Omosa (2000) also asserts that success or failure of the use of communication channels heavily depends on socioeconomic factors such as the literacy level (education level) and wealth status as well as other factors including political environment.

2.8 Traditional Approaches for Disseminating Agricultural Innovations to Farmers

The extension officers in the Ministry of Agriculture Livestock and Fisheries (MoALF) have been working closely with researchers and other stakeholders including farmers in disseminating the Quality Protein Maize (QPM) technologies especially in Kathonzweni Sub County. Anderson and Feder (2007) defined agricultural extension as the "delivery of information inputs to farmers" and also refer to a form of education that introduces new knowledge and technology to farmers. Agricultural extension is about sharing scientific findings and know-how with farmers and helping them capture a greater share of the Value chain." Investing in the sharing of knowledge and learning for farmers through extension and training can be an effective means of reducing poverty and promoting food security and sustainable development. A combination of traditional and modern communication methods (Radio, magazines, television, internet and mobile phone) can help extension workers to improve the quality in dissemination of agricultural innovations.

In supporting the traditional methods (Field demonstrations and field days), the application of information and communication technologies (ICTs) has inadequately given farmers ability to access information for improved crop productivity despite the perceived increased

benefit(Weiss *et al.,*2000). Traditional methods do not reflect the many well-documented ways in which agricultural innovation actually occurs, such as experimentation by individual farmers, informal networking among farm communities, private sector participation, collaboration among extension workers interested in a particular idea, collaboration between researchers and farmers, and the adaptation by all of these actors of knowledge and practices from domains outside agriculture.

An agricultural show is also a public event exhibiting the equipment, animals, sports and recreation associated with agriculture and animal husbandry. The agricultural shows therefore have been used as communication channel to disseminate QPM and other agricultural technologies.

2.9 Conceptual Framework

During communication, the idea is rarely evaluated from a scientific standpoint; rather, subjective perceptions of the innovation influence diffusion. The process occurs over time. Finally, social systems determine diffusion, norms on diffusion, roles of opinion leaders and change agents, types of innovation decisions, and innovation consequences.

The leading and most influential model of innovation is the Everett Rogers's Diffusion of Innovations (Rogers, 2003). He is viewed as the pioneer of Technology adoption research. According to Rogers, on which the conceptual framework for this study was based and built, four main elements including innovation, communication channels, time, and a social system influence the spread of a new idea. He adds that individuals experience 5 stages of accepting a new innovation: knowledge, persuasion, decision, implementation, and confirmation. If the innovation is adopted, it spreads via various communication channels.

The conceptual framework for the study is presented in Figure 3 showing communication channels influencing the diffusion and quality protein maize adoption process.

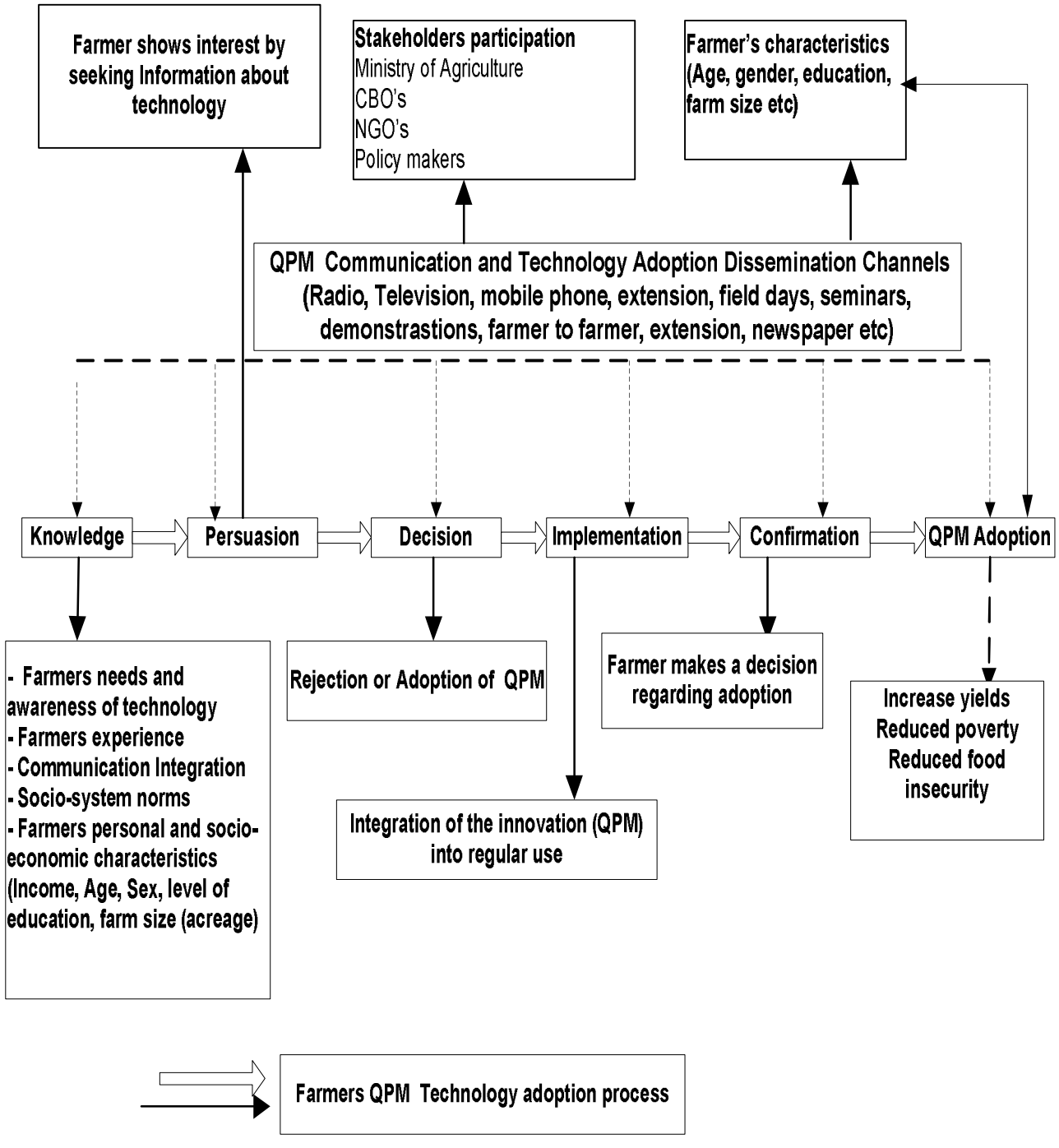


Figure 3: Conceptual Framework (Modified from; Rogers, 2003)

At the knowledge stage, the farmer is first exposed to an innovation but lacks information about the innovation. During this stage of the process, the farmer has not been inspired to find more information about the innovation. The farmer at persuasion stage is interested in the innovation and actively seeks information/detail about the innovation. At the decision stage, the farmer takes the concept of the change and weighs the advantages/disadvantages of using the innovation and decides whether to adopt or reject the innovation. The decision might be influenced by change of attitude towards uptake of an innovation.

The farmer's attitude on whether to adopt quality protein maize or not might be determined by knowledge and perception towards the technology. In reference to, Burton *et al*, (2006), people in many situations need to acquire new skills and self-perception that allow newly acquired attitudes and intentions to be translated into actions. However, even when new skills have been learned, there is no guarantee that actions will follow. A farmer's change of attitude does not take place in a vacuum, but is indeed influenced by the social context in which they occur. The decision of a farmer on whether to adopt quality protein maize or not, may be affected by views from the extension and other factors such as education, age, income, farm size, and the community at large.

For example, a farmer with relatively high level education or well positioned in social networks has greater access to information including new technologies which has an effect on their perceptions and attitudes. On the other hand, a farmer with favourable climate and good soil, like in Kirinyaga County may have a positive attitude towards an agricultural innovation compared to a farmer in Kathonzweni Sub County who is faced with more challenging circumstances. A new farmer often seeks advice on how an innovation is produced, while younger farmers may seem to be more receptive to agricultural innovations.

Some economic factors such as income might influence the farmer's attitude. This may determine the affordability choice of communication channels that enables the farmer take advantage of the choice made which includes accessibility of information. Farm size has also been considered as an important determinant of adoption. Farmers with large farms

are more likely to participate in the production of quality protein maize on large scale compared to those with small farm sizes. Internal factors such values and beliefs of a farmer towards an innovation have an important impact on their behavior as by suggested (Burton et al, 2006) that attitudes have a greater effect on behaviour in particular circumstances; for example, when the attitudes in question are consistent with underlying beliefs, based on high amounts of issue-relevant information and personal experience, are formed as the result of considerable issue-relevant thinking.

It has been noted that, for farmers just as an entire population, there are specific 'moments of change' when it is easier to make alterations to farm management practices. The 'moments of change' arise periodically when fundamental farm management changes are required, such as when farmers plan to exit, diversify, extend or intensify production. The windows of opportunity as such are particularly important because on these occasions, change is inevitable and all of the options available will have costs (either financially or in terms of farm management). Consequently, farmers are likely to be more receptive to suggestions as to how change may be accomplished most efficiently. At this point, it is important for a famer to capitalize upon such moments because after the decision has been made, farmers are likely to be locked into the chosen practices for some time (Burton *et al*, 2006).

In the implementation stage, a farmer employs the innovation to a varying degree depending on the situation. During this stage the farmer determines the usefulness of the innovation and may search for further information about it. A farmer may change the usual habits and practices as it may be necessary. Rogers (2003) explains that during this stage, re-invention may occur. Re-invention refers to the process by which a farmer adapts or modifies a technology to better meet his/ her needs and improve its overall compatibility.

Confirmation is the final stage where the farmer finalizes his/her decision to continue using the innovation. A farmer at this point may finalize the decision regarding the adoption of the technology. One option is exactly to adopt an innovation because at this point, the farmer is committed, for example, to adopting quality protein maize to its fullest potential that can benefit him.

CHAPTER THREE

DATA AND METHODOLOGY

3.0 Introduction

This chapter presents a detailed description of the theoretical framework, data types and sources, sampling procedures including sampling frame, operational definitions of study variables, and methodologies for data collection and analysis. These items are described sequentially in the subsections that follow.

3.1 Theoretical Framework

This study set out eight theoretical statements upon which a model theoretical framework for the study was formulated. The farmer needs and interests were first established, then awareness of the existence of quality protein maize and gaining understanding of its importance with regard to nutritional value were determined. The farmer was exposed to a communication channel where he/she either formed a positive or negative opinion towards the quality protein maize. The farmer at some point was engaged in activities which lead to acceptance or rejection of the Quality Protein Maize (QPM). A decision was made by the farmer but risked reversing to previous decision if exposed to previous dissemination channels. An interaction between a farmer and the extension officer occurred which might have led to an increase in the yield through adoption of modern technologies.

The theoretical framework developed for the study is presented in Figure 4

Model

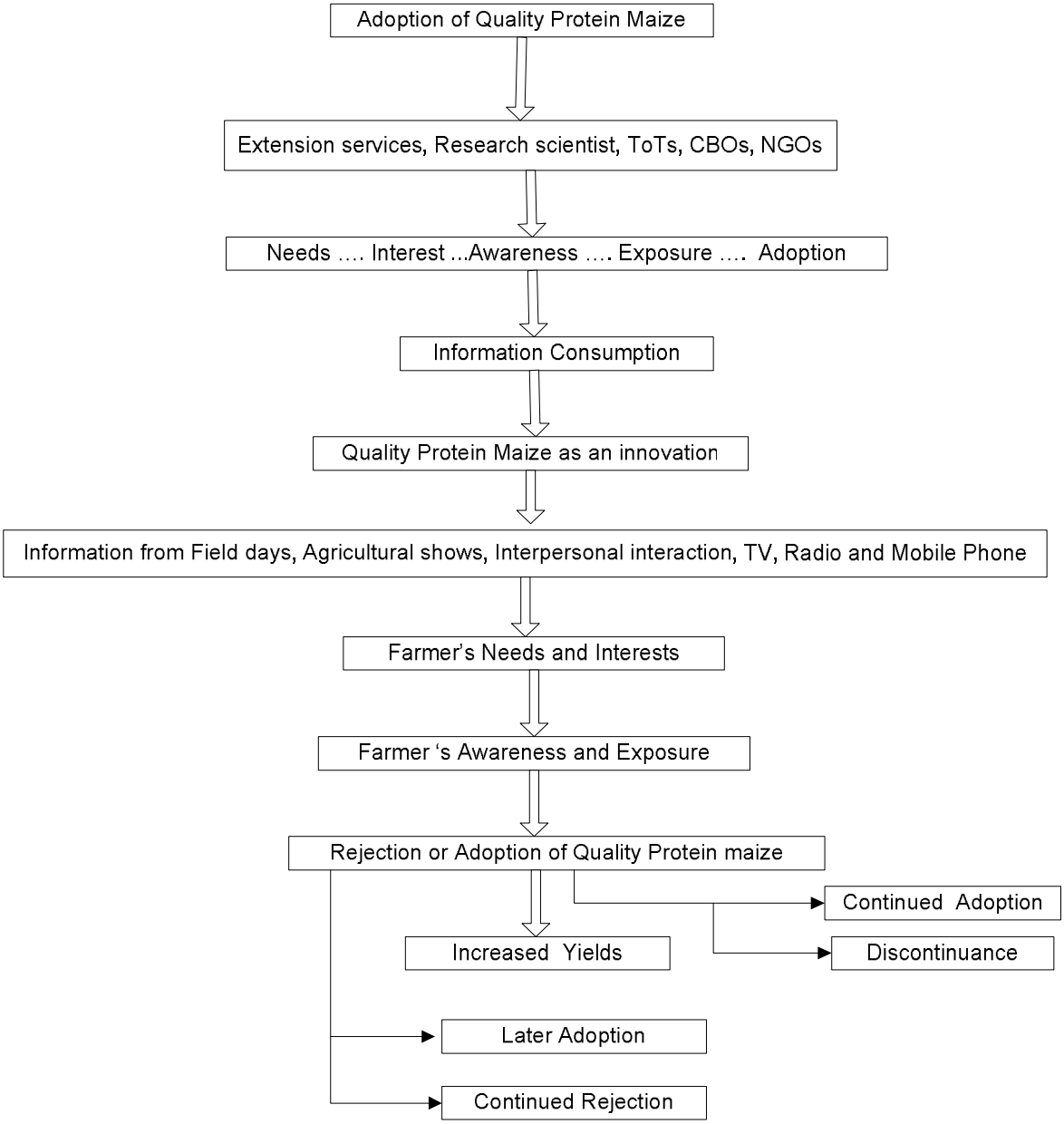


Figure 4: Theoretical Framework Model for the Study (Author's own conceptualization)

3.3 Sampling and Sample Size

Participating farmers in this study were randomly selected from existing farmer groups in the sites where quality protein maize trials were being conducted in both Kirinyaga and Kathonzweni areas. The farmers were sorted into three adopter categories (appendix 3) classified by Rogers (2003) based upon how they quickly adopted the technology. In Kathonzweni, the farmers were sampled from different sub-locations namely Mavindini central, Kanthuni, Mathangathi, Thavu, Kinthini and Kitumbai. The study in Kirinyaga was conducted from the specific project farmers in the catholic diocese of Murang'a, from different sub-locations namely Kanjuu, Githumbu, Mirichi, Maitha-Rui, Gariambu and Merisi. A list of a total of 440 farmers was obtained from the Ministry of Agriculture Office, Kathonzweni and from the Catholic Diocese of Murang'a for Kirinyaga site. A total of 230 farmers were selected for Kathonzweni Sub County, while Kirinyaga had a total of 210 farmers.

The sample size for this study was determined using the Cochran's (1977) formula (-) for categorical data given in equation 1.

$$n = \frac{\square}{\square\square\square(\square)^{\square}} \qquad \text{---------- (1)}$$

where N - target population size

n - sample size

α - set level of significance (taken as 0.05)

Table 1 shows the resultant distribution of sample sizes by study site with the overall sample size of 210 from a total population of 440, and a sampling proportion of 48%.

Table 1: Sampling and Sample Size

	Population size	Sample size
Kathonzweni	230	110
Kirinyaga	210	100
Total	440	210
Sampling Fraction		21/44
Sampling Proportion		47.73%

Since farmers in Kathonzweni belonged to 10 groups while in Kirinyaga, farmers belonged to 5 groups, it was necessary to ensure that everyone in each group of population was represented according to population proponents to the size. To achieve this goal, therefore, the study used random but proportionate sampling approaches leading to 110 members from Kathonzweni Sub County and 100 members from Kirinyaga county. Proportionate sampling is a sampling strategy that is used when a population is composed of several subgroups that are vastly different in number. With proportionate stratification, the sample size of each stratum is proportionate to the population size of the stratum. This gave each stratum the same sampling fraction.

For Kathonzweni Sub County, 10 strata (A – J) were identified with corresponding population sizes of 20,25,15,16,20,30,34,15,25, and 30. A sampling fraction of 53 was adopted. Table 2 presents the final sample sizes that were used for this study.

Table 2: Proportionate Stratified Random Sampling for Kathonzweni

Strata	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**
Population size	20	25	15	16	20	30	34	15	25	30
Sampling fraction	53	53	53	53	53	53	53	53	53	53
Final sample size	10	12	7	8	10	14	16	7	12	14

For Kirinyaga County, 5 strata (A – E) with corresponding population sizes of 60, 30, 40,45,and 35 were adopted. A sampling fraction of 48 was used. Table 3 presents the final sample sizes that were used in Kirinyaga County.

Table 3: Proportionate Stratified Random Sampling for Kirinyaga

Strata	A	B	C	D	E
Population size	60	30	40	45	35
Sampling fraction	48	48	48	48	48
Final sample size	29	14	19	21	17

3.4 Data Types and Sources

Primary data, both qualitative and quantitative, that was required for the analysis and evaluation of farmers' access to information sources as well as their preferred dissemination pathways for receiving quality protein maize information was collected from selected farmers engaged in QPM project activities in the study areas.

3.5 Data Collection

A household survey instrument deployed was the structured questionnaire (Appendix A) which was administered in Kathonzweni and Kirinyaga to QPM famers as the research instrument to capture the data required to achieve the objectives of this study. In Kathonzweni 110 farmers were randomly selected from farmer groups, while 100 farmers in Kirinyaga were also selected from the farmers involved in QPM production. In this case, the farmer was considered as a sampling unit and the household as the observation unit.

3.5 Data Analysis

Different methodologies for analysis of qualitative and quantitative data were employed in this study. The respective approaches used are described in the sub sections that follow.

3.5.1 Descriptive Statistics

The SPSS version 21 statistical analysis software (IBM SPSS 21) was used for descriptive, regression and analysis of variance (ANOVA). Descriptive statistics were employed for analyzing specific objectives (a) and (c) to characterize the samples used in this study as well as their respective observations by respondent farmers. The methodology involved computations of frequencies and associated frequency distributions, the means, median,

percentages and standard deviation. The study also provided a synthesis of the general characteristics of farmers interviewed and their preferred channels of communication.

3.5.1 Correlation Analysis

To establish relationships between socio economic factors and communication channels, covariance analysis was carried out to find out how they are strongly correlated with adoption and dissemination of quality protein maize technologies. The socio economic characteristics and channels of communication used in the study areas were each correlated with the rate of adoption of the Quality Protein Maize to depict the degree of association among these variables. The socio economic characteristics used are age, gender, marital status, income, distance and education. The communication channels used included seminars, field days, demonstrations, extension visits, farmer to farmer, radio, television, mobile phones, magazines and farmer groups. The correlation coefficients have been reported as computed by SPSS application software.

To measure the effectiveness of communication channels, the channels were grouped into three categories including conventional, mass media and print media. To categorize the effective communication channels, the average percentage of ranks based on the farmer preference were calculated and the average percentage from the rankings of the communication channels scored on a basis of their effectiveness.

3.5.3 Binary Logistic Regression

Study variables in section 3.5.2 which had significant correlation coefficients with the rate of diffusion of QPM were regressed on the adoption of QPM to obtain quantitative relationships governing the rate of uptake of QPM. The form of the regression function used in this analysis is given.

Y=A+ *x1 ï *x2 - *x3 - *x4 + *x5.

Where Y= Adoption of QPM

A= the intercept (constant)

X_1¨ X_5 = variables under study where X_1 = Age, X_2= education, X_3 = marital status, X_4 = Gender, X_5, = Farm size.

µ= Error term which was assumed to be evenly distributed across the study population

3.5.4 Effectiveness of Media

The binary logistic regression was used to examine the effectiveness of mass media compared to conventional channels of communication in disseminating quality protein maize technology among the farmers was undertaken using the regression function below.

Y=A+ *x1 ï *x2 - *x3 - *x4 + *x5.

Where Y= Adoption of QPM

A= the intercept (constant)

X_1¨ X_5 = variables under study where X_1 = Field days, X_2= extension, X_3 = demonstrations, X_4 = television, X_5, = radio.

µ= Error term which was assumed to be evenly distributed across the study population

3.6 Operational Definition of Variables

The study variables, both dependent and independent types, are defined in Table 4 below.

Table 4 Definition of the Dependent and Independent Variables

Dependent Variable s	**Description**
QPMP	Farmer production of QPM (1=Yes, 0=None)
Income	Annual on-farm / off-farm income in kshs. in categories: A is 0-5000, B= 5001-10000, C= 10001-15000, D=15001-20000 E=20001-25000 , F = 25001-30000, G=30001-35000, H=35001-40000, I=40001-45000, J=45001-50000, K>50001
Independent Variables	**Description**
Age	Age (farmer's age in years), thus the number of years of the respondent. In categories: 1 = < 18 _____2 = 8-30_____ 3 =31- 40_____,4 = 41-50 _____, 5 = 50) _____
Gender	Gender of the household head (1=Male, 2= Female)
Mrtalstatus	Marital status of the respondent 1= Married, 2 =Single, 3 = Widowed, 4 = Divorced
Educlev	Level of educational attainment of the respondent in years. Categories: 1-8 = Primary, 8-12= Secondary, 12 -15= Tertiary, >15 = University
Famsize	Family size (No of children)
Onffincom	On-farm income of the respondent from farming
Offincom	Off-farm income of the responded in categories: 1= Self employed, 2 = Formal employment, 3 = Casual employment, 4 = Business, 5 = Remittances, 6 = Loans
Lstkval	Livestock value (Number of cattle the respondent has)
Ownership	Land ownership of the farm in categories: 1 = Free hold, 2 = Leasehold/Rented, 3 = Communal, 4 = Borrowed, 5 = Squater
Dstnifoctre	Distance from nearest information market (in Kilometers)
Frmsize	Farm size (hactres) categories: 1=<5_____, 2= 5-10_____, 3=10-15____, 3= 15-20_____ , 4= >20 _____.
Extvisits	Number of visits an extension officer pays a farmer
Dist	District (1=Kirinyaga, 2=Kathonzweni)
Massmedia	Mass media channels of communication in categories: 1=Radio, 2=Tv, 3=Print Media, 4=Mobile phone
Conchnncommun	The conventional channels of communication in categories: 1= Research, 2=Field days, 3=Demonstrations, 4=Agricultural shows/Exhibitions, 5=Seed fairs, 6=Training/seminars
AccQPM	Access measure by the number of times an extension officer visits the farmer

CHAPTER 4

RESULTS AND DISCUSSION

4.0 Introduction

This chapter presents the results of this study together with a detailed discussion of the results in line with the specific objectives and methodologies outlined in Chapter Three. A careful Identification of the existing communication channels used in the diffusion of quality protein maize technologies in Kathonzweni and Kirinyaga is made. Farmer preferences with regards to communication channels that influence the rate of adoption of quality protein maize by farmers, influence of socio-economic factors on the rate of adoption and preference of communication channels have been presented and discussed.

4.1 Communication Channels Used for Disseminating Quality Protein Maize Technologies in Kathonzweni and Kirinyaga.

The level of awareness and choice of available dissemination channels are crucial for adoption and sustainability of any technology. These attributes are presented in the subsections that follow in the context of Kathonzweni and Kirinyaga Sub counties.

4.1.1 Farmer Awareness of QPM Technology

Table 5 presents the results of the level of awareness of the existence of the QPM technology between the farmers of the two study regions.

Table 5: Awareness of Quality Protein Maize

Sub county	Awareness of QPM (% respondents)	
	No	**Yes**
Kathonzweni	0.0%	100.0%
Kirinyaga	2.0%	98.0%

Source: Survey data, 2014

According to Table 5, the levels of awareness of the existence of QPM in Kathonzweni were much higher (100%) compared to Kirinyaga (98%) despite QPM having been introduced much earlier in Kirinyaga (2008) compared to Kathonzweni (2010). This might have been caused by inappropriate communication dissemination pathways of QPM in Kirinyaga among other factors.

4.1.2 Dissemination Channels for QPM Technology in Kathonzweni and Kirinyaga

Table 6 shows a range of communication channels used for disseminating the quality protein maize technology.

Table 6: Channels through which Farmers got to know about Quality Protein Maize (QPM)

Sub county	Channels for awareness about QPM								
	Seminars	Extension	Radios	KARI	Farmer to Farmer	Farmer group	Field day	CARITAS	Community
Kathonzweni	21.8%	49.1%	.9%	9.1%	6.4%	10.9%	1.8%	0.0%	0.0%
Kirinyaga	0.0%	7.4%	0.0%	0.0%	38.9%	27.4%	2.1%	23.2%	1.1%

Source: Survey data,2014

In Kirinyaga County, where the quality protein maize was introduced much earlier, the most dominant channel of creating awareness amongst farmers was the farmer to farmer information exchanges (38.9%). This channel was followed closely with the farmer groups (27.4%) and finally CARITAS (23.2%), an NGO that was involved in the dissemination of the technology in the district. In Kathonzweni, agricultural extension played the largest role (49.1%), followed by seminars (21.8%) and farmer groups (10.9%).

In Kathonzweni (Table 7), the majority of the farmers got to know of the quality protein maize in the year 2010 with the agricultural extension service playing the major (52.1%) role in disseminating the technology.

Table 7: Communication Channels and Years of Adoption by Farmers in Kathonzweni

	How the farmer knew about Quality Protein Maize							
	Seminars	**Extension**	**Radio**	**KARI**	**Farmer to Farmer**	**Farmer group**	**Field day**	**Total**
2010	21.9%	52.1%	0.0%	7.3%	5.2%	11.5%	2.1%	100%
2011	23.1%	23.1%	7.7%	23.1%	15.4%	7.7%	0.0%	100%,
2012	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100%

Source: Survey data, 2014

Seminars also played a considerable role (21.9%) in raining awareness of the QPM technology in 2010. Agricultural extension remained in the lead through 2011 to 2012 when all the QPM adoption cases (100%) were engineered by agricultural extension.

4.2 Adoption of QPM

4.2.1 Kirinyaga County

In Kirinyaga district, adoption started much earlier than in Kathonzweni with the farmers acquiring knowledge of the technology for the first time from CARITAS (Table 17).

Table 8: Source of Information on Quality Protein Maize

	Farmer to Farmer	**Farmer Group**	**CARITAS**
2004	0.0%	0.0%	100.0%
2005	23.5%	47.1%	29.4%
2006	0.0%	0.0%	100.0%
2007	11.8%	23.5%	35.3%
2008	0.0%	50.0%	50.0%
2009	92.3%	7.7%	0.0%
2010	40.0%	46.7%	13.3%
2011	100.0%	0.0%	0.0%
2012	100.0%	0.0%	0.0%
2013	87.5%	12.5%	0.0%

Source: Survey data, 2014

In Kirinyaga, the earliest adopters were the fewest and 2007 provided the largest number of first time planters with the numbers consequently varying slightly along the subsequent years. Farmer to farmer 11.8%, farmer groups 23.5%, CARITAS 35.3%, and 2.9% community which includes chief's barazas and meetings. Table 8 shows the sources of information on QPM technology. Inception of adoption of QPM technology was first driven by CARITAS in 2004. Subsequent adoption shifted more towards farmer groups in 2005. However, there was an apparent initiative in 2006 that again broke the adoption pattern with 100% of the adoption being attributed to CARITAS initiatives. Thereafter, the importance of farmer groups emerged with the adoption of technology mainly being driven through farmer groups.

4.2.2 Kathonzweni Sub County

Introduction of quality protein maize in Kathonzweni came in the year 2010 and the largest number of respondents had their first go at planting it the same year. The remainder adopters were much less and in 2013 there were no new adopters. Seminars and farmer groups combined also played a big role (33.4%) in influencing adoption of the technology (Table 7). The two channels were pooled together owing to the fact that most seminars targeting farmers often engage farmer groups, thereby capturing the direct linkage between farmer groups and seminars in the dissemination of technologies. Further, agricultural extension works more easily with farmer groups arguably because of the desired logistics aimed at lowering the costs. In view of this background, it can be inferred that the combined effect of agricultural extension services, training of farmers through seminars and farmer groups enabled approximately 84.5% of the farmers in Kathonzweni in 2010 to adopt the quality protein maize.

However, after inception of technology in 2010, subsequent new adoption levels dropped in 2011 and 2012, reducing to 54% and finally 1 farmer out of those sampled were consistent. No seed was available for planting quality protein maize in 2013 for both districts.

4.2.3 Interest to Adopt Quality Protein Maize

Pursuant to adoption rates, interest, also plays a primary part in diffusion of technology. An overwhelming number of respondents in both counties had an avid interest in the quality protein maize (Table 9).

Table 9: Interest in Quality Protein Maize

County	**% Farmers Interested in Quality Protein Maize**	
	No	Yes
Kathonzweni	5.5%	94.5%
Kirinyaga	7.1%	92.9%

Source: Survey data, 2014

In both study sites, farmers had a lot of interest in planting QPM with Kathonzweni having the highest proportion (94.5%) of farmers compared to Kirinyaga (92.9%). Despite the late introduction, farmers in Kathonzweni who rely more on the short rains (October-December) unanimously agreed to plant the maize for the first time during this season with slight variations in the month planted in the three years of adoption. Table 9 gives the month and year farmers first planted QPM.

Table 10: Year and Month First Quality Protein Maize

Year first grown	**Month first planted**	
	October	November
2010	40.2%	59.8%
2011	26.3%	73.7%
2012	0.0%	100.0%

Source: Survey data, 2014

Over the three years of the DONATA project, the majority of farmers across study sites planted QPM in the second month (November) of rainfall onset during the short rainy

season. In Kathonzweni, during the first year of adoption of QPM, farmers planted the maize in the short rainy seasons (Table 10).

In Kirinyaga district on the other hand, for the first year of adoption, farmers planted the QPM in both the long and short rainy seasons (Table 11).

Table 11: Production of Quality Protein Maize in Kirinyaga

Year first planted	March	April	June	July	October
2004	50.0%	0.0%	0.0%	0.0%	50.0%
2005	100.0%	0.0%	0.0%	0.0%	0.0%
2006	100.0%	0.0%	0.0%	0.0%	0.0%
2007	50.0%	50.0%	0.0%	0.0%	0.0%
2008	100.0%	0.0%	0.0%	0.0%	0.0%
2009	100.0%	0.0%	0.0%	0.0%	0.0%
2010	93.8%	0.0%	6.3%	0.0%	0.0%
2011	50.0%	50.0%	0.0%	0.0%	0.0%
2012	0.0%	0.0%	100.0%	0.0%	0.0%
2013	62.5%	0.0%	12.5%	12.5%	12.5%

Source: Survey data, 2014

In the majority of cases, farmers preferred to plant QPM in the long rainy season with a few exceptions in 2004 and 2013 when 50% and 12.5% respectively, planted QPM during the short rainy season. There were no adopters in 2012 during long rains, although there was 100% adoption in June 2012 during the short rains.

4.2.5 Adoption of Quality Protein Maize Varieties

The dominant QPM varieties that have been adopted in the study sites are given in Table 12.

Table 12: Varieties of Quality Protein Maize grown in Study Sites

County	QPM varieties		
	KH631Q	KH500Q	WS104Q
Kathonzweni	2.8%	38.9%	58.3%
Kirinyaga	47.1%	52.9%	0.0%

Source: Survey data, 2014

The majority of farmers in Kathonzweni have adopted WS104Q while those in Kirinyaga have adopted KH500Q. In Kirinyaga, considerable proportions of farmers (47.1%) have adopted KH631Q while in Kathonzweni, a decimal proportion (2.8%) have adopted it. In Kirinyaga, no farmers have adopted WS104Q, because of climatic conditions, lack of seed and farmer preferences. A low percentage 12.5% of farmers planted in 2013 due to seed unavailability. Results from multiple response analysis (Table 12) support these observations.

Table12: Quality Protein Maize (QPM) Varieties grown based on Multiple responses

County of Study		**QPM maize varieties grown**		
		KH631Q	KH500Q	WS104Q
Kathonzweni	% within sub counties	2.1%	46.2%	51.7%
	% within QPM varieties Grown	6.8%	55.5%	98.7%
Kirinyaga	% within sub counties	43.2%	55.8%	1.1%
	% within QPM varieties Grown	93.2%	44.5%	1.3%

Source: Survey data, 2014

From this table, it is readily seen that 98.7% of the farmers who planted WS 104Q were in Kathonzweni while on the other hand, 93.2% of those who planted KH631Q were in Kirinyaga. There was a fair balance in the proportions who planted KH500Q representing 55.5% and 44.5% for Kathonzweni sub country and Kirinyaga County respectively.

Several reasons, both main and secondary, were given by respondents for growing QPM in both Kirinyaga and Kathonzweni districts (Table 13).

Table13: Reasons for growing Quality Protein Maize (Main reason)

County of Study		Reason for growing QPM		
		Sale	Animal feed	Food
Kathonzweni	within sub county	69.2%	30.8%	100%
	Within reason for growing	23.7%	17.4%	
Kirinyaga	Within county	60.4%	39.6%	100%
	Within reason for growing	76.3%	82.6%	

Source: Survey data, 2014

The reasons ranged from purely for food (main reason) to secondary reasons including for selling (income) and for animal feed. In both study areas, 100% of the farmers were unanimous for food as the main reason). However, besides growing QPM for food, in Kathonzweni the larger percentage (69.2%) of the farmers grow QPM for selling and 30.8% for use as livestock feed while in Kirinyaga, the larger percentage (60.4%) grow QPM for selling and 39.6% for use as livestock feed.

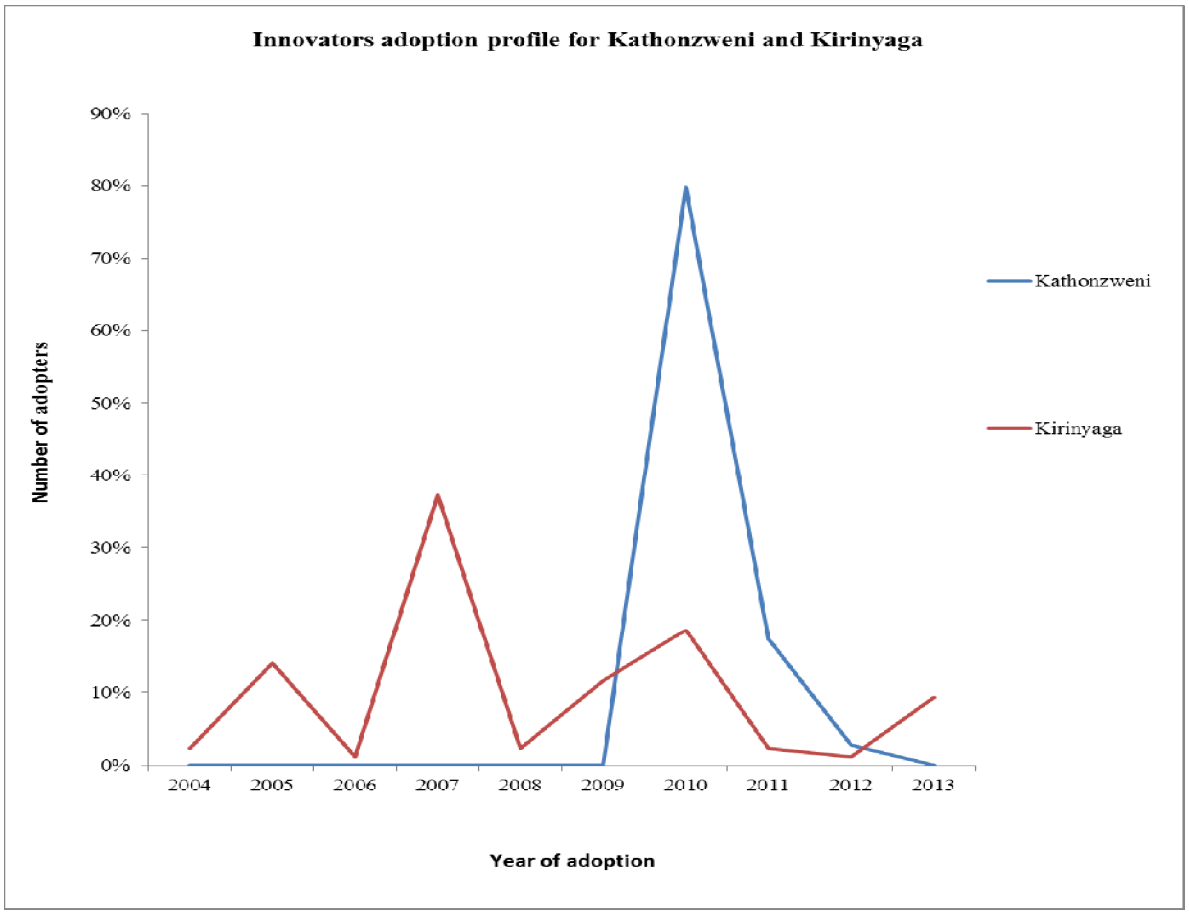
The results of this study also indicated that despite the popularity of QPM in the study districts not all farmers grew QPM. Table 14 presents the reasons given by the respondent farmers.

Table 14: Reasons for not Adopting QPM in Kirinyaga and Kathonzweni Sub Counties

District	Lack of awareness of QPM	Lack of knowledge about QPM	Lack of labour	Lack of seed	Rainfall requirements	The size of the maize and weight
Kathonzweni	0.0%	0.0%	0.0%	0.0%	.9%	0.0%
Kirinyaga	1.0%	1.0%	1.0%	8.1%	0.0%	1.0%

Source: Survey data, 2014

In Kathonzweni, a small proportion (0.9%) highlighted rainfall requirements as a hindrance to adopting QPM technology while those of Kirinyaga gave many reasons that include lack of awareness (1%), lack of knowledge about QPM (1%), lack of labour (1%), the size of the maize and weight (1%) , and lack of seed (8%). With regard to the year when farmers officially adopted (in the case of the early adopters) the QPM maize, Kirinyaga had the largest number of its farmers adopting the maize in 2007 as compared to the earlier and later years. Figure 5 shows the innovation adoption profiles for Kirinyaga and Kathonzweni sub counties.



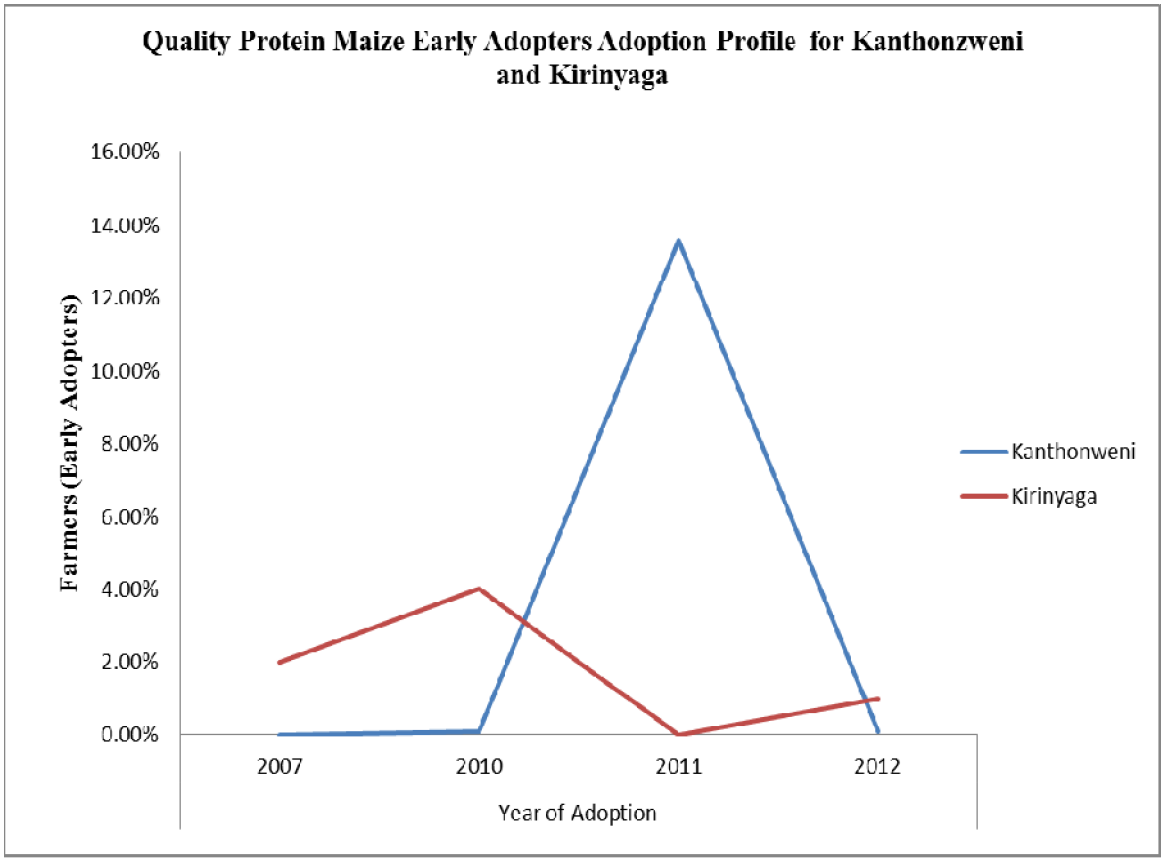
Source: Survey data, 2014

Figure 5: Quality Protein Maize Innovators Profile in Kanthonzweni and Kirinyaga

Innovators were the first farmers who adopted the quality protein maize technology immediately. In Kathonzweni (79.8%) of farmers adopted QPM immediately in 2010, (17.4%) in 2011and (2.8%) in 2012 while in Kirinyaga, (37.2%) of farmers adopted QPM in

2007, 14% in 2005, 18.6% in 2010, 11.6% in 2009, 2.3% in 2011, and 9.3% in 2013 (Figure 5). Apart from late introduction in Kathonzweni, the farmers who rely more on the short rains (October-December) unanimously planted the maize for the first time during the season with slight variations in the month planted in the three years of adoption.

A smaller percentage of farmers adopted quality protein maize at a later stage after becoming aware of the technology. This is presented in Figure 6.

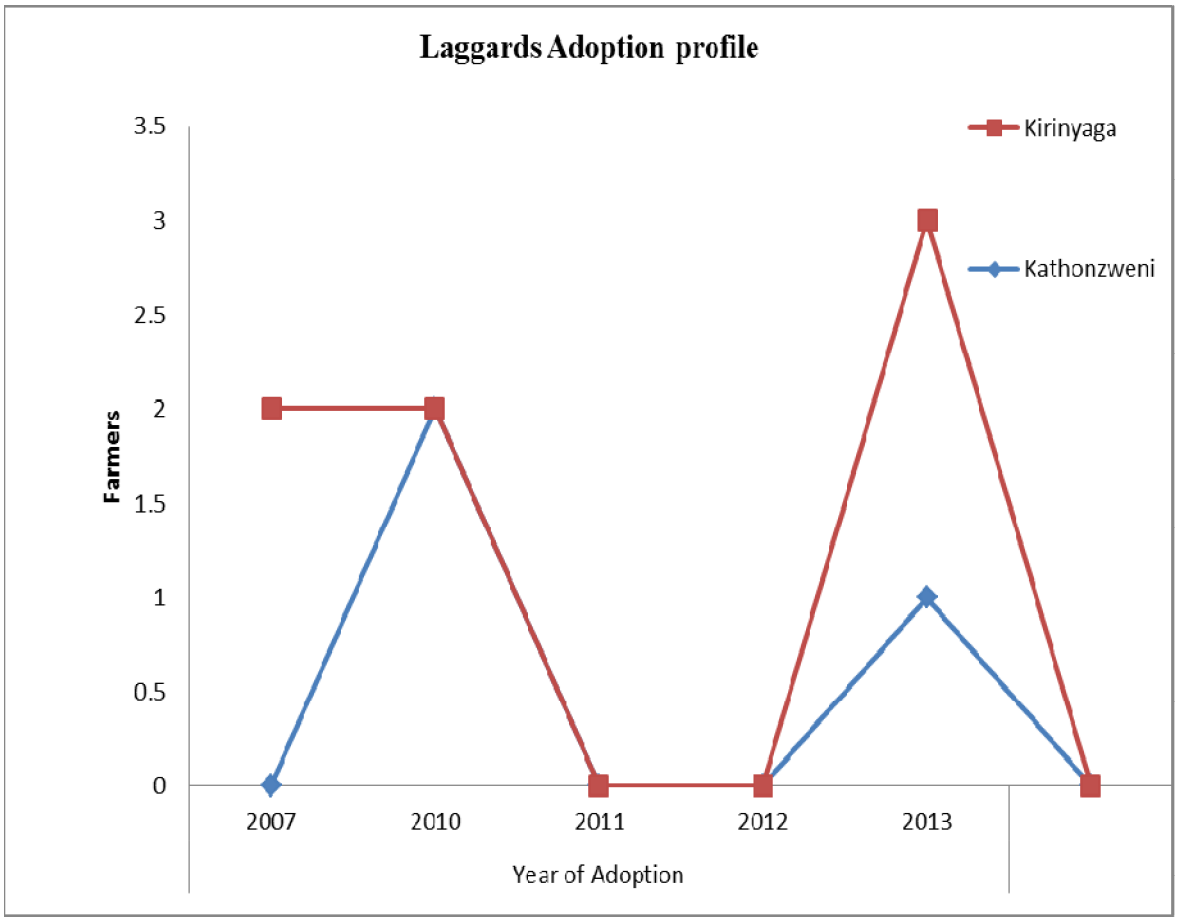


Source: Survey data, 2014

Figure 6: Quality Protein Maize Early Adopters Profile in Kathonzweni and Kirinyaga

The second category of adopting famers for the QPM technology were the 'Early adopters' with the highest proportion coming from the opinion leaders comprising of both extension and group leaders. Kathonzweni had the highest percentage of early maturity adopters (13.6%) in 2011, while Kirinyaga had 4% in 2010,2% in 2007 and 1% in 2012.

Figure 7 shows the laggards adoption profiles for Kathonzweni and Kirinyaga Sub counties.



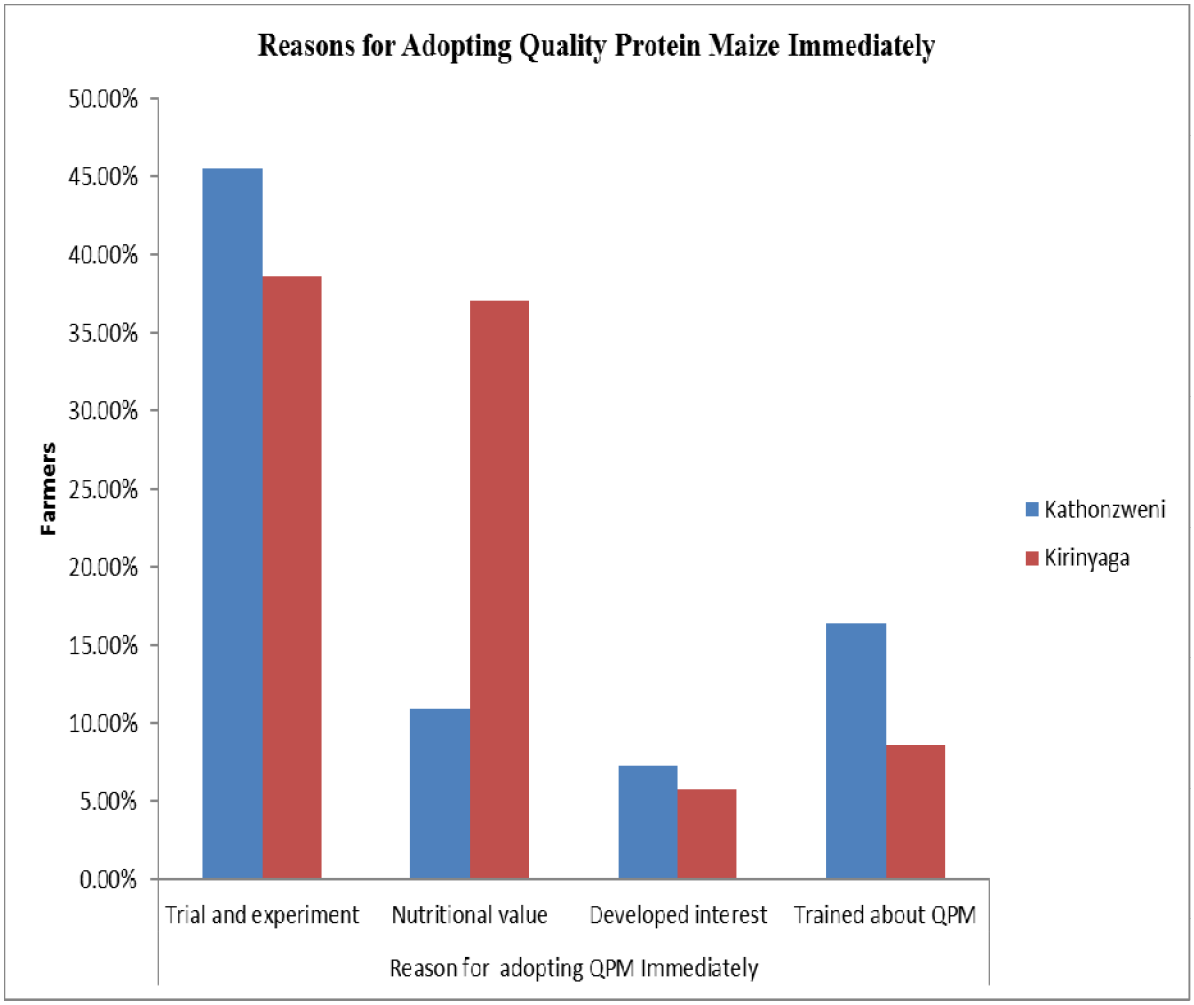
Source: Survey data, 2014

Figure 7: Quality Protein Maize Laggards Adoption Profile in Kathonzweni and Kirinyaga

The last category of farmers to adopt QPM technologies were the "Laggards". Kirinyaga had highest number of laggards (3%) in 2013 compared to (1%) in Kathonzweni during the same year, while on the other hand in the year 2010, Kathonzweni had (2%) laggards and (2%) 2007 for Kirinyaga respectively.

Few farmers adopted the technology later because they lacked interest in the production of quality protein and therefore, were the last individuals to adopt the technology as shown in figure (7) above.

Farmers in both Kirinyaga and Kathonzweni Sub counties adopted QPM immediately due to varied reasons (Figure 8).



Source: Survey data, 2014

Figure 8: Reasons for Adopting QPM Immediately Kathonzweni and Kirinyaga

The largest percentage of farmers who adopted the maize immediately did so for trial and experiment to understand how it would perform in Kathonzweni (45.5%) and Kirinyaga (38.6%) sub counties. However, in Kirinyaga district, there was a big difference (37.1%) between the percentage of respondents who adopted the QPM maize for nutritional value versus Kathonzweni (10%) implying that the degree of education on quality protein maize in Kirinyaga district was higher than that in Kathonzweni. Interest also played a role in famers decision making on whether to adopt QPM or not.7.3% of famers in Kathonzweni developed

interest immediately and 5.7% in Kirinyaga. Farmer training had a positive effect on prompt decision making on QPM adoption in both sites, representing 16.4% in Kathonzweni and 5.6% in Kirinyaga Sub county

On the other hand, the laggards (late adopters) gave a different array of reasons for late adoption of QPM (Table 15).

Table 15: Reasons for Late Adopting of Quality Protein Maize

County	Reason for adopting later			
	Confirm productivity benefits	**Nutritional value**	**Lacked seeds at first**	**Waited to see from others**
Kathonzweni	18.20%	0.00%	18.20%	45.50%
Kirinyaga	14.30%	14.30%	57.10%	0.00%

Source: Survey data, 2014

The majority of respondents in Kathonzweni (45.50%) indicated that the most prevalent reason was that the farmers waited to see how the QPM maize would perform in the neighbours' fields before adopting the technology. On the other hand in Kirinyaga, the largest proportion of farmers (54.10%) had no access to the QPM seeds for planting compared to counterparts in Kathonzweni (18.20%). Both study sites also had a fair proportion of farmers who wanted to confirm productivity benefits with Kathonzweni and Kirinyaga being represented by 18.20% and 14.30% respectively.

4.3 Effect of Communication Channels on the Uptake of QPM Technologies by Farmers

Table 16 presents the proportion of QPM technology adopters by communication channels through which they receive QPM information that influenced their adoption.

Table 16: Quality Protein Maize Communication Channels

Communication channel	Percentage of QPM Adopters
Farmer to Farmer	84.2
Extension	77.5
Demonstrations	65.6
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
Church meetings	0.5

Source: Survey data, 2014

The results indicate that farmers received quality protein maize information through a wide range of channels including farmer to farmer (84.2%), extension (77.5%), demonstrations (65.6%), field schools (63.2%), seminar (60.8%), radio (47.4%), field schools (16.7%), television (9.1%), newspapers (7.2%), mobile phone (3.8%), group meeting (3.8%), magazines (3.8%), CARITAS (1%), chief's barazas (0.5%), school meetings (0.5%) and church meetings (0.5%). It is evident from this table that a high percentage of farmers

received quality protein maize information through farmer to famer, extension, demonstrations, field days, seminar, field schools, radio, television and newspaper.

4.3.1 Influence of Frequency of Communication on Uptake of QPM Technology

Farmers received QPM information through certain communication channels at different frequencies/ number of times as shown in Table 17.

Table 17: No of times the farmer has received QPM information through QPM communication channels (Multiple responses)

Communication Channels	Percentage number of times
Field days	56.7
Farmer to farmer	52.6
Field schools	15.8
Demonstrations	44.6
Radio	40.1
Extension	65.6
Television	6.8
Mobile phone	1.9
Seminar	52.2

Source: Survey data, 2014

Field days are one of the conventional communication channels which were highly used in both study regions to diffuse quality protein maize technologies to farmers. This study reveals that 56.7% of farmers received information on quality protein maize through field days.

A new model where individual farmers are trained so that they can themselves train fellow farmers is gaining ground in Kenya, known as farmer to farmer extension (FFE) and is being driven by the government's shortage of extension workers to meet the rising interest by farmers in modern farming. An important aspect in the farmer to farmer model is a participatory approach, which facilitates farmers' demand for knowledge, and offers

opportunity for the end users to choose, test and adopt knowledge according to their needs. Farmer to farmer is an interpersonal communication channel that was highly used in the diffusion of quality protein maize technologies in both Kirinyaga and Kathonzweni The results from this study show that 52.8% farmers received information through farmer to farmer approach at different times.

The Farmer Field Schools are a core aspect of the farmer to farmer extension model, which determines how fast information is communicated to farmers. While traditionally farmers would listen to their fellow farmer, take notes and ask questions, a desire to give farmers an exercise that would be memorable to them is now seeing trainers to come up with new and interesting training ideas about agricultural technologies. Farmers in the study regions received information on quality protein maize through field schools (15.8%) and demonstrations 44.6% different number of times

Radio is a very important tool for rapid diffusion of information on agricultural innovations and also remains a powerful, cheapest mass medium that can reach large numbers of farmers. Radio also promotes dialogue and can also be used for training and transfer of agricultural technologies. It can be used to develop community cohesion and solidarity. Community involvement is fundamental for the successful use of radio with rural populations. Radio programmes are most effective when produced with audience participation, in local languages and with consideration for cultural traditions. Farmers can voice their concerns and speak about their aspirations with extension and other external partners such as national policy-makers and development planners through radio. In Kirinyaga and Kathonzweni, a whopping 40.1% farmers received information about QPM technologies through radio at different number of times.

This study reveals that although extension is a traditional method of bringing and sharing agricultural innovations to farmers, it is still one of the best dissemination channels currently used as shown in table 17.

Langyituo and Mungoma (2008) findings also agrees that visits by farmers to the extension officer and vice-versa exposes farmers to the new technologies. The interaction stimulates

communication which leads to reduction in information imbalance which is associated with new agricultural innovations. Farmers in Kirinyaga and Kanthonzweni received quality protein maize technologies through extension 66% several times.

This study is in agreement with that of Yaron *et al*, (1992) who also noted that access to extension services is critical in promoting adoption of modern agricultural production technologies because it can counter-balance the negative effect of lack of years of formal education in the overall decision to adopt some technologies. Agricultural information passed through an extension services therefore, reduces the level of uncertainty about a technology's performance that may change farmers' assessment to purely objective than subjective over time, thereby, facilitating adoption.

Television is an important, powerful and empowering tool that was used to raise QPM awareness and increase knowledge to farmers in the study regions as shown in Table 17; Farmers (6.8%) received information about QPM through television.

The rapid growth of mobile phones in developing countries over the past decade has introduced a new search technology that offers several advantages over other alternatives in terms of cost, geographic coverage and ease of use. The number of mobile phones per 100 people in developing countries often exceeds access to other information technologies, such as landline, newspapers and radios (Aker and Mbiti 2010). Landline coverage has been limited, with less than one landline subscriber per 1,000 people in 2008 (ITU 2009). The findings of this study in table 17 have shown that farmers 1.9% in both Kirinyaga and Kanthonzweni received information about quality protein maize technologies through mobile phone

Reduced communication costs either via SMS or a call-in hotline could not only increase farmers' access to (private) information, but also public information provided via agricultural extension services. Reducing the costs of disseminating technical information on agricultural innovations could increase the extension system's geographic scope and scale, and allow for contact between field agents and farmers at more crucial moments. This could, in turn, improve the quality (or value) of the information services provided. Several

studies have pointed out the risk and supply-side constraints (related to poor Infrastructure) as barriers to agricultural technology adoption (Suri 2009).

It can be acknowledged through the findings of this study that seminar is among the best communication channels through which farmers received information on quality protein maize technologies as shown in table 17. Farmers 52.2% received QPM information through seminar different number of times.

4.4 Socio-Economic Factors Influencing Preference for Communication Channels for Adoption of QPM

Different socio economic factors determine the adoption of quality protein maize in both study regions. The socioeconomic characteristics of farmers such as age and marital status in Kirinyaga and Kathonzweni played a crucial role in determining the adoption of quality protein maize using existing available communication channels. Each of the factors played a role in the adoption of quality protein maize technologies as explained in subsections that follow.

Tables 18 and 19 show the Pearson's correlation coefficients between socioeconomic factors and communication channels.

Table 18: Pearson's Correlation for Kirinyaga

	Respondents status	Gender	Age	Marital status	Education	Income	Family size	Farmer group	Land ownership	Distance	Farmer to Farmer	Field days	Field schools	Demonstrations	Radio	Television	Mobile phone	Extension	Seminars	News papers	Group meetings	Chief's barazas	CDM (CARITUS)
Respondents status	1																						
Gender	.103	1																					
Age	-.255**	-.007	1																				
Marital status	-.090	-.335**	.046	1																			
Education	-.123	.195*	-.027	-.274**	1																		
Income	-.080	.073	.133	-.164	.358**	1																	
Family size	-.094	.159	.241**	-.228*	.046	.010	1																
Farmer group	-.202*	-.191*	.175*	.000	.004	.112	.153	1															
Land ownership	.182*	-.040	-.365**	.153	-.026	-.154	-.098	-.062	1														
Distance	.229*	-.033	.120	-.012	-.121	.074	.017	.046	-.210*	1													
Farmer to Farmer	-.075	-.212*	.002	.082	-.097	-.019	-.060	-.141	.069	-.106	1												
Field days	-.236**	-.130	.202*	-.038	-.097	.005	.223*	.365**	-.191*	.033	-.112	1											
Field schools	-.067	-.140	-.057	.004	.031	-.086	-.013	.207*	.241**	-.056	.003	.116	1										
Demonstrations'	-.135	-.233*	.016	-.006	-.074	-.096	.003	.221*	.007	-.022	.373**	.277**	.270**	1									
Radio	.059	.006	-.123	-.014	.003	.048	.127	.199*	.005	.096	.151	.123	.261**	.313**	1								
Television	.238**	.230*	-.196*	-.179*	.205*	.142	-.064	-.012	.103	.082	-.046	-.100	.015	.103	.243**	1							
Mobile phone	.184*	-.150	-.034	-.068	-.187*	-.020	-.020	.104	.160	.202*	-.111	.124	.177*	.162	.134	.124	1						
Extension	-.151	-.121	.193*	-.081	.080	.063	.142	.401**	-.125	.078	-.123	.377**	.064	.248**	.026	-.272**	.088	1					
Seminars	-.142	-.102	-.076	-.051	.143	.131	.191*	.301**	-.089	-.015	.116	.209*	.175*	.337**	.500**	.095	.180*	.158	1				
News papers	-.135	-.013	-.003	-.114	.226*	.149	.088	.171*	-.122	-.051	.039	.166	.334**	.313**	.314**	.130	-.061	.055	.277**	1			
Group meetings	.251**	.218*	-.072	-.037	-.166	-.002	-.044	-.024	-.089	.085	-.452**	-.132	-.111	-.280**	-.249**	-.035	-.044	.016	-.164	-.126	1		
Chief's barazas	-.046	-.106	.086	.097	-.073	-.056	-.143	.074	-.030	-.273**	.048	.086	-.038	.113	.097	-.046	-.015	.063	.129	-.043	-.031	1	
CDM (CARITUS)	-.066	.142	.123	-.070	-.103	-.163	.252**	-.051	-.043	.054	.068	.122	-.054	-.135	.138	-.066	-.022	-.239**	.184*	-.061	-.044	-.015	1

*. Correlation is significant at the 0.05 level (1-tailed).

**. Correlation is significant at the 0.01 level (1-tailed).

	Respondent status	Gender	Age	Marital status	Education	Income	Farmer groups	Farm size	Land ownership	Distance	Farmer to Farmer	Field days	Field schools	Demonstrations	Radio	Television	Mobile phone	Extension officer	Seminars	News papers	Group meetings
Respondents status	1																				
Gender	-.019	1																			
Age	.018	-.013	1																		
Marital status	-.050	-.523**	.247**	1																	
Education	.022	.130	-.029	-.249**	1																
Income	-.020	.006	.097	-.061	.027	1															
Farmer group	.021	-.100	.041	.065	-.032	.026	1														
Farm size	.014	-.046	.168*	.039	-.014	.000	-.012	1													
Land ownership	.035	.169*	.030	-.258**	-.011	.010	-.011	-.017	1												
Distance	.095	-.075	-.083	-.093	.089	-.049	.087	.062	.074	1											
Farmer to Farmer	.022	.149	.104	.063	-.027	.027	-.025	-.012	-.011	-.017	1										
Field days	.034	.254**	.111	-.011	.177*	-.283**	-.044	-.016	-.017	.034	.641**	1									
Field schools	.032	.259**	.106	-.011	.175*	-.281**	-.041	-.016	-.016	.044	.642**	.999**	1								
Demonstrations	.018	.070	-.126	-.151	.383**	-.571**	-.016	-.016	-.010	.100	-.025	.520**	.520**	1							
Radio	.028	.215*	.059	-.026	.196*	-.308**	-.041	-.019	-.014	.078	.696**	.921**	.922**	.565**	1						
Television	.038	.191*	-.003	-.082	.143	-.385**	-.049	-.032	-.023	.040	.562**	.736**	.737**	.454**	.802**	1					
Mobile phone	.037	.193*	-.003	-.082	.142	-.385**	-.049	-.032	-.019	.040	.562**	.737**	.737**	.454**	.802**	1.000**	1				
Extension	.026	.100	-.065	-.068	.256**	-.179*	-.027	-.022	-.013	-.089	.267**	.345**	.345**	.335**	.378**	.650**	.650**	1			
Seminars	.023	.211*	.105	.073	-.030	-.390**	-.033	-.006	-.014	.162*	.563**	.744**	.744**	.335**	.808**	.651**	.651**	-.040	1		
News papers	.038	.117	.111	.016	.141	-.241**	-.049	-.021	-.020	.020	.562**	.736**	.739**	.454**	.802**	.758**	.757**	.472**	.649**	1	
Group meetings	.038	.118	.112	.016	.141	-.241**	-.049	-.021	-.020	.020	.562**	.736**	.739**	.454**	.802**	.758**	.757**	.472**	.649**	1.000**	1

*. Correlation is significant at the 0.05 level (1-tailed).

**. Correlation is significant at the 0.01 level (1-tailed).

Table 19: Pearson's Correlation for Kathonzweni

From the Pearson's Correlation for Kirinyaga (Table 18), gender and farmer to farmer are correlated at significant 0.05 level while field days and respondent status, farmer groups strongly correlated to adoption of quality protein maize at 0.01 respectively. Field days correlates with age, land ownership and farmer groups at 0.05 level of significant. Land ownership and field schools correlated at 0.05 significant level, field schools with farmer groups at 0.01 significant level. Demonstrations correlated with gender and farmer groups at 0.05 at 0.01 significant level. Radio and farmer groups correlated at 0.05 level of significant. Television is strongly correlated with respondent status at 0.01 level of significant. Television correlated with gender, age, marital status and education at 0.05 significant level. Field schools are strongly correlated with landownership at 0.01 significant levels. Demonstrations correlates with gender and farmer groups at 0.05 level of significant, farmer to farmer and field days at 0.01 level of significant.

Mobile phone correlated with respondent status, the level of education of the farmer and distance at 0.05 level of significant. Extension is correlated with age of the household at 0.05 on the other hand seminars are correlated with family size at 0.05 level of significant, seminars and farmer groups at 0.01 level of significant. Newspapers, education correlated at 0.05 level of significant and chief's baraza's related to distance at 0.01 level of significant. Group meetings and respondent status strongly correlated at 0.01 level of significance, gender and group meetings at 0.05 significant level. Family size is strongly correlated with CARITAS an NGO based in Kirinyaga at 0.01 level of significance.

For Kathonzweni (table 19), field days are strongly correlated with gender and income at 0.01 level of significant and level education of the household at 0.05 level of significant. Field schools correlated with gender and farmers income at 0.01 level of significant, demonstration and education plus income correlated at 0.001 level of significant. Radios correlate with income at 0.01 and education at 0.05 levels of significant. Television, gender correlated at 0.05 and income at 0.01 significant level. Newspapers, group meetings, mobile phone, seminar strongly correlated with income of the household at 0.01 level of significant. Seminar

correlates with gender and distance at 0.05 level of significant. Extension strongly correlates with education level of household at 0.01 level of significant and income at 0.05 significant level.

Table 20: Family Size for Quality Protein Maize Farm Household

The family sizes of the household for Kathonzweni and Kirinyaga table 20

	Family size				
	1-3	**4-7**	**8-11**	**12-15**	**>15**
Kathonzweni	7.3%	40.9%	37.3%	11.8%	2.7%
Kirinyaga	20.2%	54.5%	20.2%	4.0%	1.0%

Source: Survey data, 2014

The family sizes table 20 varied greatly in Kirinyaga but majority (55%) were between 4 and 7 household members, 1 -3 members (20.2%), 8-11 (20.2%) and >15 (1%). Family members contribute (23.5%) of farm labour. Kathonzweni on the hand had family sizes between ages 4-7 (40.9%) and 8-11 family members (37.3%).

Table 21: Land Ownership

	Land ownership of the household			
	Free hold	Leasehold/Rented	Communal	Borrowed
Kathonzweni	86.2%	0.0%	13.8%	0.0%
Kirinyaga	91.8%	1.0%	2.0%	5.1%

Source: Survey data, 2014

In Kirinyaga, majority of the famers (91.8%) as shown in table 21 held their own land as opposed to those who had leased (1%), communal (2%) or borrowed land (5.1%). Kathonzweni had (86.6%) free hold and 13.8%) communal.

Table 22: Income Categories of the Households

The income annual categories of the households in study areas are as shown in table 22

	Annual income										
	0-5000	**5001-10000**	**10001-15000**	**15001-20000**	**20001-25000**	**25001-30000**	**30001-35000**	**35001-40000**	**40001-45000**	**45001-50000**	**>50000**
Kathonzweni	0.00%	0.00%	7.40%	3.70%	1.90%	4.60%	4.60%	3.70%	5.60%	5.60%	63.00%
Kirinyaga	3.10%	9.20%	9.20%	7.10%	16.30%	6.10%	4.10%	1.00%	4.10%	6.10%	33.70%

Source: Survey data, 2014

Most households in Kirinyaga (33.7%) as reflected in table 22 received an annual income of > Ksh.50,000 with the lowest income earners (12.3%) of the respondents earning less than Ksh. 10,000 per annum as compared to Kathonzweni where, the high income earners per household (63%) make an annual income of > Ksh. 50,000. Where the lowest income earners had a gross income of at least Ksh 10,000 per annum, it was noted that this was due to the undervaluing of incomes by respondents in Kirinyaga.

Table 23: Gender Composition of the Sample in Percentage

Table 23 shows gender composition of the sample in percentage for both study regions.

	Female	**Male**	**Total**
Kathonzweni	27.3	72.7	100
Kirinyaga	48.5	51.5	100

Source: Survey data, 2014

Kathonzweni presented large percentage of male (72.7%) as compared to (51.5%) for Kirinyaga. The female counterparts were (48.8%) and (27.3%) respectively, implying that male farmers are more likely to adopt quality protein maize technologies than their female counterparts.

Table 24: Education levels of the respondents

The following table 24 gives a summary of Education levels of respondents

	No schooling	**Primary 1-8**	**Secondary 8-12**	**Tertiary 12-15**	**University 12-20 years**
Kathonzweni	1.9%	71.3%	24.1%	2.8%	0.0%
Kirinyaga	5.1%	43.9%	38.8%	8.2%	4.1%

Source: Survey data, 2014

In the two sample sites, Kathonzweni presented an overwhelming number of respondents educated up to primary school level (71.3%) and even lower secondary (24.1%) and tertiary level educated respondents (2.8%). Kirinyaga on the other hand had a fairly balanced distribution of education levels with 43.9% of the respondents having completed primary school and a subsequent 38.8% having attained a secondary education. In contrast, more respondents in Kirinyaga had attained higher education with 8.2% in tertiary and 4.1% having gone through university than in Kathonzweni district although still a small percentage of the total as shown in table 24.

This means that an educated farmer can readily access information through any preferred communication channel of choice on quality protein maize and how it can be correctly implemented. It is therefore important to encourage younger members of the farm household to pursue formal education to at least secondary level.

In Ghana for example, the study by Mamudu *et al*,(2012), showed the maximum level of education within the farm household to have a statistically significant positive relationship with the probability of adoption at 1 percent significance level using normal distribution. This implies that farm households with well-educated members are more likely to adopt new agricultural production technologies such as the quality protein maize than the uneducated household

heads. The educated members of a household, owing to their high exposure, are more likely to bring home new and emerging agricultural production technologies, such as improved crop varieties. According to Waller *et al*, (1998) and Caswell *et al*,(2001), education creates a favourable mental attitude for the acceptance of new practices especially of information-intensive and management-intensive practices.

Table 25: Age of Category of Household Heads

District	Age category of the household head in years			
	18-30	31-40	41-50	>50
Kathonzweni	0.90%	23.60%	27.30%	48.20%
Kirinyaga	3.00%	24.20%	20.20%	52.50%

Source: Survey data, 2014

The ages of respondents were as presented below with the majority of respondents in both the districts being above 50 years of age. There is a smaller number of farming respondents below the age of 30. A higher percentage of household heads above 50 years of age in Kirinyaga were (52.50%) while in Kathonzweni (48.20%).

4.4.1 Binary Logistic Regression

The classification table below shows that given the base rates of the two decision options, (Yes 1=Adoption, 0= No adoption) 94% of the farmers adopted quality protein maize in Kirinyaga and Kathonzweni.

Table 26: Classification Table

Classification Table[a]

	Observed		Predicted		
			Adoption		Percentage Correct
			No	Yes	
Step 1	Adoption	No	0	13	.0
		Yes	0	194	100.0
	Overall Percentage				93.7
Step 2	Adoption	No	0	13	.0
		Yes	0	194	100.0
	Overall Percentage				93.7

a. The cut value is .500

Under Variables in the Equation it can be noted that the intercept-only model is ln(odds) = 2.703 if we exponentiate both sides of this expression we find that our predicted odds [Exp(B)] = 14.923. That is, the predicted odds of deciding to continue the adoption of the quality protein maize technology are 14.923. Since 194 of farmers in the study regions decided to continue with the production of quality protein maize and 13 decided to not to adopt the observed odds are 194/13 = 14.923

Table 27: Variables in the Equation

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	2.703	.286	89.010	1	.000	14.923

Omnibus Tests of Model Coefficients gives us a Chi-Square of 9.239 on 2 df, significant at .010. This is a test of the null hypothesis that adding the age and marital status variables to the model has significantly increased our ability to predict the decisions made by farmers on adoption. Therefore, the null hypothesis that socio-economic conditions do not influence access to and use of available communication channels was rejected and the alternative one accepted that highlights the critical contributions of as, age and marital status.

Table 28: Model Coefficients

Omnibus Tests of Model Coefficients

		Chi-square	**df**	**Sig.**
	Step	6.234	1	.013
Step 1	Block	6.234	1	.013
	Model	6.234	1	.013
	Step	3.006	1	.083
Step 2	Block	9.239	2	.010
	Model	9.239	2	.010

The next summary table includes the Pseudo R^2, the -2 log likelihood is the minimization criteria used by SPSS. We see that Nagelkerke's R^2 is 0.044 which indicates that the model is good. Given the Cox & Snell's R^2 we can interpret this as 4% probability of the farmers socio conditions influenced their decisions to adopt and use available communication channels in dissemination of quality protein maize as explained by the binary regression model.

Table 29: Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	90.894[a]	.030	.079
2	87.888[a]	.044	.117

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

Age and marital status significantly contributed to adoption of quality protein maize and access to available communication channels as shown in the Variables in the Equation output regression function which includes the test of significance for each of the coefficients in the logistic regression model. For small samples the t-values are not valid and the Wald statistic should be used instead. Wald is basically t^2 which is Chi-Square distributed with df=1. The regression function given as;

IN (ODDS) =.164+.879 Age+-.671 Marital status.

Table 30: Variables in the Equation

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
								Lower	Upper
Step 1[a]	Age	.778	.318	5.989	1	**.014**	2.177	1.168	4.059
	Constant	-.369	1.202	.094	1	.759	.692		
Step 2[b]	Age	.879	.327	7.246	1	**.007**	2.409	1.270	4.570
	Marital status	-.671	.363	3.414	1	**.065**	.511	.251	1.042
	Constant	.164	1.218	.018	1	.893	1.178		

a. Variable(s) entered on step 1: Age.

b. Variable(s) entered on step 2: Marital status.

The age of the household head indicates the farmerôs capacity to work, which affects the ability to adopt any innovations. The results showed a positive relationship between age and the decision to choose the communication channel for disseminating quality protein maize technologies. The age of the farmer is affected by knowledge and awareness of any activity in the surrounding environment which includes other farmers. This indicates that age influences the farmers' decision to adopt the quality maize.

At the younger age, a farmer may not be able to adopt quality protein maize technologies, especially choosing a capital intensive communication channel because of the fact that they might not have adequate resources to do so. At an older age, farmer on the hand with a volume of economic activities reduced hence might not be in a position to pay for technologies. Older farmers have accumulated years of experience in farming through observations and experimentation and may find it difficult to leave such experiences for new agricultural technologies. For example Caswell *et al*, (2001) and Khanna, (2001), noted that farmersô perception that technology development and the subsequent benefits, require a lot of time to realize and can reduce their interest in the new technology because of farmersô advanced age, and the possibility of not living long enough to enjoy it.

Marital status also contributes to decisions on production and communication channels to use. In the study regions it was noted that (83%) of the respondents were married). The relationship between marital status and adoption of quality protein maize was significant at 0.065 level of significance. In essence a married farmer engage most of his time in farming and access to agricultural information through available dissemination channels unlike a single farmer who lacks adequate time in farming activities.

4.5 Effectiveness of Mass Media and Interpersonal Channels for Disseminating Quality Protein Maize Information and Technologies to Farmers.

Despite the wide range of communications channels used by farmers in the two study sites, farmers had different perceptions regarding their effectiveness in delivering information regarding QPM on a three point ranking scale (Very effective, effective, less effective) basis.

4.5.1 Farmers Scoring of Communication Channels in Kathonzweni

Table 31 shows how farmers in Kathonzweni scored the communication channels they use to access information on quality protein maize and their effectiveness.

Table 31: Farmers' scoring of communication channels in Kathonzweni

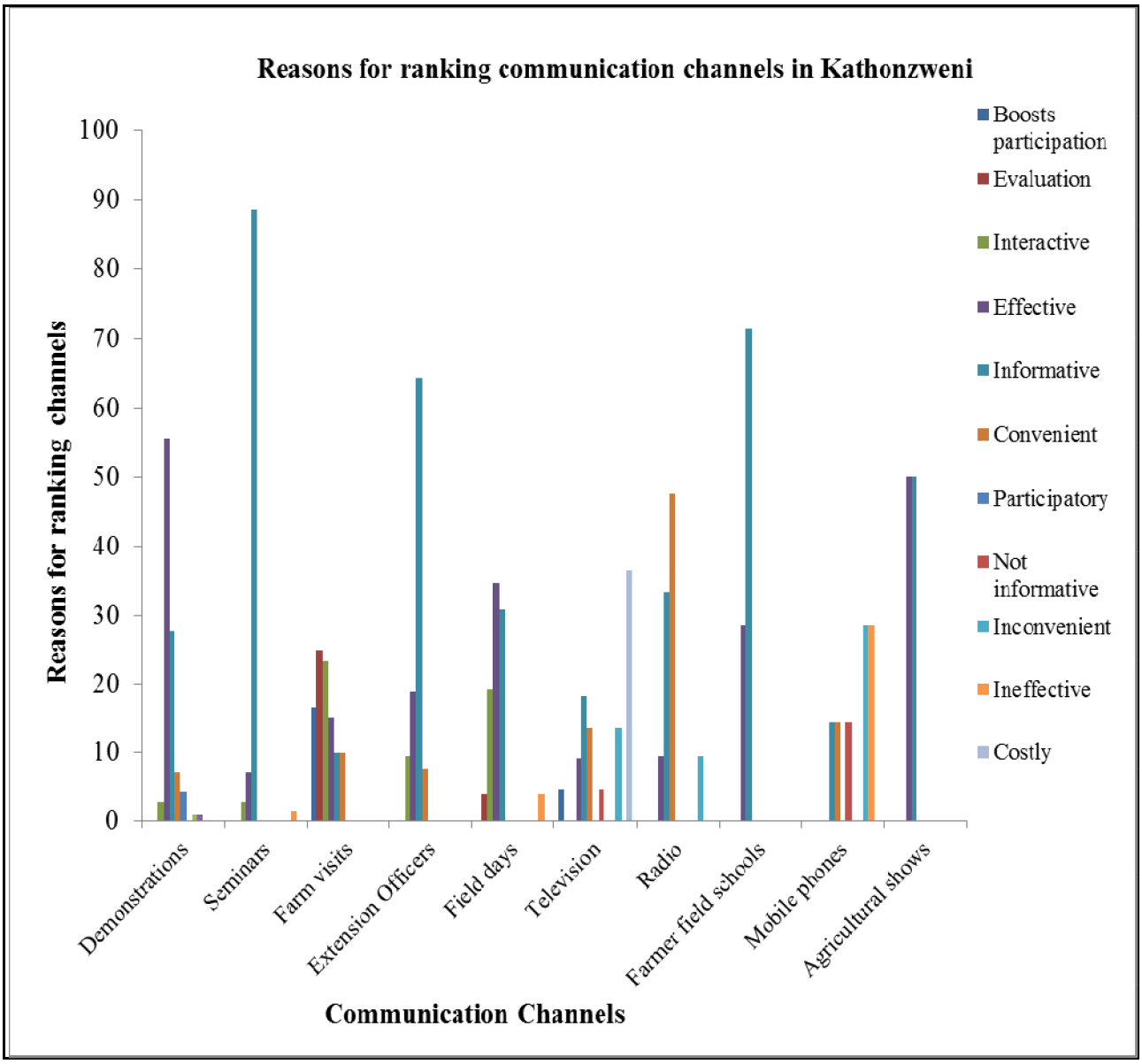
Channel	Very Effective(%)	Effective(%)	Less Effective(%)	Total
Demonstrations	27.5	42.5	30.0	100
Farmer visits	32.8	31.3	35.9	100
Extension	29.0	29.0	41.9	100
Field days	28.2	30.8	41.0	100
Radio	32.1	35.7	32.1	100
Group meetings	75.0	25.0	0.0	100
Seminars	26.3	47.4	26.3	100
Farmer field schools	11.1	44.4	44.4	100
Agricultural shows	14.3	42.9	42.9	100
Newspapers	14.3	28.6	57.1	100
Mobile Phone	12.5	12.5	75.0	100

Source: Survey data, 2014

From Table 30 group meetings (75%) were ranked the most effective channel, followed by farmer visits (32.8%), radio (33.1%), extension (29%), field days (28.2%), demonstrations

(27.5%), and agricultural extension (27.5%). As observed from this study, farmer groups play a crucial role in the transfer of technologies as a communication channel as well as a training platform on agricultural technologies and farming practices, thereby contributing immensely towards knowledge management. Therefore, this study concurs with a research carried out by (FAO, 2013) on farmer groups in food production systems, where it was found out that while working through small farmer groups, farmers can reduce the cost of accessing inputs, production technologies, information and markets by sharing these costs amongst all members of the group.

The effective channel category were seminars (47.4%), the second being the farmer field schools (44.4%), followed closely by agricultural shows (44.9%), demonstrations (42.5%), radio (35.7%), farm visits (31.3%) field days (31.3%). The less effective communication channels ranked highly by farmers were mobile phones (75%), newspapers (57%). The underlying reasons for their scoring by farmers in Kathonzweni are as shown in Figure 11.



Source: Survey data, 2014

Figure 9: Basis of Scoring Communication Channels in Kathonzweni

The level to which a communication channel is informative came out as very important to farmers and in this respect, seminars scored highest (88.7%), followed by farmer field schools (71.4%), the third channel in terms of in formativeness was agricultural extension officers (64.2%), agricultural shows (50%), radio (33.3%), field days (30.8%), demonstrations (27.8%),

mobile phone (14.3%) and informative farm visits (10%). This was attributed to the fact that these approaches are practical and interpersonal hence making learning easier.

The second most important parameter was the effectiveness of the channel and in this respect, demonstration plots were the farmer preferred channel by 55.6% of the respondents due to the fact that they can be able to see what is on the ground by example and compare notes with what they do on their own farms. They were followed by agricultural shows effective (50%), field days (34.6%), farmer field schools (28.6%), extension visits (18.9%), farm visits (15%), mobile phone (14.3%), radio (9.5%) and television (9.1%) since these offer the farmer on the spot advice while touring their farms and hence induce a level of interaction with the respondents while answering their questions.

Farm visits on the other hand, were preferred for their ability to be more interactive (23.3%) and also boost farmer participation (16.7)% by fostering a free approach, offering close contact with experts and in tandem, incentives are offered to farmers. On the lower rung, television scored low due to the cost of the television sets acquisition (36.4%), while radio (9.1%) was low because of inconvenient caused by poor timing of programs.

4.5.2 Scoring of Communication Channels in Kirinyaga

Table 32 shows how farmers in Kirinyaga scored the communication channels they use to access information on quality protein maize and their effectiveness.

Table 32: Farmers' Scoring of Communication Channels in Kirinyaga

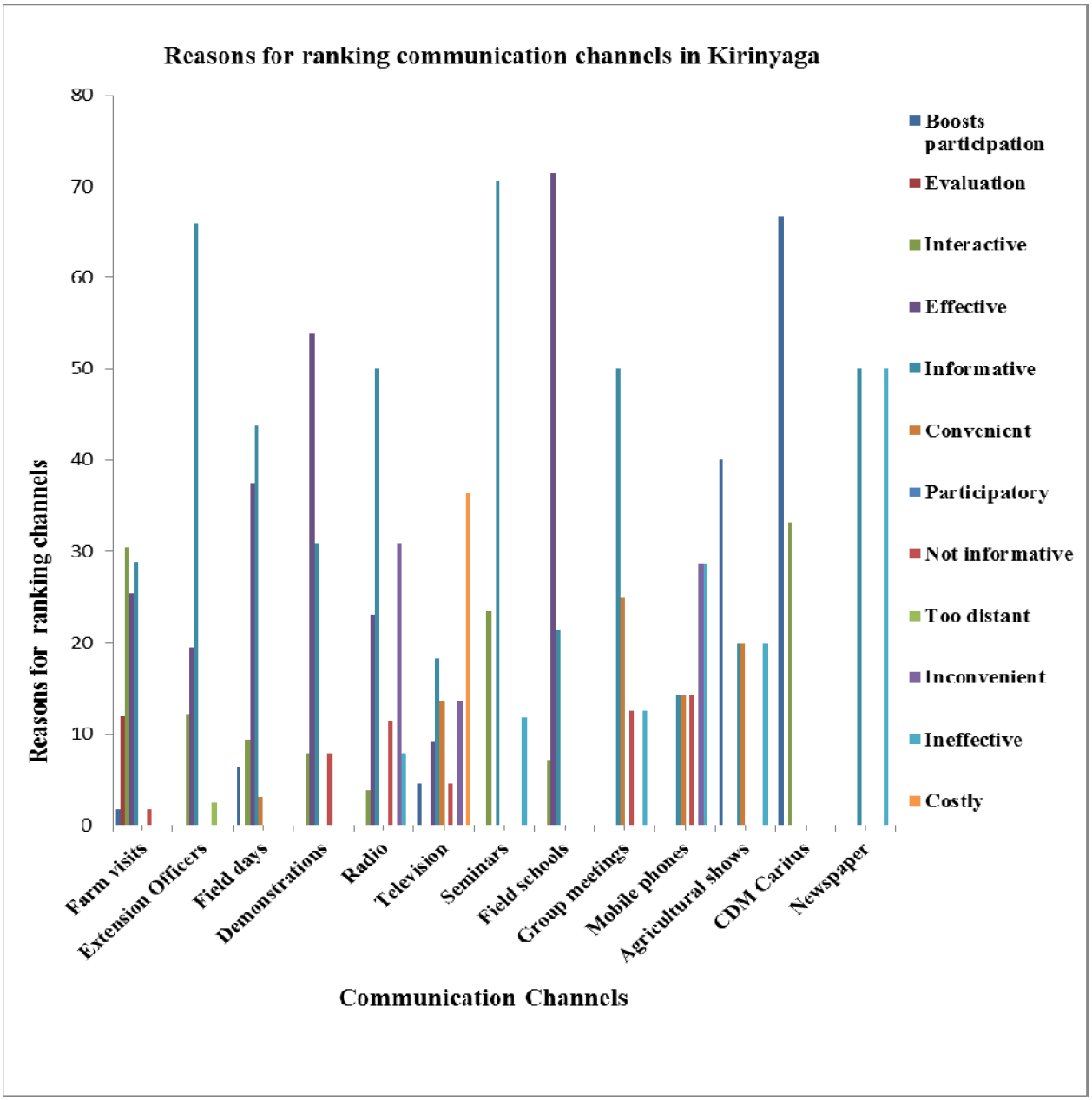
Channel	Very effective (%)	Effective (%)	Less effective (%)	Total
Seminars	68.3	23.2	8.5	100
CDM	66.7	33.3	0.0	100
Farmer visits	66.1	24.2	9.7	100
Farmer field schools	57.1	28.6	14.3	100
Extension	53.1	28.6	18.4	100
Field days	35.0	50.0	15.0	100
Agricultural shows	28.6	14.3	57.1	100
Demonstrations	27.6	51.7	20.7	100
Newspapers	25.0	0.0	75.0	100
Radio	18.8	43.8	37.5	100
Television	7.7	15.4	76.9	100
Group meetings	0.0	50.0	50.0	100
Mobile Phone	0.0	0.0	100.0	100

Source: Survey data, 2014

Farmers scored highly on Seminars 68.3%), CDM (66.7%), farmer visits (66.1%), Farmer field schools (57.1%), extension 53.1%), field days (35%), demonstrations (27.6%), newspapers (25%) and television (7.7%) in order of overall effectiveness.

The effective communication channels were demonstrations (51.7%), groups meetings (50%), field days (50%), radio (43%), CARITUS (33.3%).by 51. Television was ranked the less effective channel (76.9%), followed by newspapers (75%), agricultural shows (57.1), group meetings (50%) and radio (37.5%).

The reasons for scoring communication channels in Kirinyaga district are given in Figure 12.



Source: Survey data, 2014

Figure 10: Reasons for Scoring of Communication Channels in Kirinyaga Sub County

From this figure, seminars deemed to be most informative (70.6%) compared to other channels in the same way as the case for Kathonzweni, followed by Extension officers (65.9%), followed

by radio, group meetings and newspaper each at (50%), Field days (43.8%), farm visits (28.8%), Farmer field schools (21.4%), agricultural shows (20%), television (18.2%) and mobile phones (14.3%).

In terms of effectiveness, Farmer Field schools were ranked the highest (71.4%), followed by demonstrations (53.8), Field Days (37.5%), Farm Visits (25.4%), Radio (23.1%), Extension visits (19.5%) and Television scoring the lowest (9.1%) due to its higher cost implication of 36.4%. Communication through Farm visits was considered easier to understand, practical and information was first hand compared to other channels discussed above.

On the basis of interactivity in delivery QPM information to farmers, CARITAS, a community based NGO in Kirinyaga was ranked the most interactive channel by (33.3%), followed closely by farm visits (30.5%), seminars (23.5%), extension visits (12.5%), field days (9.4%), Demonstrations (7.7%), farmer field schools (7.1%) and lastly radio (3.8%). The low score of radio was due to the inappropriate timing of radio programmes and lack of feedback mechanisms from farmers after airing of agricultural programmes.

Participatory approach was another means of promoting and disseminating technologies in Kirinyaga. Participatory approach facilitated farmers' demand for knowledge, and offered opportunities to choose and adapt QPM knowledge according to their needs. CARITAS an NGO based in Kirinyaga boosted the farmer participatory approach by (66.7%), agricultural shows (40%), field days (6.3%) and television (4.5%).

Multiple responses were conducted and separated by district in order to rank the parameters most important to farmers when selecting a communication channel to use for obtaining information on agriculture (Table 33)

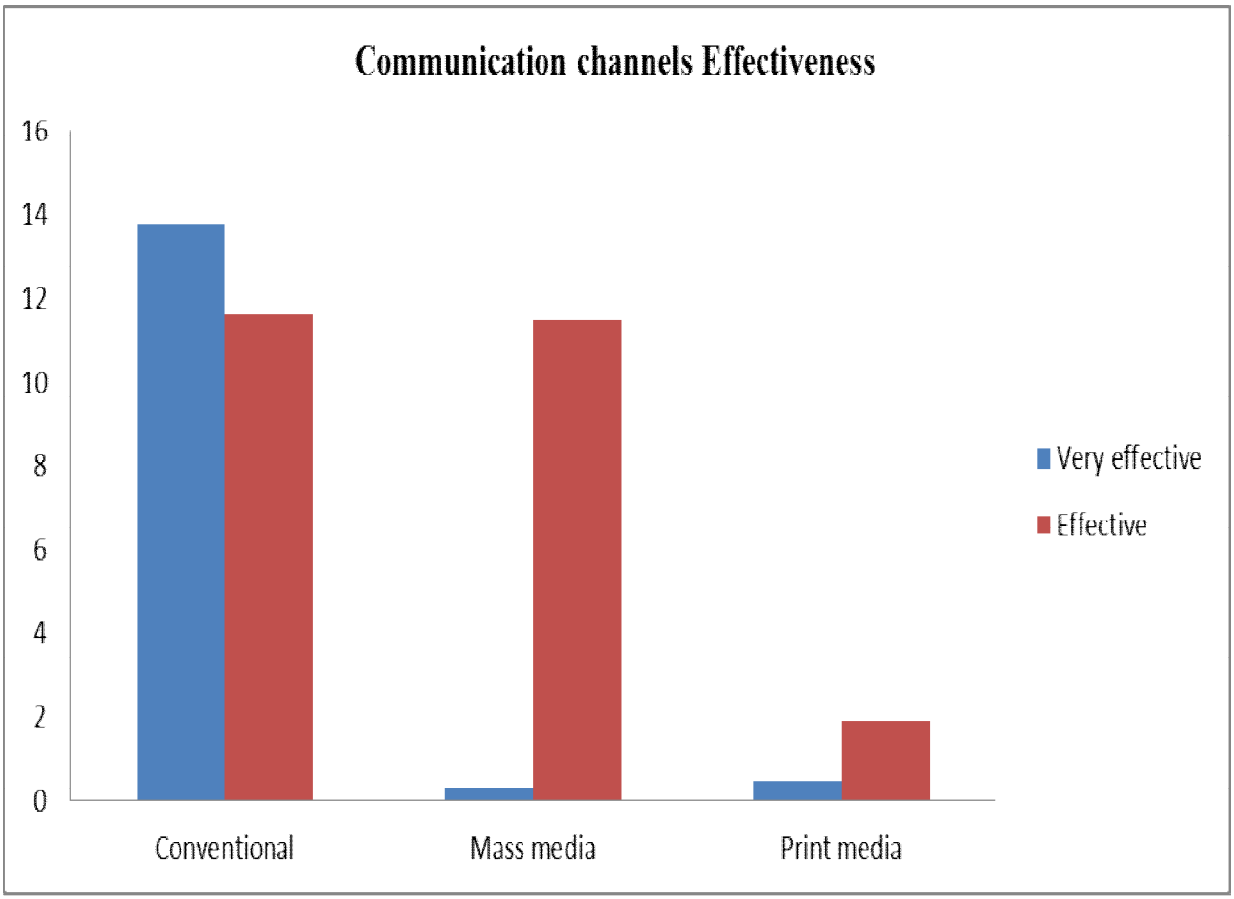
Table 33: Reasons for Scoring on Communication Channels (multiple responses)

Reasons for ranking communication channels	Kathonzweni	Kirinyaga
Informative	46.80%	37.40%
Effective	24.70%	25.60%
Interactive	9.90%	13.30%
Convenient	7.90%	6.30%
Evaluation	5.10%	5.40%
Boosts participation	3.20%	3.10%
Participatory	0.90%	3.10%
Inconvenient	0.60%	2.70%
Inefficient	0.60%	2.70%
Too distant	0.30%	0.40%

Source: Survey data, 2014

Across the board, it was established that farmers considered these for three main reasons; first being how informative the channel was and its effectiveness and interactivity. This was the case as observed in both districts. In terms of in formativeness, Kathonzweni farmers (46.80%) agreed that the communication channels were informative, effective (24.70%) and interactive (9.90%). Also a high percentage of farmers in Kirinyaga acknowledged the channels were informative (37.40%), effective (25.60%) and convenient (13.30%) in the dissemination of quality protein maize technologies.

The communication channels were categorized into three groups based on farmer perceptions as whether conventional (Farmer to farmer, field days, demonstrations, field schools, seminar, group meetings, agricultural shows, extension), mass media (radio, television, mobile phone) and print media (news paper) as shown in Figure 13;



Source: Survey data, 2014

Figure 11: Categorization of Communication Channels on Basis of Effectiveness

These results indicate that in the context of diffusion of innovation theory media as well as conventional channels for example farmer to farmer, extension, seminars, field days provide valuable information to farmers on quality protein maize and hence influence their opinion and judgment regarding adoption. It was found that conventional channels scored the highest (13.8%) in the very effective and (11.6%) in the effective categories. The uses and gratification theory, a research carried out on the effectiveness of the mass media as a medium (Luo 2002), agrees with the findings of this study which brings an understanding of why quality protein maize farmers might have preferred using a certain channel of choice as opposed to others in diffusing quality protein maize technologies. This concurs with results showing fairly large percentage of farmers in the study areas who preferred mass media (11.5%) and print media (1.9%).

4.6: Influence of Communication Channels on Adoption of Quality Protein Maize

Binary Logistic regression was used to analyze the communication channels that significantly influenced the farmer's decision on whether adopt quality protein maize or not. The binary logistic regression adoption function was generated. Given the base rates of the two decision options, (Yes 1=Adoption, 0= No adoption) as shown in the classification table below, 93% of the farmers adopted quality protein maize in Kirinyaga and Kathonzweni.

Table 34: Classification Table

Classification Table[a]

		Observed	Predicted		
			Adoption		Percentage Correct
			No	Yes	
Step 1	Adoption	No	0	13	.0
		Yes	0	184	100.0
	Overall Percentage				93.4

a. The cut value is .500

Under Variables in the Equation it can be noted that the intercept-only model is ln(odds) = 2.650 If we exponentiate both sides of this expression we find that our predicted odds [Exp(B)] = 14.154. That is, the predicted odds of deciding to continue the adoption of the QPM technology are 14.154. Since 184 of farmers in the study regions decided to continue with the production of quality protein maize and 13 decided to not to adopt the observed odds are 184/13 = 14.154

Table 35: Variables in the Equation

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	2.650	.287	85.267	1	.000	14.154

Omnibus Tests of Model Coefficients gives us a Chi-Square of 10.831 on 1 df, significant at .001. This is a test of the hypothesis that adding the field days variable to the model has significantly increased our ability to predict the decisions made by farmers on adoption. Therefore hypothesis which states that communication channels determine the rate of adoption of quality protein maize is accepted.

Table 36: Model coefficients

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	10.831	1	.001
	Block	10.831	1	.001
	Model	10.831	1	.001

The next table includes the Pseudo R^2, the -2 log likelihood is the minimization criteria used by SPSS. We see that Nagelkerke's R^2 is 0.139 which indicates that the model is good. Given the Cox & Snell's R^2 we can interpret this as 5% probability of the farmers decisions being influenced to adopt quality protein maize as explained by the binary logistic model.

Table 37: Model Summary

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	84.966[a]	.053	.139

a. Estimation terminated at iteration number 7 because parameter estimates changed by less than .001.

The field days significantly contributed to adoption of quality protein maize as shown in the Variables in the Equation output regression equation (Table 37) given;

IN (ODDS) = 1.740+1.997 Field days.

Table 38: Variables in the Equation

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
								Lower	Upper
Step 1[a]	Fielddays	1.997	.677	8.694	1	**.003**	7.368	1.953	27.793
	Constant	1.740	.343	25.771	1	.000	5.700		

a. Variable(s) entered on step 1: Field days.

The overall goal of a field day is to increase agricultural literacy in rural communities. Field days are meant to educate and increase farmers awareness on the different emerging technologies such as the QPM technologies based on what is in the field demonstration plots and also instill appreciation of agricultural systems. Field days include events such as farmers visiting the agricultural research institutions to learn the technologies in the field demonstrations. The events are good sources of agricultural information as organizers can arrange for guest speakers to talk on a range of topics. For instance, a talk on the benefits and production of QPM plus its value addition.

4.7 Farmers Opinion on Improvement of Quality Protein Maize Production

Farmers gave different opinions on what should be done to improve production of quality maize (Table 38).

Table 39: Farmers opinion on improvement of quality protein maize production

Farmer opinions	% Responses
Provide suitable QPM varieties (better varieties, more research on drought tolerance)	6.4%
Training (seminars, educate farmers)	14.4%
Early Seed provision	26.8%
Reduce cost of inputs	5.9%
Crop management- Knowledge and information on QPM techniques and practices	1.6%
Spread technology	0.7%

Source: Survey data, 2014

14.4% of farmers indicated the need for training on QPM technology, 26.8% would like seed to be availed early enough for timely planting before onset of the season, 5.9% want the cost of farm inputs to be reduced. 6.4% of the farmers suggested that there was need for farmers to be provided with suitable quality protein maize varieties (better varieties, more research on drought tolerance), while 1.6% indicated the need for Crop management through provision of knowledge and information on QPM techniques and practices and 0.7% the spread of quality protein technology as also being very important.

CHAPTER 5

5.0 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

The study findings show that communication channels significantly played a major role in quality protein maize awareness and adoption. In Kirinyaga famer to farmer, farmer groups and in Kathonzweni extension were the major channels which farmers got to know about quality protein maize technologies. Conventional channels (field days, demonstrations, farmer groups, farmer field school, farmer to farmer, seminar) and mass media (radio) are significantly preferred channels among farmers and have a significant influence on farmer access to quality protein information and subsequent adoption. Famers ranked extension, farmer to farmer, demonstrations and farmer field days as interactive, effective and very informative channels in diffusing quality protein maize technologies. The binary logistic regression indicates that field days contribute positively to the adoption of quality protein maize in the study regions.

The socio economic factors that influence significantly the adoption of quality protein maize technologies are age and marital status of the farmer. Farmers opinion on improvement of QPM production include early provision of low cost seed and farm input, farmer trainings seminar, lack of knowledge and information on QPM practices and spread of the technology . The constraints to production of quality protein maize are mostly, climate change and inadequate seed.

5.2 Conclusions

In conclusion conventional channels which include farmer field days , farmer groups, famer field schools, seminars and demonstrations should continue being promoted through increased extension visits, and investing in farmer education via seminars, as vehicles of disseminating agricultural innovations. This is because field days and demonstrations showed a significant contribution to adoption of quality protein maize. Seminars and farmer to farmer were also highly ranked and preferred by farmers as most effective for the communication and dissemination of quality protein maize information and knowledge to farmers. A very low percentage of farmers preferred radio, television and mobile phone thus need for information and communication technologies to be used to complement the conventional channels which promote access to quality protein maize information. This study also revealed that access to agricultural information and knowledge improves increase adoption, enhancing farmer productivity and high yields which will be an answer of arising questions of food security and raised poverty level in the country.

However, the social factors that influence probability of adoption of quality protein maize technologies by farm households include, age and marital status.

Policy makers, extension officers and researchers, need to consider exploiting the use of community based FM radio stations through local vernacular language and mobile phone services to promote the dissemination of quality protein maize technologies in both study areas. The research organizations should also continue supporting farmer field schools (FFS) which is a good concept but is not fully utilized as a knowledge source among farmers. Levels of education of farmers were highly significant with regards to accessing information and adoption of quality protein maize technologies. The literacy levels may be boosted by the government of Kenya (G.o.K) initiative taken in providing free primary and secondary education in the country.

Lastly, there is need to engage and persuade farmers on benefits of quality protein maize through farmer field days, farmer group meetings, seminars, farmer to farmer (ToTs) and demonstrations in order for give them knowledge, ask questions and provide their own feedback to the extension workers and researchers.

5.3 Recommendations

The following recommendations are proposed:

1. Increasing awareness of quality Protein Maize using field days, demonstrations and farmer group meetings will increase adoption in Kirinyaga. Also an increase in field days, farmer field schools, seminars and farmer to farmer visits will increase adoption in Kathonzweni. Therefore, the stakeholders who extensively use the channels (research institutions, Community Based Organization, Non Governmental Organizations) to disseminate agricultural information found them effective and should continue promoting the same.
2. Each of the socio-economic variables studied should be addressed at levels in which it affects the farmer's decision to adopt Quality protein maize. For example, adult literacy programs could be promoted while at the same time encouraging younger family members of to pursue formal education to at least to secondary level. Secondly, the gender balance in household decision making should be embraced to promote and enhance increase of adoption of agricultural innovation.
3. Information technologies among rural farmers are currently under – utilized, so stakeholders should take necessary precautions to boost its usage in order to promote the global village initiative therefore necessary measures should be taken by stakeholders (research institutions, Community Based Organization, Non Governmental Organizations) to promote the use of other channels like television, mobile phone and community based radios to convey information on quality protein maize. This avenue should be pursued as a platform of educating farmers on the benefits of quality protein maize technologies and production.
4. Lack of seed was a major constraint to production, it should be availed to farmers early enough.
5. Since extension services have a greater impact on information delivery to rural farmers, as gents of change, there is an urgent need to equip them with the requisite facilities and funds as well as streamlining their extension activities.

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APPENDICES

APPENDIX 1:

Questionnaire

Enumerator's Name_____ Questionnaire Number_____

Date of the Interview_____(DD/MM/YY) Start Time_____

Site Identification

1. Sub –County (District)_____Division_____Location_____

Sub-Location_____Village_____

2. GPS Reading:- Latitude (N/S)_____Longitude_____Altitude(Masl)_____

AEZ _____

Socio-Economic Characteristics

3. Respondents Names_____.

4. Contact (Mobile No.)_____

5. Indicate whether respondent is Owner____Employee _____Relative, _____

Tenant _____Others (specify)_____

6. Is the respondent the household Head (major decision Maker): Yes_____No ____.

7. If No who DECIDES? Spouse) Son_____ Daughter _____Relative _____,Labourer

_____.

8. Gender of the Household head: - Female_____Male_____

9. Age category of the Household head in years :< 18 ____ 18-30_____ 31-40_____

41-50 _____>50)_____.

10. Marital Status: Married _____Single _____ Widowed _____ Divorced _____.

11. Educational level of respondent in years:-Primary 1-8 Years _____Secondary 8 – 12 years -

_____

Tertiary 12 – 15 Years_____University12 – 20 Years_____.

12a. Main Sources of Income: - On- farm: Farming _____ Off-farm: Formal Employment

_____

Casual employment _____Business _____Remittances_____ Loans _____

Others _____

12b. Annual Income categorization _____*Cat A is 0-5000 B= 5001-10000 C= 10001-15000 D=15001-20000 E=20001-25000 F = 25001-30000 G=30001-35000 H=35001-40000 I=40001-45000 J=45001-50,000 K>50001*

13. Persons in the household, and age category?

Age bracket	**Number**
Children <12 years	
Teenagers 13-19 years	
Young Adults 20 – 35 years	
Middle aged 36 – 64 years	
Old >65	

14. How many family members are living on the farm and contributing labour to farming activities in the last twelve (12) months?_____ .

15. What are the main sources of Labour for the household? Family _____,Hired ____, Both family and hired ____, Group members____, Others_____

16 Does the household head belong to a farmer group: Yes____No_____.

17. Do you employ farm labour: Yes _____, No_____.

18. If Yes, At what time:- Ploughing) _____ Planting _____ Weeding _____ Harvesting _____Threshing _____ Storage_____

19.a. If Yes, how many per season; No. of man days Long Rains._____ Short Rains_____.

19.b.What is the cost of farm labour per Man Day?_____(Kshs),

20. What is your approximate farm size (Acres):- <5_____,5-10_____, 10-15_____, 15-20_____ , >20 ____.

21. Land ownership of your farm. Free hold , Leasehold/Rented _____Communal _____ _____, Borrowed _____, Squatter _____

22. How long have you been farming in years? _____

23. Distance to the nearest market (Km) _____

Diffusion of Quality Protein Maize (QPM)

24. Are you aware of Quality Protein Maize?; - Yes _____, No___.

25. If yes which year did you know?_____

26. How did you get to know about QPM:-

……

……

27. Have you been interested in the production of the QPM: Yes_____, No _

27b. Have you started the production of the QPMA (Adopted): Yes_____, No _

28. If growing QPM which year and month did the farmer start growing it; YYYY_____MM____

29. Which varieties: (01)_____, (02)_____,(03)

_____

QPM Varieties:1= KH631Q 2=KH 500Q 3=WS104Q

30. If NO please give your reason for not growing QPM:_____

_____

_____

31. Why do you grow QPM? For food _____, Sale _____,Animal feed _____,

Others Specify _____.

32. If Yes when did you fully adopt QPM?

Immediately YYYY/MM_____ Explain……

After sometime YYYY/MM_____Explain……

Later YYYY/MM_____Explain……

Season	**LR 2010**	**SR 2010**	**LR 2011**	**SR 2011**	**LR 2012**	**SR 2012**	**LR 2013**	**SR 2013**
QPM Variety								
Acreage								
Kgs seed Planted								
Yield (Kgs)								

33. Did you receive enough rainfall during this period? Yes _____, No_____

34. If yes , which season/year _____

35. If no , which season/year _____

36. Do you irrigate your crops? _____

37. Please give any other alternative you copped with climate change _____

38. Have you sought agricultural information in the last one year: Yes _____, No ___.

Communication channels and Sources of Information (2010-2012)

39. What are your sources of Agricultural information?

Ministry of Agriculture_____ Research _____NGO'S _____Television _____, Newspapers _____, FM radio _____Seminars _____Mobile Phone _____

Others Specify)……

40. Who among those working on the farm has received training on QPM production:

Household head _____,Spouse _____, Child _____, Relative _____,

Farm worker , None _____.

41. Please tick appropriately in the following table the communication channels which you receive information on QPM production: -

Communication Channel	**Yes**	**No**	**No. of times**
Farm visits (Farmer to Farmer)			
Field days			
Farmer field schools			
Demonstrations			
Radio			
Television			
Mobile phone			
Extension officer			
Agricultural shows			
Seminars			
Newspapers			
Others (specify)			

42(a). Rank the communication channels you consider most effective in disseminating QPM production technologies above: - *(1= **Very Effective 2= Effective 3= Less effective)***

Communication Channel	**Ranking**	**Reason for your preference ranking**
Farm visits (Farmer to Farmer)		
Field days		
Field schools		
Demonstrations		
Radio		
Television		
Mobile phone		
Extension officer		
Agricultural shows		
Seminars		
Newspapers		
Others (specify)		

42(b). List any other communication channel/s you consider most effective and has not been used in disseminating QPM production technologies above:

Communication channel	**Reason**

Farm Enterprises and their relative importance

43. Do you keep livestock: Yes , No___ (if yes fill the table below)

Livestock	**No owned**
Local cattle	
Cross breeds	
Local Goats	
Improved goats	
Sheep	
Local poultry	
Exotic poultry	
Donkey	
Others (specify)	

44. Do you sell Livestock; Yes _____, No

45. Why do you sell livestock? _____

46. How much land is set aside for livestock: _____acres

Crop Enterprises and their Relative importance (2010-2012)

47. What other crops are grown on the Farm? (Fill table):- in order of importance

Crop	**Acreage**	**Kgs planted**	**Yield**	**Reason**

48 Soil type _____

49. Do you sell your farm produce? Yes _____, No

50. If yes do you have a ready market for your farm produce?

51. Why do you sell farm produce? _____

52. What are the main Problems you have encountered in quality protein maize production?

No	Constraint	Tick	Rank
1	Climate change		
2	Inadequate soil moisture		
3	Low soil fertility		
4	Availability of seeds		
5	Pests and diseases		
6	High cost of inputs		
7	Lack of market		
8	Low prices		
9	Lack of storage facilities		
	Others (Specify)		

53. How did you handle the above constraints?

.....

54. Do you have any cropping system in place? Yes _____, No

List of cropping systems

1. _____ 2. _____

3. _____ 4. _____

55. In your opinion, what do you think should be done to improve quality protein maize production in your area?.....

ASANTE SANA MKULIMA

APPENDIX 2:

Definitions of Key Terms

Adoption: Adoption refers to the acceptance and the continued use of an innovation (Robertson, 1971) and can also be considered as 'a decision to continue full-scale use of an innovation' (Rogers, 1962). In this study adoption was conceived as the farmer's willingness to accept quality protein maize and continue full– scale production of the QPM.

Communication: Communication is a process through which one person (or group) shares and imparts information to another person (or group) so that both people (and group) clearly understand one another (Udall and Udall, 1979).

Communication channels: These are means through which information is passed from the source to the receiver (e.g. Field days, radio, television, mobile phones, agricultural shows, extension services).

Diffusion: Diffusion is the process by which an innovation is communicated through certain channels over a period of time among the members of a social system (Rogers, 2003).

Socio-economic factors: - These are factors that describe something which relates to or is concerned with the interaction of social and economic factors. It is basically refers to issues to do with income and social positions that measure the status of a family such as educational level, experience in farming, farm size, age, gender and level of income.

Innovation: An innovation is an idea, technology or practice that is perceived to be new by a unit of adoption, wherein, in this study, the innovation is the quality protein maize.

Quality protein maize (QPM): Type of maize that contains nearly twice as much usable protein as other maize grown in the tropics and yields 10% more grain than the traditional, conventional varieties of maize. The quality protein maize varieties grown in study regions are KH631Q, KH 500, WS104Q.

Dissemination: The act of spreading information to various audiences without direct feedback from them. The main aim of dissemination is to increase the farmer's awareness of agricultural innovations which result into rapid adoption of the technologies.

Preference: A greater liking for an alternative over another or others. It is important to make a desirable choice of communication channel provided for with different options.

Effectiveness: Effectiveness refers to the degree to which desired results are produced or successful (Reference required). In this study, effectiveness was conceived as the ability of farmers to receive information on QPM technologies and practices effectively through specific communication channels with an ultimate aim of increasing the rate of adoption and yields.

Stakeholders: These are entities (persons or organizations) that have an interest in the project (QPM – DONATA project) and are directly or indirectly involved in the project research activities and may have a positive or negative influence. Examples of the stakeholders in this study are the farmers, extension officers, researchers, NGOs, CBOs, MoA and policy makers.

APPENDIX 3:

Adopter Categories

These are the classifications of members of a social system on the basis of innovativeness namely, innovators, early adopters, early majority, late majority and lastly laggards (Rogers, 2003).

Innovators: Sometimes referred to as venturesome, innovators are the first individuals to adopt an innovation and very eager to try new ideas. This research conceives them as the first farmers who adopted the quality protein maize technology.

Early adopters: These are the second fastest category of farmers to adopt an innovation with the highest degree of opinion leadership among the other adopter categories.

Early majority: These are individuals who adopt an innovation after a varying degree of time. The time of adoption is significantly longer than the innovators and early adopters. However, early majority tends to be slower in the adoption process as compared to innovators and early adopters.

Late majority: These are Individuals who adopt an innovation after the average member of the society. They comprise individuals who approach an innovation with a high degree of skepticism and after the majority of members in a society have adopted the innovation.

Laggards: These are the last individuals to adopt an innovation and show no little interest to extension or researchers.