

**SELECTED FACTORS INFLUENCING ADOPTION OF IMPROVED POTATO
(*Solanum tuberosum*) VARIETIES AMONG SMALLHOLDER FARMERS IN
MUMBERES DIVISION, BARINGO COUNTY, KENYA**

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**Thesis Submitted to the Graduate School in Partial Fulfillment of the Requirements of
Master of Science Degree in Community Studies and Extension of Egerton University**

EGERTON UNIVERSITY

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DECLARATION AND RECOMMENDATION

Declaration

This research thesis is my original work and has not been presented in any University or other institution of learning for any award.

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DEDICATION

This thesis is dedicated to my Father Njuguna Mwangi and my mother Anastasia Wambui Njuguna for their continued moral support during the course of my study.

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The preparation of thesis was made possible by the guidance and help I received from several individuals whose assistance and contribution should not go unmentioned.

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This study was a success because of all your efforts. May the almighty God bless you abundantly in all your endeavors.

ABSTRACT

Potato is widely consumed as a staple world over with direct consumption by humans as food being 31.3 kg per capita. In Kenya, potato follows maize in order of importance for human consumption with a countrywide production of between 4.4 t/ha and 15 t/ha. However, 40t/ha are possible. The Ministry of Agriculture through collaborative efforts with other stakeholders developed improved potato varieties and released them for farmers to plant in Kenya in order to bridge the low level of production. Nonetheless, the adoption rate of these varieties was significantly low in Mumberes division. The main aim of this study was to investigate the influence of selected factors namely demographic factors (family size, level of education of household head, age and gender), access to extension services, access to credit services and farmer's perception about improved potato varieties on adoption of improved potato varieties in Mumberes division, Baringo county. The population of study comprised of smallholder farmers in Mumberes and the sample was selected from this population using proportionate and systematic sampling. The study used a cross sectional survey research design where 128 household heads were interviewed. Interview schedule was used as the data collection instrument. The face and content validity of the instruments was assessed by experts from the field of community studies and extension. A Cronbach alpha coefficient of reliability of 0.87 was obtained after the pre test. Statistical Packages for Social Sciences (*SPSS*) computer program aided data analysis. The study revealed that the selected demographic factors namely gender and marital status of the household head, age, level of education and family size had no statistically significant influence on adoption of improved potato varieties. Only a small fraction of the farmers had access to extension services in the study area. The study showed that access to extension also had no statistically significant influence on adoption of improved potato varieties. The average amount of credit received by farmers was about KES 10000 per year. Access to credit also had no statistically significant influence on adoption. Farmers had a high positive perception of improved potato varieties about taste, maturity, improving food security and increasing incomes for families. However they felt that the improved varieties were not resistant to blight and that production of these varieties was labour intensive. The study therefore recommended that there is need to increase access to extension by farmers by increasing the number of extension staff. Promoting farmer-farmer extension through formation of groups would also necessary to allow sharing of information. Also the amount of credit accessed should be increased since the amount received was low. Additionally, research efforts geared towards seeking varieties resistant to blight and bacterial wilts is paramount. Another research would be necessary to assess other factors influencing adoption in the study area such farm characteristics.

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LIST OF ABBREVIATIONS AND ACCRONYMS

CBOs	Community Based Organizations
CIP	International Potato Center
EAGC	Eastern Africa Grain Council
FAO	Food and Agricultural Organization
KARI	Kenya Agricultural Research Institute
KNBS	Kenya National Bureau of Statistics
IFPRI	International Food Policy Research Institute
MoA	Ministry of Agriculture
NCST	National Council of Science and Technology
PRAPACE	The Regional Network for Improvement of Potato and Sweet Potato in East and Central Africa
SPSS	Statistical Package for Social Sciences

CHAPTER ONE

INTRODUCTION

1.1 Background Information

Many developing countries of the world have to increase their food production by the year 2020 in order to successfully feed their growing populations. This may be done by maintaining and/or increasing the current rates of growth in national food production in sustainable ways that do not compromise the natural resource base (Nkamleu & Manyong, 2005). World Bank (2007) noted that, Africa ranks first in population growth rates, in number of malnourished and undernourished children. It also leads in the proportion of arable land that is degraded and in poverty. Economies of developing countries such as Africa as well as the wellbeing of their people can be achieved through the application of improved agricultural technologies. Such technologies not only promote agricultural production and improve human health but also help in reducing environmental degradation (Nyange, Kingamkono, Kullaya & Mneney, 2011).

According to Loffler and Ochieng, (2008) Irish potato, which is commonly referred to as potato, is a crop of major economic significance worldwide. With increasing cereal prices, potatoes have the potential of relieving pressure from the poorest poor and promote food security. Potatoes are ranked fourth after wheat, rice and maize in cultivation on a global scale. Among the tuber crops, potato is the most important and ranks first. It has an estimated annual output of 300 million tones cultivated on about 19 million hectares globally (FAO, 2008). Further, FAO asserts that the average production globally is about 17 t/ha whereby the direct consumption by humans as food is 31.3 kg per capita. The importance of potatoes as food in developing countries is because they are grown and eaten locally with little significance in the international market (FAO, 2008).

In Kenya, potato ranks second after maize in order of importance (Muthoni & Nyamongo, 2009). About 500 000 farmers grow this crop on about 120 000 ha per season where the annual production is about 1 million tons in two growing seasons (MoA, 2008). The average annual production of potato is reported to be 1 million tones and per hectare yield of 7.3 metric tones (mt/ha) (Obare, Nyagaka, Nguyo, & Mwakubo, 2010). However, 14.5-20mt/ha at farm level and 25-35mt/ha under research conditions are attainable (KARI, 2005).

Food security in Kenya is a measure of available maize in the country (East African Grain Council, EAGC, 2009). Nonetheless, maize productivity has steadily declined over the years, which has promoted food insecurity in the country. In addition, the prices of cereals such as maize and rice have been on an upward trend thus increasing the burden on the poorest of the poor (Loffler & Ochieng, 2008). However, improved potato may act as a way out of this situation. Potatoes produce more calories as compared to cereals and are easy to cook and process. These aspects combined with a short maturity period of about three months, (FAO, 2008), imply that potato production is able to address the twin problem of food security and low household incomes that faces smallholder farmers in developing countries (Mpogole, Mlambiti & Kadigi, 2012).

Through collaborative efforts between Kenya Agricultural Research Institute (KARI), the International Potato Centre (CIP) and the Regional Network for Improvement of Potato and Sweet Potato (PRAPACE), significant developments of several high yielding varieties of potato have been made in Kenya (Kaguongo et al. 2008). The MoA (2007) also indicated that it has focused on development and dissemination of high yielding varieties. Improved potato varieties promise increased savings since they are bred with superior characteristics such as pest resistance and high yields (Abong, Okoth, Karuri, Kabira, & Mathooko, 2009). This decreases the need for pesticide sprays thereby increasing yields and profits. The improved crop varieties may also have a potential to lower labour costs as they may be resistant to certain herbicides making chemical weed control possible (Meghani, 2007). The outputs are higher compared to the indigenous crop varieties and as such they increase land productivity and ultimately profitability of agricultural enterprises.

Potato is a crop of major economic significance in Mumberes division. It is grown both for subsistence and commercial purposes. This is influenced by the location of Mumberes division of about 2750m above sea level which makes it a suitable area for potato production. Potato production mainly is practiced in areas with high altitudes between 1500m-3000m above sea level (Abong et al., 2009; FAO, 2008; Muthoni & Nyamongo, 2009). Although improved potatoes have been introduced in Mumberes division, still grow the old varieties of potato (MoA 2010). These varieties are highly susceptible to bacterial wilt, early and late blight, and their productivity is relatively low at about 50 bags of 110kgs/ha (table 1). However, improved potato

varieties that have been developed in the recent years including Asante and Tigoni in 1998; Kenya-Sifa, Kenya-Karibu, Kenya-Mavuno and Kenya-Faulu in 2003 (Kaguongo et al. 2008) have good quality traits, high yields and show some level of resistance to late blight (Abong et al., 2009; Felix, Onyango & Eliazer, 2010; Kaguongo et al. 2008). Despite such major developments, the farmers have remained with their old varieties which have been declining in production and have failed to adopt the new varieties. As shown in table 1, the varieties that farmers are growing have been declining in production since 2007. It is evident from the table that the output of the varieties has been in a steady decline over the years. However, improved potato can yield up to 100 bags/ha (MOA, 2010).

Table 1: Average production of previously grown potato varieties in Mumberes division

Year	Variety	Average output per ha (110kg bags)
2007	Nyayo	50
	Komesha	60
	Asante	60
	Kenya mpya	60
2008	Nyayo	43
	Komesha	53
	Asante	50
	Kenya mpya	53
2009	Nyayo	40
	Komesha	47
	Asante	45
	Kenya mpya	42
2010	Nyayo	31
	Komesha	39
	Asante	34
	Kenya mpya	32

Adapted from MoA 2010

Research on adoption has pointed to such factors as demographic characteristics of farmers; for example, level of education, gender, age and experience of the farmers, farmers perception about

the technology, family size, technological factors such as complexity, the location of adopter institutions, access to extension services and access to production resources as some of the factors that may influence adoption of agricultural technologies in other parts of the world (Ani & Ifah, (2004); Delgado & Johnson, (2005); Franzel & Scherr (2002); Mwabu, Mwangi & Nyangito, (2006); Idrisa, Ogunbameru & Amaza, (2010) and Rajasekharan & Veeraputhran, 2001). Given the role that improved potato can play in averting food insecurity, the adoption rate of improved potato varieties that are high yielding is expected to be high for potato farmers in Mumberes division. However this has not been the case. Thus a study that will give an insight into the factors leading to low adoption was necessary.

1.2 Statement of the Problem

Despite research efforts geared toward potato varieties improvement and the role improved potato varieties can play in alleviating rural poverty and averting food insecurity in Mumberes division and in Baringo County as a whole, the adoption of improved potato varieties is low. There was a steady decline in production of potato per hectare over the years leading to an unfavorable comparison between current outputs with potential. It was expected that adoption of improved potato varieties would be high given the trend in declining production of the varieties the farmers were currently growing in Mumberes division. However, this was not the case. Before the current study, there were no known studies carried out to investigate the influence of the selected factors on adoption of improved potato varieties in Mumberes division, hence this study. The previous studies have shown that demographic characteristics such age, education level, marital status family size, access to extension services, access to credit services and perceptions are important in adoption of technologies. This study sought to investigate whether these factors were also important in influencing the adoption of improved potato varieties in the study area.

1.3 Purpose of the Study

The purpose of this study was to investigate the influence of age, marital status, gender of the household head, access to extension, access to credit services and farmer's perception on the adoption of improved potato varieties in Mumberes division Baringo County.

1.4 Objectives of the Study

The study objectives were to:

- i) investigate the influence of the selected demographic characteristics of farmers on adoption of improved potato varieties in Mumberes division, Baringo County
- ii) find out the influence of access to credit services by farmers on adoption of improved potato varieties in Mumberes division Baringo County
- iii) determine the influence of the access to extension services by farmers on adoption of improved potato varieties in Mumberes division, Baringo County
- iv) investigate the influence of farmers' perception about improved potato on adoption of improved potato varieties in Mumberes division, Baringo County

1.5 Hypotheses of the Study

H₀₁ The selected demographic characteristics of the farmers have no statistically significant influence on the adoption of improved potato varieties in Mumberes division, Baringo County.

H₀₂ Access to credit services has no statistically significant influence on adoption of improved potato varieties in Mumberes division, Baringo County

H₀₃ Access to extension services has no statistically significant influence on adoption of improved potato varieties in Mumberes division, Baringo County

H₀₄ Farmer's perception has no influence on adoption of improved potato varieties in Mumberes division, Baringo County

1.6 Significance of the Study

The results generated from the study will be useful to scholars in understanding how the selected factors influence adoption of improved potato varieties thus adding to the body of knowledge on adoption of potato varieties over time and space. The results will also be useful in providing basis for policy formulation on research and extension for potato breeding technology, dissemination and promotion. Furthermore, the results can be used by credit and extension service providers in redefining their role in agricultural production and more so adoption of agricultural technologies.

1.7 Scope of the Study

The study was carried out in Mumberes division, Baringo County. All the locations were included in the study. The study focused on selected factors, namely, selected demographic characteristics of the farmers, level of to access extension services and access to credit services. The study focused only on adoption of improved potato varieties namely *Shangi* and *Asante*. Thus, generalization of the results is limited to these potato varieties.

1.8 Assumptions of the Study

- i) It was assumed that farmers are aware of existence of improved potato varieties.
- ii) It was further assumed that farmers in Mumberes division knew that the use of improved potato varieties increases agricultural productivity per unit area

1.10 Definition of Terms

Access: According to the oxford dictionary (2011), to *access* is to have the right or opportunity to have or use something that will bring you benefits.

Access to credit: A household can be said to have access to credit if one or more members of the household can get that credit (Bogale, 2009). In this study, access to credit was viewed as the ability of at least one household member to get credit from credit service providers particularly for agricultural production.

Adoption: Rogers, (1983) has defined adoption as the use or non-use of a new technology by a farmer at a given period of time. The definition was used in this study and the technology studied was the use of improved potato varieties.

Demographic characteristics: Demographic characteristics are features associated with a family, a community or a segment of the society that depicts its growth patterns. Such aspects include age, family size, gender and literacy levels (Biza-Khupe, 2011). This study used this definition

Extension services: Extension services imply the technical education rendered to farmers through fostering the flow of information between them (farmers) and technology providers (Evenson, 2001). In this study extension services were viewed as the advisory services and information rendered to farmers on improved potato varieties. Access to extension services was measured by the number of visits made by extension agents to the farmers or vice versa in the previous two cropping season prior to the study.

Food security: FAO, (1996) at the World Food Summit noted that “food security exists when all people, at all times, have physical and economic access to sufficient safe and nutritious food to meet their dietary needs and food preferences for a healthy and active life. This definition has been adopted for this study.

Household: Household refers to a person or a group of persons who reside in the same homestead or compound but not necessarily in the same dwelling unit, have similar cooking arrangement and are answerable to the same household head (KNBS, 2010). This definition was adopted for this study.

Household head: According to KNBS, (2010), a household head is the most responsible or respected member of the household who makes key decision in the household on a day to day basis and whose authority is honored by all members of the household. This definition was adopted for this study.

Improved potato varieties: These are those potato varieties which have been bred for high yields, resistance to diseases, have a short period to maturity among other desirable characteristics (Kaguongo, Gildemarcher, Demo, Walgolre & Kinyae, 2008). This study looked at *Shangi* and *Asante* as the main improved potato varieties in the study area. Potato in this study will be used to refer to Irish potato (*Solanum tuberlosum*).

Influence: The free online dictionary (2012) defines the term influence as “ a power affecting a person, thing, or course of events, especially one that operates without any direct or apparent effort.” In this study, influence will be viewed as the power of the selected factors to cause the farmers to adopt the improved potatoes or not.

Perception: the free online dictionary (2012) defines perception as the feelings and opinions that people have regarding something. This study used perception to mean opinions about attributes of the improved potato varieties in the study in general.

Productivity: Muthoni and Nyamongo (2009) describe productivity as the output generated from a given farm enterprise in units per unit area over a specified period of time. Productivity was viewed as the amount of potato varieties produced by a farmer per unit area of land. This will be assessed by looking at the 110kg bags of potatoes produced per hectare, per year.

Smallholder farmers: World Bank, (2003) defined smallholder farmers as those farmers that operate less than two hectares of cropland and have low resource base. In addition, Hazell, Poulton, Wiggins, and Doward, (2007) defined smallholder farmers as those depending majorly on household members to provide most of the farm labour and who practice agriculture mainly for subsistence. In this study, smallholder farmers was defined as those with less than five hectares of crop land under potatoes and who depend majorly on household members for farm labour.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter contains a review of related literature on adoption of various agricultural technologies in the world, in Africa and in Kenya. The section provides information on the role of agricultural production in food security, both globally and in Kenya; the significance of the potato industry in food security; determinants of adoption of technologies which include technology related factors and location of the adopter institutions; the influence of social characteristics of a family including gender of the household head, family size, age and experience and education on the adoption process. The section also details the role of extension services, access to credit and other sources of income in the adoption process. Finally, both the theoretical and the conceptual frameworks are provided at the end of the section.

2.2 Agricultural Production and Food Security

Food production is one of the factors that influence food security globally (Rosegrant, Cline, Li, Susler & Valmonte-Santos, 2005). Food security exists when all people within a population have enough food at all times in order to carry on with life (FAO, 2008). Many of the economies of the developing countries in the world rely largely on agriculture in order to meet and ensure food security for their populations. However, as populations increase, food demand increases and food insecurity ensues. Thus, to feed their growing populations, many developing countries will be forced to increase their agricultural production using sustainable approaches that do not have adverse effects the natural resource base (Nkamleu & Manyong, 2005).

In the sub Saharan Africa, population growth has led to decline in the production of cereals and roots and tubers. The productivity of these crops has been on a stable decline since 1997 and the trend is expected to continue further. The harvested area of these crops is expected to decline from 0.16 ha per capita in 1997 to 0.11 ha per capita in 2025 (Rosegrant et al. 2005). This decline can be addressed by using improved agricultural technologies. Such technologies improve agricultural production, promote human health and enhance environmental sustainability (Nyange et al., 2011). This will promote food security in many third world countries including Kenya.

In Kenya, food security is a measure of the available maize in the country (East African Grain Council, EAGC, 2009). An analysis of available maize in Kenya as at 30th June 2011 indicated that there was a deficit of about 342 000 tonnes experienced in the period between June and December 2011 (Ministry of Agriculture, 2011). This situation was likely to persist given the variations in the ongoing food security trends in the country, considering that 52.6% of the population lives below the poverty line (World Bank, 2007). There is therefore a need to diversify the food sources for the country to avoid over dependence on maize.

2.3 Significance of Potato Sector in Food Security

Potato (*Solanum tuberosum* L.) is a crop of major economic significance worldwide. This crop provides a reliable source of income, employment and food for many populations in the developing countries (FAO, 2008). Globally, potato provides employment and food security to an estimated 800 million people (Loffler & Ochieng, 2008). As the prices of major staples including wheat, rice and maize continue to rise, millions of people in the developing countries including Kenya are facing food crisis (Muthoni & Nyamongo, 2009). However, the prices of potato have remained relatively stable (Loffler & Ochieng, 2008), and thus can be targeted in improving food security in the developing countries (Muthoni & Nyamongo, 2009).

Potatoes have less significance in the international trade compared to cereals and therefore they can form a significant source of food in the developing countries. Maganga (2012) has pointed out that the potato sector can help improve the incomes of smallholder farmers and subsequently curb food insecurity together with poverty. This is partly because potatoes are grown and consumed locally, mature within a short period (3-4 months) and have high yields (about 40 tons/ha). Additionally, potato can be grown in areas with limited land and abundance of labour (FAO, 2008).

According to FAO, (2008), Kenya's annual potato output is about 790, 000 tons. Thus Kenya ranks 8th in Africa and 5th in sub Saharan Africa in potato production. The crop follows maize in order of importance as a staple and plays a vital role in food and nutritional security of the country. Additionally, in high altitudes, it is a major cash crop for smallholder farmers and is grown by about 500000 farmers on 120 000 ha. The farmers produce about 1 million tons in two growing seasons (MOA, 2008).

Potato has a superior comparative advantage to major cereals in the high altitude areas. While farmers complete only one planting season for maize, three cropping seasons are possible with potato in these areas (Muthoni & Nyamgongo, 2009). This way, it acts as a more reliable source of income for farmers. In addition, in the high altitude areas, research has shown that the average revenue for potato is more than twice that of maize (Obare et al. 2010). Thus, in such areas, potato becomes a more realistic venture which should be promoted not only for food security but also to ensure increased revenues for farmers. With the increasing population and low output from agricultural land, use of improved potato varieties may be one way out of the looming food security situation world over.

Mumberes division is located in high altitude areas and as such potato growing would have a superior comparative advantage over maize. However, despite potato production declining from 7.7 tonne produced in 2008 to about 5.5 tons per hectare in 2010, (MOA, 2010) the adoption of improved potato which can yield up to 14.3 tons per hectare is low. The MoA (2007) noted that investment has been made on research on development and adoption of improved potato varieties. These varieties have been lowly adopted in Mumberes division which is a major food basket for Baringo County.

2.4 Determinants of adoption

According to Rogers, (1995) there are four main elements involved in the adoption and diffusion of a new idea: the innovation, communication channels, time and the social system or context. The author defines an innovation as an idea, practice or object that is perceived as new by individual or other units of adoption. Viewed from a multidisciplinary perspective, adoption is a multi-dimensional process dependent on a variety of factors such as perceived profitability, costs of establishment, compatibility with value systems and communication of knowledge and information between and among adopters and potential adopters Miller (2001). Factors that influence adoption of innovations have been categorized into three broad categories namely nature of innovation, characteristics of the setting in which adopter institutions are located and characteristics of the relationship and communication patterns between inventor and adopter; that is, extension services.

2.4.1 Influence of the nature of the innovation on its adoption

Roger (1995) identifies five characteristics of an innovation that affects its adoption. They are relative advantage; which reflects the degree to which an innovation is considered to have advantages over the current ones in use; compatibility with an individual's values, beliefs, experiences and needs; level of complexity; which is a function of innovation's features like technical requirement; requirement of technical staff or skills during implementation) and conceptual sophistication; language and concepts used in use and observability; whether the innovation's benefits and results are visible and easily observed. Innovations that have visible benefits are likely to be more adopted than those that have benefits that are hardly detectable (Obare et al. 2010).

Any agricultural technology system has three parts namely production, storage and sales and marketing. However, many agricultural technologies developed in the third world are biased towards increasing production at the expense of storage, sales and marketing (Baah, 2004). Therefore, the nature of an innovation depending on these features would influence its adoption among the different individuals and different gender in at the household level. For instance, a study in Nigeria on adoption of soy bean seeds technology indicated that utilization of soybean at the household level, maturity period and yields were the significant factors related to technology that influenced adoption of improved soybean seeds as a production technology (Idrisa et al., 2010). This implies that increased yields promise higher revenues while the utilization at the household level implies that families have enough food for consumption, hence promoting household food security. Improved potato varieties promise increased output within a relatively short time and therefore more income and food for the family (Maganga, 2012).

2.4.2 Characteristics of the location of the adopter institution

The settings in which an institution is located encompass both the geographical and the climatic suitability of the technology to be adopted in the area. Adopter institutions mainly are the communities and community members. Decision to adopt a technology or not may also be influenced by the distance one has to cover to reach the accessible road to the town or the tarmac or the market itself (Okoedo-Okojie & Onemolease, 2009). For instance a study on adoption of dairy cattle technology in Kenyan highlands indicated that distance on all-weather roads to urban centers delays the adoption decision (Baltenweck & Staal, 2000). Distances on dry-weather roads

informs of market accessibility by the farmers as they deliver their produce, since they provide a connection to the main road infrastructure .This location influences not only access to extension but also delivery of commodities to the market. Additionally, accessibility makes extension services especially by private agents easy. Private companies focus mainly on profits and as such tend to extend their services to area with better infrastructural advantage to minimize distribution costs (Munyanga & Jayne, 2006).

However, the influence of distance on adoption of improved agricultural technologies for potato among farmers in Mbeya rural district in Tanzania was found not to be significant (Namwata, Lwelamira & Mzirai, 2010). The authors point out that there is need to understand contextual specific factors of adoption improved agricultural technologies before any generalization can be made. This therefore implies that the past studies caution against generalization of study results on various aspects to all areas. Thus this study will also seek to find actually if distance could be influencing adoption of improved potato varieties in Mumberes division.

2.4.3 Characteristics of communication patterns between inventor and adopter

The communication patterns between the innovator and the adopter is reflected in the extension services provision (Rogers, 1995). Access to such services has been shown to play a role in the adoption process. This aspect is widely acknowledged by various authors (Namwata et al. 2010; Odoemenem & Obinne, 2010; Okoedo-Okojie & Onemolease, 2009). Access to extension services may influence adoption. Malikista, (2010) noted that with efficient extension services, the cost agricultural production reduces and thus productivity of a farm enterprise is increased. The author indicated that extension services play a critical role in crop husbandry, land management practices and farm input use. Thus if farmers have access to extension services, they are able to increase the productivity of their agricultural lands. Obare et al. (2010) also showed that access to extension was significantly associated with adoption of new technologies that improve efficiency. Nchare (2007) also reported that continued contact between farmers and extension agents was able to facilitate their practical utilization and adoption of modern technology.

Extension service providers provide farmers with information on aspects of agricultural production such as crop price and marketability, seed varieties and their availability, crop husbandry and management as well agronomic practices all of which influence a farmer's

decision to adopt an agricultural technology. In addition, access to extension services influences the extent of adoption of technologies. As noted by Obare et al. (2012), access to extension allows farmers to be able to optimize their use of resources in agricultural production. Thus, with access to extension, farmers' adoption of improved potato varieties would be high since such services would influence their knowledge on crop husbandry, management, marketability, input use and seed sources.

2.5 Influence of family's social characteristics on adoption of agricultural technologies

The adoption process may also be influenced by the social characteristics of a family. Social characteristics are those that relate to the relationships within a family. They include the gender relations in distribution of power, access to production resources, family size, education and experience of the household head and decision making within a family context. Duze and Mohammed (2006) noted that many African societies are characterized by patriarchy system and male dominance is rampant in decision making.

2.5.1 Role of gender of the household head in adoption

Gender of the household head is an indicator of marital status. Thus households headed by males are likely to be married. The influence of gender on adoption of agricultural technologies is widely acknowledged. Gender influences division of labour, the type of agricultural commodity to be planted (Nkamleu & Manyong, 2005) and access to extension services (Feder & Umali, 2002; Mikalista, 2010; Namwata et al. 2010; Ofuoko, Egho & Enujeke, 2009). Delgado & Johnson, (2005) reported that gender of the household head would influence the enterprise the family would be involved in. The authors noted that the potential financial returns from the sale of fruits was a stronger motivating factor for men to plant fruit trees as opposed to women in their study in Santiago, Cape Verde. They attributed this to the fact that fruits represent a cash crop in this area and thus it appeared to be a strong incentive for men. However, potato is grown both as a cash crop and a food crop in many parts of the Kenyan highlands (Muthoni & Namongo, 2010). Thus it would be expected that families headed by men would plant improved potatoes varieties more than those headed by women. This is because while women may concentrate on food for the family only, men would also explore financial productivity advantage of a variety. As noted by Delgado and Johnson (2005), men are more influenced by profits accruing from an enterprise more than women who pay attention to food for the family first.

Since improved potato varieties promise both income and improved availability of food for the family through improved farm outputs, there would be no discrepancy in their adoption in both male and female headed households in Mumberes division. This study sought to find out if indeed gender of the household head may be influencing the adoption of improved potato varieties in Mumberes division.

2.5.2 Family Size and adoption of agricultural technologies

Family size is an indicator of the available household labour that can be used in adoption of technologies. Large family sizes however may have a large number of dependents thus calling for more food production in the family. The average family size for many African households is about nine members (Ekwe & Nwachukwu, 2006). This indicates that most of the family systems in Africa are extended, where parents, children and other family relations dwell together as a household. Teklewold et al., (2006) indicated that families with larger family sizes are more likely to adopt technologies irrespective of their labour demands. This is due to the assured supply of workforce at all times both for management and other activities.

Potato production is a relatively labour intensive venture since it increases labour demand during weeding and harvesting (Muthoni & Namgongo, 2011). Thus, it provides employment for family members during peak seasons. Improved potato varieties promise to reduce labour since they are developed with resistance to chemical damage thus facilitating chemical weeding. Subsequently, both families with larger family sizes and those with smaller family sizes would adopt. Family with smaller family sizes would adopt since they would employ chemical weeding while those with large family sizes would enjoy employment for family labour. However, planting and harvesting requires manual operations and thus a lot of labour is required. This would limit the capacity of small families to adopt due to limited supply of labour. Large families on the other hand would be constrained since family members may be involved in alternative ventures in order to increase incomes for the family. This may limit the available farm labour thus inhibiting adoption. This study sought to establish whether family size which reflects availability of labour influences adoption of improved potato varieties.

2.5.3 Influence of age and experience of household Head on adoption of a technology

Age comes hand in hand with experience. Previous studies have pointed out that as age increases, individuals gain experience and as such it is hard to separate these two aspects. These

two mutually inclusive factors may influence technology adoption. Research however reports contradicting results in the influence of this factor on technology adoption. Rajasekharan & Veeraputhran (2001) for instance noted that older farmers did not prefer intercropping practices in Kerala, India. Further, Nwachukwu, (2010) noted that age and experience are factors that significantly influenced adoption of organic agricultural technologies which included crop rotation, indigenous varieties growing and use of compost manure in his study in Imo state Nigeria. On the same note, Nkamleu and Manyong (2005) observed that there is a positive and significant relationship between experience of the house hold head and the adoption level of improved fallows and apiculture practices in Cameroon. Age was also shown to have a significant positive influence on adoption of agricultural technologies in Ghana (Baffoe-Asare, Danquash & Annoir-Frempong, 2013)

Ani, Ifah and Ogunnika, (2004) as well as Gbegeh and Akubuilu (2013) however observed that age was not significantly related to adoption of new recommended farm practices in Nigeria. This can be attributed to the fact that farmers who have been long into farming are usually older, less educated and are more resistant to change than new entrants. Young farmers on the other hand tend to be more flexible in their decision to adopt new ideas and technologies more rapidly than their aged counterparts (Teklewold et al., 2006). However, younger farmers may be resource constrained and thus fail to adopt.

If this is the case, it is unclear whether farmer's age and experience influence technology adoption. This study sought to investigate whether age and experience of the farmer are potential factors influencing adoption of improved potato varieties in Mumberes division, Baringo County.

2.5.4 Influence of level of education on Adoption

The level of education reflects the number of years one has been in school. The levels of education namely primary, secondary, tertiary and university also reflect the knowledge base of an individual and reflects their ability to judge a technology for adoption. Research has indicated that level of education significantly influences adoption of agricultural technologies (Ndiema, et al., 2007; Namwata et al. 2010). For instance, Ani et al. (2004) noted that there was a significant positive relationship between level of education and adoption level of use of fertilizer, improved seeds, mechanized farm operations, use of insecticides and herbicides by female farmers in

Southern Ebonyi state in Nigeria. Educated farmers are more objective and aware of the role these resources can play in increasing the overall outputs in a production situation. Furthermore, farmers with a higher level of education are able to understand crucial the aspects of a technology like use of chemicals in weed and pests control.

A study in Niger delta states of Nigeria revealed that education of farmers was significant in influencing adoption of banana based technologies (Faturoti, Emah, Isife, Tenkouano & Lemchi, 2006). Education helps in the responsiveness of the farmers even to the complex aspects that may be contained in an innovation. Education level assists one in assimilating, idealizing and internalizing new knowledge. Consequently, low levels of education tend to favour negative attitudes towards acceptance of improved farm practices within a family (Ani et al. 2004).

Mercer (2004), however notes that if the household head can utilize the knowledge of other more educated members of the household then education of the household head may be irrelevant in influencing the adoption process of innovation. Nevertheless, this is a function of other factors such as culture. For instance, in a culture that prohibits women and men from directly interacting in an open family discussion, a female in this culture who is more educated may not share her knowledge with others within the family settings. Similarly, the holder of the knowledge may be unavailable in the household for agricultural activities and thus, sharing of the knowledge may be limited. Further to this, the holder of the knowledge should be willing to share otherwise the household may not benefit from the knowledge. Thus, if there is no one within the family who can understand the innovation properly, then the rate of its adoption is likely to face setbacks.

However, a study in Narok and Nakuru districts in Kenya indicated that there was no statistically significant relationship between level of education and utilization of technologies in these areas (Ndiema, Kinyua, De Groote & Mahagayu, 2007). The authors, however, noted that there is a significant relationship between farmer's level of education and technology awareness in wheat production. This was supported by Ndiema et al. (2007) who observed that education was one of the aspects that had a significant influence on fertilizer adoption on maize in Kenya. In light of this, this study sought to investigate whether education of the household head was influencing adoption of improved potato varieties in Mumberes division.

2.6 Access to Extension in Adoption

Access to extension is a function of whether or not one is visited by extension service providers and the number of times such a farmer is visited. Access to extension services is seen as a factor that influences adoption of improved technologies. This aspect is widely acknowledged by various authors (Okoedo-Okojie & Onemolease, 2009; Odoemenem & Obinne, 2010 and Namwata et al. 2010). Using knowledge obtained from extension agents, farmers are expected to increase the outputs of their farm enterprises. Extension agents fragment and manage the complex agronomic aspects of an agricultural technology by simplifying it for the farmers. This may facilitate adoption of agricultural technologies. However, access to extension services has been significantly low in developing countries with less than 20% of farmers receiving such services annually (Barungi, Ng'ong'ola, Edriss, Mugusha, Waithaka, & Tukahirwa, et al. 2013)

2.7 Role of Credit Services in Adoption of agricultural technologies

Access to credit is another factor that is related to the family and influenced by gender relations within the household. If farmers are able to access credit, it is one way to promote farmers' access to new production technologies and increase productivity. Farmers' ability to purchase inputs like improved seed varieties, fertilizers, agro chemicals are of particular importance. This is because they form the basis for agricultural production as inputs. Credit accessed by farmers thus increases their purchasing power. A study has shown that the amount of credit received by farmers in Ethiopia had a significant and negative influence on food insecurity (Bogale & Shimeli, 2009). That is to say, people who had access to credit were more food secure than those that did not. This can be attributed to the fact that households which have access to credit would have the power to purchase and use agricultural inputs to improve their production levels. Teklewold et al., (2006) noted that farmers who have access to credit facilities are more likely to adopt technologies compared to the families that are constrained in this respect. Accessing credit helps farmers to invest in buying of raw materials. Therefore if farmers can access credit within the household, their chances of adopting a said improved crop variety will increase. However in Kenya, there are gender based differences in accessing credit (Mikalista, 2010). Olwade, Sikei, and Mathenge, (2010) noted that among the strongest determinants of fertilizer use intensity in Kenya were gender and access to credit. However, if gender relations are strong and there are consultative decision making, women within families can still access and use credit indirectly for

adoption of improved potato varieties. Investigation into specific access to credit by families bearing in mind the gender aspect is thus paramount. Therefore this study sought to investigate if access to credit which is related to gender relations actually influences adoption of improved potato varieties in Mumberes division Baringo County.

2.8 Other Income Sources and Adoption

Agricultural production could be accompanied by involvement in other income generating activities by the household members. Such an increase in off farm activities will imply that less time is probably dedicated to learning and managing unfamiliar practices. Increased income however could lead to increased adoption of practices. Rajasekharan and Veeraputhran, (2001) reported an inverse relationship between off-farm income and the number of soil conservation practices adopted in Kerala, India. However the authors established that the other sources of income (off farm income) did not have a statistically significant influence on intercropping in Kerala, India. Another study in Malawi reported a positive and significant effect of the amount of off farm income on the likelihood of adoption but had a significant negative effect on the extent of adoption. Off farm income could help to increase the working capital especially in instances that the initial capital is high. However, households with high off farm income may allocate smaller proportions of land to agricultural production (Simtowe, Zeller and Phiri, 2006). Additionally, as farmers get involved in other on and off farm activities, they reduce the amount of time they dedicate to agricultural production and this may interfere with the adoption process. Therefore, this study investigated whether involvement in other off farm activities could be influencing adoption of improved potato varieties in Mumberes division.

2.10 Influence of farmers perceptions on adoption of technologies

How a farmer perceives a technology may influence whether or he or she will adopt it. The technology-specific attributes have been shown in the past to significantly determine farmers' decision to adopt a technology (Idrisa, Ogunbameru & Madukwe, 2012). Perceptions act as a filter through which new technologies are taken in and interpreted. Through perception, farmers are able to transform the information they receive into psychological awareness and later make decision of whether or not the information can be utilized. Kafle, (2010) noted that farmer's perception on an innovation largely depends on their knowledge and the information they have

about the technology. Thus, by evaluating their yield for a short period, farmers are able to prefer a said technology compared to another. More so basing on their perceptions, farmers are able to assess the expected outcomes of any innovation. The actions taken by the farmer many times depends on his evaluation of the outcomes depending on his personal perspectives. Since the role of any technological improvement in agriculture is to improve production, adoption may be influenced largely the perceptions that the targeted user of the technology has towards the technology (Idrisa, Ogunbameru & Madukwe, 2012).

Past studies have revealed that perception actually has a positive influence on adoption. Perceptions on availability of a ready market for instance influenced adoption of improved potato varieties in Tanzania (Namwata et al. 2010). Perceptions on good taste influenced adoption of yam minisett in Nigeria (Gbegeh & Akubuilu, 2013). Similarly, if farmers have a negative perception towards a technology, this may hinder its adoption. Perceptions on cost of production among other technology related factors may limit the extent to which a technology is adopted by farmers. This study sought to investigate the influence of perceptions on adoption of improved potato varieties among small holder of farmers.

2.10 Theoretical Framework

This study was guided by both the general systems theory as developed by Ludwig von Bertalanffy and others and the diffusion of innovation theory as developed by Rogers. According to the systems theory, components of a system interact with one another to form one whole. The theory's stronghold is its use of the feedback loops to restore equilibrium. The proponents of the theory argue that incase one component of the system changes, the systems equilibrium is compromised and has to be restored using these loops. Although they are sometimes criticized because they are so abstract, systems analyses offer holistic vantage points for understanding the factors that constrain or enhance technology adoption (Mercer, 2004). This is by looking at the two-way flow of technology and information between farmers and the public organizations, through extension, and nature of families and their characteristics, that constitute the system. The interdependence of these sub systems within the larger system made it more suitable for a study such as this one.

According to the diffusion of innovation theory, a technology has four main elements that influence its adoption. They are the innovation itself, the communication channels, time and the social context within which the adopter institutions are located (Rogers, 1995). Viewed from a multidisciplinary prospective, adoption is a multi-dimensional process dependent on many of factors such as perceived profitability, costs of establishment, compatibility with value systems, and the ability to communicate new knowledge and information between developers and among adopters and potential adopters.

All the factors that may influence adoption of improved potato varieties were viewed as a system of interacting sub systems all geared towards adoption of improved potato varieties. Nevertheless, in this study, the only aspect of factors related to adoption that was looked at was the aspect of adopter institution, their location and characteristics. Here the selected factors were viewed as a subsystem of the bigger system.

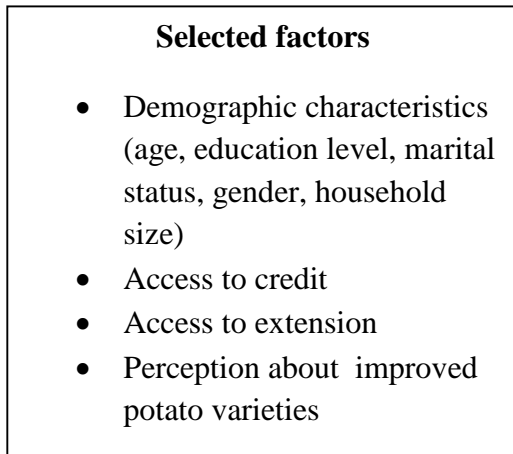
The adoption of improved potato varieties was looked at as a system of interacting factors, each dependent upon the other. These components are interdependent on each other and should be in equilibrium. For example, the age of the household head, the gender of the household head, intra household division of labour, and education of family members are factors that are related to technology adoption and form a subsystem. Depending on the household head, intra household division of labor may influence access to information through extension which would have a direct impact on adoption of improved potato varieties. In addition to this, the systems theory places emphasis on feedback loops. It is therefore expected that, if the household head has low level of education, then adoption of technologies would still be possible if he/she relied on other family members with higher level of education. Thus, adoption process should be achieved by using feedback systems where one component of the system or subsystem is compromised. If a farmer's age is a hindrance to adoption, then younger family members could still go forth to implement improved technologies if they had access to resources such as land and capital, for instance.

2.11 Conceptual Framework

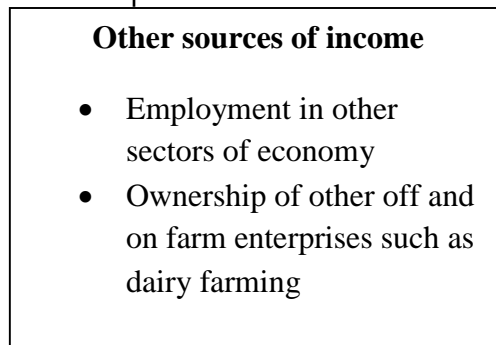
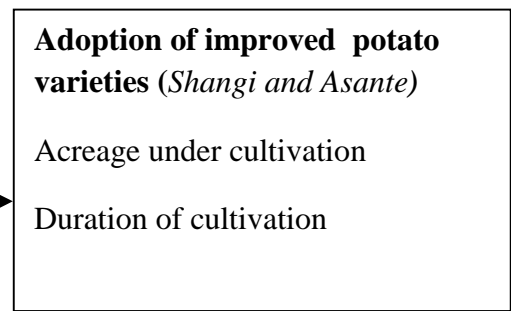
Selected demographic characteristics (Age of the household head, gender, family size, education level of the household head), access to credit services and access to extension are the selected factors that were viewed as independent variables with a potential influence on adoption of

improved potato varieties; the dependent variable (figure 1). Other sources of income forms the moderator variable. It is moderating in that off farm activities affects the relationship between the selected factors (independent variable) and the adoption process of improved potato varieties (the dependent variable). The study proposed that the selected factors would influence the adoption of improved potato varieties. However, their relationship would also be affected by other activities in which the household was involved in. From the study, it was clear that the selected factors did not have a statistically significant influence on adoption of improved varieties. The access to credit was expected to influence the acreage of potato varieties cultivated and the period of time farmers had done so. More so, the access to extension services was also expected to influence the acreage under cultivation as well as the period of time the farmers had cultivated the improved potatoes. On the same note, the perceptions of farmers about improved potato varieties was expected to influence their adoption of improved potato varieties as shown by the two indicators. However, the relationship between these variables would be moderated by the other sources of income such as employment in the formal sector. The study supported the model and indeed showed that the selected factors were responsible for the adoption of improved potato varieties although the influence was not statistically significant. The observations made in this study are therefore mainly attributed to the moderator variables which were also included in the study.

Independent Variable



Dependent Variable



Moderator variable

Source: Author

Figure 1: Selected factors influencing adoption of improved potato varieties.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This section details the procedures that were used in conducting the study. It describes the research design, study area, population of study, sampling procedure and sample size, instrumentation, data collection procedure and the way the collected data was analyzed. A summary of how the hypothesis was tested is presented at the end of this section.

3.2 Research design

The study used a cross sectional survey research design. This design allows researchers to collect data from a large sample, to use hypotheses and to get respondents' opinions and feelings on issues relevant to the study (Kothari, 2008). In addition, it is cost effective since it collects data at one point in time.

3.3 Study area

Mumberes division is located in Koibatek district in the larger Baringo County at an altitude of about 2400 meters above sea level. The division has a cool climate with an average annual rainfall of approximately 1425mm per year and a mean temperature of about 18°C. Night temperatures range between 14°C and 18°C. The average slope of the land ranges between 14% and 22% (Ministry of Agriculture, 2010). Soils are mainly clay loams with average pH of between 5.0 and 6.5. These features make this division a high potential area characterized by its ability to promote crop growth. The main agricultural activities in this area are crop and animal agriculture. Various crops are grown which include potatoes, maize, vegetables such as cabbages and kales, and fruits such as plums and pears. However, potato farming is the main agricultural activity for farmers and forms the backbone of agricultural sector in this area. The area has a total population of 21, 891 of which 11,009 are males and 10,882 are females. Also, there are 4611 farming households in Mumberes division (Kenya National bureau of Statistics, 2010). The division has four locations namely; Mumberes, Chemoswon, Timboroa and Seguton. Their populations are 1253, 482, 581 and 344 households respectively (KNBS, 2010). All these locations were included in this study.

3.4 Population of study

Mugenda & Mugenda (2003) describe a population as an entire group of individuals, events or objects having a common observable characteristic. The population of study in this case was smallholder potato farmers from Mumberes division. These farmers owned less than 5 hectares of land. They were growing potato both for subsistence and commercial purposes. The target population was smallholder potato farmers from Mumberes division. The accessible population was 2660 farming households and it is from this that the sample size was obtained. The farmers were those growing potato varieties and had been practicing it even before the improved potatoes were developed and disseminated.

3.5 Sampling Procedure and Sample Size

The sampling unit was all households growing potatoes and owned less than 5 hectares of land in Mumberes division. The information on sampling frame was obtained the divisional agricultural office as well as the chiefs' offices in the various locations. The study used a sample of 128 households determined using the formula suggested by Gatotoh, Omulema & Nassiuma, (2011). The formular is stated as;

$$n = NC^2/C^2 + (N - 1)e^2 .$$

Where n is the sample size,

N is the population size, C is the coefficient of variation e is the standard error Nassiuma (2000) asserted that the coefficient of variation should be $\leq 30\%$ while the standard error should lie between 2 and 5%. In this study, C was set at 23% while the standard error was set at 2%. These values are selected so that the expected degree of accuracy is as high as possible. Thus,

$$\begin{aligned} n &= 2660(0.23^2)/0.23^2 + (2660-1)0.02^2 \\ &= 128 \end{aligned}$$

Mumberes division has 4 locations namely Timboroa, Chemoswon, Seguton and Mumberes locations all of which were included in the study. Proportionate sampling was used to determine the number of households from the different locations to be used in the study (Table 1, below).

Table 2:

Summary Table for proportionate sampling

Location	Population (households)	Proportion(p)	Number to be sampled
	(n)	(n/N)	(n/N)x 128
Mumberes	1253	0.471	60
Chemoswon	482	0.181	23
Timboroa	581	0.218	28
Seguton	344	0.130	17
Totals (N)	2660	1	128

Adopted from Kenya National Bureau of Statistics (2009)

Simple random sampling procedure will then be used to select the actual households to be interviewed from each location. Kothari, (2008) noted that simple random sampling allows each item in the population to have an equal chance of being included in the study.

3.6 Instrumentation

Primary data for this study was collected using structured interview guides. The interview guides were preferred because the population is comprised of illiterate and semi-literate persons who cannot complete questionnaires (Ministry of Planning and National Development, 2005). This type of a study that investigated selected factors required probing crucial information from respondents, something promised by interviews as a method of data collection. Furthermore, the language of the interview can be adopted to suit the interviewee which reduces misinterpretation of questions. Also, information on farmer characteristics can be collected which may be useful in interpretation of results (Kothari, 2008). The instrument contained both close-ended and open-ended questions. Close ended questions provided a basis for quantifying the data obtained while the open ended ones provided useful information that was used in explaining observation in the study.

The instrument had three sections. Section I contained information on demographic characteristics of the farmers, including age, gender, education level, experience and family size. Section II contained information on social aspects of the farmer, including awareness and perceptions about improved potato varieties, and access to extension services. The third section collected data on farmers' economic factors namely access to credit services, other sources of income, land owned and actual land committed to potato production.

3.6.1 Validity

The instrument's content validity was verified by using experts in the field of community studies and extension. A panel of six experts assessed what concepts the instrument was trying to measure and they determined whether the items or indicators accurately depicted the concepts of interest. The panel confirmed that the instrument was able to elicit the information required to answer the study objectives correctly.

3.6.2 Reliability

Reliability of a research instrument is its ability to yield consistent results or data after repeated trials (Kothari, 2008). The research instrument was pilot tested using thirty farmers randomly selected from Kesses division in Uasin Gishu County. Kesses and Mumberes division both have similar climatic conditions and the farmers in both divisions practice potato farming. The results from the pilot test were used for testing reliability of the instrument.

The reliability of the instrument was assessed using Crobach alpha coefficient and a coefficient 0.87 was obtained. Mugenda and Mugenda, (2003) recommends that a reliability coefficient of greater than or equal to 0.7 is acceptable.

3.7 Data Collection

With the recommendation of the graduate school, a permit was acquired from the National Council of Science and Technology (NCST). The divisional officer in Mumberes division together with various chiefs' and sub chiefs' offices in the division were contacted so as to be informed of researcher's presence and to provide the sampling frame. Face-to-face interviews were used to collect data from individual farmers. Interviews offer the researcher a chance of collecting personal information from the client easily, controlling missing returns and thus reducing cases of non-response and easily adapting the language of the interview to the education level of the interviewee (Kothari, 2008). In addition, interviews facilitate collection of supplementary information about individual attributes as well as the environment which are vital in results interpretation.

3.8 Data Analysis

The data collected was analyzed with the aid of the statistical package for social sciences (SPSS). After the data was collected, it was cleaned up, coded and then entered into the computer

program. Descriptive and inferential statistics was used to summarize the data. The descriptive statistics used were the mean, frequencies and percentages. Chi square was the inferential statistics that was used at $\alpha=0.05$ (See table 3). As noted by Kothari, (2008) Chi square is useful when the data collected is categorical or nominal. Since the data collected from this study was mainly either categorical or ordinal, chi square was preferred. Where ordinal data was collected, it was changed to categorical data so as to facilitate analysis. The summary of hypothesis testing is shown in table 3.

Table 3

Summary Table for Data Analysis

Hypothesis	Independent variable	Dependent variable	Test statistics
i) investigate the influence of the selected demographic characteristics of farmers on adoption of improved potato varieties in Mumberes division, Baringo County	Selected demographic characteristics	Adoption of improved potato varieties	Descriptive statistics (Frequency, means, percentages) Chi square,
ii) find out the influence of access to credit services by farmers on adoption of improved potato varieties in Mumberes division Baringo County	Access to credit	Adoption of improved potato varieties	Descriptive statistics (Frequency, means, percentages) Chi square
iii) determine the influence of the access to extension services by farmers on adoption of improved potato varieties in Mumberes division, Baringo County	Access to extension services	Adoption of improved potato varieties	Descriptive statistics (Frequency, means, percentages) Chi square
iv) investigate the influence of farmers' perception about improved potato on adoption of improved potato varieties in Mumberes division, Baringo County	Farmer perception	Adoption of improved potato varieties	Descriptive statistics(means, percentages, Standard deviation)

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the findings of the study. The chapter is divided into four sections based on the objectives of the study. Section one focuses on the selected demographic characteristics of the respondents including age, education level, marital status, family size and the gender of the household head. Section two presents information on the access to extension services by the respondents including visits by extension agents, number of visits and the distance respondents have to cover to acquire such service. The third section details access to credit services by the respondents in terms of whether they receive credit or not, sources of credit, amount received and how such credit is used in potato farming. Finally, the fourth section looks at the perception of the respondents towards improved potato varieties. The influence of the respective variables on adoption of improved potato varieties is discussed at the end of each section.

4.2 Demographic characteristics of the respondents

The demographic characteristics of the respondents that were studied in this study are gender of the household head, age of the household head, level of education, household size and marital status. The results are shown in Table 4. A total of 128 household heads were interviewed. Of these, 68% were males while 32% were females. Majority of the respondents (74%) were aged between 20 and 40 years. Fifty five percent of the respondents had primary level education while 35% had secondary level education, six percent had either tertiary level education while four percent had no formal education at all. This implies that majority of the respondents in the study area had acquired basic literacy. Fifty eight percent had family sizes of between 5 and 9 members while 30% had family sizes of between 1 and 4 members. The remaining 12% had family sizes of more than 9 members. These results reveal that many of the families in the study area are relatively large. In this case parents, children and their other relations dwell together in the same household. Ninety two percent of the respondents were married while the rest were not. None of the farmers were separated or divorced.

Table 4

Demographic Characteristics of the Respondents (n=128)

	Category	Frequency	Percent
Gender of the respondent	Male	87	68
	Female	41	32
Age of the farmer	Below 20 years	9	7
	20-30 years	34	27
	31-40 years	60	47
	41-50 years	14	11
	Above 50 years	11	8
Family size	1-4 members	39	30
	5-9 members	74	58
	More than 9 members	15	12
Highest level of education attained	Primary	70	55
	Secondary	45	35
	Tertiary	8	6
	None at all	5	4
Marital status of the farmer	single	10	8
	married	118	92

Source: Field survey 2013.

4.3 Empirical analysis and hypothesis testing for the selected demographic factors

4.3.1 Introduction

The first study objective was to investigate the influence of selected demographic characteristics on adoption of improved potato varieties. Marital status, education level, age of the farmer, gender and family size were the demographic characteristics that were used in this study. Adoption of improved potato varieties was assessed by the number of years the farmers had

cultivated the varieties and the proportion of land the farmer had allocated for the cultivation of the potatoes. The study hypothesized that the selected demographic characteristics have no statistically significant influence on adoption of the improved potato varieties. Chi square test of independence was used in testing the hypothesis at 95% level of confidence.

4.3.2 Influence of marital status and gender of household head on adoption of improved potato varieties

The results from this study indicated that about 92% of the farmers were married. Majority of household in this study were headed by males (87%). According to Mikalista (2010), many African families are headed by males.

A cross tabulation of marital status of household head with the period of time the farmer had grown the improved potato varieties revealed that about 42% of the married farmers and 20% of those that were single had planted improved potato varieties for less than 2 years. It was shown that many single farmers (40%) had cultivated the improved varieties for between three and four years while only about 22% of those that were married had cultivated the potatoes for that same period (Table 5). The analysis also gave chi square probability $p=2.45$ at 2 degrees of freedom. Thus it can be noted that the influence of this factor on adoption was not significant.

Table 5

Influence of Marital Status on Period of Time Farmer has Cultivated the Improved Potato Varieties (n=128)

		Period of time the farmer has cultivated the variety(s)			Total
		Below 2 years	2.01years-3 years	3.01years-4 years	
Marital status	Single (%)	20.0	40.0	40.0	100
	Married (%)	42.4	35.6	22.0	100

$X^2=2.455, df=2 p\leq 0.05, \chi^2_{\text{Critical}}=5.99$

Source; Field survey, 2013

Similarly, a cross tabulation between marital status and proportion of land cultivated showed that 43% of the married farmers and 60% of the single farmers were growing improved potato varieties on less than 1.5 ha. Only a small percent of the married (14%) were cultivating more than 4.5ha. none of those that were single were cultivating more than 4.5 ha (table 6). The

analysis gave a chi square value of 2.55 at 2 degrees of freedom which is greater than $p \leq 0.05$. It was thus noted that the association between marital status and proportion of land allocated to improved potato production was also not significant. This therefore showed that actually marital status does not have a statistically significant influence on adoption of improved potato varieties in the study area.

Table 6

Influence of Marital Status on Proportion of Land Cultivated (n=128)

		Proportion of land under potato cultivation				Total
		less than 1.5 ha	1.51-3.0 ha	3.01-4.5 ha	more than 4.5	
Marital status	Single (%)	60.0	20.0	20.0	.0	100.0
	Married (%)	43.2	28.8	13.6	14.4	100.0

$X^2=2.55$ $df=2$ $p \leq 0.05$, χ^2 Critical =5.99

Source; Field survey, 2013

In line with the inferential analysis, the research hypothesis was accepted. Thus whether one is married or not, does not influence his/her decision to adopt improved potato in Mumberes division. The low level of adoption may be associated with the fact that many household heads were married and the household heads were males. Males may be allocating land and other production resources to other farm enterprise such as dairy farming thus reducing the land allocated to improved potato varieties. The female headed households on the other hand may not be adopting improved potato varieties due to the fact that they may have limited access to production resources such as land, labour, information and credit because of traditional social barriers.

It is expected that when one marries his responsibility for fending for the increasing household members is increased. Thus married people are expected to adopt improved agricultural technologies in order to increase food production. Although marital status may influence household decision making as reported by Ofuoko, Egho & Enujeke (2009), males are central to the decision making especially in patriarchal systems which are common in African societies. They have a stronger access to and control over production resources and this may lead them to dictate which enterprises are to be undertaken in the farm (Mikalista, 2010). In addition, males are able to influence the division of labour as well as access to extension and credit services (Feder & Umali, 2002) something that influences agricultural production.

The results from this study support Okunlola et al. (2011) who also reported that marital status had no statistically significant influence on adoption of new technologies by fish farmers in Akure, Ondo state of Nigeria. The findings also support Ani, Ogunnika & Ifah (2004) who noted that the influence of marital status on adoption of farm technologies in South Ebonyi state, Nigeria was almost negligible. However, these findings contradict Namwata et al. (2010) and Ofuoko, Egho and Enujeke, (2009) who noted that the marital status had a significant positive association with adoption of improved potato varieties in Mbeya Rural district, Tanzania and adoption of integrated pest management among farmers in central agro-ecological zone of Delta State, Nigeria respectively.

4.3.3 Influence of family size on adoption of improved potato varieties

The family as a social institution plays a critical role in adoption of technologies. This study investigated the proportion of land cultivated with improved potato varieties in regard to family size. Family size in this study was used to imply the absolute number of persons including husband(s), wife/wives, children and other relatives who are available to contribute to farm labour within the household. Family size is indicative of the available farm labour that can be dedicated to agricultural production. The study revealed that 58% of farmers had family sizes of 5-9 members (table 4).

The study showed that 81% of the families relied on both hired labour as well as family labour for potato farming. The rest utilized only family labour. Nonetheless, none of the respondents reported that they utilized hired labour alone. It was noted that only 19% of the households relied on only family labour while 89% relied on both family and hired labor in their farms as shown in Table 7.

Table 7

Source of Labour Against Family Size (n=128)

Source of labour	Family size			Total
	1-4 members (%)	5-9 members (%)	More than 9 members (%)	
Family only	10	22	27	19
Both hired and family	90	78	73	81

Source : Field survey 2013.

It can be asserted that households with larger family sizes may attach more importance to nonfarm activities than smaller households in order to meet the increased needs that may be associated with such families. To this effect, families end up hiring labour in order to meet increased demand of labour for farm enterprises. This partly explains why irrespective of the family size, both small families and the large families ended up utilizing hired labour in farming, although smaller families hired more labour.

A cross tabulation of family size with proportion of land the farmer had dedicated to potato production revealed that about 50% of those with 5-9 members and 41% of those with 1-4 members were cultivating less than 25% of their land with improved potato varieties. Few farmers, that is, 10.3% of those with 1-4 members, 14.9% of those with 5-9 members and 13.3% of those with more than 9 members had allocated more than 75% of their land to improved potato cultivation (Table 8). The analysis gave a chi square probability of 0.515 at 6 degrees of freedom which is greater than $p \leq 0.05$ thus not statistically significant.

Table 8

Influence of Family Size on Proportion of Land Dedicated to the Improved Varieties Production (n=128)

	proportion of land under potato cultivation				Total
	Less than 25% (%)	25%-50(%)	50.1%-75% (%)	More than 75% (%)	
1-4 members	41.0	35.9	12.8	10.3	100.0
5-9 members	50.0	21.6	13.5	14.9	100.0
More than 9	26.7	40.0	20.0	13.3	100.0

$X^2=0.515$; $df=6$; $p \leq 0.05$; χ^2 Critical =12.59

Source: Field survey, 2013

Similarly a cross tabulation of family size with the period of time the farmer had cultivated the varieties revealed that 45% of those with family size 5-9 members and 40% of those with families more than 9 members had cultivated the potatoes for less than two years (Table 8). A chi square probability of 0.509 at 6 degrees of freedom was obtained which indicated that there is no statistically significant association between family size and period of time the farmer had grown the improved potato varieties.

Table 9

Influence of Family Size on Period of Time Farmer has Cultivated the Improved Varieties
(n=128)

Family size	period of time the farmer has cultivated the improved variety(s)			Total
	Below 2 years (%)	2.01years-3 years (%)	3.01years-4 years (%)	
1-4 members	33.3	33.3	33.3	100.0
5-9 members	44.6	36.5	18.9	100.0
More than 9 members	40.0	40.0	20.0	100.0

$X^2=0.509$; $df=4$; $p\leq 0.05$. χ^2 Critical =9.488

Source: Field survey, 2013

The findings from this study revealed that family size has no statistically significant influence on adoption and therefore the null hypothesis was accepted. Namwata et al. (2010) argued that large families have increased demand for food and hence necessitating increased food production. Thus they are most likely to adopt improved agricultural technologies in order to increase food production. Improved potato varieties are bred with increased output as a major characteristic (Kaguongo et al. 2010; Obare et al. 2010). As asserted by Voh et al. (2001), larger families may comprise many dependents and thus farmers are likely to adopt improved agricultural technologies to feed the increasing number of family members. However, in the study area, large families may have caused fragmentation of land and thus making the available land for improved potato production to decline over time. Additionally, members in large family sizes may be involved in other off farm activities which reduce the available farm labour to help in adoption. For small family sizes, lack of sufficient farm labour may have led to low adoption. The fact that improved potato production requires high capital input in terms of labour may have made the smaller families to rely more on hired labour which makes it unaffordable to them thus leading to low adoption.

The results in this study contradicted Kafle and Shah (2012) who reported that family size is one of the factors that significantly influence adoption of improved potato varieties in Bara district,

Nepal. In addition, the study results also contradicted Tawari and Davies (2009) as well as Ofuoko et al. (2009) who noted that family size has a significant role to play in adoption of new agricultural technologies. The authors argued that large family sizes have more hands available to provide labour in case the technology is labour intensive and also to offer assistance. This was not the case in Mumberes division.

4.3.4 Level of education and adoption of improved potato varieties

The level of education was another demographic factor that was selected for analysis in this study. The variable was assessed by getting the total number of completed years an individual has been in school. The results showed that only 4% of the respondents had no formal education. This tells us that over 80% of the respondents had acquired the basic literacy.

A cross tabulation of level of education and period of cultivation revealed that about 44% of those with primary level education, 38% of those with secondary education, 25% of those with tertiary level education and 40% of those with no formal education at all had cultivated the improved varieties for less than two years. This was a total of 41% of all the farmers and it indicated that irrespective of the level of education farmers had cultivated the varieties for less than two years. The inferential analysis gave a chi square probability of 0.819 at 6 degrees of freedom (Table 10). This showed that the association was not statistically significant.

Table 10

Influence of Level of Education on Period Farmer had Cultivated Improved Potato Varieties (n=128)

Level of education	period of time the farmer has cultivated the variety(s)			Total
	below 2 years (%)	2.01years-3 years (%)	3.01years-4 years (%)	
Primary	44.3	37.1	18.6	100.0
Secondary	37.8	33.3	28.9	100.0
Tertiary	25.0	37.5	37.5	100.0
None at all	40.0	40.0	20.0	100.0

$\chi^2=0.819$; $df=6$; $p\leq 0.05$. χ^2 Critical =12.59

Source; Field survey, 2013

Similarly the level of education was cross tabulated with level of education. The results revealed that many farmers (45%) irrespective of their level of education had allocated less than 25% of

their land to improved potato production. Nonetheless, it was noted that majority (75%) of those with tertiary level education, 60% of those with no formal education, 40% of those with primary education and 44% of those with secondary level education had allocated only 25% of their land to improved potato production (table 10). These formed the largest portion in their respective categories. The inferential analysis gave a p value of .633 at 6 degrees of freedom. This value was greater than 0.05 which indicates that there is no statistically significant association between level of education and proportion of land allocated to improved potato varieties in Mumberes division.

Table 11

Influence of Level of Education on Proportion of Land Dedicated to the Improved Varieties Production (n=128)

Education level	proportion of land under potato cultivation				Total
	less than 25% (%)	25%-50% (%)	50.1%-75% (%)	more than 75% (%)	
Primary	40.0	27.1	15.7	17.1	100.0
Secondary	44.4	33.3	13.3	8.9	100.0
Tertiary	75.0	12.5	.0	12.5	100.0
None at all	60.0	20.0	20.0	.0	100.0

$\chi^2 = 0.633$; $df=6$; $p \leq 0.05$. χ^2 Critical = 12.59

Source; Field survey, 2013

This study hypothesized that the selected demographic characteristics have no statistically significant influence on adoption of improved potato varieties in Mumberes division Baringo County. From the results obtained, the null hypothesis was accepted. Lowly educated farmers may lack the ability to assimilate and internalize the aspects of improved potato varieties such as chemical use requirement and thus shy away from adopting. In addition, these farmers may lack information about improved potato varieties and even if they got it, they may not be able to interpret such information adequately.

On the other hand, farmers who had higher levels of education may be involved in other income generating activities including employment in the formal sector and thus end up adopting less as they spend a lot of time in those activities. More so, they may be diverting other production

resources such as land to other off farm enterprises thereby adopting less. Those with secondary and tertiary level education may have heard about improved varieties when they were released for adoption by farmers but may have been unable to adopt due to their involvement in other activities off farm.

The findings from this study supported Namwata et al. (2010) who noted that among other factors, level of education of the farmer was not significant in influencing adoption of improved potato varieties in Tanzania. The study however contradicted De Groote et al. (2006) who indicated that level of education was a significant factor in influencing adoption of fertilizer utilization on maize in Kenya. The authors argued that education plays a key role in influencing responsiveness of the farmers to new technologies. This is because the level of education attained helps farmers to assimilate, idealize and internalize all aspects of a technology including even the complex aspects.

4.3.5 Influence of age of the farmer on adoption of improved potato varieties

The age of the farmer was another demographic characteristic that was selected in this study. Age was measured by the number of completed years the farmer said they had. A cross tabulation of age with the proportion of land the farmers had allocated to improved potato varieties revealed that over 50% of those aged above 50 years were cultivating more than 50% of their land while 93% of those aged 41-50 years were cultivating less than 50% of their land with improved potato varieties. Similarly, many of those aged below 20 years, (67%) had allocated up to 50% of their land to improved potato varieties while 77% of those aged 31-40 were cultivating the potatoes on not more than 50% of their land (Table 12).

Table 12

Cross Tabulation of Age Against Proportion of Land Allocated to Improved Potato Varieties

Age (years)	Proportion of land under potato cultivation				Total
	Less than 25% (%)	25-50% (%)	50.1-75% (%)	More than 75% (%)	
Below 20	56	11	22	11	100
20-30	38	29	15	18	100
31-40	44	33	12	11	100
41-50	71	22	7	0	100
Above 50	27	19	27	27	100

$\chi^2 = 0.418$; $df = 12$; $p \leq 0.05$. χ^2 Critical = 9.488 *Source; Field survey, 2013*

Many farmers (71%) aged 41-50 years and 56% of those aged below 20 years had allocated less than 25% of their land to improved potato farming. While none of those aged 41-50 years had allocated more than 75% of their land to improved potato production, 27% of those aged above 50 years and 11% of those aged below 20 years had allocated more than 75% of their land to improved potato production. The analysis gave a chi square probability of 0.418 at 12 degrees of freedom. This indicated that age has no statistically significant influence on the proportion of land farmers allocated to improved potato production. Age of the farmers was also cross tabulated with the other indicator of adoption; period of time farmer had cultivated the varieties. The results were as shown in table 13.

Table 13

Cross Tabulation of Age Against Time the Farmer had Cultivated Improved Potato Varieties

Age (years)	period of time the farmer has cultivated the variety(s)			Total
	below 2 years	2.01years-3 years	3.01years-4 years	
below 20	44	23	33	100
20-30	41	38	21	100
31-40	40	37	23	100
41-50	50	29	21	100
above 50	27	46	27	100

$\chi^2 = 0.965$; $df=8$; $p \leq 0.05$. χ^2 Critical = 15.51

Source; Field survey, 2013

The results showed that 41% of the farmers aged 20-30 year had cultivated the varieties for less than two years. it was also noted that, 50% of those that had cultivated the improved varieties for less than two years lay in the 41-50 years category. About 77% of those aged below 20 years, 79% of those aged 20-30 years, 77% of those aged 31-40 years, 79% of those aged 41-50 years and 73% of those aged above 50 years had grown the varieties for between less than two years and three years. This revealed that only a minority of the farmers in all age categories had cultivated the varieties for more than three year to four years.

The analysis gave a chi square probability of 0.965 at 8 degrees of freedom. This implied that age had no statistically significant influence on the period of time the farmers had cultivated the improved varieties. The study hypothesized that age has no statistically significant influence on adoption of improved potato varieties in Mumberes division. From the analysis, the null hypothesis was accepted. This can be attributed to the fact that older farmers may be risk averse and thus were resistant to adopting the new improved varieties. Older farmers might also have wanted to remain with their 'old' varieties as they may not have known what the new improved varieties promised. The younger farmers on the other hand may be inexperienced in farming and thus fear engaging in improved potato production. More so, they may not be able to assess the desirable attributes of improved varieties and thus shy away from adopting more due to low level of experience. As noted by Baffoe-Asare, Danquash & Annoir-Frempong, (2013), through experience, farmers get enhanced skills and their capacity to address both practical and technical problems associated with agronomic principles in the field is facilitated. Thus inexperienced

young farmers may resist adoption. This may explain the short period of time for which the farmers had grown the varieties.

Younger farmers especially those below twenty years may also have been resource constrained especially in terms of access to land. Thus, they would not adopt even if they had the ability since the land resource was inaccessible to them. It was also noted that in all age categories, farmers may have been unable to adopt since they were likely to be involved in other income generating activities such as employment in the formal or informal sector. This reduced the amount of time they spent on the production of improved potato varieties.

This study supported Gbegeh and Akubuilu (2013) who noted that age has no significant influence on adoption of yam minisetts in their study of socioeconomic determinant of adoption of yam minisetts by farmers in Rivers State, Nigeria. This study however contradicted Baffoe-Asare, Danquash and Annoir-Frempong (2013) who asserted that age was a strong factor influencing adoption in Ghana. The authors argued that younger farmers have low risk aversion characteristic which when coupled with their long term planning makes younger farmers better adopters.

4.4 Influence of access to extension on adoption of improved potato varieties

4.4.1 Introduction

This study also sought to investigate the influence of access to extension services on adoption of improved potato varieties. Access to extension was measured by assessing whether or not individuals were visited by extension agents and the actual number of times they were visited in the past one year preceding the study year. The study revealed that only 17% of the farmers were visited while a majority, about 83%, had not received extension services. Checking for the number of times the farmers were visited, the results revealed that 73% of those that were visited received the extension services between 1 and 4 times in a period of one year. The remaining 27% were visited for 5-10 times (Table 14).

Table 14

Number of Times Farmers are Visited By Extension Staff in A Year (N=128)

Number of times visited	Percent
1-4 times	72.7
5-10 times	27.3
Total	100.0

Source : Field survey 2013.

The farmers were also asked to indicate the areas that were emphasized by the extension agents during their visit. The farmers were given four options namely agronomic practices, availability of seeds, marketing of produce and importance of improved potato varieties. The results from the study revealed that many farmers (55%) said that the extension agents would emphasize any two aspects of improved potato production as shown in table 15.

Table 15

Area of Emphasis By Extension Agents (N=22)

Areas of emphasis	Frequency	Percent
any one	3	13.6
any two	12	54.6
any three	7	31.8

Source: Field survey 2013.

The study also investigated where the farmers got information on agricultural production from. The results showed that 70% of the respondents got the information from the radio. The rest said they got from either extension staff or fellow farmers and friends. Radio programs may have given the farmers alternative source of information on improved potato varieties. The information would range from agronomic practices, seed availability as well as markets for their produce. Additionally, the farmers may have been aggressive and thus seek for the information on improved potato farming from other sources such as research centers. However, information from these alternative sources may not have been specific so as to target specific issues of farmers in Mumberes division. Radio programs are usually general and not targeted to specific farmers in specific areas. Utilizing such information would have led farmers to adopt less since

the information may have been inadequate. Additionally, the information would not be acquired whenever needed because farmers may have had to wait until such a day when the radio was broadcasting information on potatoes.

Data was also collected to establish if indeed distance could influence access to extension. However it was noted that majority of the farmers, 75%, would have to cover between 3 km and 9 km to access extension services. Only 32 respondents (25%) would have to walk for less than 3 kilometers to access the nearest extension services office. The distance farmers had to cover while seeking for information may discourage them from seeking for such services. This is because as they cover these distances, they lose time that they would otherwise use in other activities. Thus as the distance increases, the farmers may reduce their visit. Additionally, the extension agents may also shy away from visiting farmers who are located far away from their offices due to lack of transport means. The low level of access to extension services may be attributed to individual farmer's lack of will to seek the services or the shortage in manpower from the extension service providers.

4.4.2 Hypothesis testing for influence of access to extension services on adoption

The second hypothesis of the study was that access to extension services has no statistically significant influence on adoption of improved potato varieties in Mumberes division Baringo County. Access to extension was measured by whether or not the farmers were visited by extension agents. For those that were visited, the number of times they were visited was also studied. However, for hypothesis testing, whether one was visited or not in the past one year was used as an indicator of access to extension in the study area.

A cross tabulation of visits by extension agents and period of time the farmer had cultivated the varieties is shown in table 16. The results revealed that majority of the farmers (77%) who were visited and majority of those that were not (76%) had cultivated the improved varieties for not more than three years. This also showed that only 23% had cultivated the varieties for more than three years. The analysis also gave a chi square probability, $p=0.996$ at 2 degrees of freedom. This therefore implied that visitation by extension agents had no statistically significant influence on the period of time the farmers had cultivated the improved potato varieties.

Table 16

Access to Extension Services and Period of Time the Farmer had Cultivated Improved Varieties (n=128)

Visitation by extension agents	period of time the farmer has cultivated improved variety(s)			Total
	Below 2 years (%)	2.01years-3 years (%)	3.01years-4 years (%)	
Yes	40.9	36.4	22.7	100.0
No	40.6	35.8	23.6	100.0
Total	40.6	35.9	23.4	100.0

$\chi^2 = 0.996; df=2; p > 0.05. \chi^2_{\text{Critical}} = 5.99$

Source; Field survey, 2013

A cross tabulation of access to extension and the proportion of land allocated to improved potato varieties revealed that many of the farmers (46%) who were visited by extension agents were cultivating less than 25% of their land with improved varieties. Only 27.3% of those that were visited were cultivating more than 75%. Among those that were not visited, only 10% were cultivating more than 75% of their land with the varieties (Table 17). This implied that irrespective of visits by extension agents, the trend in allocation of land to improved potato production was almost similar.

Table 17

Influence of Access to Extension Services and Proportion of Land the Farmer Cultivated With Improved Potato Varieties (n=128)

Visitation by extension staff	proportion of land under potato cultivation				Total
	Less than 25% (%)	25%-50 (%)	50.1%-75% (%)	More than 75% (%)	
Yes	45.5	18.2	9.1	27.3	100.0
No	44.3	30.2	15.1	10.4	100.0
Total	44.5	28.1	14.1	13.3	100.0

$\chi^2 = 0.150; df=3; p > 0.05.; \chi^2_{\text{Critical}} = 7.82$

Source; Field survey, 2013

The analysis gave a chi square probability of 0.150 at 3 degrees of freedom. This indicated that the association between the two variables was not statistically significant. Thus, the null hypothesis of the study was accepted. The low number of people of people who were visited by the extension agents in the past one year may explain the low level of adoption. The study showed that only 17% of farmers had received extension services. In addition, even those that were visited, the number of visits was too low (1-4 times) in a year. Another reason for the low adoption in line with access to extension services may be lack of subject matter specialists in the area. The agents may have visited the farmers but did not address the specific issues related to improved potato production. Farmers noted that even when the agents visited, or they attended agricultural trainings, the trainings were not specific to potato production but rather to other farm enterprises such as dairy. For those that were not visited, the most likely reason for low adoption was lack information on improved potato varieties including resistance to disease, fertilizer requirement and other agronomic practices related to improved potato varieties. Extension services are meant to provide farmers with the information they need in order to increase production from their farm enterprises (Barungi et al., 2013). This may be through informing farmers about the current varieties that have been bred, agronomic practices as well as markets for their produce and commodities. The extension visits were low thus this may have limited the farmers' capacity to adopt.

Lack of other alternative sources of information on improved potato varieties to the farmers may have also led to low adoption. The radio and research stations were the only other alternative source of information for the farmers. The radio does not always address issues of improved potato varieties when the farmers need such information. The research institutions on the other hand are far away from the farmers. Private extension service providers did not always address potato farming but rather, other on farm enterprises such as dairy and poultry keeping.

Low access to extension services has been noted to be a limiting factor to increasing agricultural productivity in Sub-Saharan Africa and in many developing countries (Kabungo, 2008; Okoedo-Okojie & Onemolease, 2009). Access to extension influences farmers profitability as farmers become equipped with information by the extension agents (Okwoche & Asogwa, 2012). This may influence their adoption of agricultural technologies as they know which agricultural investments are more profitable to them. Since farmers in Mumberes division had low access to

extension services, they may not have got timely information on improved potato varieties and as such the level of adoption remained low.

The basis of extension services delivery is information which is an indispensable factor in agricultural production. According to Adereti et al. (2006), the quality of information that enhances a farmer's decision making is a function of accuracy, timeliness and relevance. Thus, farmers may have delayed in the time they knew about the improved varieties due to the few number of farmers who were visited and this may explain the short period of time many farmers had cultivated the varieties. Extension services also provide farmers with the required agronomic knowledge which allows farmers to accept or reject technologies (Namwata et al. 2010). The information required by potato farmers includes availability of seeds, agronomic practices such as fertilizer application and spacing as well as available of markets. The level of adoption may have remained low because fewer farmers were visited, and the number of visits was also low thus farmers may have been less equipped with the information they needed on improved potato production.

The results from this study supported Barungi et al. (2013) and Okunlola et al. (2011) who acknowledged that although access to extension services was among the important factors that influenced adoption of agricultural technologies, the level of access to extension is important in the adoption process. Barungi et al. (2013) who studied factors influencing the adoption of soil erosion control technologies by farmers along the slopes of Mt. Elgon in Eastern Uganda noted that the level of access to extension services influenced the type and number of technologies adopted. However, the authors noted that more than half of the farmers had received extension services only once in the past two years preceding the year of their study implying a low level of access to extension services in that area. In addition, while farmers in those study areas got extension services also from non-governmental organizations, the Ministry of Agriculture was the only service provider in Mumberes division and where other players came on board, they did not target potato production.

4.5 Access to credit services and adoption of improved potato varieties

4.5.1 Introduction

Objective three of the study was related to access to credit among the respondents. The study sought to investigate the influence of access to credit on adoption of improved potato varieties in the study area. Access to credit was measured by whether or not the farmers were receiving any financial support for their agricultural production. The study also investigated the sources of this credit and how the farmers utilized the credit in production of improved potato varieties. The study results showed that about 70% of the farmers received credit. The study showed that 33% got the credit from local commercial banks including Equity bank and K-rep bank while 24% said that they got their finances from farmer groups. The rest got the credit from private companies, Agricultural Finance Corporation or cooperative society (Table 18).

Table 18

Source of Credit for Agricultural Production among the Respondents (n=128)

Source of credit	Frequency	Percent
Agricultural Finance Corporation	12	13.2
Commercial banks	30	33.0
Farmer groups	22	24.2
Private companies	8	8.8
Cooperative societies	19	20.9
Total	91	100.0

Source : Field survey 2013.

The respondents were asked whether they used the credit they received for purchasing inputs such as seeds, fertilizer and pesticide; hiring of labour, transporting produce to market and/or seeking extension services. The results revealed that about 57% of the respondents would utilize the credit for more than three of these options. Nonetheless, the main aspect reported by the respondents was purchasing of farm inputs and hiring of labour. The study also examined the amount of money the farmers were receiving on average from the credit providers. It was established that about 88% of those that received credit received between KES 1000 and 10000 per year. This amount was relatively low compared to the amount of money required to start up

potato production. On average, a hectare of potato would require about KES 50000 to start up (MOA, 2010).

A cross tabulation of access to credit with the period of time the farmers had cultivated the varieties showed that 40% of those that received credit and 42.1% of those that did not receive credit cultivated the varieties for less than two years (Table 19). Similarly, a cross tabulation with proportion of land under improved potato varieties showed almost similar results with about 44% of those that received credit and 45% of those that did not allocating less than 25% of their land to improved potato production (Table 20).

Table 19

Cross Tabulation of Access to Credit and Time Farmer had Cultivated Improved Potato Varieties (n=128)

Receiving credit	period of time the farmer has cultivated the variety(s)			Total
	below 2 years (%)	2.01years-3 years (%)	3.01years-4 years (%)	
Yes	40.0	36.7	23.3	100.0
No	42.1	34.2	23.7	100.0

$\chi^2 = 0.963; df=2; p > 0.05; \chi^2_{\text{Critical}} = 5.99$

Source: Field survey, 2013

Table 20

Cross Tabulation of Access to Credit and Proportion of Land Allocated to Improved Potato Cultivation (n=128)

Receiving credit	proportion of land under potato cultivation				Total
	less than 25%	25-50%	51-75%	More than 75%	
Yes (%)	44.4	27.8	14.4	13.3	100.0
No (%)	44.7	28.9	13.2	13.2	100.0

$\chi^2 = 0.997; df=3; p > 0.05; \chi^2_{\text{Critical}} = 7.82$

Source: Field survey, 2013

4.5.2 Hypothesis testing for influence of access to credit on adoption of improved potato varieties

This study hypothesized that access to credit has no statistically significant influence on adoption of improved potato varieties in Mumberes division, Baringo County. A correlation of period of time the respondent had cultivated the improved potato varieties gave a chi square probability value of 0.963 at 3 degrees of freedom as shown in table 18. Similarly a correlation between access to credit and the proportion of land the respondents had allocated to potato production gave a probability of 0.997 at 3 degrees of freedom as shown in table 19. The two values obtained were greater than $p \leq 0.05$ which indicated that there was no association between access to credit and adoption of improved potato varieties.

Therefore the hypothesis of the study was accepted. The level of adoption was low in the study area despite the fact that majority of the farmers had received credit. Majority of the farmers received about ksh 10,000 per year which is marginally little to allow for full adoption. Research has shown that if farmers cannot purchase farm inputs, they are less likely to intensify their adoption of improved agricultural technologies (Olwade, Sikei & Mathenge, 2010). The adoption level in the study area can be attributed to low amount of credit received. As shown earlier, potato production is a capital intensive venture and thus the amount received could not adequately allow farmers to allocate more land to improved potato production. Similarly, involvement in other off farm activities would have made farmers to allocate the loan they received to those activities thus reducing the amount of money that can be used in potato production.

Access to credit allows farmers to purchase farm inputs which are major constraint in agricultural production (Okwoche & Asogwa, 2012). Smallholder farmers face the challenge of lack of collaterals to secure credits thus leading to low access to credit (World Bank, 2008). However, this may lead to a vicious cycle of poverty as the poor are trapped in a cycle of income inequality as they try to repay the credit with other sources of income on the farm or off the farm. In the study area, farmers would give out other products from the farm such as milk as collateral to obtain the credit they used in potato farming. This would be hard especially for those with fewer animals and thus use all the produce to repay their credit.

This study contradicted Teklewold et al. (2006) who noted that farmers who are able to access credit tend to adopt technologies more than those that are constrained in this respect. Simtowe, Zeller and Phiri, (2006) argued that access to credit allows farmers to adopt even risky technologies since their household's-risk bearing ability is boosted while at the same time relaxing their liquidity constraint. However, this may apply only to those who utilize the credit they get entirely on the adoption of the technologies. But, since the problems facing many families and communities are multifaceted, the farmers may borrow credit for agricultural production just to utilize it to meet other obligations such as paying school fees for their children. This may have led to the low level of adoption among the study population. Additionally, the credit accessed may be little and thus limit the farmer's ability to adopt to technologies.

The study also contradicted Barungi et al. (2013), Namwata et al. (2010) and Simtowe and Zeller (2007) who reviewed factors that affect adoption in Uganda, Tanzania and Malawi respectively. The authors independently highlighted credit access as an important factor in adoption of improved agricultural technologies. The authors reported that actually access to credit had a significant influence on adoption in their study areas. In this study, since there was no association between access to credit and adoption of improved potato varieties, the amount of money received would have played the key role. Thus, it is noted that low level of access to credit has a negative influence on adoption.

4.5. Farmers perception about improved potato varieties

This study sought to describe farmers' perceptions of improved potato varieties. Perceptions were viewed as attributes that farmers consider significant about the improved potato varieties. Taste of the varieties, tolerance to bacterial wilt and blights (early and late blight), food security, incomes for the family, marketability, time to maturity and soil nutrients consumption were the main attributes that were investigated. The farmers were asked to indicate on a scale of 1=strongly agree, 2=agree, 3=neutral, 4=disagree and 5= strongly disagree with the given aspects related to improved potato varieties.

The results were analyzed to compute an aggregate score that would infer perceptions in general. The average score was computed for each respondent's response to all the statements provided. The average scores were weighted on a scale of 1-5 and values allocated scores such that a score

of 5 would be a strong positive perception while a score of 1 would be strong negative perception, and 3 would be the neutral score. The results were as shown in table 21.

Table 21

Means and Standard Deviations on Farmers Perceptions about Improved Potato Varieties (n=128)

	Mean	Std. Deviation
Improved varieties are tastier	3.898	.8770
Improved varieties are resistant to blights	1.516	1.0647
Improved varieties have a ready market	4.523	.5014
Improved varieties mature early	4.734	.4434
Improved varieties increase food production	4.512	.5174
Improved varieties increase family incomes	4.336	.6905
Improved varieties labour intensive	4.586	.4945
Improved varieties deplete soil nutrients	4.383	.6290

Source field data 2013

The results revealed that the respondents agreed that improved potato varieties are tastier with a mean of 3.9 and a standard deviation of 0.877. On resistance to blight, a mean score of 1.5 and a standard deviation of 1.1 was obtained which inferred that farmers had a negative perception about this trait on improved potato varieties and they tended towards strongly disagreeing. Regarding availability of a ready market, early maturity, increasing food production, increasing family incomes, depleting soil nutrients and labour intensity, a mean score of between 4.4 and 4.7 was obtained. This implied that farmers agreed or tended towards strongly agreeing that improved potato varieties had these traits. Generally, it was noted that although farmers strongly agreed that the improved potato varieties had positive attributes such as early maturity, high yields, were tastier and increased family incomes, these varieties were susceptible to blight and bacterial wilt, required substantial labour and depleted soil nutrients fast.

The improved potato varieties that the farmers were growing were *Asante* (CIP381381.20) and *Shangi* which are red skinned and according to the respondents, they were tastier, were high yielding and had a high demand among consumers and traders hence ready market. According to

Kaguongo et al. (2008), consumers prefer the red skinned varieties since they remain fresh for a long time, and this may have influenced the marketability of the varieties. As noted by Namwata et al. (2010), availability of a ready market for improved potato varieties was a key factor that influenced adoption of improved potato varieties in Tanzania. Respondents in the study strongly agreed that the improved potato varieties had a ready market and thus this may have influenced their adoption decision. These findings agree with results from a study in Meru Central district in Kenya as well as in Kabale and Kisoro in Uganda (Kaguongo et al. 2008) where taste, the red skin colour, high yields and availability of market were reported to have influenced adoption of improved potato varieties in those areas.

Perception on maturity was another aspect of the improved potato varieties that was assessed. The respondents strongly agreed that improved potato varieties mature early. They noted that on average, the varieties matured in two and a half months. This attribute is especially important in food security as well as helping families to meet their economic obligations such as paying schools fees and loans. Thus, this may have been a key motivating factor to adopting the improved potato varieties. Additionally, early maturity allows farmers to have many cropping seasons in a year thus reducing pressure on land especially where land pressure is dominant. Early maturity allows a farm produce to be harvested early thus avoiding droughts or heavy rains (Idrisa et al., 2009). In Mumberes division, the month of July is extremely cold which is a predisposing factor to early and late blight. However, early maturity of improved potato varieties is an advantage to the farmers because the frequency of spraying is reduced thus reducing the cost of managing the blights.

The perception by farmers that improved potato varieties were not resistant to blight may have led to low adoption among the study population. This may be because blights require a lot of capital investment in controlling since only chemical control is possible. As noted by Kaguongo et al. (2008) and MoA (2011), there are two types of fungicides mainly used in control of late blights namely Mancozeb and Ridomil (Kaguongo et al. 2008; MoA, 2011) which according to the farmers were unaffordable to them. More so, bacterial wilt has no treatment and as described by Wakahiu et al. (2006), “it is an endemic disease in potato production in Kenya”. Farmers in Kenya consider it to be a catastrophe once it strikes since chemical application does not guarantee a cure (MoA, 2011). Thus tolerance to bacterial wilt is a trait potato farmers consider

important but according to KARI (2004), no variety is considered tolerant to bacterial wilt in Kenya and the only solution is uprooting. This may have caused farmers to allocate less portions of land to improved potato varieties so as to allow for caring for them when blights attack.

The results from this study are in line with Kaguongo et al. (2008), Idrisa et al. (2009) and Chi (2008) who noted that a farmer's perception about a technology actually influences their adoption of such a technology. Attributes related to a technology largely influences how a farmer will perceive its importance. This in turn will influence their decision of whether or not to adopt (Idrisa, Ogunbameru & Madukwe, 2012).

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter is divided into four sections. The first section provides an overview of the entire study, the second section gives the conclusions of the study. The third section gives recommendations made for the study as well as for further studies.

5.2 Overview of the study

Research efforts have been geared towards breeding and dissemination of improved potato varieties in Kenya. Mumberes division is located in Koibatek district, Baringo County. The altitude of this place is 2750 m a.s.l which makes it a high potential area for production of potatoes. Farmers in this area rely on agriculture as their main source of livelihoods with potato production being the main economic activity. Declining outputs of the potato varieties the farmers had been growing over time coupled with declining agricultural productivity of land had caused farmers to adopt improved varieties although the rate of adoption was low in the study area. These varieties were bred for high yields, early maturity and increased resistance to diseases.

The purpose of this study was to investigate the influence of the selected factors on adoption of improved potato varieties in Mumberes division Baringo County. The factors studied were selected demographic factors (marital status of the household head, age, gender of the household head, level of education of the respondent and family size), access to extension services, access to credit and farmer's perception about improved potato varieties.

This study was guided by four objectives and three hypotheses. The study objectives were to:

- i) investigate the influence of the selected demographic characteristics of farmers on adoption of improved potato varieties in Mumberes division, Baringo County
- ii) describe the influence of the access to extension services by farmers on adoption of improved potato varieties in Mumberes division, Baringo County
- iii) determine the influence of access to credit services by farmers on adoption of improved potato varieties in Mumberes division Baringo County

- iv) investigate the influence of farmers' perception about improved potato varieties on adoption of improved potato varieties in Mumberes division, Baringo County

The null hypotheses to be tested for the study were generated from the first three objectives.

The target population was all smallholder farmers in Mumberes division. The sample used for this study was obtained from all the four locations that make up Mumberes division namely Timboroa, Mumberes, Chemoswon and Tinet. The sample was proportionately obtained to ensure equal representation. A sample size of 128 systematically sampled household heads were interviewed. The study employed a cross-sectional survey design where open ended and close ended questions were asked to the respondents and their responses obtained and documented. Data was analysed using SPSS version 17 which was used to compute the descriptive statistics from numerically coded responses made by the household heads. Chi square test of independence was used in hypothesis testing.

5.3 Summary of the Major Findings of the Study

The study revealed that majority of the households were headed by males (92%). In addition, majority of the farmers had attained basic literacy level, which is primary level. Many farmers were aged between 20 and 40 years (74%) while only few were aged less than 20 years (7%). Many families (58%) were consisting of 5-9 members. The large sized families as well as the small sized families all utilized both hired and family labour for potato production. Using chi square test of independence it was established that all the selected demographic factors had no statistically significant influence on adoption of improved potato varieties in the study area. This is because the chi square values obtained for the correlation of all the selected factors with indicators of adoption gave $p > 0.05$ which was greater than the desired α of 0.05.

Only a few of the respondents had access to extension services and they had to cover up to nine kilometres on poorly developed road networks to access extension. However those that did not access extension utilized information from the radio as well as from other farmers for agricultural production. The results of hypothesis testing gave chi square probability of 0.996 at 2 degrees of freedom and 0.15 at 3 degrees of freedom respectively for the two indicators of adoption namely period of cultivation and proportion of land allocated to improved potato varieties. Thus the study revealed that there was no statistically significant influence of access to

extension services on adoption of improved potato varieties in Mumberes division. The level of adoption observed in the study area was attributable to the few number of visits by extension agents as well as the few number of individuals that reported to have visited or been visited by the extension agents.

Many farmers had access to credit where many of them received at most Ksh 10000 per year. The respondents utilized the credit they received for purchasing inputs such as fertilizers, pesticides and hiring of labour. The main source of credit was the cooperative society and equity bank. This amount of money was too little compared to the KES 50000 that is required to start up improved potato farming on a hectare of land. The results of hypothesis testing gave chi square probability values of 0.963 and 0.997 at 2 and 3 degrees of freedom respectively for the two indicators of adoption; period of cultivation and proportion of land allocated to improved potato varieties. This indicated that there was no statistically significant influence of access to credit on adoption of improved potato varieties in Mumberes division. The low level of adoption may have been caused by the little amount of money received by the farmers compared to the high capital demand of improved potato varieties.

Many farmers had a strong positive perception about improved potato varieties. The farmers strongly agreed that the varieties matured early, were high yielding, were tastier, increased family incomes and had a ready market with the mean score being between 4.3 and 4.7. They also felt that the varieties had superior culinary traits like they were easy and faster to cook as opposed to other varieties. However, the results showed that farmers had a negative perception about improved varieties in relation to susceptibility to bacterial wilt with a mean score of 1.5. This means that just like the varieties they had been growing, the farmers felt that the improved varieties were susceptible to blights. More so, they strongly agreed that the improved varieties required more resources in terms of labour for production and were depleting soil nutrients. This aspect may have influenced the adoption of improved potato varieties by the farmers in the study area.

5.4 Conclusions

Based on the findings of the study, the following conclusions were drawn:

Marital status and gender of the household head, level of education, family size and age were the demographic characteristics that were selected in this study. The study showed that neither of these factors had a statistically significant influence on adoption of improved potato varieties in the study area.

Many families in the study were large with 5-9 members and the need for increased food production may have influenced adoption. Nonetheless the large families also implied small land portions occasioned by land subdivision and therefore low adoption. It was thus concluded that family size was not a significant factor influencing adoption in the study area.

The level of education would allow farmers to assimilate and internalize even the complex aspect of a technology thus allowing its adoption. However, in this study the level of education did not influence the adoption of improved potato varieties. To this effect, it was concluded that the level of education did not influence the adoption of improved potato varieties in the study area.

The age of the farmers was shown not to have a statistically significant influence on adoption of improved potato varieties in the study area. Younger farmers may have been resource constrained especially in access to land and thus allocated less portions land to potato production. Lack of experience may also have limited the capacity of the younger farmers to adopt since experience allows farmers to understand the technical as well as the agronomic issues related to technologies. The study thus concluded that age of the farmers was not a significant factor that influenced adoption of improved potato varieties in the study area.

Access to extension did not have a statistically significant influence on adoption of improved potato varieties in Mumberes division. Interaction with extension agents allows farmers to know the varieties that are available for them to adopt. Thus the low level of adoption among the respondents that received extension services would be attributed to non-targeting where the agents did not really address specific issues related to improved potato production in Mumberes division.

Access to credit also does not influence either the proportion of land allocated to improved potato production or the period of time the farmers has cultivated the varieties. Although farmers received credit, the level of adoption of improved potato varieties was low. This may be attributed to the low amount of credit received where many farmers received KES 10000 per year. It was therefore concluded that access to credit did not have a statistically significant influence on adoption of improved potato varieties in the study area. .

Farmer's perception about high yields, time to maturity, taste, market availability and increased incomes from the improved potato varieties may have influenced the adoption of improved potato varieties in Mumberes division. Farmers agreed that improved potato varieties were tastier, matured early, increase household incomes and yield more compared to the old varieties they had been growing. Additionally, the negative perceptions the farmers had about resistance to blights, labour requirement and consumption of soil nutrients may have led to low adoption of improved potato varieties in the study area.

5.5 Recommendations

Based on the findings and conclusions the following are the recommendations of the study:

1. The ministry of agriculture needs to improve access to extension services in the study area in order to increase access to this important service to farmers. This could be done through increasing the number of extension staff in the area who can frequently visit farmers and provide them with the required knowledge and skills relating to improved potato production.
2. Financial institutions in the area including AFC and other commercial banks have to improve the access to credit by farmers in the study area which would increase the proportions of land allocated to improved potato production. This could be done by government subsidizing the credit available to farmers from banks.

5.5.1 Recommendations for Further Research

There is need for further studies in this area to establish the extent of other factors that may be influencing the adoption of improved potato varieties in Mumberes division. The study could use a different design so as to incorporate all the factors that may influence adoption so as to establish other factors that are influencing the adoption of improved potato varieties in this area and the magnitude of their influence.

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APPENDIX

Farmers' Interview Schedule

I am a student at Egerton University pursuing a Master's of science degree in Community Studies and Extension. You have been randomly selected to participate in this study. May I first assure you that you will remain completely anonymous, that the details you give was treated with the utmost confidentiality and was used only for the purpose of this study. This study is designed to investigate selected factors influencing adoption of improved potato varieties in Mumberes division. The results generated may be useful to policy makers in future policy designs for technology development and dissemination to you as farmers in potato production. **SECTION I**

: Demographic Data

1. Gender: Male [] Female []
2. What is your marital status?
 - a) Single []
 - b) Married []
 - c) Divorced []
 - d) Separated []
3. How old are you?
 - a) Below 20 years []
 - b) 20-30 years []
 - c) 31-40 years []
 - d) 41-50 years []
 - e) above 50years. []
4. Highest Level of formal education attained
 - a) Primary []
 - b) Secondary []
 - c) Tertiary []
 - d) None at all []
5. Family size (*including you*)
 - a) 1-4 members []
 - b) 5-9members []
 - c) >9 members []

6. What is your main source of labour?

- a) Hired []
- b) Family members []
- c) Both of the above []

Section II: potato varieties Currently Grown by Farmers

7. Approximately what proportion of your land is under potato cultivation?

.....

Variety	Hectareage
a) Kenya-Karibu	
b) Shangi	
c) Kenya-Mavuna	
d) Shangi	
e) Tigoni	
f) Kenya-Faulu	
g) Kenya-Sifa	
h) Asante	
Others (<i>specify</i>).....	

8. For how long have you grown this variety(s)?

Variety	Period
a) Kenya-Karibu	
b) Kenya-Mavuno	
c) Shangi	
d) Tigoni	
e) Kenya-Faulu	
f) Kenya-Sifa	
g) Asante	
Others (<i>specify</i>).....	

Section III: Access to Credit

9. Do you receive any form of credit for agricultural production? Yes [] No []

10. If yes, from whom?

- a) Agricultural finance corporation []
- b) Banks []
- c) Farmer groups []
- d) Private companies []

- e) Cooperative society []
- f) Others, (*Specify*).....

11. If you receive credit, how much did you receive last year?

Ksh

12. Do you use the credit you receive for potato production? Yes [] No []

13. If yes, how do you use the credit in potato production?

- a) Purchase of improved seeds varieties []
- b) Purchase of fertilizer []
- c) Purchase of pesticides []
- d) Hiring labour []
- e) Transporting produce (potato) to market []
- f) Others (*Specify*).....

Section IV: Access to Extension

14. How far is your home from the nearest town or Agricultural office?

.....(Km)

15. Have you been visited by extension agents in the past six months? [] Yes [] No

16. If yes, how many times have you been visited?

- a) 1-4 times []
- b) 5-10 times []
- c) 10-15 times []
- d) More than 15 times []

17. Where did the extension agents who visited you come from?

- a) Ministry of Agriculture []
- b) Non Governmental Organizations []
- c) Faith based Organization []
- d) Private sector []
- e) Others (*Specify*).....

18. Did the extension agents who visited you give information on improved potato varieties?

[] Yes [] No

If yes, what was the area of emphasis?

- a) Seed availability []
- b) Currently bred varieties []
- c) Importance of improved potato varieties []
- d) Agronomic practices []
- e) Market for improved potato varieties []
- f) Others (specify).....

19. For the statement below regarding access to extension services, say whether you strongly agree, agree, are neutral, disagree or strongly disagree.

Extension services	Strongly agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly disagree (1)
I am regularly visited by extension agents					
The extension package addresses my improved potato varieties needs					
The extension staff are conversant with improved potato varieties production					
I am visited by different extension agents at different times					
I seek extension services on improved potato varieties regularly					
The extension office is accessible to me at all times					
Extension agents are not conversant with improved potato varieties					
The extension package does not address issues relating to improved potato varieties					
I am rarely visited by extension agents					

Section V: Farmers Perception on Improved potato varieties

20. Have you heard about the new potato varieties, namely *Asante and Shang*i?

Yes [] No []

21. If *yes* how did you know about it?

- a) From a friend []
- b) From extension officer []
- c) From research stations []
- d) From a seminar []
- e) From the radio []
- f) Other sources (specify)

22. For the statements below regarding improved potato varieties, say whether you agree strongly, agree, are neutral, disagree or disagree strongly.

	Agree strongly (5)	Agree (4)	Neutral (3)	Disagree (2)	Disagree strongly. (1)
Improved potato varieties increase food production					
Improved potato varieties are expensive to produce					
Improved potato varieties deplete the soil nutrients fast					
Improved potato varieties do not increase income for families					
Improved potato varieties production is labor intensive					
Improved potato varieties are vulnerable to pests and diseases					
Improved potato varieties do not have locally available market					
Improved potato varieties are a solution to food insecurity in this area					
Improved potato varieties are sweeter and cook fast					

23. For the statement below regarding availability of improved potato variety seeds, say whether you agree strongly, agree, are neutral, disagree or disagree strongly.

Availability of improved potato seeds	Strongly agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly disagree (1)
The seeds are always available for farmers when needed					
Farmers trust the source of the improved potato seeds					
The seeds are always provided in time during planting by breeders					
Seeds sources are close to farmers at all times					
There are always enough seeds at planting time					
The seeds are affordable by farmers					
Farmers do not trust the source of improved seed sources					
The seeds available are free from diseases					
The seeds available are unaffordable by farmers					

Section VI: Other Sources of Income

24. Do you have other sources of income apart from farming?

Yes [] No []

If yes, how much do you earn from these activities per month?

- a) 1000-5000 []
- b) 5001-10000 []
- c) 10001-15000 []
- d) Above 15000 []

25. Do you engage in other income generating activities apart from potato farming?

Yes []

No []

If yes, which one(s)?

.....

How much time do you spend in those other activities per day on average?

a) 1-3 hours []

b) 4-6 hours []

c) 7-9 hours []

d) More than 9 hours []

26. Are there any other factor(s) that in your own opinion may be influencing your adoption of improved potato varieties in this area?.....

.....
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.....
.....
.....
.....
.....

Thank you very much for participating in this research.

GOD BLESS YOU