INFLUENCE OF FARMER'S CHARACTERISTICS, AGRICULTURAL EXTENSION AND TECHNOLOGY SPECIFIC FACTORS ON ADOPTION OF ORGANIC FARMING TECHNOLOGIES IN EMBU WEST SUB COUNTY, EMBU, KENYA.

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A RESEARCH PROJECT SUBMITTED IN PARTIAL FULFILLMENT FOR THE REQUIREMENTS OF THE AWARD OF THE DEGREE OF MASTER OF ARTS IN PROJECT PLANNING AND MANAGEMENT OF THE UNIVERSITY OF NAIROBI.

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DECLARATION

Declaration by the candidate.

This Research Project is my original work and has not been presented for award of a degree in any other University.

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Declaration by the Supervior.

This Research Project has been submitted for examination with my approval as the appointed University supervisor.

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DEDICATION

I dedicate this research project to my family for their unfailing love and support throughout my life.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABBREVIATION AND ACRONYMS

ACEF	Africa Children Education fund
EM	Effective Microorganisms Technology
EU	European Union
FAO	Food and Agriculture Organization
FOMAT:	Forum for Organic Resource Management and Agricultural Technologies
HCDA:	Horticulture Crop Development Authority.
IFPRI:	International Food Policy Research Institute.
IFOAM:	International Federation of Organic Agriculture Movement
JKUAT:	Jomo Kenyatta University of Agriculture and Technology
KIOF:	Kenya institute of Organic Farming
KOAETEC	Kenya Organic Agriculture and Environmental Technologies (KOAETEC) Institute
KOFA:	Kenya Organic Farmer Association
NGO:	Non Governmental Organization
SACDEP:	Sacred Agriculture Community Development Program

ABSTRACT

Farmers' training is intended at promoting uptake of knowledge and skills, changing of attitudes and making farmers achieve their aspirations. When improved agricultural practices are systematically and effectively delivered, farmers' training is known to enhance adoption of improved agricultural practices and finally improve the social and economic development of the farmer. This study was conducted to assess the influence of farmer's social-economic characteristics, Agricultural extension and Technology specific factors on enhancing adoption of the improved organic farming technologies among trained farmers in Embu west sub-county, Embu County, Kenya. A descriptive sectional survey design was applied in the study and data was collected from Three hundred (300) trained organic farmers. The results of descriptive analysis showed that, awareness of the Organic Farming Technologies in Embu west Sub County was high among all the farmers across different socio-economic backgrounds. Among the socio-economic characteristics of the farmers that were found to be influencing their adoption decision of the entire package were level of formal education, gender and off-farm income. Age of the farmer, farm size and contact with technology promoters did not affect their adoption decision. The technology-specific attributes that negatively influenced adoption of the entire package included cost involved, complexity of the technology and high perceived risks. Adopters of the entire package were motivated to do so by the benefits of high yields realized from adopting the entire package and the fact that they perceived that the cost of farming was low especially for farmers who had enough organic waste for composting and enough labour. Among the adopters of the entire package, about 60% reported that they have been harvesting an estimate of more harvest per acre per season as compared to seasons before adopting entire organic farming. Many non-adopters cited technology-specific attributes of costs, complexity and perceived risks as the major factors that hinder their efforts to adopt the entire package. Overall, the factors that influence adoption of the Organic Farming Technologies in Embu West Sub County seem to lie more on technology-specific attributes and economic constrains other than the social characteristics of the farmers. The findings of this research project provide useful information which can be used by Africa Children Education Fund to evaluate the impacts, effectiveness and sustainability of the farmers training project they sponsored. The study provide useful data and recommendations which can be used by future researchers and training institutions dealing with farmers training and extension.

CHAPTER ONE
INTRODUCTION

1.1 Background to the study

Poverty reduction is core to the field of development economics. With 75% of the world's poor living in rural areas, the topic of improved agriculture is viewed as central to poverty reduction (Thirtle, Lin, & Piesse, 2003). Farmers' training refers to educational services for influencing farmers to adopt improved practices in crop and livestock production (Halakatti *et al.,* 2007). A farmer being a rational decision maker normally strives for a better standard of living and seeks ways of adopting new technologies to accomplish the set goals (Murai and Singh, 2011).

Extensive research on agricultural growth since India's green revolution in the 1960s has provided evidence on ways to uplift production, livelihoods and food security for the rural poor. Agricultural productivity gains in India, mainly through the adoption of high yield seeds varieties (HYV), brought both absolute and relative gains to poor rural households, although those gains took time to manifest themselves (Ravallion & Datt, 1998). As described by Umar and Kumar (2011), majority of rural farmers in Africa have experience in farming and rearing animals while relying on traditional husbandry practices which may be the cause of low production and productivity of their farming activities, however, these coupled with inadequate knowledge and skills on improved farming practices, constrains them from adopting modern agricultural technologies.

In Kenya, about 80% of the population live in rural areas and thrive on farming. The growth in agriculture has been on the in recent years. In Kenya, as of 2005, 61% of the population was employed within the agriculture sector (World Bank, 2013).The Government of Kenya has put in place and proposed a strategy for revitalizing agriculture, 2004 –2014 with the aim of raising the sector's growth rate, reduction of unemployment and poverty. This revitalizing agriculture strategy aims at achieving the country's Millennium Development goal of Poverty Reduction (HCDA, 2008). The Kenyan government through "Vision 2030" has come up the following initiatives; strengthening agricultural extension which is aimed at encouraging farmers to produce products for local and international markets, encouraging and supporting rural industries, encouraging and supporting irrigation in arid and semiarid areas and better management the arable land(Republic of Kenya, 2008). According to International Food Policy Research Institute (IFPRI, 2002), success in Kenya's agriculture lies in improvement of agricultural technologies and their subsequent diffusion to the farmers.

Africa Children Education Fund (ACEF), an NGO based in Embu, has been training farmers on new agricultural technologies so that farmers in the region can increase the productivity of their farm. From January 2012 to December 2013 ACEF sponsored a two year Farmers training project. The Project objective was to empower farmers from Embu County with new skills which could use to increase the productivity of their farms and also to manage their household wastes. The seminars were conducted at the Kenya Organic Agriculture and Environmental Technologies (KOAETEC) Institute training facilities located at Ena town in Embu County. The total number of farmers who attended the three (3) days course at KOAETEC Institute from January 2012 to December 2013 was 3395 farmers out of which 1200 were from Embu West Sub County. The content of the training was: Organic farming technologies, Organic Composting techniques, Organic soil fertility management technologies, household waste management technologies, Effective Microorganisms (EM) technology, value addition technologies and sustainable waste management. After the seminar the farmers were expected to practice the skills learnt and also teach other farmers.

1.2 Problem Statement

Adoption of improved agricultural technologies involves a process in which awareness is created, attitudes are changing and favourable conditions for actual use of recommended practices are provided to the farmers (Lemma and Trivedi, 2012). Agricultural development strategy at the smallholder level requires some change in knowledge and management skills, which calls for training on improved agricultural practices. It has been a usual trend, such that little is done to follow up and trace back if trained farmers do put in practice the skills they learned, even to establish the extent to which improved farming skills are practiced by farmers and constraints which trained farmers do face leading to them failing to exercise what they learnt. Farmers' training programmes may operate with an assumption that farmers will put into practice the improved practices they were taught while in reality there might be other factors limiting them. It is important to follow the degree by which the ultimate beneficiaries are actually changing and depicting any problems that have occurred so that measures and or modifications could be advanced to ensure increased use of improved practices (Quddus, 2012).

This study therefore, focused on investigating the influence of farmer's social economic characteristics, agricultural extension and technology's specific attributes on adoption of organic farming technologies among the trained farmers, also the study focused on determining the extent to which the trained farmers practiced what they were taught at KOAETEC Institute, Embu County.

1.3 Purpose of the Study

The Purpose of the study was to determine the extent to which famers in Embu west Sub County have adopted organic farming technologies taught at KOAETEC institute during the project, Also the study accessed the influence of farmer's social economic characteristics, Agricultural extension and technology's specific attributes on enhancing adoption of the Organic Farming practices among farmers in Embu West Sub County.

1.4 Objectives of the study

The study was guided by the following research objectives:

1) To assess the influence of farmer's social economic characteristics on adoption of Organic farming technologies in Embu west Sub County.
2) To establish the influence of agricultural extension services on adoption of Organic farming technologies in Embu west Sub County.
3) To identify the influence of technology's specific attributes on adoption of Organic farming technologies in Embu west Sub County.

1.5 Research questions

The study was guided by the following research questions:

1) To what extent does farmer's characteristic influence the adoption of Organic farming technologies in Embu west Sub County?
2) How does agricultural extension service influence the adoption of Organic farming technologies in Embu west Sub County?
3) What are the technology's specific attributes influencing the adoption of Organic farming technologies in Embu west Sub County?.

1.6 Significance of the Study

Considering the fact that most farmers participate in agriculture in developing countries, this research on agricultural technology adoption was critical. This research determined the effectiveness of farmer's trainings and extension services on adoption of organic farming technologies in Embu west Sub County; the study also determined the farmers' social economic characteristics and technology's specific factors which influence adoption of organic farming in Embu West Sub County. The study also suggested ways of improving farmers training programs so as to maximize the adoption of new agricultural technologies.

The study was integral in increasing adoption of technology and subsequent reduction in poverty. Therefore, the findings of this research can be helpful to farmers, donor funding organizations, academicians, researchers and the Ministry of Agriculture in assessing the underlying reasons contributing to the low adoption of agricultural technologies and poor agricultural production leading to higher poverty levels. The findings from this study forms a basis and add knowledge to various stakeholders of the sub-sector in assessing the influence of farmers' training in enhancing adoption of the improved organic farming practices to trained farmers, it also forms a basis of noticeable and measurable behavior change in the activity performance using knowledge and skills gained by trained farmers after the training. The result of this study can be used as a guide to extension service management in their training policy design and training program designing in the future.

1.7 Delimitations of the Study

This study was carried out in Embu west Sub-County and focused on how farmer's social economic characteristics, agricultural extension services and Technology's specific attributes influences the adoption of Organic farming technology among trained organic farmers in Embu west Sub-County, Kenya. The study only involved farmers from Embu West Sub County who attended organic farming seminars at KOAETEC Institute (Tenri-Ena) from January 2012 to December 2013. The study employed questionnaires and interview schedules in data collection. The study used descriptive survey design.

1.8 Limitations of the Study

The study was limited by lack of adequate time and finance for the whole project. The Researcher had to ensure maximum utilization of available limited fund within the budget. There was little time available to the researcher to conduct the research study but the researcher overcame this by engaging three research assistants in collecting data and also the researcher working over the weekend to ensure the study is completed within the work plan.

1.9 Assumptions of the Study

This study was carried out with the following assumptions in mind: all the trained organic farmers were faced with challenges of technology adoption; the instruments that were used to collect data were valid and reliable; the target respondents were co-operative and gave voluntarily, accurate information; extraneous factors not meant for study did not interfere with the main focus in this study (like government policies, culture and community cooperation). The study also assumed that all respondents were honest and found appropriate time to respond to questionnaires.

1.10 Definitions of Significant Terms

Adoption: It is acceptance and use of new agricultural technologies by the farmers. At individual level, it is the degree to which a new technology is used in the long- run equilibrium when the farmer has full knowledge about the technology including its potential

Effective Microorganism solution-Liquid organic based microbial inoculants used for enhancing decomposition and fermentation of organic matter compost making.

EM Technology-Technology that make use of EM solution.

Intensity of adoption: The extent or degree of adoption, and is expressed by use of a continuous variable such as hectare or percentage of land devoted to a new technology or the quantity of the technology used per hectare.

Organic Farming: A farming system that emphasizes on the reduction of the use of synthetic chemicals and synthetic fertilizers in crop and animal husbandry, it advocates the use of naturally occurring products as alternative to synthetic products.

Organic Pest repellant: Liquid extracted from medicinal plant and used to chase the pest away.

Perception: The process by which people select, organize and interpret sensory situations connected with a phenomenon into a meaningful and coherent picture of the world.

Rate of adoption: The proportion of potential adopters who have adopted the technology.

Technology: New innovations developed by the researchers, that are intended to improve agricultural productivity for high quality and quantity yield gains. Rogers (1971) defined it as a means by which resources are combined to produce the desired output, while innovations are ideas, practices or objects that are perceived as new by their recipients.

1.11 Organization of the Study

This study is organized in five chapters. Chapter one describes the background to the study, statement of the problem, purpose of the study, the objectives, research questions, significance of the study, delimitation of the study, the limitations of the study, assumptions of the study, definition of significant terms used in the study and the organization of the study. Chapter two comprise of literature review that is relevant to the research topic like organic farming at both global level and in Kenya, influence of farmers social-economic characteristic's, availability of agricultural extension services, and technology characteristics on the adoption of agricultural technology among smallholder farmers. Then it ends with conceptual framework. Chapter three consists of the research methods to be used in carrying out the study. It includes research design, location of study, target population, sampling procedures and sample size, research instruments, validity and reliability of research instruments, data collection procedures and data analysis techniques. Chapter four consists of data analysis, presentation, interpretation and discussion and finally. Chapter five that consists of a summary of the conclusions and recommendations.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter comprises literature review that is relevant to the research topic, and includes the empirical literature on: Overview of global organic farming; the development of Organic farming in Kenya; Organic farming training institutions in Kenya; training and the adoption of agricultural technology; availability of agricultural extension services and the adoption of agricultural technology; farmers characteristics influencing the adoption of agricultural technology and demographic information and the adoption of agricultural technology; and conceptual framework showing the relationship between variables. The aim of the literature review was to reveal the knowledge gaps which the study sought to fill in.

2.2. Organic farming.

Modern agriculture depends on high input of chemical fertilizer and pesticides for crop production. Although such technology-based agricultural practice has increased agricultural productivity and abundance, the resulting ecological and economical impacts have not always been positive. Environmental pollution and food safety due to chemical contamination have become a great concern worldwide. In order to cope with this problem, the Food and Agriculture Organization (FAO 1999) proposed "The World Food Summit Plan of Action (1999)" in recognition of the importance of developing alternative sustainable agriculture practices such as organic farming. The goal of the Action Plan was to reduce environmental degradation while creating income from the farming operation.

Organic agriculture has its root in traditional farming practices developed over the millennia all over the world. The modern approach to organic agriculture emerged in the late 1960s, when farmer and consumers began to recognize that the enormous amount of chemicals being used in both crop and animal production could have dire consequences for the earth and its people (FAO 2003).Organic farming is an integrated farming system which involves both technical aspects (soil, agronomy, weed, and pest management) and economic aspects (input, output, and marketing) as well as human health.

IFOAM interpret the term "Organic" with "of plant or animal origin". It also refers to the organizational aspect of organism (Eyhorn et al.2002). Organic farming follows the principle of sustainability. Sustainability in agriculture refers to successful resource management that maintain natural resources and environment quality, and assures food security and satisfaction of human needs (Eyhorn et al.2002)

In Organic Agriculture a wide variety of Organic resources are used. Organic resources include: farm wastes, animal manure, compost, and green manure, residues from processing of plant and animal products, town waste and Soil inoculants e.g living microorganisms, Effective Microorganisms (EM). Common crop residues and animal manures are utilized as organic resources. Large quantities of crop residues and animal manure are applied as fixed carbon to soils in many organic systems. The release of the nutrient from the organic matter and thus nutrient availability for plant plays a major role in these systems (IFA 1996-2004)

2.2.1 Overview of global organic farming

Chemical-free safe foods produced from organic farms are widely welcomed by consumers around the world today, especially in North America, Europe, South America, Asia and Oceania. Organic farming in the US was first initiated by farmers who sold organic products as early as 1940. The "Organic Farming Act of 1982" was first passed by the Congress to serve as the guideline for organic production. This law was later revised into a more detailed and strict regulation, the "Federal Organic Food Production Act of 1990." (USDA1990) Under this law, the National Organic Standard Board was established. The Board is responsible for implementing measures to assure that food products labeled as "organic foods" or "made with organic ingredients" meet the strict organic standard across the United States. Because of these measures, organic farming becomes the fastest growing agricultural industry in the US with a growth rate of 20-25 percent every year since 1990.The main food categories for organic products in the US are vegetables, fruits, cereals, meats and dairy products. Organic dairy belongs to a large-growth category in the organic industry: its sales reached an estimated US$24 million in the US in 1994 (Dunn 1995).

Due to the great global market demand, production of organic foods has increased rapidly in the past decades. According to Hanuman (2003) of the Organic Trade Association (OTA), US retail sale of organic foods and beverages, which has grown approximately 20-24 percent per year for the past 12 years, was estimated to have reached US$11 billion in 2002, representing about 2 percent of the overall US retail food sales. The US market was expected to continue to grow, particularly after the full implementation of the national organic standards. According to estimates, the sale of organic products in North America and Europe was to reach US$105 billion in 2006.

Organic production is also becoming a booming industry in Asia and Oceania. The area of organic farm in Japan increased to 5,083 hectares, which produced organic foods at a value of US$3.5 million in 2003. In Taiwan, the area of certified organic farm increased from 159.6 hectares in 1996 to 1,092.4 hectares in 2003. Australia has a total organic area of 10,500,000 hectares which is the largest in the world. In other Asian countries like China, Malaysia, the Philippines, Vietnam, Thailand and Indonesia, the area for organic farming is rising from year to year. There are strict organic certification laws in the US, EU, Australia and Japan, and each has its own official organic law which serves as the sole guideline for high quality organic production. Other Asian countries like China, India, Israel, Thailand and Taiwan have their own official versions of organic standards and rules, but have not yet been legislated into laws to include penalty for the violators. Other Asian countries such as Indonesia, Malaysia, the Philippines, and Singapore do not have organic standards yet (IFOAM 2003).

According to the SOL-Survey (2001), Oceania had the largest share (48.51 percent) of total area under organic management in the world in 2001. The share decreased to 42 percent in 2004. This was due to the expansion of organic farming in Asia from 0.33 percent in 2001 to 4 percent in 2004, which is a ten-fold increase in three years. The farm area under organic management in Latin America was 20 percent in 2001 and increased to 24 percent in 2004, becoming the second largest organic area after Oceania. Europe shared 23.58 percent in 2001 and 23 percent in 2004, and remained to have the same share between the years 2001 (23.58 percent) and 2004 (23 percent), the third largest continent to grow organic products in the world. It was followed by North America, which shared 6 percent in 2004. It is worth noticing that Africa, which is a natural-resource poor continent, was increasing its operation of organic farms in recent years. The total area under organic management in Africa shared a small portion of 0.14 percent in 2001 and increased to 1 percent in 2004.

According to the Organic Consumers' Association (2004), the world market for organic foods and beverages is the largest in the USA, with a retail sale of US$11,000-13,000million in 2003. According to the Organic Consumers' Association (2004), Asian consumers are following the global trend of increased use of organic products, but American, European, and Australian producers are getting the profits. High start up costs, hot climate, and shortage of reliable labeling schemes cause Asian organic farmers to struggle to grab a slice of the fast growing organic market.

2.2.2 Development of Organic Farming in Kenya

In the 1960s the inorganic fertilizer use in Kenya small holder's farm was promoted in combination with subsidization of fertilizer and improved maize varieties. The use of organic fertilizer , especially animal manure was neglected (Lekasi et al.2001) in the 1980s soil fertility depletion, excessive use of synthetic agro-chemical and chemical fertilizer and inadequate natural resources management led to the development of alternative technologies e.g ecological agriculture, low external input and sustainable agriculture(LEISA), biological agriculture, biodynamic agriculture and organic agriculture(KOFA 2002).

Kenya has 20 years history of institutional development for promoting organic and sustainable agriculture. Today organic agriculture is promoted by a great number of local self help group, church development programs, private companies, regional, national and international NGOs and local government organizations (Omare and Woomer 2003). In Kenya the pioneer of organic agriculture, the Kenya institute of Organic Farming (KIOF) was founded in the late 1980s.

In the early 1990s, the liberalization of Kenya's agricultural sector caused increasing prices of farm inputs because parastatal's subsidies were withdrawn.NGO promoted organic inputs as a replacement for synthetic fertilizer and created extension programs to sustain smallholders' farmers (Omare and Woomer 2003). Since liberalization, inorganic fertilizer use declined steadily due to increasing costs. The focus of research and science turned back to organic fertilizers methods and thus the utilization of locally available organic resources. Research was carried out on quality, quantity and application methods of organic matter (Lekasi et al.2001).According to Stiftung Okologie and Landbau (SOL) survey in February 20003, only 494 hectares of agricultural land in Kenya are formally certified as organic land(Waloga 2003).

The organic movements in Kenya make use of various technologies to realize soil fertility management e.g manure utilization, composting, traditional crop mixture and heavy mulches. Other technologies practiced in conventional agriculture but particularly shared in integrated nutrient management (INM) are: crop rotation, green manure, improved furrow, cover crops, reduced tillage, additional of raw agricultural minerals (Omare and Woomer 2003).

Compost production is a major practice in Organic farming. Many different composting systems of organic wastes are adopted. In Kenya the open system of turned pile is commonly used for compost production (Lekasi et al 2003).Traditional Boma composting is widely adopted (Njoroge and Mau 1999).Further variation s are the “14-day compost” where the compost is frequently turned and ready in 14 days. The techniques of trench and basket composting produce the compost in the site where it is being used (Njoroge and Mau 2003). Tithonia divesfolia is a commonly used in the field of organic agriculture as organic fertilizer, livestock feed, soil and conservation (Farming solution 2004).

Some of the techniques are unique to organic systems in Kenya includes the preparation of liquid manure and plant tea, double deep digging and “5-9 seed” in a hole. Liquid manure is used as a top dressing product extracted from fresh fermented livestock dropping in water. Manure is filled in a gunny bag and suspended in a water drum. Plant tea, as a nitrogen rich product is produced from fermented succulent or leguminous plant in water, fresh manure or green leaves are fermented in water for 10-21 days, solution is diluted 2:1 with water and applied as liquid fertilizer (Omare and Woomer 2003)

Some major organizations that have been leading the way in the field of organic agriculture in Kenya include: The Kenya Institute of Organic Farming (KIOF), based in Juja near Nairobi, was initiated in 1986 as a pioneer of Organic farming in Kenya (Parrot and Van Elzakker, 2003); The Sacred Agriculture Community Development Program (SACDEP) was established in 1992, located in Thika(Omare and Woomer 2003) ; The Kenya Organic Farmer Association (KOFA) based in Thika, was established in 2002 by farmers that participated at KIOF extension and training program (KOFA 2002); Located in Kitale the Manor House Agricultural Centre was established in 1984 and now is the leading training agriculture in Kenya on the field of organic farming(Parrot and Van ELzakker,2003). These training organization offers training in organic crop production, organic soil fertility management, organic pest and disease management, organic animal husbandry and organic waste management techniques (Farmers Jounal 2003),(Omare and Woomer 2003).

Besides NGO's the Jomo Kenyatta University of Agriculture and Technology (JKUAT) offers post graduate program in organic agriculture at the Institute of Energy and Environmental Technology (IEET). The Diploma is offered in collaboration with KIOF (Jomo Kenyatta University of Agriculture and Technology 2004). Also the Rockefeller foundation established the national forum on organic resource management FOMAT(Forum for Organic Resource Management and Agricultural Technologies)in the year 2000.The book "organic Resource management in Kenya, perspective and guidelines" was published in 2003 by FORMAT; and present the state-of -the-art in organic resource management from FORMAT national events(Savala et al 2003).

2.3 Determinants of agricultural technology adoption

There exist vast literatures on factors that determine agricultural technology adoption. According to Loevinsohn et al. (2013), farmers' decisions about whether and how to adopt new technology are conditioned by the dynamic interaction between characteristics of the technology itself and the array of conditions and circumstances. Diffusion itself results from a series of individual decisions to begin using the new technology, decisions which are often the result of a comparison of the uncertain benefits of the new invention with the uncertain costs of adopting it (Rogers,1995). An understanding of the factors influencing this choice is essential both for economists studying the determinants of growth and for the generators and disseminators of such technologies (Rogers, 1995).

Traditionally, economic analysis of technology adoption has sought to explain adoption behavior in relation to personal characteristics and endowments, imperfect information, risk, uncertainty, institutional constraints, input availability, and infrastructure (Feder et al. 1985; Koppel 1994; Foster & Rosenzweig 2010; Kohli & Singh 1998; Rogers, 2003 and Uaiene, 2009). A more recent strand of literature has included social networks and learning in the categories of factors determining adoption of technology (Uaiene, 2009). Some studies classify these factors into different categories. For example, Akudugu *et al*. (2012) grouped the determinant of agricultural technology adoption into three categories namely; economic, social and institutional factors. Kebede *et al.* (1990) as cited by Lavison (2013) broadly categorized the factors that influence adoption of technologies into Social, Economic and physical categories. Namara *et al.* (2003) categorized the factors into, farmer characteristics, farm structure, institutional characteristics and managerial structure.

Although there are many categories for grouping determinants of technology adoption, there is no clear distinguishing feature between variables in each category. Categorization is done to suit the current technology being investigated, the location, and the researcher's preference, or even to suit client needs (Bonabana- Wabbi 2002). For instance the level of education of a farmer has been classified as a human capital by some researchers while others classifies it as a household specific factor. This study will review the factors determining adoption of agricultural technology by categorizing them into technological factors, economic factors, institutional factors and household specific factors. This will enable a depth review of how each factor influences adoption.

2.3.1 Farmer's Social Economic characteristics influencing adoption of agricultural technologies.

Human capital of the farmer is assumed to have a significant influence on farmers' decision to adopt new technologies. Most adoption studies have attempted to measure human capital through the farmer's Education, age, Gender, and household size (Fernandez-Cornejo & Daberkow, 1994; Fernandez-Cornejo *et al*., 2007; Mignouna et al, 2011; Keelan *et al*., 2014).

Education of the farmer has been assumed to have a positive influence on farmers' decision to adopt new technology. Education level of a farmer increases his ability to obtain; process and use information relevant to adoption of a new technology (*Mignouna et al*., 2011; Lavison 2013; Namara *et al*., 2013). For instance a study by Okunlola *et al.* (2011) on adoption of new technologies by fish farmers and Ajewole (2010) on adoption of organic fertilizers found that the level of education had a positive and significant influence on adoption of the technology. This is because higher education influences respondents' attitudes and thoughts making them more open, rational and able to analyze the benefits of the new technology (Waller *et al*., 1998). This eases the introduction of a new innovation which ultimately affects the adoption process (Adebiyi & Okunlola, 2010).

Other studies that have reported a positive relationship between education and adoption as cited by Uematsu and Mishra (2010) include; Goodwin and Schroeder (1994) on forward pricing methods, Huffman and Mercier (1991); Putler and Zilberman (1988) on adoption of microcomputers in agriculture, Mishra and Park (2005); Mishra et al. (2009) on use of internet on use of internet, Rahm and Huffman (1984) on reduced tillage, Roberts et al. (2004) on precision farming and Traore, *et al*. (1998) on on-farm adoption of conservation tillage.

Age is also assumed to be a determinant of adoption of new technology. Older farmers are assumed to have gained knowledge and experience over time and are better able to evaluate technology information than younger farmers (Mignouna et al, 2011; Kariyasa and Dewi 2011). On contrary age has been found to have a negative relationship with adoption of technology. This relationship is explained by Mauceri et al. (2005) and Adesina & Zinnah (1993) that as farmers grow older, there is an increase in risk aversion and a decreased interest in longterm investment in the farm. On the other hand younger farmers are typically less risk-averse and are more willing to try new technologies. For instance, Alexander and Van Mellor (2005) found that adoption of genetically modified maize increased with age for younger farmers as they gain experience and increase their stock of human capital but declines with age for those farmers closer to retirement.

Gender issues in agricultural technology adoption have been investigated for a long time and most studies have reported mixed evidence regarding the different roles men and women play in technology adoption (Bonabana- Wabbi 2002). In analyzing the impact of gender on technology adoption, Morris and Doss (1999) had found no significant association between gender and probability to adopt improved maize in Ghana. They concluded that technology adoption decisions depend primarily on access to resources, rather than on gender and if adoption of improved maize depends on access to land, labor, or other resources, and if in a particular context men tend to have better access to these resources than women, then in that context the technologies will not benefit men and women equally.

On the other hand gender may have a significant influence on some technologies. Gender affects technology adoption since the head of the household is the primary decision maker and men have more access to and control over vital production resources than women due to socio-cultural values and norms (Tesfaye *et al.*, 2001; Mesfin, 2005; Omonona *et al.*, 2006; Mignouna *et al*., 2011). For instance, a study by Obisesan (2014) on adoption of technology found that, gender had a significant and positive influence on adoption of improved cassava production in Nigeria. His result concurred with that of Lavison (2013) which indicated male farmers were more likely to adopt organic fertilizer unlike their female counterparts.

Household size is simply used as a measure of labor availability. It determines adoption process in that, a larger household have the capacity to relax the labor constraints required during introduction of new technology (Mignouna et al, 2011; Bonabana- Wabbi 2002)

Farm size plays a critical role in adoption process of a new technology. Many authors have analyzed farm size as one of important determinant of technology adoption. Farm size can affect and in turn be affected by the other factors influencing adoption (Lavison 2013). Some technologies are termed as scale-dependant because of the great importance of farm size in their adoption (Bonabana- Wabbi 2002). Many studies have reported a positive relation between farm size and adoption of agricultural technology (Kasenge, 1998; Gabre-Madhin and Haggblade, 2001 Ahmed, 2004; Uaiene *et al*., 2009; Mignouna et al, 2011). Farmers with large farm size are likely to adopt a new technology as they can afford to devote part of their land to try new technology unlike those with less farm size (Uaiene *et al*., 2009). In addition, lumpy technologies such as mechanized equipment or animal traction require economies of size to ensure profitability (Feder, Just and Zilberman, 1985).

Some studies have shown a negative influence of farm size on adoption of new agricultural technology. Small farm size may provide an incentive to adopt a technology especially in the case of an input-intensive innovation such as a labor-intensive or land-saving technology. Farmers with small land may adopt land-saving technologies such as green house technology, zero grazing among others as an alternative to increased agricultural production (Yaron, Dinar and Voet, 1992; Harper et al, 1990). Other studies have reported insignificant or neutral relationship with adoption. For instance a study by Grieshop *et al*. (1988), Ridgley and Brush (1992) Waller et al. (1998) Mugisa-Mutetikka et al., (2000), Bonabana- Wabbi (2002) and Samiee et al. (2009) concluded that size of farm did not affect Integrated Pest Management (IPM) adoption implying that IPM dissemination may take place regardless of farmers' scale of operation. Kariyasa and Dewi (2011) also found that extensive of land holdings had no significant effect on the degree of Integrated Crop Management Farmer Field School (ICM-FFS) adoption probability.

The above mentioned studies consider total farm size and not crop acreage on which the new technology is practiced. Since total farm size has an effect on overall adoption, considering the crop acreage with the new technology may be a superior measure to predict the rate and extent of adoption of technology (LowenbergDeBoer,2000). Therefore in regard to farm size, technology adoption may best be explained by measuring the proportion of total land area suitable to the new technology (Bonabana- Wabbi, 2002)

2.3.2Agricultural Extension services and the Adoption of Agricultural Technology

It is imperative that agricultural training and extension programmes be intensive enough to promote adoption not only of improved yield-raising technologies, such as improved seeds, but also of fertility-restoring and conservation technologies (Nkonya and Norman 2003). Synergies need to be created between government departments, non-governmental organizations, researchers, donors and local communities in implementing programs that promote smallholder farmers' adoption of technologies which can increase agricultural productivity and reduce environmental degradation and the deterioration of soil quality (Nkonya and Norman 2003).

Major problems in sub-Saharan Africa is that year after year extension workers who are hardly afforded in-service training, and are loosely linked to research, continue to disseminate the same messages repeatedly to the same audience (Bwisa *et al.* (1997). A situation has consequently arisen where the disseminated messages to the majority of the extension audience, have become technically redundant and obsolete (Bwisa *et al.* (1997).An additional problem is that most trainings tend to focus on the well resourced, wealthier farmers and perceive farmers as simply agents of change (Bwisa *et al.* (1997).

Feder *et al.* (1985) noted that extension efforts increased the adoption probability of new technology by increasing the stock of information pertaining to modern production increment. The major role of extension in many countries in the past was seen to be mainly transfer of new technologies. Now it is seen more as a process of helping farmers to make their own decisions by increasing the range of options from which they can choose, and helping them to develop insight into consequences of each option (Amandeep and Bhatti, 2006). As noted by (Hagmann *et al.*, 2003). The role of extension may include building the capacity of farmers and farmer's organization to pursue their development goals, this can be influenced by close follow up which enable them to examine their farming situations. This in turn, develops farmers' aspiration for change through adopting farm technologies. Also, linking farmers and farmers' organization to other support agencies including credit facilities, market and input systems creating platform for their interaction and facilitating negotiations between the different stakeholders. Generally, extension plays a great role in popularizing improved organic agriculture practices to farmers.

A study by Makokha *et al.* (1999) found that farmers' participation in agricultural exhibition, field days and demonstration have significant influence on perception and hence adoption decisions of farmers. Study tour to different areas with related production activities increases the farmers' insight and appreciation of learned technologies by seeing to be possible practiced by others. Location factor such as soil fertility, climate and availability or access to information like market and inputs, can influence the adoption of different technologies across different farm or location of production enterprise. Heterogeneity of resource base has shown to influence technology adoption and profitability. However, Batz *et al*. (1999) and Kaliba *et al*. (1997) have underscored the need of considering the improved practice characteristics influencing adoption in a situation where the sample is relatively homogeneous with respect to farmer's characteristics and if the farmers are also working under comparable farming circumstances.

Additional constraints inhibiting increased fertilizer use among smallholders include lack of knowledge and ability to differentiate between various nutrient sources; and lack of understanding of cost-effective methods of soil fertility management (Amir and Pannel, 1999). It has also been found that income from off-farm sources is important in the financing of purchased farm inputs (e.g. seeds, fertilizers, labor) (Amir and Pannel, 1999). In addition, cash proceeds from crop sales, and income obtained from the sale of livestock and livestock products, also provide cash for the purchase of inputs in crop farming (Amir and Pannel, 1999).Higher levels of income from each of the above sources will lead to higher rates of adoption of yield-raising technology. Labor bottlenecks, resulting from higher labor requirements that new technologies often introduce, and seasonal peaks that may overlap with other agricultural activities, are important constraints to technology adoption (Meinzen-Dick *et al*., 2002).

Acquisition of information about a new technology demystifies it and makes it more available to farmers. Information reduces the uncertainty about a technology's performance hence may change individual's assessment from purely subjective to objective over time (Caswell *et al*., 2001). Exposure to information about new technologies as such significantly affects farmers' choices about it. Feder and Slade (1984) indicate how, provided a technology is profitable, increased information induces its adoption. However, in the case where experience within the general population about a specific technology is limited, more information induces negative attitudes towards its adoption, probably because more information exposes an even bigger information vacuum hence increasing the risk associated with it.

Good extension programs and contacts with producers are a key aspect in technology dissemination and adoption. A recent publication stated that "a new technology is only as good as the mechanism of its dissemination" to farmers (IFPRI, 1995 p. 168). Most studies analyzing this variable in the context of agricultural technology show its strong positive influence on adoption.

2.3.3 Technology characteristics and its influence on adoption of agricultural technology

A key determinant of the adoption of a new technology is the net gain to the farmer from adoption, inclusive of all costs of using the new technology (Foster and Rosenzweig, 2010). The cost of adopting agricultural technology has been found to be a constraint to technology adoption. For instance, the elimination of subsidies on prices of seed and fertilizers since the 1990s due to the World Bank-sponsored structural adjustment programs in sub-Saharan Africa has widened this constraint (Muzari *et al*., 2013). Previous studies on determinants of technology adoption have also reported high cost of technology as a hinderance to adoption. The study done by Makokha *et al*. (2001) on determinants of fertilizer and manure use in maize production in Kiambu county, Kenya reported high cost of labor and other inputs, unavailability of demanded packages and untimely delivery as the main constraints to fertilizer adoption. Cost of hired labor was also reported by Ouma *et al*. (2002) as one among other factors constraining adoption of fertilizer and hybrid seed in Embu county Kenya. Wekesa *et al.* (2003) when analyzing determinants of adoption of improved maize variety in coastal lowlands of Kenya found high cost and unavailability of seeds as one of factors responsible for low rate of adoption.

Off farm income has been shown to have a positive impact on technology adoption. This is because off-farm income acts as an important strategy for overcoming credit constraints faced by the rural households in many developing countries (Reardon *et al*., 2007). Off-farm income is reported to act as a substitute for borrowed capital in rural economies where credit markets are either missing or dysfunctional (Ellis and Freeman, 2004; Diiro, 2013). According to Diiro (2013) off- farm income is expected to provide farmers with liquid capital for purchasing productivity enhancing inputs such as improved seed and fertilizers. For instance, her study when analyzing the impact of off-farm earnings on the intensity of adoption of improved maize varieties and the productivity of maize farming in Uganda, Diiro reported a significantly higher adoption intensity and expenditure on purchased inputs among households with off-farm income compared to their counterparts without off- farm income. However not all technologies has shown positive relationship between off-farm income and their adoption. Some studies on technologies that are labor intensive have shown negative relationship between off-farm income and adoption. According to Goodwin and Mishra (2004) the pursuit of off-farm income by farmers may undermine their adoption of modern technology by reducing the amount of household labor allocated to farming enterprises.

2.4 Theoretical Framework on Farmers' Adoption Decision

This study will be anchored on the Innovation Diffusion Theory advanced by Rogers (1995). Adoption is a decision –making process in which an individual goes through a number of mental stages before making a final decision to adopt an innovation. The decision making is the process through which an individual passes knowledge of an innovation, to forming an attitude towards innovation, to a decision to adopt or reject, implementation of new ideas, and confirmation of decision (Rogers, 2003).

Professionals in a number of disciplines, from agriculture to marketing, have used this theory to increase the adoption of innovative products and practices. Adoption of improved practices by a farmer is necessarily based on his capacity to acquire and absorb information about new techniques and on his /her capacity to convert this knowledge into practice (Abebe, 2007). Adoption is a decision –making process in which an individual goes through a number of mental stages before making a final decision to adopt an innovation. The decision making is the process through which an individual passes knowledge of an innovation, to forming an attitude towards innovation, to a decision to adopt or reject, implementation of new ideas, and confirmation of decision (Rogers, 2003). Ehui *et al.* (2004) noted that an improved agricultural practice that introduces to smallholder farmers by itself does not guarantee its wide spread adoption and efficient use. For efficient utilization of the improved farming practice, the fulfillment of specific socio-economic, technical and institutional conditions are required.

According to adoption perceived attribute theory by Rogers, (1995) an innovation is judged for adoption by a farmer: when it can be tried out (trialability), that results can be observed (observability), that it has an advantage over other innovations or the present circumstance (relative advantage), that it is not overly complex to learn or use (complexity), that it fits in or is compatible with the circumstances into which it will be adopted (compatibility). Therefore, introducing improved organic farming practice with those attributes can be adopted at higher level by trained farmers.

2.5 The Conceptual Framework

Based on the literature review, adoption of given technologies is hypothesized to be influenced by farmer's social demographic characteristics such as age, gender , level of education, family size, and socioeconomic factors like income, land size, off-dairy income and extension contact and improved organic farming practices characteristics like its relevance, compatibility, simplicity, costs). As noted by Degnet and Belay (2001) the reasons for adoption or non-adoption at farm level vary over various reasons. A total effect of the socio-demographic and other factors may in one way or the other influence a trained farmer to adopt and continue practicing the skills one learned. The total effect imposed by the different factors on an individual might enhance or retard the level at which a trained farmer will use the practices (See Fig.1 in the next page)

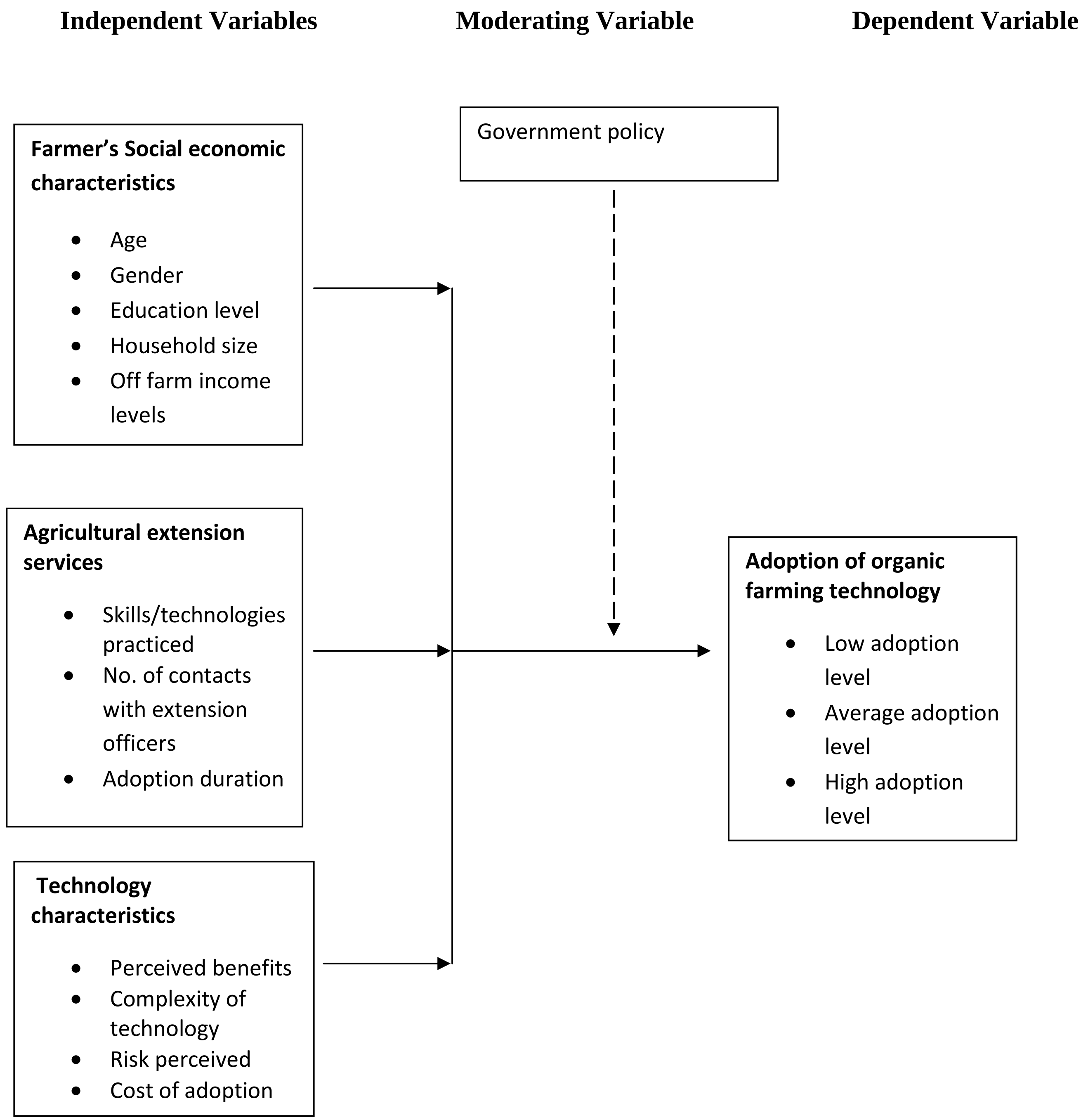

Figure 1: Conceptual Framework showing Interrelationships between Key Variables of the Study

2.6 **Knowledge Gaps**

A survey by Kenya Horticulture Competiveness Project (USAID Funded Project, 2013) indicated that the adoption of agricultural technologies and subsequently food production in the Country is low (KHCP 2014). Most of the Technology adoption studies were carried out in developed economies though focused on the factors affecting adoption of technologies among farmers. For example, Chi and Yamada (2002) carried out a study in Japan on the factors affecting farmers' adoption of technologies in farming system. Therefore, this study sought to examine factors influencing the adoption of organic farming technology among small holder farmers in Embu West Sub-County, Embu County, Kenya.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents research methodology which was used to collect data and explains how the data was analyzed. The chapter will contain the research design, target population, sampling techniques, data collection method, reliability, validity of the data and the procedure that will be used to analyze the data.

3.2 Research Design

The study used descriptive survey design. According to Mugenda and Mugenda (2003) descriptive survey design is appropriate because it involves collecting data in order to answer questions concerning the current status of subjects of the study. Kothari (1995) notes that descriptive design is concerned with describing, recording, analyzing and reporting conditions that exist or existed.

This study was carried out in Embu west Sub County in Embu County. Embu west Sub County is one among the five sub counties of Embu County. It is made up of two divisions (i.e Central and Nembure Division), the area has a population of 98,376 and an area 14,390 square kilometer. Agriculture is the backbone and livelihood of Embu West County. The agriculture sector employs more than 70% of the population and 7.7% of the household are employed in agricultural activities. The Embu west sub county people relies mainly on cash crops such as coffee and macadamia and food crops such as maize, beans bananas. Also livestock keeping is a major economic activity in Embu West Sub County (KNBS 2012).

3.3 Target population

The target population for this study comprises 1200 Organic Agriculture farmers from Embu West Sub County who had been trained on organic farming technologies at KOAETEC Institute from January 2012 to December 2013.

3.4 Sample size and sampling procedure

This section will discuss the sample size and sampling procedure.

3.4.1 Sample size

To obtain the desired sample, a simplified formula for the proportions by Yamane (1973) was adopted. The formula was adopted assuming a 95% of confidence level and precision of 0.05. A resulting sample size was:

$$n = \frac{N}{1+N(e^2)}$$

Where ;

n is the sample size,

N is the population size = 1200

e is the level of precision (sampling error) = 0.05

When this formula was applied to 1200 populations of the trained farmers in the study area, it gives,

$$n = \frac{1200}{1+1200(0.05^2)}$$

Sample size (n) = 300

Hence the sample size will be 300

Target population and sample size from each ward is illustrated in the table below.

Table 3.1 Sample size determination

	Division	Ward	Total No. of trained farmers	Sample size
1	Central division	Kirimari ward	270	68
		Mbeti North ward	390	98
2	Nembure division	Kithimu ward	180	44
		Gaturi south ward	360	90
Total			1200 Farmers	300 farmers

3.4.2 Sampling Procedure

This is a systematic process of selecting a number of individual for a study to adequately represent the target group from which they are selected. Since it was not possible to interview all 1200 trained farmers from Embu west Sub County, the study focused on a few trained farmers (ie 300) who were selected from the total number of trained farmers through systematic sampling.

The sample size was drawn from the four wards from Embu west Sub County. According to Kothari, (1998) there are two methods of sampling (i.e probability and Non-probability sampling techniques). In probability technique, each member of the population has an equal probability of being selected. However, in non-probability sampling members are selected from a population in some non random manner because it allows some individuals to be deliberately selected in the research. Non-probability sampling technique includes convenience, judgment, quota and snowball.

In this study, the researcher used both probability and non-probability sampling method. The probability was used to select all the wards to be involved in the study. The non-probability techniques that were used are purposeful and convenient sampling. The researcher used purposeful sampling to handpick all trained organic farmers because they have in-depth and required information with respect to the objectives of the study.

Convenience sampling was used to select members from the population based on easy accessibility. It involved choosing the organic trained farmers who were member of common interest group from different villages in the study area.

3.5 Data collection methods

To obtain the required data from the field, the researcher used the following instruments.

3.5.1 Questionnaires

The questionnaires were used because of its simplicity to the respondent may be literate. It also guided the researcher when interviewing farmers who will be illiterate. The questions were both closed and open-ended. The questionnaire was divided into four sections, each section had a number of closed and open- ended questions depending on the numbers of indicators to be sought. The close-ended question provided the data that was easily analyzed to describe qualitative information. The open-ended questions were used to generate grouped data to enable further expression of the indicator in question.

3.5.2 Interview schedule

The interview schedule was preferred for the farmers who are illiterate, instead of filling the questionnaires on their own. The interview schedule are very important due to their flexibility in allowing for the interpretation of the meaning of the questions, developing rapport with the respondent, and allowing face to face contacts between the interviewee and the interviewer. The interview schedule was divided into the following sections; general information, social economic status of the farmer, source of information and general information available to the farmer.

3.6 Pilot testing of the instruments

The research questionnaires were administered to 10 trained organic farmer from Nembure Village who were not involved in the main study. The answers were recorded for the farmers who were not able to express themselves clearly in writing. This assisted the researcher to identify and rectify weakness in the questionnaire before the accrual research will be conducted.

3.7 Validity

According to Gakuu and Kindombo,(2010),validity refer to the appropriateness, meaningfulness and usefulness of the inference the researcher makes. Validity is therefore about drawing warranted conclusion on a situation based on the data obtained from an assessment. An instrument is valid if the research design fully addresses the research questions and the objectives the research has set.

The entire research instruments were based on the objectives of the study to ensure that they are all relevant. To ensure validity the research used expert judgment of the supervisor in combination with the pilot testing the instruments in which questions with the problems or which gives unexpected answers were modified to avoid misinterpretation of question. The final questionnaire was then developed.

3.8 Reliability of the instruments

According to Mugenda and Mugenda,(1999) reliability is a measure of degree to which a research instrument yields consistence result or data after repeated trials. In this study, reliability was censured by preparing the instrument in such a way that they could be split into two. After administration during pilot testing the responses were scored. The two parts of the instruments was treated as two instruments. The scores of the two parts were then mathematically correlated through the use of spearman’s correlation coefficient. The correlation coefficient was found to lie between 0.5 and 1.00 hence this meant that the instrument were reliable.

3.9 Data collection procedure

Three hundred (300) questionnaires were administered to the selected respondents in a 10 days interview program organized between the researcher and his assistant. They were administered by reading them and filling the responses in the spaces provided in the questionnaires. The filled in questionnaires were later collected for data inputting and analysis.

3.10 Data Analysis techniques

The collected data was coded and coding involved transforming data categories into symbols that can be tabulated and counted(Kothari,2003).The coded data was then entered into statistical package for social science (SPSS) and computed ready for analysis. Descriptive statistics like percentages, frequencies, mean, and mode were generated. The results of the findings were represented in form of tables and were used for conclusion and recommendations. To analyze the relationship between variables, regression coefficient correlation and Pearson's product moment correlation coefficient were used.

3.11 Ethical Considerations

Ethical considerations protect the rights of participants by ensuring confidentiality. It is unethical for the researcher to share identifying information regarding the study with anyone not associated with this study. This ethical consideration is necessary to maintain the integrity of the study as well as the integrity of the researcher (Creswell, 2002).The respondents were assured of the confidentiality of information given and were informed that their views was to be used for the purpose of research only.

3.12. Operational definition of variables

Objective	Indicator	Measurement	Scale of analysis	Instrument to collect data
Dependent Variable: To determine the level of adoption of Organic farming Technology	Low adoption Average adoption High adoption	No of Technologies practices adopted less than 40% No of Technologies/practices adopted between 40-60% No of Technologies practices adopted more than 60%	Ordinal Ordinal Ordinal	Questionnaire Interview Observation
Independent Variable: 1) To establish the influence of agricultural extension on adoption of Organic farming technologies in Embu west Sub county	Acquired skills Skills practiced contacts with extension officers field events Adoption duration Study tours	No. of skills the farmer remember No of skills practiced frequency of contacts with extension officers No of field events attended No of seasons skill is practiced No of study tours attended	Ordinal Ordinal	Questionnaire Interview
Independent Variable: 2) To examine the influence of farmer's social economic characteristics on adoption of Organic farming technologies in Embu west Sub County	• Age • Gender • Education level • Household size • Farm size • Off farm income	• Age braket. • Male or Female • Highest education level • No of family members involved in organic farming activities • Area in acres used for organic farming • Other source of income not related with farming	Ordinal Norminal Norminal Ordinal Ordinal Norminal	Questionnaire Interview
Independent Variable: 3).To examine the influence technological factors on adoption of Organic farming technologies in Embu west Sub County.	Cost of technology Complexity Perceived risks Perceived benefits	Amount of money used in adopting organic farming. No. of Challenges encountered in adopting technology No of reasons given for not adopting. No. of gains from adopting	Ordinal Ordinal Ordinal Ordinal	Questionnaire Interview

Fig 2. Operationalization of variables

CHAPTER FOUR

DATA ANALYSIS,PRESENTATION AND INTERPRETATION

4.0 Introduction

In this chapter, the major results of the study are discussed. Statistical methods such as percentages, frequencies and cross tabulations were used to analyze the socio-economic characteristics of the farmers, contacts with agricultural extension officers and the extent to which farmers are adopting the entire package and the factors which influence their level of adoption of the whole package as recommended. Statistical tests such as the chi-square and Spearman's rho were carried out to check for existence of any statistical relationship between some selected socio-economic characteristics of the farmers and technology-specific attributes, agricultural extension and adoption behavior. These factors were thought to influence farming decisions in as far as adoption of taught Organic farming technologies are concerned.

4.1 Results of Descriptive Analysis

This section used frequencies and percentages to discuss the socio-economic characteristics of the farmers that were likely to influence adoption of Organic Farming technology's package in Embu west Sub County. These characteristics included age of the farmers, gender, level of formal education, level of off-farm income and contact with agricultural extension agents.

4.1.1 Socio-economic Characteristics of the Farmers

The study interviewed Three hundred (300) farmers from Kithimu ,Mbeti North ,Kirimari and Gaturi South wards in Embu west Sub County. The study found that a majority of farmers in the sample (96.6%) have less than two acres of land. So they are smallholder farmers. That means there was no much difference in landholdings between the adopters and the non-adopters of the entire package. This being the case, farm size was not considered as a factor influencing adoption of the package since all the interviewed farmers have small land size. Farmers were also found to be devoting nearly every available land to farming activities.

Most of the interviewed farmers were females (62%) while males were 38% (Table 4.1). Those female farmers are the managers of their farms and therefore the main decision makers of farming activities. Adoption of the entire package along the gender line was found to follow the same pattern that, female farmers were found to have adopted the package components more than their counterpart male farmers. Being the main decision makers, they tend to be more rigorous in trying out new agricultural innovations unless when economic constrains restrains their efforts.

Table 4.1 Gender of the Farmers

Sex	Frequency	Percent
Male	114	38.0
Female	186	62.0
Total	300	100.0

Source: Field Work, February 2016

Ages of the farmers appeared to be evenly distributed across the four categories of age groups with a very minimal difference (Table 4.2). Most of the sampled farmers fell within the middle ages category of between forty and fifty years. It would be expected under normal circumstances that, such middle aged people are engaged in some kind of employment outside farming activities (Cheryll et al., 2000) other than doing farming as their main economic activity. However, being farmers it is expected that, they would be more anxious to adopt new agricultural technologies which was not the case as discussed in another section in this chapter.

Table 4.2 Ages of the Farmers

Age category	Frequency	Percent
21-30	58	19.3
31-40	78	26.0
41-50	84	28.0
50+	80	26.7
Total	300	100.0

Source: Field Work, February 2016

Most of the interviewed farmers had gotten formal education up to primary level (67.3%) while only 14.7 % have not had any formal education (Table 4.3). However, farmers who had gone beyond primary school level were few (about 18%) which reflect some handicap in education standards. This implies that, there are some problems that hinder education progress among children in Embu West Sub County which requires further research because such low levels of education can affect adoption of new agricultural technologies among farmers.

Table 4.3 Farmers' Level of Education

Level of Education	Frequency	Percent
Non-formal	44	14.7
Primary	202	67.3
Secondary	50	16.7
Higher Level	4	1.3
Total	300	100.0

Source: Field Work, February 2016

Farming was the primary occupation of the interviewed farmers for 88.7% had no off-farm employment and therefore had no off-farm income. They depend on their farms entirely for their livelihood. Among those with an off-farm employment, majority receive an income of less than ten thousand shilling per month and may therefore be economically constrained (Table 4.4)

Table 4.4 Farmers' Level of Off-farm Income

Level of Income	Frequency	Percent
No Off-farm Income	266	88.7
Less than 5000	16	5.3
5000-10, 000	14	4.7
10, 000 and above	4	1.3
Total	300	100.0

Source: Field Work, February 2016

Contact between farmers and the agricultural extension staff was found to be very little. Out of the three (300) hundred interviewed farmers, only 14.0% reported that they had received extension advice within the last two years (Table 4.5). However, most of them reported that they were visited only once and were given agricultural information orally. Without demonstrations, they perceived the information given as irrelevant to their region in relation to their farming circumstances.

Table 4.5 Contact with Agricultural Extension Staff

Contact with Extension	Frequency	Percent
Contacted	42	14.0
Not contacted	258	86.0
Total	300	100.0

Source: Field Work, February 2016

4.2 Descriptive Statistics on adoption of the entire Organic farming Package

In this section, the extent to which farmers have adopted the organic farming technologies recommended in Embu West Sub County is discussed. Frequencies and percentages were used to establish the level of adoption of the improved maize seeds and the agronomic practices that go with those maize seeds. These statistical methods together with the cross tabulation were used to categorize the data as dichotomous and therefore grouped the farmers as either adopters or non-adopters of the entire package. The criteria for this categorization and the level of adoption of the entire package using these criteria are also discussed in this section.

4.2.1 Adoption of Organic farming Technologies in Embu West Sub County

The organic farming technologies taught at KOAETEC Institute from January 2012 to December 2013 were ; organic soil fertility management, use of organic fertilizers ,composting techniques, use of organic pest repellants, use of organic foliar fertilizers, crop rotation, and Effective Microorganisms (EM) Technology. The agronomic practices prescribed in the package are shown by table 4.6.

Table 4.6 Organic Agriculture technologies taught to farmers at KOAETEC Institute

Agronomic Practices	Description
Organic soil fertility management	Organic compost (1000kgs per acre),making furrows,
Organic foliar fertilizers	Use organic plant extracts Use of repellants crops and organic pest repellants (1 L diluted at ratio of 1:100 per acre,twice a month)
Organic Pest management	Use of repellants crops and organic pest repellants (1 L diluted at ratio of 1:100 per acre,twice a month)
Planting Date	Before onset of the rains
Early planting and Weed Control	Twice per season
Crop Rotation	Planting plants of different families in consecutive seasons
Effective Microorganisms (EM) Technology	Used for making compost, making repellants and plant extracts

Source: KOAETEC Institute (2013).

The study revealed that, farmers are not adopting the organic farming technologies taught to them to the recommended standards.

As for application of organic compost in soil fertility management, 65.3% of the farmers in the sample used either organic compost or cattle manure or a mixture of both, 30% used a mixture of organic compost with synthetic fertilizer, while 4.7 % used synthetic fertilizer only. Table 4.7 shows the frequency and percent of different inputs the sampled farmers used for planting

Table 4.7 Planting material used by the sampled famers.

Planting inputs	**Frequency**	**percent**
Organic compost	196	65.3
Organic compost plus synthetic fertilizers	90	30
Synthetic fertilizer only	14	4.7
Total	300	100

Source: Field work -February 2016.

The study also revealed that the more than 95% of the farmers were applying organic compost for planting .The amount differed from one farmer to another. Application of cattle manure is the traditional method of maintaining soil fertility used by the farmers in the region because it is less expensive. However, their rate of application was also low as many were applying less than the recommended amount of 2.5 tons per hectare (Table 4.8). This could be attributed to the fact that, the amount of cattle manure available at farm level is low yet the cost of purchasing the deficit amount is high. This constrains the farmers from adopting it to the recommended standards. Cattle manure requires to be further composted by covering it for at least three weeks to prevent nitrogen escape as it decomposes further in readiness for use. This agronomic practice is inadequately adopted for none of the interviewed farmers was found to be decomposing it for the period recommended.

Table 4.8 Level of Application of organic compost by the trained Farmers in Embu west Sub County

Organic compost Amount in kg/acre	Frequency	Percent
0-250	24	8
251-500	36	12
501-750	112	37.3
751-1000	88	29.3
Above 1000	26	8.7
Total	286	90
Missing System	14	4.7
Total	300	100.0

Source: Field Work, February 2016

Top dressing is vital for crop growth as it increases growth vigour (Welch, 1979). It is done one month after planting or when plants are at knee-high (Wanjohi, 2005). The recommended type of top dressing for organic farming is fermented plant extract or commercial organic boosters. Many farmers (28.7%) were found to be top dressing their crops at the right time using organic boosters and fermented plant extract. Other 47% used synthetic fertilizer eg Calcium Ammonium

Nitrate (C.A.N.). Only 24.3% of the interviewed farmers did not use either organic booster or synthetic fertilizer for top dressing. This reflects lack of adequate information about top dressing technology.

Of the sampled farmers, 37% planted before the onset of the rain as recommended while 67% planted after onset of the rains which is not the recommended time for planting. The uncertainty of rainfall continuity causes them to fear the risk of huge losses should the rain fall after they had planted. Many farmers also argued that, the soil becomes very hard to penetrate during the dry season which discourages them from planting before the rains begin. This concurs with Allan's (1971) observation that, small-scale farmers find it difficult to plant early due to the hardness of the soil. Farmers also fear that, the rains may be late and the dry-planted seed get wasted though planting after onset of the rains results to loss in yields. This is a clear indication that, adoption of timely planting in the region is low, implying lack of awareness about planting time and the principles behind it.

As for use of Effective Microorganisms (EM) Technology, 84.7% of the sampled farmers used EM solution for preparation of Organic compost, organic foliar fertilizer and organic pest repellant. The high levels of adoption of use of EM technology was associated with the fact that the farmers were trained on in using EM Technology to maximize yields and reduce cost of organic farming. The non-adopters of the using EM Technology were of the view that the EM products were expensive and they were comfortable with natural way of making compost and pest repellants

Fifty nine percent (59%) of the farmers in the sample practiced crop rotation; most farmers rotated legumes with cereals and vegetables. This is an indication of high level of awareness of importance of crop rotation in nutrient recycle and organic pest management among the trained farmers.

Twenty three percent (23%) of the trained farmers applied organic based pest repellant while 77% of the trained farmers preferred using conventional pesticide. Most of the non adopters were of the view that it was very hard to manage pest organically since the organic pest repellants were not very effective for many pest and also did not have knock down effect. Table 4.9 gives a summary of adoption of the package components.

Table 4.9 Summary of Adoption of the Package Components

Organic farming technology	Adopters Count	%	Non-Adopters Count	%	Total Count
Organic soil fertility management	300	100.0	0	0	300
Application of organic foliar fertilizers, boosters	86	28.7	214	71.3	300
Application of EM Technology in compost making, and pest repellant	254	84.7	46	15.3	300
Application of Organic Pest repellants	70	23.0	230	77.0	300
Early planting and Proper Weed Control	68	24.3	232	75.7	300
Crop rotation	177	59.0	123	41.0	300

Source: Field Work, February 2016

4.2.3 Level of Adoption of the organic farming components

As for adoption of all the six organic farming technology, only 1% of the farmers in the sample were found to have adopted it as required. Adoption level was determined using formulae;

Y= d1+ d2 + d3 + d4 + d5 + d6

Where; Y is adoption of the entire package, d1 is Organic soil fertility management, d2 is application of organic foliar fertilizer, d3 is application of EM technology, d4 is application of organic pest repellant, d5 is early land preparation and planting before rain fall and d6 is practicing crop rotation appropriately. Farmers were found to have adopted these technology components at different levels. Table 4.10 shows the level to which farmers had adopted each technology component.

Table 4.10 Level of Adoption of the organic farming components

Adoption Level Technology Component	Count	Percentage
d1	300	100.0
d2	86	28.7
d3	254	84.7
d4	178	59.0
d5	68	23.0
d6	74	24.6
Total	300	100.0

Source: Field Work, February 2016

These results show low level of adoption of the entire organic farming package. They were therefore not found to be sufficient enough to draw a comprehensive adoption conclusion for the study area. The data was then classified as dichotomous whereby; adopters were taken to be those farmers who adopted above 50% of the package components i.e more than three of the technology components to the recommended level. This was taken as satisfactory level of adoption. Non-adopters were those farmers who adopted three technology components and below, to the recommended level. This was taken as adoption below expected level.

Following this criteria, adoption index level established that, only 33.3% of the sampled farmers had adopted the entire package to satisfactory level while 66.7% of the sampled farmers had adopted it at below the expected level (Table 4.11).

This analysis of the dichotomous data therefore revealed a low level of adoption of the entire package. This concurs with Batz et al.‟s (1999) study in Embu District who found that, farmers had largely adopted the improved maize variety but had ignored the agronomic practices contained in the package partially or entirely leading to low yields as was established by this study. The results are also congruent with a study on adoption of composite soil fertility enhancement technology by Makokha et al. (1999) which established that, all farmers were applying the technologies but at rates far below the standards recommended hence , low production potential. This reveals that, there is need to promote utilization of agricultural technologies to the optimal level to enable high production potential of the land to be achieved.

The adopters reported various incentives contained in the package as motivational factors in their adoption decisions. High yields was cited by 45.1% of farmers in the sample, 39.2% cited reduction in cost of production, 9.8% cited reduced pest and diseases incidences while 5.9% cited better tasting crop. The main reasons for not adopting the entire package as given by the non adopters included a combination of perceived high cost involved in technology adoption as reported by 67.9% of the interviewed farmers, complexity of the technology (71.4%), high perceived risks (86.7%) and lack of technical knowledge about it (8.3%). Adesina and Zinnah (1993) made similar observations that, inadequate access to factors of production limits farmers‟‟ ability to adopt agricultural technologies. Four farmers did not give reasons for their non-adoption decision.

Table 4.11 Adoption Index of the organic Farming Technologies in Embu West Sub County.

Number of Technology Components Adopted	Percentage of Adoption	Frequency	Percent	Percentage of Adopters	Percentage of Non adopters
1	16.67	8	2.7	-	2.7
2	33.33	58	19.3	-	19.3
3	50.00	136	45.3	-	45.3
4	66.67	72	24.0	24.0	-
5	83.33	24	8.0	8.0	-
6	100.00	2	0.6	0.6	-
	Totals	300	100.0	32.6	67.4

Source: Field Work, February 2016

4.3 Socio-economic and Technology Characteristics and Adoption of organic farming Technologies in Embu West Sub County.

Cross tabulation and Chi-square test were used to establish whether there were any relationships between selected socio-economic variables, technology characteristics and adoption of the entire package components.

4.3.1 Socio-economic Characteristics and Adoption of the Entire Package

4.3.1.1 Age and Adoption of the Entire Package

Age of the farmers had no effect on adoption of the entire package. Low adoption of the package components was found across farmers of different ages. Of those who had adopted the package entirely, 23% were between ages twenty one and thirty years, 29% were between thirty one and fourty years, 23% were between fourty one and fifty years while 25% were above fifty years. This shows that adopters were evenly distributed across the four different age categories used in the study. The calculated p-value of 0.44 (Table 4.12) shows no significant relationship between farmers‟ age and adoption level at 5 % level of significance ($p>0.05$). Hence adoption of the entire organic farming package was not in any way influenced by the farmers‟ age. This is contrary to Adesina and Forson‟s (1995) findings in West Africa that older farmers could have had preferential access to new technologies through increased contact with technology promoters and other development projects in the area thus promoting their probability of adopting new agricultural technologies.

Table 4.12 Ages of the Farmers and Adoption Status

Technology adoption status	Age in Years				X^2	P-value
	21-30	31-40	41-50	50+		
Adopters	23.3	29.0	23.0	25.0	2.701	0.440
Non-Adopters	17.5	25.0	29.5	28.0		

[N S =Not Significant at 0.05 (5% level of significance)]

Source: Field Work, February 2016

Age of the farmers was found to have no influence on their adoption decision, though young farmers would be expected to be more curious in trying out new agricultural technologies. These results are contrary to Ashby's (1991) findings that, adoption of new farming technologies is greatly influenced by the age of farmers. According to him, young farmers are eager to participate in agricultural research more than old farmers and therefore become more anxious to adopt new agricultural technologies. Contrary to his findings, this study established no significant difference in ages between the adopters and the non-adopters across the four age categories because there were many adopters and also non adopters of the technology components in each category.

4.3.1.2 Gender and Adoption of the Entire Package

Gender was found to have a significant influence on adoption of the entire package at 5 percent level of significance. High level of adoption of the entire package was found among female farmers. Fifty four percent(54%) of the adopters were females while forty six(46%) percent were males. These findings differ from the norm that, females are disadvantaged economically and may not afford costs involved in adoption of new agricultural technologies. Female farmers normally tend to be less curious in trying out new innovations unlike their male counterparts. They would therefore be expected to lag behind male farmers in adopting new agricultural technologies which was not the case in this study. The calculated p-value of .035 (Table 4.13) is an indication of a positive and significant relationship between gender of the farmers and adoption of the entire package at 5% level of significance.

Table 4.13 Gender of the Farmers and Adoption Status

Technology Adoption Status	Females	Males	X^2	P-value
Adopters	54.0	46.0	4.437	0.035*
Non-adopters	66.5	33.5		

[* Significant at 0.05 (5% level of significance)]

Source: Field Work, February 2016

These findings may be attributed to the fact that, female farmers are more likely to adopt the recommended package when farming represents their major economic enterprise and they explore all available mechanisms and opportunities of achieving maximum benefits from farming. Women do most of the farm work unlike their male counterparts and as a result make more reliable farming decisions. In this region of study, women were found to be better and faster adopters of new agricultural technologies since farming form the main economic enterprise for most of them. Further, males may be more educated than females giving them a wider opportunity of off-farm employment and therefore farming may be a part time activity for them. Low levels of education among females generally tend to limit their chances of being absorbed in off-farm employment. They are mostly confined in the farms and are expected to be more likely to adopt new agricultural technologies that provide high yields, due to their obligations of meeting food demands for their families.

This contradicts Ndiema et al. (2002) who found no significant relationship between adoption of improved seed varieties and gender of the farmers.

4.3.1.3 Education Level and Adoption of the Entire Package

Among the adopters, 27.3% had not received formal education, 30.7% had attained primary school education while 50% had attained education beyond primary school level. Therefore as the level of education increases, the level of adoption of the whole package also increases. The p-value of 0.050 (Table 4.14) reveals some relationship between education level and adoption of the whole package at 5% level of significance ($p \leq 0.05\%$)). This concurs with Nkonya et al.‟s (1997) study in Northern Tanzania on adoption of improved maize technologies who made similar observations that, farmers‟ level of education had significant influence on adoption of fertilizer and hybrid seeds.

Table 4.14 Education Level of the Farmers and Adoption Status

Technology adoption status	Non-formal	Primary	Secondary	Tertiary	X^2	P-value
Adopters	27.3	30.7	48.0	66.7	7.786	0.050*
Non-Adopters	72.3	69.3	52.0	33.3		

[* Significant at 0.05 (5% level of significance)]

Source: Field Work, February 2016

This implies that, formal education is vital in promoting adoption of agricultural technologies as farmers may use the information given more effectively. Education enables them to assess the relative benefits and risks from using alternative complex technologies and therefore make rational decision on farming. Also, it may widen their scope of understanding the rationale behind adoption of all the technology components contained in a package. Education increases managerial competence, thereby enhancing the ability to assess, comprehend and respond to new ideas. It also enables the farmers to choose wisely from a stock of available technologies. These findings concur with those by Amudavi (1993) in which education was found to invariably enhance technology utilization. Extension system must, therefore, seek to compensate for lack of formal education among the farmers by going beyond the extension role of prescriptive communication and emphasize on education and skill enhancement (Byerlee, 1994). The many adopters who had attained formal education beyond primary school show the importance of formal education in promoting adoption of agricultural technologies among the farmers. Educated farmers are more likely to undertake risks associated with adoption of new agricultural technologies in their efforts to practice agricultural skills learnt from various institutions or agricultural seminars, hence, high level of adoption among them. However, the relatively high number of non-adopters who had attained formal education is an indication that, there are other factors that influence adoption of the package components other than education levels.

4.3.1.4 Income Level and Adoption of Organic Farming Technologies in Embu West Sub County.

Income level showed significant relationship with adoption of the entire package. Most adopters had off-farm income while many non-adopters had no off-farm income. Among the farmers who had no off-farm income, only 30 % adopted the package entirely, 41.2% of the farmers with an income of less than five thousand shillings per month adopted the package entirely, 50% of adopters earned an income of between five to ten thousand shillings per month while 69.2% from among the farmers who earned an income of above ten thousand shillings per month adopted the entire package. Hence adoption of the entire package increased with increase in levels of off-farm income. This implies that, an increase of a farmer's income would probably raise the level of adoption of the entire package by improving the ability of that farmer to buy farm inputs. Income level was positively related to adoption of the entire package at 5% significant level (Table 4.15). Farmers with an off farm income invested part of it to purchase farm inputs. They were able to afford the costs involved in the package adoption. This is contrary to Juliet's (2004) findings that, off-farm income had no positive relationship with intensity of adoption of soil fertility management technologies in Western Kenya. Furthermore, farmers employed outside their local environment have more exposure that result in greater access to information about new agricultural technologies and are therefore more likely to try them out.

Table 4.15 0ff- farm Income and Adoption Status

Technology adoption status	No Off farm Income	Less than 5000 Ksh	5000-10,000 Ksh	10,000+Ksh	X^2	P-value
Adopters	30	41.2	50.0	69.2	9.261	0.026*
Non-Adopters	70	58.8	50.0	30.8		

[*Significant at 0.05 (5% level of significance)

Source: Field Work, February 2016

Most adopters had an income of more than five thousand shillings per month. The positive relationship between income level and adoption of the entire package implies that, farmers with off-farm income expect to realize high returns from investing it in the farm and therefore use part of it to improve farming practices. The small percentage of adopters among farmers without off-farm income is a further indication that, farmers could be aware of the benefits associated with adopting the whole package but their efforts are limited by financial constraints other factors held constant. This implies that, economic intervention measures such as reduced costs of farm inputs would promote the levels and intensity of adoption of the entire package among such farmers.

4.3.1.5 Contact with Extension and Adoption of the Entire Package

Knowledge about the technology is crucial to the potential adopters in their adoption decision. The traditional conceptualization about the adoption process favoured by Rogers (1983) considers awareness and knowledge about new technologies as the first stage through which potential adopters go through before they finally decide to adopt or reject a technology. During this stage farmers seek information that can help them in their adoption decision. The results of this study revealed no significance difference in adoption between the farmers who had received extension advice and those who had not. The adopters who had not been contacted by the technology promoters within the last two years were more (33.6%) than the adopters who had been contacted at least once in the last two years (31.7%). This shows no significant difference between them ($p > 0.05$) at significant level of 5%.

Though contact with technology promoters is hypothesized to promote adoption of new agricultural technologies the p-value of 0.812 (Table 4.16) is an indication of no relationship between contact with extension staff and adoption of the package at significant level of 5%. This is congruent with Omiti et al., (1999) that extension contact had no significant influence on adoption of fertilizer because extension messages may neither be practical nor relevant to the large number of farmers contacted. Furthermore, extension recommendations may not be suitable within the farmers‟ farming circumstances (Byerlee, 1994).

Table 4.16 Contact with Extension and Adoption Status

Technology adoption status	Contacted by Technology Promoters	No Contact with Technology Promoters	X^2	P-value
Adopters	31.7	33.6	0.570	0.812
Non-Adopters	68.3	66.4		

[N S =Not Significant at 0.05 (5% level of significance)]

Source: Field Work, February 2016

Technology promoters provide technical backstopping in terms of information which makes it easier for the contacted farmers to adopt a technology or increase intensity of its use. However, the high percentage (68.3%) of non-adopters who had been contacted by the agricultural extension agents implies that, there are problems either in the manner in which agricultural technologies‟ information is disseminated to the farmers or that there are some constraints which hinder farmers from implementing the technologies. Many farmers who had been contacted by agricultural extension staff reported oral method to have been the main method of dissemination of agricultural information to them. Only 1.3% of the interviewed farmers reported to have attended agricultural demonstrations, while a bulk of 86.7% reported they had not heard of agricultural demonstrations in their region within the last two years. Yet, demonstrations enable farmers to assess the feasibility of new agricultural technologies within their environment and farming circumstances. Exposure to agricultural technologies has been found to highly enhance intensity of their adoption (Ransom et al., 2003). This is contrary to the findings of this study.

The higher number of adopters who had no contact with extension advice (33.6%) than the adopters who had been contacted by technology promoters (31.7%) is an indication that, farmer's awareness of improved agricultural practices does not necessarily result from contact with extension services. Rather, information about agricultural technologies can come to the farmers through other channels than from the extension system even if the original source of that information was the extension system. Information gap was clearly evidenced in the study area. This causes farmers to have inadequate conceptualization of the importance of adopting the whole package. Therefore the level of adoption of the whole package among them is low. This concurs with the innovation-diffusion model (Agrawal, 1983) that considers access to information as a key factor in determining adoption decision. Diffusion of information about agricultural technologies and measures that promote diffusion process are important in influencing adoption decision. There is therefore need for frequent contact between farmers and the promoters of technology and also need to improve channels of communication about agricultural technologies in order to promote their adoption.

4.3.2 Technology Characteristics and Adoption of Organic Farming Technologies in Embu West Sub County.

Farmers make adoption decision based on the appropriateness of a technology. Technology attributes influence farmers adoption decision as much as their own socio-economic characteristics influence adoption decision of a new agricultural technology (Mulugeta et al., 2001). This is why farmers need to fully understand the technology attributes in order to increase its adoption. Perception of technology characteristics as a problem was high among the farmers in the sample as many non-adopters cited them as the factors that have been influencing their adoption decision. Among the non-adopters, 71.4% gave complexity of the technology as an impending factor to adoption of the entire package while 86.7% and 67.9 % reported high risks perceived and high costs respectively as the factors that affect their adoption decision (Table 4.17). Also, 63.2% of non-adopters perceived the benefits of adopting the entire package in terms of yields to be low. This is more so because preparation of the organic compost requires more time, and a farmer is required to gather a lot of organic matter of different types. Also compost making and application of compost is labour intensive. Technology-specific attributes were also perceived to be a problem among the adopters. They also cited complexity; risks of loss should the pest repellant fail to work on specific pest and high costs involved in adopting the entire package as factors affecting their adoption decision. The three factors had negative influence on adoption of the entire package at 5% level of significance. This implies the importance of understanding a technology's attributes by the farmers in order to promote its adoption. Table 4.17 shows the technology-specific attributes that influenced farmers‟ adoption decision as given by both adopters and the non-adopters.

Table 4.17 Technology Characteristics and Adoption Status

<table>
<tr><th>Technology adoption status</th><th>Complexity of Technology</th><th>Risk Perceived</th><th>Cost of Adoption</th><th>X^2</th><th>P-value</th></tr>
<tr><td>Adopters</td><td>28.6</td><td>13.3</td><td>32.1</td><td rowspan="2">3.080</td><td rowspan="2">-0.688*</td></tr>
<tr><td>Non-Adopters</td><td>71.4</td><td>86.7</td><td>67.9</td></tr>
</table>

[* Negatively Significant at 0.05 (5% level of significance)]

Source: Field Work, March 2016

Technology characteristics negatively influenced adoption of the entire package. A high percentage of the farmers in the sample were found to be affected more by the technology specific attributes in their adoption decision. Farmers tend to adopt technologies that give them high profits as this is the major reason for any adoption of a technology. Perception of low benefits from adopting a technology in relation to its complexity or high perceived risks or costs involved discourages its adoption. This is because, farmers prefer to adopt technologies that give them maximum yields at minimum cost of production and which would also ensure achievement of the targeted objectives.

Among the technology-specific attributes, high costs and complexity of the technology were cited by both the adopters and the non-adopters to have influenced their adoption decision. The two variables are disincentives towards adoption of the entire package. The recommended package is complex in the sense that, the seeds must be planted with specific fertilizer types and amounts or specific amount of cattle manure. Also, preparation of compost before onset of the rains, also advance land preparation before onset of rain when the soil is dry and difficult to penetrate hence, hard labour. Further, weed control and making of pest repellant involve a lot of labour all which account for complexity of technology. Sometimes the farmer has to make use and use of hired labour in land preparation and weed control all amount to high costs involved in adopting the entire package. Many farmers therefore fail to apply these agronomic practices to the expected level out of fear that, should the compost quality rains fail, investment losses would be high in terms of both capital and human labor involved. This concurs with Just and Zilberman (1983) and Adesina and Baidu-Forson (1995) who made similar observations that, perception of technology-specific attributes inherent in a new agricultural technology such as risks and complexity in use of a technology influence farmers‟ subjective decision to adopt or reject a technology.

As far as the socio-economic and technology characteristics were concerned, the variables that were found to affect the probability of adoption of the entire package positively were education level, income level, gender, and perceived benefits in terms of yields. Complexity of technology, risks perceived and costs involved negatively influenced adoption of the entire package at 5% level of significance. Age of the farmers and contact with technology promoters did not influence adoption of the entire package. This leads to rejection of the stated hypothesis that, there is no significant relationship between farmers‟ socio-economic characteristics, technology's characteristics and adoption of the whole package.

4.4 Results of Logit Regression Analysis

Logit regression model was used to analyze the data. The method was chosen because it is suitable in predicting the outcome based on values of a set of predictor variables. It is applicable in analyzing data whose dependent variables are dichotomous while the independent variables are either interval or categorical.

4.4.1 Factors Affecting Adoption of the Entire Package

Logistic regression based on stepwise selection method was used to establish the variables that had influenced adoption of the entire package. The method has a probability selection criteria of selecting those variables based on ANOVA model F1 and F2 (Appendix v), at 5% (0.05) level of significance. The models established education and income levels of the farmer to have significant influence on adoption of the entire package at 5% level of significance ($p< 0.05$). For education level, the calculated p value of 0.003 ($p<0.05$) is an indication of a significant relationship between education level and adoption of the entire package while for the income level, the calculated p value of 0.032 ($p<0.05$) implies a significant effect of off-farm income on adoption of the entire package. Also, the βeta index values of 0.136 and 0.127 for education and income levels respectively are indicators of existence of a significant relationship between the two variables and adoption of the entire package. Further, the model established no relationship between ages of the farmers and contact with extension agents and adoption of the entire package at significant level of 5%. The p values of 0.634 for age of the farmers and 0.726 for contact with extension staff

($p>0.05$) are evidences of no relationship between the two variables and adoption of the entire package at 5% level of significance. Table 4.18 shows the factors that were found to have influenced adoption of the entire package by the two models.

Table 4.18 Factors Affecting Adoption of the Entire Package Based on the ANOVA Model

Model	Constant	Beta In	t	Coefficient
1	Education Level	.136	2.951	.003*
	Income Level	.127	2.150	.032*
	Age	-.029	-.477	.634
	Contact with extension	-.020	-.351	.726 2
2	Education Level	.136	2.314	.021*
	Income Level	.127	2.150	.032*
	Age	-.042	-.697	.486
	Contact with extension	-.021	-.376	.707

[* Significant at 0.05 (5% level of significance)]

Source: Field Work, March 2016 and Data Analysis

Levels of education and income of the farmers had significant effect on adoption of the entire package while age and contact with technology promoters had no effect on adoption. This implies that there is need to provide farmers with credit facilities to enable those with low incomes or with no off-farm incomes to afford farm inputs to the recommended amounts. There is also need to provide farmers with agricultural education. Agricultural based education through agricultural extension services would enable the farmers to comprehend the benefits of adopting agricultural innovations hence promote their level and intensity of adoption of the entire package for more food security gains.

4.5 Results of Spearman's Rho Test

Spearman‟s rho test was applied to investigate existence of a correlation coefficient between the dependent and independent variables. The method was chosen because the dependent variables were dichotomous and the independent variables are interval. The method is also easy to compute and the outcome is clearly indicated hence easy to understand and interpret.

The Spearman‟s rho test rejection level of the null hypothesis is at 1% (0.01) level of significance. The null hypothesis is rejected and the alternative hypothesis accepted when the calculated p value is at less than or equal to 1% significant level ($p \leq 0.01$). On the factors determining adoption of the entire package, a positive and significant correlation coefficient was established between levels of education and income and adoption of the entire package at 1% level of significance ($p < 0.01$). The p values of 0.003 and 0.004 ($p \leq 0.01$) respectively are indicators of existence of positive and significant relationship between the two variables and adoption of the entire package at 1% level of significance.

Table 4.19 indicates that, there is a significant linear relationship between adoption of the entire package and levels of education and income. This implies that as the level of formal education increases, the level of adoption of the entire package also increases. Also, as the level of farmers‟ off-farm income increases, the level of adoption of the entire package also increases. Farmers with more income are able to meet the cost involved in adopting the entire package.

Table 4.19 Spearman's Rho Results on Factors Affecting Adoption of the Entire Package

			Adoption index	age of the farmer	level of education	Income level
Spearman's rho	Adoption index	Correlation Coefficient	1.000	-.096	.169(**)	.167(**)
		Sig. (2-tailed)	.	.097	.003	.004
		N	300	300	299	300
	age of the farmer	Correlation Coefficient	-.096	1.000	-.351(**)	-.043
		Sig. (2-tailed)	.097	.	.000	.454
		N	300	300	299	300
	level of education	Correlation Coefficient	.169(**)	-.351(**)	1.000	.198(**)
		Sig. (2-tailed)	.003	.000	.	.001
		N	299	299	299	299
	Income level	Correlation Coefficient	.167(**)	-.043	.198(**)	1.000
		Sig. (2-tailed)	.004	.454	.001	.
		N	300	300	299	300

[** Correlation is significant at the 0.01 level (2-tailed)].

Source: Field Work, March 2016 and Data Analysis

Education and income levels of the farmers were the only variables which were found to influence adoption of the Organic Farming Technologies in Embu West Sub County. The relationships were positive and significant ($p<0.01$). As earlier stated, educated farmers are likely to apply modern farm inputs more efficiently because education increases their managerial competence by enhancing their ability to comprehend, evaluate and respond to new ideas. Also, farmers with an off-farm income are capable of investing part of it in the farm while expecting returns on their investment. They are able to withstand risk of losses should the investment fail since they have financial resources to embark on. Age of the farmers and contact with technology promoters which were also hypothesized to influence adoption of the entire package and were included in the model were not significant at 1% probability level in explaining the adoption decision.

4.6 Summary of the Key Findings on the Factors Influencing Adoption of Organic Farming Technologies in Embu West Sub County.

The major premise regarding factors that affect adoption is that, farmers‟ own socio economic characteristics and their perception of specific attributes inherent in a technology represent the most important factors in determining farmers‟ adoption decision of given technology alternatives. Farmers were found to be aware of the organic farming technologies taught to them. However, most of them do not adopt the agronomic practices that accompany those technologies to the recommended levels. As a result, the level of adoption of the whole package recommended for the region is low. Among the socio-economic characteristics of the farmers that were found to be influencing their adoption decision of the entire package were level of formal education, gender and off-farm income. Age of the farmer, farm size and contact with technology promoters did not affect their adoption decision. The technology-specific attributes that negatively influenced adoption of the entire package included cost involved, complexity of the technology and high perceived risks.

Adopters of the entire package were motivated to do so by the benefits of high yields realized from adopting the entire package and the fact that they perceived that the cost of farming was low especially for farmers who had enough organic waste for composting and enough labour. Among the adopters of the entire package, about 60% reported that they have been harvesting an estimate of more harvest per acre per season as compared to seasons before adopting entire organic farming. Many non-adopters cited technology-specific attributes of costs, complexity and perceived risks as the major factors that hinder their efforts to adopt the entire package.

Overall, the factors that influence adoption of the Organic Farming Technologies in Embu West Sub County seem to lie more on technology-specific attributes and economic constrains other than the social characteristics of the farmers.

CHAPTER FIVE

5.0 SUMMARY OF DATA ANALYSIS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

The study was carried out in Embu West Sub County in Embu County. It analyzed the socio-economic and technology-specific attributes that influence adoption of Organic Farming Technology in Embu West Sub County. The socio economic variables considered were age of the farmers, gender, and level of formal education, income level and contact with agricultural extension services. The technology-specific attributes considered were cost of the technology, complexity, perceived risks and benefits expected from adopting the entire package. Data was collected through formal interviews and use of questionnaires. A multi-stage purposive sampling and proportional allocation techniques were used to obtain sample farmers. A total of three hundred trained farmers were sampled and interviewed using structured and unstructured questionnaires.

Adopters of the package were taken as those farmers who applied the recommended organic farming practices that go up to a level of above fifty percent in the last two years. Non-adopters were taken as the farmers applied below fifty percent of the recommended organic farming practices. The recommended agronomic practices included planting with organic compost or cattle manure 2.5 tons per hectare or 1 tonne per acre, top dressing with organic foliar fertilizer (Fermented plant extract) or commercial organic based boosters, planting before onset of the rains, weeding twice per season, controlling pest organically, practicing crop rotation and applying Effective Microorganisms microbial innoculants in compost making, making repellants and organic boosters.

Descriptive statistic summaries of frequencies and percentages were used in determining the level of adoption of the entire package. They were also used to investigate the influence of socio-economic characteristics of the farmers and technology characteristics" on adoption of the entire package. Cross tabulation and chi-square test were used to investigate existence of any relationship between socio-economic characteristics of farmers, technology-specific attributes and adoption of the entire package. Further, logit regression, specifically stepwise multiple regression and spearman's rho test were carried out to explore for existence of statistical relationship between the selected socio-economic characteristics of the farmers, technology-specific attributes and adoption of the entire package.

Results from the descriptive statistics showed that, more than 95% of the interviewed trained farmers planted with organic compost or cattle manure. However, though majority of the interviewed farmers used organic compost for planting, only 4.7% among them applied the required amount of 1,000 kg per hectare. A total of 59% of the interviewed farmers were practicing crop rotation. Organic pest and Diseases control (23%) and application of organic boosters (28.7) level were very low among the interviewed farmers. Use of Effective Microorganism (EM) inoculants to make compost, foliar fertilizer and pest repellant was highly adopted among the interviewed farmers. Most of the farmers in the sample (76%) planted after onset of the rains instead of the recommended time before rains. As far as the adoption of the entire package was concerned, only one percent of the sampled farmers were found to have adopted the package as recommended. This is an indication of very low level of adoption of the Organic Farming technologies in Embu West Sub County.

The computed p values showed that, gender, levels of education and income positively influenced adoption of the entire package at significant level of 5% (0.05). Cost of the technology, complexity, high perceived risk and low perceived benefits had negative influence on adoption of the entire package. Age of the farmer and contact with extension staff had no significant influence on adoption of Organic Farming Technologies.

Stepwise multiple regression analysis found a coefficient correlation between education and income levels and adoption of the entire package at 5% or 0.05 level of significance ($p<0.05$). Age of the farmer and contact with extension staff were found to have no significant influence on adoption of the whole package. Spearman's rho test established existence of a positive correlation coefficient between adoption of the entire package and levels of education, income. There was a significant linear relationship between adoption of Organic Farming Technologies, levels of education and income at 1% level of significance ($p<0.01$).

Non-adopters cited lack of information and high cost involved in the technology adoption in terms of labour requirement for compost making and long time to wait for the compost to be ready while decomposing manure at times as the main constraints hindering adoption. Complexity of the technology was also cited as an impending factor especially in manure adoption as it requires further decomposing. Preparing the farm through tilling and application of compost for planting before onset of the rains was hindered by uncertainty of rainfall continuity and many farmers reported a high risk of loss of incase the rains fail. They preferred to plant after onset of rains as security against losses. Weeding twice is a common practice among all the interviewed the farmers. Many farmers across different socio-economic backgrounds preferred to use synthetic pesticide as organic pesticide did not have knock down effect on the pest and many reported that it was difficult to manage pest using organic pest repellant. Adopters of the entire package gave high yield, healthy foods and reduced use of synthetic /chemical farm inputs as the major benefit of adopting the entire organic farming package.

5.2 Conclusion

The results of descriptive analysis showed that, awareness of the Organic Farming Technologies in Embu west Sub County was low among all the farmers across different socio-economic backgrounds. However, adoption of the agronomic practices that go with the organic farming in order for it to realize maximum yield expected is low. Compost and cattle manure amounts were adopted far below the recommended levels of 2500 kg and per hectare or 1000kg per acre respectively. Their adoption lags behind adoption of other components. This can be attributed to the high costs of labour and long time required for compost making .Users of cattle manure did not fully decompose it which is an indication of inadequate technical knowledge about manure application. Many farmers who did top dressing did not use the correct type of plant materials for making the organic foliar fertilizer hence making it less effective. This could also reflect inadequate information about plants to use to make organic foliar fertilizer for top dressing among the farmers. From these findings it can be concluded that high costs and information gap affect adoption of soil replenishing agronomic practices.

Awareness of organic pest and diseases control is relatively low among the farmers. This is new practices because they have been applying synthetic products to manage diseases and pest. Farmers were not sure of the effectiveness of this organic product and it was difficult for the farmers to know which plant to use for making pest repellant for managing a given pest or disease. Past experience about crop pest and diseases and unreliability and uncertainty of the effectiveness of organic pest and disease control has conditioned the farmers to be planting after onset of the rains in order to reduce the risk of loosing the planted seeds and inputs used should the organic pest repellant fail to be effective. The level of adoption of all the technology components contained in the package was low among the farmers in the sample. The conclusion is that, farmers experience some constraints which condition them to adopt the agronomic practices at levels far below the recommended standards. Logit analysis results showed that, factors that are related to resources affect adoption.

Costs of input and income level influence farmers‟ ability to afford new technologies. This implies that resource factors influence farmers‟ adoption decision. Education level had a positive effect on adoption of the entire Organic farming Technologies. It enhances farmers‟ evaluation of the benefits of adopting new technologies. It enables them to synthesize information about new technologies thus influencing their decision-making process especially regarding relatively complex technologies. There is therefore need to provide farmers with more practical agricultural education and advise them to invest any income available in agriculture especially in adoption of agricultural enhancing technologies in order to meet food security needs. Technical backstopping is very important in terms of information which enhances adoption of agricultural technologies. Technology profitability in terms of high yields was significant in influencing adoption decision. This shows the importance of enlightening the farmers about the technology attributes. They need to be encouraged with motivating information about the gradual realization of benefits associated with adopting a new technology. They should be made to know that, the full potential profitability of a technology may not be realized in the initial years of its adoption but it increases with increased intensity of its use as the farmer gets used to it.

Age had no influence on adoption though it would be expected that older farmers have more experience in the farming enterprise thus a higher likelihood of adopting a new technology than younger farmers. Alternatively younger farmers would be expected to be more vigorous in trying out new innovation thus; have a higher adoption level of a new technology which was not the case in this study. This may be a proof that, technologies are very specific and the factors affecting their adoption are very diverse. Contact with extension services had no influence on adoption. This was attributed to the poor method of disseminating the agricultural information to the farmers. Increase in yield with increased level of adoption of the entire package is an indication that, none of the technology component in the package is efficient on its own and therefore there is need to combine all of them to the required standards in order to achieve maximum yield gains expected from adopting the entire package.

Overall, this study identified economic and information constraints as the main factors that impede adoption of the entire package. These two factors need to be given more attention during introduction and implementation of new agricultural technologies. Communication factor and cost of farm inputs are very powerful in influencing farmers" response towards adoption of the entire package. This study therefore supports the notion that above other factors contact of farmers with the technology promoters and subsidies on farm inputs or provisions of agricultural credits can influence them to adopt all technology components in the package adequately. The problem of non-adoption of the entire package seems to lie more on economic constraints and information gap than on social characteristics of the farmers. Further, the problem also lies on environmental factor of rainfall uncertainty. This makes it necessary for the researchers and the crop breeders to investigate ways of reducing the magnitude of output variability in the face of weather variations especially by introducing seed varieties with more drought tolerance potentials.

In general conclusion, promotion of the agricultural sector needs a package of policies which include inputs, price policies, credit availability and adequate incentives to farmers. This means incorporation of the factors that have negative influence on adoption of agricultural technologies in the design of policies and strategies for promoting their adoption so as to meet food security needs.

5.3 Recommendations

This study established economic constraints and information gap as the main factors impending adoption of the Organic farming Technologies in Embu west Sub County. Following these findings, the study has made the following research and extension policy recommendations to be put in place as measures to promote adoption of the organic farming technologies in Embu West Sub County and elsewhere. The study has also suggested areas for further research in order to come up with more precautional measures against food insecurity problems in the face of variation in climatic patterns in the region.

5.3.1 Research and Extension Policy Recommendations

The following recommendations were made from this study:-

- The study established information gap as one factor that impedes adoption of the organic farming practices in Embu West Sub County. There is therefore need to strengthen contact between the technology promoters and the farmers. This can be done by raising the number of agricultural extension officers in the region and improving their access to the farmers by providing them with transport means and all the necessary materials required for dissemination of agricultural technologies.
- The study also found that, there is weakness in the method of disseminating agricultural technologies to the farmers since most of the interviewed farmers cited oral communication method as the main media of dissemination. Another recommendation therefore is improvement of the methods of diffusing agricultural technologies to the farmers. This can be done in various ways. One of them is the use of e extension using telecommunication devices. This can be done by linking the agricultural extension agents with interested organizations such as farmers groups, common interest groups, church groups and community based organizations that they can work closely with and educate them through demonstrations. Then, the same would disseminate the agricultural information to the rest of the farmers within their region. Further, demonstration of agricultural technologies needs to be encouraged. It plays an important role as it enables farmers to see the feasibility of new technologies within their own region.
- The study recommends establishment of on-farm trials within farmers‟ reach and involving farmers in demonstrations in order for them to assess the feasibility and the benefits of adopting those technologies. Dissemination can be further improved by use of mass media such as radios using both Kiswahili and local languages to enhance understanding among the illiterate and semi-literate farmers. Another way of improving dissemination can be by printing information about new agricultural technologies on posters and then displaying them on strategic places such as market places and shopping centers where they can capture attention of many farmers. Those farmers would then seek further clarification about the displayed information from the agricultural extension agents.

- The study further established that, many farmers learnt about the package from other farmers. The study therefore recommends the need to strengthen farmer-to farmer extension whereby few progressive farmers would be trained on new agricultural innovations. The same would in turn disseminate the technology to the rest of the farmers in their region. Many farmers tend to take information from their colleagues more seriously than from other sources. Strengthening farmer- to- farmer extension would therefore promote adoption of agricultural technologies to a great extent.
- To overcome cost problem which affected many non-adopters, the study further recommends provision of credit to the farmers at affordable rates and also advising them on how to invest it in improving agricultural productivity especially in adoption of new innovations. Credit would enable farmers to access the resources needed especially farm inputs. Capital is necessary to finance the uptake of new agricultural technologies. This is especially so when adoption of a particular technology requires huge capital outlay that constitutes a significant proportion of the total amount of capital available to the farmer (Feder and Zilberman, 1985).
- The study also found out that, technology-specific attributes mainly complexity and perceived risks discourage adoption of the entire package. It therefore recommended that technologies whose adoption process does not involve many activities outside the usual traditional farming practices be developed and embraced. Also development of technologies that is less risky to adopt. Priority can be given to development of compost making technology that will require less labour and less time to decompose.
- Formal education had significant influence on adoption of organic foliar fertilizer and organic repellant. The study therefore recommends the need to encourage teaching of organic farming/agriculture in all learning institutions as it may enhance the ability of the farmers who have attained formal education to understand and interpret the benefits associated with adoption of new agricultural innovations hence, promote their adoption.

5.3.2 Suggestions for Further Research

The study suggests further research in the region on:

- Assessing adoption of organic farming technology in livestock management.
- Organic farming and its contribution in food security.
- The influence of organic waste management on sustainable environmental management.
- Traditional methods of managing crop diseases and pest.
- Sustainable and cost-effective control of post harvest losses as a measure against food insecurity in the region.
- Integration of agro-forestry into the farming systems as a measure against food insecurity in the region

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APPE NDICES

APPENDIX I: LETTER OF TRANSMITTAL FOR DATA COLLECTION

TITUS MUCHANGI CHOMBA
P.O BOX 2056
EMBU
TEL:0722 243946
EMAIL:timchomba@yahoo.com

5th January, 2016.

Dear respondent:

I am a postgraduate student at the University of Nairobi undertaking a Master of Arts in Project Planning and Management in the School of Continuing and Distance Education.

I am carrying out a study on **influence of farmer's social-economic characteristics, availability of Agricultural extension services and technology specific factors on adoption of Organic Farming Technologies in Embu west Sub-County, Embu County, Kenya.** I am using the attached questionnaire and interview schedules to collect information for the study.

It is my kind request that you fill the questionnaire, providing the relevant information to facilitate the study. Please use the space provided to fill in the information required as objectively and honestly as possible. The information provided will be treated with strict confidentiality for the purpose of this study only.

Thank you.

Yours faithfully,

Chomba Titus Muchangi

L50/77691/2012

0722-243 946

APPENDIX II: QUESTIONNAIRE FOR KEY INFORMANTS

<u>SECTION A: FARMER'S CHARACTERISTICS (Please tick where appropriate)</u>

A. Respondent's month/year of training……… Interview schedule No………

Interview date……………… Sub location……………………Ward…………………………

B. Indicate your Gender: a) Male ☐

b) Female ☐

C. What is your Age bracket: a) 20 years and below ☐

b) 21-30 years ☐

c) 31-40 years ☐

d) 41–50 years ☐

e) Above 50 years ☐

D. Indicate your Occupation

Farmer ☐ Other________________________

E. Indicate your Academic qualification: i) No formal Education ☐

ii) Adult Education ☐

iii) Primary Education ☐

iv) Secondary Education ☐

v) College/University ☐

Other (please specify) ……………………………………….

F(i) what is the size of your family………………………….. ….. (numbers)

(ii) How many participate in farming related activities?................ (numbers)

G i.)Apart from being a farmer, do you have any other form of employment? (Tick)

Yes ☐ No ☐

If yes, how much income do you earn per month on average from off-farm employment?
(a)Less than 5,000 Ksh ☐ (b) 5,000-10,000 Ksh ☐ (c) 10,000 + Ksh ☐

ii) What portion of your farm do you devote to organic farming? (In acres)____________

iii) What is the estimated land devoted for conventional farming?(In acres)________

iv) What is your estimated income from organic farming activities………(Kshs per year)

SECTION B: ACCESS TO AGRICULTURAL EXTENSION SERVICES.

1.(a) i. Where do you obtain information about organic farming technology from? (Names)

____

____

ii. If from agricultural officers, do the agricultural extension officers visit your farm?

Yes ☐ No ☐

iii. If yes, how often? (Tick)

(i) Once per season ☐ (ii) Twice per season ☐ (iii) Once per year ☐

Others specify ____

(b) What methods do they use to disseminate information to you? (Tick)

(i) Oral information ☐ (ii) Demonstration ☐

(iii) Use of charts ☐ (iv) Video ☐

(v) Others (specify) ____

2. How often are the agricultural demonstrations held in this region? (Tick)

(i) Once per season ☐ (ii) Once per year ☐

(iii) Not at all ☐

3. How do you rate their importance as methods of improving farming practices? (Tick)

(i) Very important ☐ (ii) Important ☐

(iii) Not important ☐ (iv) Don"t know ☐

4. What are your other sources of information about agricultural practices? (Tick)

(i) Radio ☐ (ii) Newspaper ☐

(iii) Posters ☐ (iv) Other farmers. ☐

Others (specify)____

SECTION C: TECHNOLOGY CHARACTERISTICS

1. Which organic farming technologies did you learn at KOAETEC Institute?(Tick)
   - i) Organic composting techniques ☐
   - ii) Organic foliar fertilizer making techniques ☐
   - iii) Organic pest repellant making techniques ☐
   - iv) Crop rotation ☐
   - v) Intercropping ☐
   - vi) Effective microorganisms(EM) Technology ☐
   - vii) Others (specify) ____

2. Do you apply the following organic farming technologies in your farm?(Tick)
   - i) Use of organic compost for planting. Yes ☐ No ☐
     If so, how much? (In kg per acre)?____________________________________
   - ii) Use of organic fertliser for top- dressing your crops Yes ☐ No ☐
     If so, which organic fertliser do you use?(Names)_________________________________
   - iii) Use of organic pest repellants in managing diseases Yes ☐ No ☐
     If so, how much do you use? (in litres per acre)
   - iv) Crop rotation Yes ☐ No ☐
     If so, which crops do you rotate?(Names)________________________________
   - v) Intercropping Yes ☐ No ☐

     If so which crops do you intercrop (specify)

     ____

     ____
   - vi) Effective Microorganism Technology Yes ☐ No ☐
     If so how do you use it (specify)

     ____

     ____

3) For how long have you used the above organic farming technologies? (i.e. continued use.)
   - i) Organic composting techniques _____________________seasons
   - ii) Making organic foliar fertlisers _____________________seasons
   - iii) Organic pest repellants _____________________seasons
   - iv) Crop rotation _____________________seasons
   - v) Intercropping _____________________seasons
   - vi) Effective microorganisms(EM) Technology _____________________seasons

4. What are the benefits of adopting the entire package of improved organic farming technologies as seen from your farm? (Tick)

- (a) High yields (% of increase per acre) ☐
- (b) reduced disease incidences ☐
- (c) Early maturity ☐
- (d) Organic plants withstand dry period ☐
- (e) Reduced pest management cost ☐
- (f) Reduced crop management cost ☐
- (g) Any other (Specify)___________________________________

5. What help would you like to be given to enable you adopt all the recommended practices in as far as organic farming is concerned? (Briefly)

____
____
____
____

6.a) For Partial Adopters Only

(i) For any practices **Not** applied in (2) above, give reasons for not applying them.

____
____
____
____

(ii) What challenges do you face in your effort to adopt the recommended organic farming technologies? (List them)

____
____
____
____

(iii) What do you think could be solutions to these challenges?

____
____
____

6.b) For those who Adopt the Entire Package.

(i) What are the benefits of adopting the entire package as seen from your own farm? (List them).

____
____
____

(ii) In your view, what help would you like to be accorded in order to promote more of the entire Organic farming technologies package?

____
____

THANK YOU VERY MUCH FOR YOUR COOPERATION

APPENDIX III: WORK PLAN AND BUDGET FOR THE RESEARCH PROJECT

ACTIVITY	TIME Time No of days	RESOURCES NEEDED	RESPONSIBLE PERSON	MONEY REQUIRED (KSh)
Literature review	1^{ST} Sep-15^{th} October 2015	Internet Data bundles, textbooks	Researcher	5,000
Typesetting the research proposal	15^{th} -20^{th} October 2015	Laptop, summary of literature reviewed	Reseacher	1,000
Printing and binding the research proposal	20^{th} October	Printer,Printing paper	Researcher	2,000
Pilot testing	22^{nd} October 2015	Questionares	Reseacher	2,500
Analyzing pilot testing data	23-24^{th} October	Filled questionares	Reseacher	1,000
Meeting with supervisors	2^{nd} November 2015	Transport	Reseacher	500
Making corrections and printing and binding	3^{rd} November		Reseacher	1,500
Proposal defense	4^{th} November 2015	Transport,Embu to Meru and back	Reseacher	1,500
Making corrections and printing questionares the questionares	11^{th} -20^{th} Novemeber 2015	-	Researcher	5,000
Distributing the questionares and Data collection	5^{TH} -20^{TH} Jan 2016	Money for movement	Researcher ,research assistants	10,000
Data analysis	Feb 2016	Filled questionares	Researcher ,research assistants	5,000
Typesetting the research project report	10-20^{th} March 2016	Analysed data	Researcher	1,000
Printing and binding the research project report	26^{th} March	Typed data,money for photocopies, binding	Researcher	2,000
Research project defence	1^{st} April	-	Researcher	2,000
Printing & binding final report	5^{th} April 2016			5,000
Transport ,movements and other Expenses			Researcher	5,000
	TOTAL		KSh	50,000

APPENDIX IV - Stepwise criteria probability to reject or accept the null hypothesis

Model	Method
1	Stepwise criteria probability to accept P < = 0.050
2	Stepwise criteria probability to reject P > = 0.050

APPENDIX V - Stepwise Probability Selection Criteria

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2152.076	1	2152.076	8.709	.003(a)
	Residual	73392.332	297	247.112		
	Total	75544.407	298			
2	Regression	3281.092	2	1640.546	6.720	.001(b)
	Residual	72263.315	296	244.133		
	Total	75544.407	298			

(a and b, Predictors: (Constant), level of education and income)