FACTORS INFLUENCING PERFORMANCE OF FOOD PRODUCTION PROJECTS IN KENYA: A CASE OF KENYA CEREAL ENHANCEMENT PROJECT-CLIMATE RESILIENT AGRICULTURAL LIVELIHOODS, MACHAKOS TOWN SUB-COUNTY, MACHAKOS COUNTY.

BY

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DECLARATION

This research project report is my original work and has not been presented for award of a degree in any other university.

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This research project report has been submitted for examination with my approval as the University Supervisor.

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DEDICATION

I dedicate this research report to my husband Sammy Chege who has always encouraged me at all times to press on during the course of my study through to the writing of this proposal. You are all forever treasured in my heart.

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ABBREVIATIONS AND ACRONYMS

ASAP	Adoption for Small Holder Agriculture Projects
ASAL	Arid and Semi-Arid Lands
CAPMAS	Central Agency for Public Mobilisation and Statistics
CSIRO	Commonwealth Scientific and Industrial Research Organization
EAS	Extension and Advisory Services
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
GMO	Genetic Modified Officer
ICIPE	International Centre of Insect Physiology and Ecology
IFPRI	International Food Policy Research Institute
KARI	Kenya Agriculture Research Institute
KCEP	Kenya Cereal Enhancement Project
KNBS	Kenya National Bureau of Statistics
NACOSTI	National Commission for Science Technology and Innovation
OCHA	Office for the Coordination of Humanitarian Affairs
PGR	Plant Genetic Resources
SAARC	South Asian Association for Regional Co-operation
SPSS	Statistical Package for Social Sciences
UK	United Kingdom
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
WFP	World Food Programme

ABSTRACT

The purpose of this study was to determine the factors influencing performance of food production projects in Kenya: A case of Kenya Cereal Enhancement Project and Climate Resilient Agricultural Livelihoods, Machakos Town Sub-County. The objectives of the study was to examine influence of drought management, to assess influence of extension services, to examine influence of pests and diseases and to assess influence of crop improvement strategies on performance of food production projects in Machakos Town Sub-County. The study applied the Demographic Theory to support the literature reviewed followed by the conceptual framework that showed the inter-relationship between the study variables. This study employed a descriptive survey design which allows the researcher to gather information, summarize, present and interpret data. The total target Population was 567 respondents which included 532 farmers, 15 project managers, 12 Kenya Cereal Enhancement Project Representatives and 8 extension service providers. A sample size of 82 respondents was used in the study using both probability and non-probability sampling techniques. Data was collected using questionnaires. The researcher then employed quantitative methods of analysis in the analysis of data collected from the questionnaires. Data was analyzed using IBM's Statistical Package for Social Sciences version 21. The study found out that majority of the respondents were of the opinion that implementation of food projects can lead to increased food production. Some of the respondents agreed that the County does not have proper measures in place to address losses from drought. From the study findings, majority of the respondents have sought pest control extension services in their farming activities which was the most sought out extension service. The respondents strongly agreed that the overall cost of the method to deal with crop pests and diseases determined its adoption. Most of the respondents disagreed with the statement that the current inter-crop breeding technology has improved food production in Machakos County. The study recommends that effective strategic plan to manage drought and its effects on food production projects should be sound and participatory so as to ascertain its sustainability and effects. It is recommended that each food production project should be assigned a personal extension service officer from the planning stage until completion of the project so as to monitor and evaluate the project's farming needs and employ his/her services when needed as valuable data is recorded. It is suggested that another study should be done in order to ascertain the extent to which GMO technology can be implemented especially in arid and semi-arid areas in order to improve food security. The results of this study will benefit farmers and other stakeholders such as non-governmental organizations, Ministry of Agriculture and Livestock and various policy makers.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

The Food and Agriculture Organization of the United Nations (FAO) defines food security as "a situation when all people, at all times, have physical, social, and economic access to sufficient, safe and, nutritious food to meet their dietary needs and food preferences for an active and healthy life" (FAO 1996). Global food security has made a rapid improvement over the past year. This is seen in the increased efficiency of food systems and improvements in the nutritional quality of the food to which populations have access. We also see it in the outcomes: 805m people were estimated to be chronically undernourished in 2012-14, down by 4.4% from 842m in 2011-13. Of these 805m, around 791m live in developing countries, despite marked food security improvements in emerging markets and low-income countries over the past decades. The United Nations Food and Agricultural Organization (FAO) states that since the early 1990s the number of people in developing countries suffering from undernourishment has fallen by more than 200m; nevertheless, about one in eight people in these regions remains chronically undernourished.

In Egypt, pockets of poverty and food insecurity have emerged in urban areas, where poverty increased by nearly 40%, between 2009 and 2011. While rural Upper Egypt continues to have the highest poverty rate, at 51.5%of the population (double the national average), Greater Cairo has a larger number of poor and food-insecure people (approximately 3.5 million). In South Africa the cause of hunger and malnutrition is not due to a shortage of food but rather an inadequate access to food by certain categories of individuals and households in the population.1 Statistics South Africa has shown that food insecurity is not an exceptional, short-term event, but is rather a continuous threat for more than a third of the population (Vogel, Smith, 2002). The vast majorities of South Africans buy their staple foods from commercial suppliers, rather than growing it themselves, and are therefore dependent on having (direct or indirect) access to cash.

Kenya's agriculture is mainly rain-fed and is entirely dependent on the bimodal rainfall in most parts of the country. A large proportion of the country, accounting for more

than 80 per cent, is semi-arid and arid with an annual rainfall average of 400 mm. Droughts are frequent and crops fail in one out of every three seasons. Kenya's agriculture is predominantly small-scale farming mainly in the high potential areas. Production is carried out on farms averaging 0.2–3 ha, mostly on a commercial basis. This small-scale production accounts for 75 per cent of the total agricultural output and 70 per cent of marketed agricultural produce (KFSSG, 2008). The agricultural sector is the mainstay of the Kenya's economy. The sector directly contributes 24% of the Gross Domestic Product (GDP) and 27% of GDP indirectly through linkages with manufacturing, distribution and other service related sectors. Approximately 45% of Government revenue is derived from agriculture and the sector contributes over 75% of industrial raw materials and more than 50% of the export earnings. The sector is the largest employer in the economy, accounting for 60 per cent of the total employment. Over 80% of the population, especially living in rural areas, derives their livelihoods mainly from agricultural related activities.

A USAID report states that, increased food insecurity in parts of northern Kenya and in the capital city of Nairobi has resulted in more than 1.5 million people requiring food assistance. On August 21-2014, U.S. Ambassador to Kenya Robert F. Godec declared a disaster due to the deterioration of nutritional conditions and declining food security. The U.S. Government (USG) provided nearly $188 million in humanitarian assistance to Kenya in FY 2014.

1.1.1 Profile of Kenya Cereal Enhancement Project

The overall goal of the project is to contribute to the national food security by increasing cereal yields in areas of potentially high productivity. The project will also provide support to farmers as they graduate from subsistence to commercial agriculture. Ten Thousand smallholder farmers, including women-headed households and young people whose livelihoods depend on maize, sorghum, millet and associated pulses living in eight eastern and coastal semi-arid counties of Embu, Tharaka Nithi, Kitui, Machakos, Makueni, Taita Taveta, Kwale and Kilifi will benefit from this project.

The project will support smallholder farmers to identify and undertake appropriate, productive and climate-resilient crop practices suited for arid and semi-arid lands. In addition, it will improve as well as stabilize productivity through adoption of good

agricultural practices, conservation agriculture and better water conservation techniques. New business partnerships between smallholder producers and buyers will be promoted. Financing for storage and processing facilities will help to avoid post-harvest losses (KCEP Report, 2015).

This new project will contribute to Kenya's national objectives of food security and poverty reduction by supporting vulnerable farmers to increase the productivity and profitability of three main cereals-maize, sorghum and millet which are not only stable foods but also have great marketing potential.

The total KCEP-CRAL cost is US $ 118 million, comprising of an amount of IFAD loan being US $ 61.8 million, a grant of US $10.0 million from the IFAD's Adaptation for Smallholder Agriculture Project (ASAP), an amount of IFAD grant to the Food and Agriculture Organization of the United Nations (FAO) – US $ 2.0 million for capacity-building and agricultural services for farming communities, amount of co-financing by the European Union US $ 11.7 million, the Government of Kenya is contributing US $ 1.5 million and beneficiaries themselves are contributing $ 29.1 million. The remaining funding of US $ 1.9 million will come from the contribution of national financial institutions to be identified. The project will be implemented by the Ministry of Agriculture, Livestock, and Fisheries of Kenya.

1.2 Statement of the Problem

Kenya Food Security Steering Group (KFSSG) projected the number of people requiring emergency food assistance between September 2009 and February 2010 to be 3.8 million. In addition, the report identified approximately 2.5 million chronically food insecure individuals located in urban areas, 1.5 million primary school students in drought-affected areas, 100,000 persons displaced by post-election violence and 2 million rural HIV/AIDS patients as food insecure and in need of humanitarian assistance countrywide (Olielo, 2013). In 2011 the number of hungry Kenyans was 3.5 million. In July 2011 deaths caused by starvation elicited organizations such as Kenya Red Cross Society, Safaricom Mobile Phone Company , Kenya Commercial Bank and the Media to launch the Kenyans for Kenya appeal for donations at which 500 million KES was raised in the first 10 days in July 2011 (Daily Nation, 2011). By end of August 2011, about 700 million KES (US $ 8.75 million) had been raised to buy food for the

affected especially school children and the vulnerable, and also disburse funds to those at risk in arid and semi-arid parts of northern Kenya and other affected rural and urban areas.

Machakos County is generally dry and this makes rain fed agriculture difficult in many areas. The situation is further aggravated by frequent droughts that deplete any surplus food in the County while affecting pastures. The County faces inadequate water for domestic, livestock, crop and industrial use. Other issues include destruction of water catchment areas, persistent droughts, destruction of existing earth dams and pans, collapse of community water committees and pest and crop disease prevalence. The climatic and human factors are causing serious threats of desertification. Poor farming methods and increased population pressure on the land have led to clearing of land which was originally reserved for forests. The county has less than 2% of its area under forest (Machakos DEAP, 2009-2013). Unsustainable farming methods and increased population pressure on the land have led to clearing of land which was originally reserved for forests in the County. The main threats to food security in Machakos remain to be poor performance and early cessation of rainfall, low adoption rate of drought tolerant crops, use of uncertified seeds and poor access to farm inputs especially in the low lands of the county. It is against this background that this study seeks to investigate the factors influencing food production in Machakos Sub-County hence the inception of the KCEP project (KCEP Report, 2015).

1.3 Purpose of the Study

The purpose of this study was to determine factors which influence performance of food production projects in Machakos sub-county, Machakos County.

1.4 Research Objectives

The study was guided by the following objectives:

i. To assess drought management strategies influencing performance of food production Projects in Machakos Town Sub-county.
ii. To assess influence of extension services on performance of food production projects in Machakos Town Sub-county.
iii. To examine influence of pests and diseases on performance of food production projects in Machakos Town Sub-County.
iv. To assess crop improvement strategies influencing performance of food production projects in Machakos Town Sub-County.

1.5 Research Questions

The study was guided by the following research questions;

i. To what extent do drought management strategies influence performance of food production projects in Machakos Town Sub-County?
ii. How do extension services influence performance of food production projects in Machakos Town Sub-County?
iii. To what extent do pests and diseases influence performance of food production projects in Machakos Town Sub-County?
iv. To what extent do crop improvement strategies influence performance of food production projects in Machakos Town Sub-County?

1.6 Significance of the Study

The end result of this study is to benefit farmers involved in the project and to a larger extent, the extension service providers, Ministry of Agriculture, Livestock and Fisheries, project managers and Non-governmental organizations. The information acquired will be beneficial to the farmers since they will be able to know how better to manage their farms in relation to drought, pests and diseases among other negative elements; the project managers will benefit from the success of the project by gaining practical firsthand information on how to implement successful similar projects in other counties whereas the government as beneficiaries will benefit from improving the food security of the nation. Findings of this study will benefit other agricultural sectors interested in improving the food production in the country; they will find this study useful in understanding the elements involved when implementing similar types of

projects hence be in a better position to avoid or mitigate them early enough for successful completion.

Ultimately, the study may be invaluable to various policy makers in formulation of regulation governing implementation of agricultural related projects more so those involved in food production. Similarly, researchers will find this useful in advancing their knowledge on the subject and offering a good link to further research to improve the country's food security in line with the Millennium Development Goals and Economic Recovery Strategy.

1.7 Delimitations of the Study

This study was carried out in Machakos County, in the Eastern region of Kenya. Majorly, the location was chosen as it is one of the areas that the KCEP Project decided to work on since its local climate is semi-arid and also the fact that subsistence agriculture is mostly practiced with cereals such as maize, sorghum and millet being grown. The area was selected since it has farmers who will form part of the respondents and who possess the necessary information being sort and also due to the fact that they have been there since the inception of the project.

1.8 Limitations of the Study

Given that the study included dealing with natural phenomenon, it was challenging to get the necessary information especially because those involved do not have control over climatic conditions and also had very minimal control over pests and diseases. The project lower level staff could also have withheld information for fear of victimization; these limitations were mitigated through anonymity and confidentiality assurance.

On the respondents' confidentiality and cooperation concerns that could have made them shield away from providing critical information for fear of being victimized or exposed, the researcher assured all the respondents that the information collected will only be used for the purpose of the study and that their identity will remain confidential.

1.9 Basic Assumptions of the Study

It was assumed that the respondents selected would provide the necessary information for the study and that they would be willing and cooperative in giving correct and truthful information. It is was also assumed that they would be available on a short notice.

1.10 Definition of Significant Terms

Crop Improvement Strategy These are strategies (genetic diversification, inter-cropping, manuring technology) aimed at enhancing a particular food crops' ability to adapt to harsh farm conditions so as to increase their productivity.

Crop Pests and Diseases These are pests (rats, army warms, locusts, weevils) and diseases (wilting, leaf blotch, sooty moulds) that are detrimental to plant food production in Machakos County.

Drought Management The employment of strategies intended to obtain efficient use of farm water, water saving strategies, utilization of available water sources and planting of drought resistant crops.

Extension Services Agricultural extension services are the application of scientific research and new knowledge to agricultural practices in relation to food production through farmer education.

Food Production Projects Agricultural food projects being implemented purposely to increase food productivity.

1.11 Organization of the Study

This study is organized into five chapters. Chapter one deals with introduction of the study, factors influencing food production projects, the Problem Statement and research objectives that guided the study. Chapter Two contains literature review that has been done by scholars and researchers in relation to agriculture insurance. Chapter Three deals with research methodology and introduces research design, target population, sample size and sampling procedure. Chapter Four contains data analysis, presentation

and interpretation of data while Chapter Five contains summary of findings, discussion, conclusion and recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents a review of literature which is relevant to the study. Past studies were studied in order to give more insight into the topic and to find out the approaches that have been used in earlier studies, compare methodologies used to examine findings obtained in the past and sample current opinions given. The chapter is organized following research objectives in order to ensure that there was relevance to the research questions. The chapter also contains empirical literature review, theoretical framework and the conceptual framework of the study.

2.2 Concept of Performance of Food Production Projects

For many people today, and also in time past, efforts to secure food have dictated our everyday activities of hunting, gathering, farming, ranching and fishing. Such efforts have also driven the way we have exploited (and often over-exploited) natural resources. The demand for food has been the main driver of land conversion (70% of Mediterranean forests, 60% of temperate broadleaved forests and 70% of tropical forests have been converted to agricultural/grazing land (Mullon et al., 2005). Improved understanding of how food systems operate will help food security planning by identifying where, when and how vulnerability arises; and hence what sorts of adaptation interventions are needed, and where and when they would be most effective. Understanding can be enhanced by integrating concepts from production ecology, agro-ecology and human ecology with concepts of food systems and scales, to develop the notion of 'food system ecology'.

Meanwhile, more human interference will quicken the changes. It was reported that ever increasing human population coupled with their changing dietary preferences significantly increased global demand for food and thereby generating tremendous pressure on native vegetation and ecosystems. A similar situation is faced by the Asians in tackling food security issues and policies related to globalization further affected by the environmental health stressing the need for regulation of the same. Australia has already seen its average temperatures increase more than 1.5 degrees Fahrenheit over

that of the last century, according to data from CSIRO, Australia's national scientific agency, and the Bureau of Meteorology. If global emissions continue at the current rate, Countries such as Australia are projected to warm more than 9 F by 2090 making many of the nation's farmers to be tested. Even with adaptation, there are limits to what farmers can do, (Hanasky, 2010). Wheat farmers, for example, will endure. Wheat will still grow even during the short rain season. A warmer climate will eventually affect crops such as chickpeas, walnuts and peaches in their ability to produce better yields.

Driven by the requirement to feed ever increasing human demand, major scientific and technical advances have been made in the production of food. The 'green revolution' which took place between 1940 and 1970 saw agriculture production increase around the world. Rapid advances were seen initially in Mexico, the US and Europe, and then in Asia (Hazell, 2009). The food production aspects of food security have long been the subject of major scientific research investment. In 1843 the Rothamsted Experimental Station was established in the UK, while the latter part of the 19th century saw the rapid growth of commercial plant-breeding in Germany (Harwood, 2005). Despite these many years' research, there is still a need to establish how to produce more food given anticipated demand (Royal Society, 2009). However, satisfying these increased demands poses huge challenges for the sustainability of both food production, and the terrestrial and aquatic ecosystems and the services they provide to society (Tilman et al., 2002).

Nigeria has been facing critical food insecurity with a growing population becoming increasingly dependent on imported food. At the same time, the once dominant subsistence-oriented farm economy is at risk of gradual marginalization. The development vision as propagated by the government of Nigeria includes a transformation in agriculture sector that would enhance food security. In addition, this will enhance sustainable development and better adaptation to the climate change challenge. The government's transformation programme is meant to wean Nigeria off food imports by boosting domestic food production (Idachaba, 2004). This entails reforms in the input supply regime, a targeted region specific increase in the output of priority commodities, post-harvest systems development, a strong orientation towards agri-business and promoting value-addition in the product chain. One major challenge faced by the Egyptian government is the limited annual freshwater quota from the Nile

of 55.5 km3 year-1 (809 m 3 capita-1 year-1). Two important strategies are possible to meet food needs: importing food or growing more food. Egypt imports about 236 m3 water per capita and year in the form of food (Handoussa, 2010). A report by WFP and CAPMAS found that an estimated 13.7 million Egyptians (or 17 percent of the population) suffered from food insecurity in 2011, compared to 14 percent in 2009. Among the major obstacles affecting the production and processing of more food for Egypt's ever growing population is the damage caused by pests (FAO, 2008).

Kenya has been facing food insecurity for a long time in both urban and rural areas, as well as in both high potential and arid and semi-arid lands (ASAL). Food insecurity has been viewed as a prevailing situation, in which not all can have a fair share of the food available or produced (Nzau, 2003). The food production can be attributed to many factors, including decline in agriculture productivity, climatic changes, inefficient food distribution systems and land fragmentation. The food available per capita has declined, despite the success in expansion of export crops. In 2009, the long rain season between March and May performed poorly resulting in a drought season in South East Kenya. Compared to other years, the 2009 drought adversely affected rain-fed subsistence farmers and livestock producers living in Kenya’s Arid and Semi-Arid areas resulting in an increased level of household food insecurity arising from a combination of poor or non-existent harvests and higher food prices; changes in rainfall and temperature patterns have been observed in the past 50 years (USGS and USAID, 2010). Although rainfall is highly variable across different regions in Kenya, wet extremes have been observed every 10 years, and this is expected to increase in the future. A key observation is that rainfall has become irregular and unpredictable, with more intense downpours (Nzau, 2003). The trend will be different for the ASALs and the highlands. On average, increases in both minimum and maximum temperatures have been observed across Kenya. In the ASALs, actual observed temperature trends indicate significant ‘warming’. Meanwhile, analysis of climate trends in Kenya shows productive crop areas are shrinking. This, coupled with the crop failure common during drought periods, is an indication of serious challenges and the need for measures within the agriculture sector that will protect livelihoods and ensure local and national food security.

The semi-arid areas of lower Eastern Kenya which cover the three semi-arid Counties of Kitui, Machakos and Makueni are characterized by poor infrastructure, low, erratic and poorly distributed rainfall (Kavoi et al., 2013). The County government of Machakos has introduced Small Scale Irrigation and Value Addition Project (SIVAP) aimed at improving food security among many households (Dennis Odunga, 2017). The project is aimed at reducing dependence on raid fed agricultural practice. In addition, the County introduced the Comprehensive Food Security Programme in 2017 to help reduce dependence on relief aid. Farmers are supplied with quality seeds to plant, affordable fertilizers and tractors for large scale farmers, (Kenya News Agency, 2017).

2.3 Drought Management and Performance of Food Production Projects

Drought is a complex natural hazard which affects the environment occurring in all climatic zones and results in socio-economic impacts, the extents of which vary depending on several factors and conditions. Agriculture is the first and most drought affected sector. Direct impacts of drought include reduced water levels; increased risks of land degradation; and damage to wildlife, forests and fish habitat. The main regional causes of droughts are often considered outside the context of their global causes. The latter depends on the global dynamics of the atmosphere and ocean general circulation, particularly in the tropics. Some observed droughts may be explained from the effect of long-term abnormal ocean surface temperature on general circulation (Tallaksen, van Lanen, 2004). Confidence in drought prediction on a timescale of a month to a season is based on regional abnormal precipitation or abnormal ocean surface temperature in an area, revealed by model calculations. Probability drought prediction is, however, quite well developed.

A reduction in crop production usually impacts the livelihoods of local populations resulting in less income for farmers, hunger and mass starvation, increased food prices, unemployment, and migration. Responding to drought after the impacts have taken their toll is commonly referred to as crisis management. It is known to be untimely, poorly coordinated and ineffective (Wallace, 2002). Climate change is expected to affect most regions of Africa negatively including through extreme events like floods and droughts which will become more frequent. In addition, new opportunities in some regions where rainfall and other climate parameters improvement will emerge. As a consequence of increasing water scarcity and drought, resulting from climate change, considerable

water use for irrigation is expected to occur in the context of tough competition between agribusiness and other sectors of the economy. In addition, the estimated increment of the global population growth rate points out the inevitable increase of food demand in the future, with an immediate impact on farming water use (Hanasky, 2010). Since a noteworthy relationship exists between the water possessions of a country and the capacity for food production, assessing the irrigation needs is indispensable for water resource planning so as to meet food needs and reduce consumption of water.

Nowadays, 22% of the land surface is used for pastures and rangelands, and another 12% is used for agriculture. Globally, the consumption of water across all sectors amounts to 9% of total freshwater resources worldwide, with agriculture being the largest consumer, in turn accounting for approximately 70% of total water usage, which is equivalent to 2700 km3 year. Similarly, the agricultural sector was estimated to receive up to two-thirds of the total water withdrawals accounting for almost 90% of the total water consumption in the world. More than 80% of global agricultural land is rain fed, thus only green water is consumed (Shiklomanov, 1998). This implies that irrigated land, which represents only 18% of global agricultural land, produces about half of the world's total supply. This is because yields of irrigated crops are on average 2–3 times more than their rain-fed counterparts. Northern Europe experiences the lowest values for specific annual fresh water withdrawals in agriculture ranging between 0%–30% of the total water withdrawals. In continents such as Asia, Africa, North and South America, the values for specific water withdrawal range from 50% to 100%. These aforementioned countries, have a great variety of climatic conditions, crop composition and watering techniques. Irrigation water withdrawals range between 96 km3 in Sub-Saharan Africa and 708 km in East Asia; the highest values for specific water withdrawal are observed in South Asia, with 913 km^3 (Alexandratos and Bruinsma, 2012).

Yang and Zehnder reported that in 1998–1999, cereal imports accounted for 52% of the total supply in the six countries. Under the baseline scenario, the cereal demand is projected to increase by 38% by 2020, whereas, under the increased consumption scenario, cereal demand will rise up to 47% by 2020. This means that some countries will be unable to meet future food demands without importing, which will cause several poor, populous countries to drop below the water scarcity threshold due to population growth and the depletion of fossil groundwater. (Yang, Zehnder, 2002). Therefore, the

international trade in agricultural products and food grains has played and will continue to play a critical role in water-scarce countries. In Machakos County, most of the residents are directly dependent on subsistence farming hence making them highly vulnerable to droughts. The County government officials need to conduct frequent studies on effects of drought and establish long lasting mitigation measures. Initiatives have been established to create awareness among farmers to grow drought resistant crops such as cassava, millet, sorghum and yams. Also, a center for cereals storage has been set up by the County government where farmers can sell their excess crop yields and are also trained on post-harvest management of cereals.

2.3.1 Consequences of Drought

Climate change primarily affects rain precipitation, temperature and potential evapo-transpiration, and thus it affects the occurrence and severity of meteorological droughts. An important question for the assessment of future socio-economic and environmental impacts is how changes in meteorological drought will affect soil water drought and hydrological drought, i.e. groundwater and stream flow droughts. Soil water drought is the low capacity of soil to enter and permeate through the profile hence reducing withholding capacity. Hydrological drought has significance for among others water resources (agriculture, domestic and industrial water use), aquatic ecosystems, power generation, and navigation.

Drought has caused many Kenyans living especially in the suburb areas to be acutely food insecure leading to malnutrition and disease outbreaks such as Cholera, (OCHA, 2017). Most Semi-Arid Lands have been experiencing high food prices with insecurity being reported in various parts of the Country such as Laikipia and Samburu, (UNICEF, 2017). The most social consequences of drought are mostly found in arid or semi-arid areas where water availability is already low under normal conditions of aridity, demand is close to, or exceeds, natural availability and society seldom lacks the capacity to mitigate or adapt to drought.

2.4 Extension Services and Performance of Food Production Projects

The backbone of agricultural extension is the transfer of agricultural information in order to enhance proactive capacity of the food producers. The adaption of new technologies and production approaches in farming to produce high quality food and provide reliable services is becoming crucial for all countries. Nowadays, it is also important that agricultural extension will be oriented towards of strengthened vertical and horizontal integrating links alongside the commodity production chains (Mária et al, 2012). Furthermore from agricultural extension is expected that it will become more market oriented, in order to help to food producers to achieve higher marketability for their products. Extension services have changed over the years; for instance, Chinese officials were making policies on agriculture, documenting practical knowledge, and disseminating advice to farmers at least 2,000 years ago. For example, in approximately 800 BC, the minister responsible for agriculture under one of the Zhou dynasty emperors organized the teaching of crop rotation and drainage to farmers. The minister also leased equipment to farmers, built grain stores and supplied free food during times of famine.

Agricultural development in different SAARC countries has followed different pathways; so did the agricultural extension education systems. Over the past half a century, for example, trajectories followed I n the course of agricultural development in Bangladesh, India and Pakistan were not similar. Largely a food deficit country India became self-reliant in food three decades ago, while Bangladesh is now near to food secured country. Compared to 20 years ago, agricultural extension now receives considerably less support from donor agencies. Among academics working in this field, some have recently recommended that agricultural extension requires reinvention and renovation as a professional practice. Other authors have abandoned the idea of extension as a distinct concept and prefer to think in terms of "knowledge systems" in which farmers are seen as experts rather than adopters (Hathurusinghe, 2010).

The role of services for the agricultural development has been recently reconsidered; their tasks are not limited to “traditional” agricultural activity, but it extends to a number of other interventions (Anderson, 2007), aimed at qualifying agricultural products, at fostering farm diversification and other strategies incorporated in the new philosophy of rural development and rural innovation in Great Britain and a few other European

countries. Besides, recent environmental and sanitary compulsory standards have engendered “new needs for advice” in Slovakia (Labarthe and Catherine, 2009). As a matter of fact, the continuously shifting scenario settles new tasks for farmers and calls for a renewed supply of extension services. To cope with a more complex consumer of extension services, supply has changed: from the simple linear technological transfer, through approaches of facilitation extension, a recent holistic view is emerging, where interconnections among agents, farmers and socioeconomic and territorial characteristics are prevalent (Swanson and Rajalahti, 2010). Faced with these trends, recent rural development policies envisage an important role for extension and technical assistance to farms. To adapt processes of farms’ boundary shift (Banks et al., 2002), rural development policy makes new tools available for farms. The true extent and the capability of AES to foster processes of agricultural adjustment along the aforementioned lines are an even more important object of study.

Agricultural extension in Kenya commenced as early as 1900s, with a major notable success in the distribution of hybrid maize technology in the late 1960s and early 1970s. In 1982, when T&V was introduced, the extension system suffered from a number of deficiencies. It was a mix of ad hoc project components, lacking a consistent national strategy. These arrangements were expensive and ineffective. Despite a well-established line of command down to the frontline extension worker, and staff numbers presumed to be adequate at the time, the service was judged to be performing well below its potential (Gautam, 2000). There are still significant challenges in providing extension and advisory services (EAS) in agricultural areas. These include lack of enough funds to support public extension, poor resourcing, disorganized structures resulting in poor infrastructure for attracting businesses, limited involvement of rural farmers and populations in extension processes to the lack of appropriate strategies for effective research and adequate extension methods. Inadequate marketing of extension services across rural areas and challenges in adapting technological systems to community-specific contexts have also been highlighted as critical issues in the delivery of EAS (IFPRI–World Bank 2010).

2.5 Pests and Diseases and Performance of Food Production Projects

The importance of pests and diseases as factors which influence crop production are not disputed, since there is no season in which infestations of greater or less extent do not occur. It is easy to fail to realize how great their effect on crop yields and quality is. Destruction of food produce is always a loss to the country as a whole, but to individual producers it can mean either loss or gain since reduced quantities may command higher prices than could otherwise have been. Crop pests and diseases are responsible for more than 50% of the potential yield of agricultural crops world- wide, though loss values are quite variable according to the crop and geographical location of the crop (Oerke and Dehne, 2004). Oerke and Dehne (2004) estimated the efficacy of the control of arthropod pests, diseases, and weeds, losses prevented by the use of control methods being 44.2%, 33.8%, and 70.1%, respectively. Significantly, they recorded the highest crop losses in those areas in the world with the highest consumption of pesticides.

More than two-thirds of cropland in the United States is devoted to the production of just four crop species which are maize, wheat, soybeans, and cotton; raising concerns that homogenization of the American agricultural landscape could facilitate widespread disease and pest outbreaks, compromising the national food supply. In addition, due to the converged nature of the agricultural landscape and scanty genetic diversity of many crops (Parker 2002, Harrington 2003), crop production is vulnerable to disease and damage by insect pests. Farm legislation that provides subsidies to growers for only a small number of crop species may inadvertently contribute to this homogeneity (Biermacher et al. 2006). Meanwhile, an average of 10 new crop pests are estimated to enter the United States accidentally each year, usually through shipments of plant materials, produce, or packing materials from other continents through US ports (Work et al. 2005). The economic damage caused by the spread of exotic crop pests is significant. The US Department of Agriculture (USDA) and other US government agencies spend more than $1 billion annually (Parker, 2002) in research, risk assessment, and emergency response to outbreaks, and in public education, outreach, and extension.

In Africa, The spread of trans-boundary plant pests and diseases has increased dramatically in recent years. Globalization, trade and climate change, as well as reduced resilience in production systems due to decades of agricultural intensification, have all

played a part. Cross-border plant pests and diseases can easily spread to other nations and reach epidemic proportions. Outbreaks and upsurges can cause huge losses to crops and pastures, threatening the livelihoods of vulnerable farmers and the food and nutrition security of millions at a time. Beetles, scale insects, mealybugs, locusts, pine sawflies and moths are among the most destructive trans-boundary plant pests and diseases. Plant pests and diseases spread in three principal ways; trade or other human-migrated movement, environmental forces – weather and windborne, insect or other vector-borne – pathogens.

In Machakos County, constraints affecting crop production have been identified from surveys and rapid rural appraisal studies. This has been necessary to understand production constraints as perceived by both farmers and researchers. From this, it has been clear that constraints are both abiotic and biotic in nature. The constraints include crop pests (weevil Cosmopolites sordidus Germar, a complex of nematodes and thrips) and diseases (black Sigatoka, yellow Sigatoka, Cladosporium freckle, Panama, cigar-end rot and viral diseases), declining soil fertility, poor crop management, lack of clean planting material, poor marketing infrastructure, postharvest losses, competition with other crops for land, labour and capital, genetic erosion and lack of inputs/credit facilities. In order to address some of these constraints, efforts have been made by the NARES and IARCs, especially ICIPE, to develop and transfer appropriate technologies to the farming communities and extension personnel.

2.6 Crop Improvement Strategies and Performance of Food Production Projects

Crop improvement is the purposeful selection, growth, and cross-pollination of particular plants. This differs from natural selection in that, in nature, plants that do better in a particular environment will set seed and pass on the genes that made them successful in that environment (Williams, 2000). In addition, crop improvement selects those plants that carry desirable qualities by humans, for instance, a larger fruit, greater yield and particular flavors. In ancient times, farmers practiced this by simply saving seed from those plants they thought had good characteristics.

Plant breeders advance this practice further by cross-pollinating plants (manually transferring pollen from anthers of one plant to the stigma of another) that bear quality favorable characteristics, harvesting the resulting seed, and picking new individuals that

carry the combined favorable traits from both parents. This process can be carried on until the resulting plants are ready to be used as a new variety (Defra, 2009).

The capacity of agricultural (and food) systems in Europe and globally to respond to the challenge of sustainability will at least partly depend on the generation of the necessary knowledge and its mobilization into improved approaches and practices. By deploying appropriate technologies and management tools and properly using ecosystem services, agriculture has the capacity to meet societal demands for food crops. The use of plant genetic resources (PGR) in crop improvement, followed by adoption, cultivation and consumption or marketing of the improved cultivars by farmers, is one of the most sustainable methods to conserve valuable genetic resources for the future, and simultaneously to increase agricultural production and food security (Campbell, 2009). Lately, there has been a comeback of interest in farmers growing various traditional crops leading to increased interests in organic production and local food. This has led to the remaining wealth of UK landrace diversity being greatly geographically localized and highly threatened with extinction.

Although crops cultivated in Africa play a vital role in their contribution to Food Security, they produce inferior yields compared to those in other parts of the world. For instance, the average cereal yield in Africa is only 1.6 t·ha compared to the global 3.9 t·ha. Low productivity in Africa is due to inadequate soil fertility and scarce moisture, with frequent attacks from a variety of weed, pests, diseases, and insects. While moisture scarcity is responsible for up to 60% of yield losses in some African staple cereals, insect pests inflict annually substantial crop losses. In order to devise a strategy towards boosting crop productivity on the continent where food insecurity is most prevalent, these production constraints should be investigated and properly addressed (Williams, 2000).

Studies in Kenya and Uganda have shown that the yield of cassava can be increased by 140% in farmers' fields using improved varieties and management practices. In addition to traditional organic and inorganic fertilizers, biochar and African Dark Earths have been found to improve soil properties and to enhance productivity, although their availability and affordability to African farmers' remains to be explored (Tadele, 2012). Crop intensification or boosting productivity per unit area is the urgent task for those involved in crop improvement due to at least the following three reasons; diminishing

size of arable land due to expansion in urbanization and industrialization, tremendous increases in African population which requires more and more mouths to feed, and gradual decrease in African population engaged in agriculture (IPGR, 2004).

The urge to build capacity and create an enabling regulatory framework for genetically modified technology in Kenya has increased pace recently with a process initially driven by the science and research establishment and then defended by senior political leadership seized with the potential benefits of the technology. The Kenyan Biosafety Act, signed by former President Mwai Kibaki in February 2009, is considered to be among the more forward-leaning and facilitative biotechnology laws in Africa, and Kenyan proponents of the technology see the legislation as a means of accelerating the process of research, development, and deployment of transgenic crops. Public opinion is still divided on the risks and benefits of genetic modification, and competing political priorities may slow full implementation of legislation (KARI Report, 2007). Postharvest loss includes the food loss across the food supply chain from harvesting of crop until its consumption. The losses can broadly be classified into weight loss due to decay, quality loss, nutritional loss, seed viability loss, and commercial loss. Magnitude of postharvest losses in the food supply chain vary greatly among different crops, areas, and economies. In most developing nations, the citizens try to make the best use of the food produced. However, a material quantity of the produce is lost in post-harvest operations due to a lack of knowledge, inadequate technology and/or poor storage infrastructure (Abass, 2013). In Machakos County, most farmers can access hybrid seeds from agri-stores with the assistance of KCEP officials and ministry officials. Farmers are trained on how to identify which seeds are good with the nature of soil in their land and favorable with the rains. Farmers have since realized high yields from cereals such as quality maize and beans.

2.7 Theoretical Framework

The study was grounded on the following theory that is relevant to the problem of the study.

2.7.1 Demographic Theory

This theory was proposed by Carl Sauer (1889-1975), an American geographer. The theory postulates that the increase in human population is hampered by the carrying capacity of the natural environment in supplying food. With further increase in population, the food that the wild naturally supplies became too insignificant. Geographer Carl Sauer believed the experiments necessary to establish agriculture and settle in one place would occur in lands of plenty. Only in a land of plenty could people afford to experiment with raising plants and breed them for domestication. Plant domestication may have originated from Southeast and South Asia (and later in South America) more than 14,000 years ago with the domestication of tropical plants. In Asia, the combination of human settlements, forest margins, and fresh water streams may have given rise to the earliest planned cultivation of root crops which are reproduced by cultivating either the roots or cuttings from plants.

2.8 Conceptual Framework

In this study, performance of food production projects is being viewed as a dependent variable. Drought management strategies, extension services, pests and diseases and crop improvement strategies constitute the independent variables. The interrelated variables are shown in the Conceptual Framework (Figure 1).

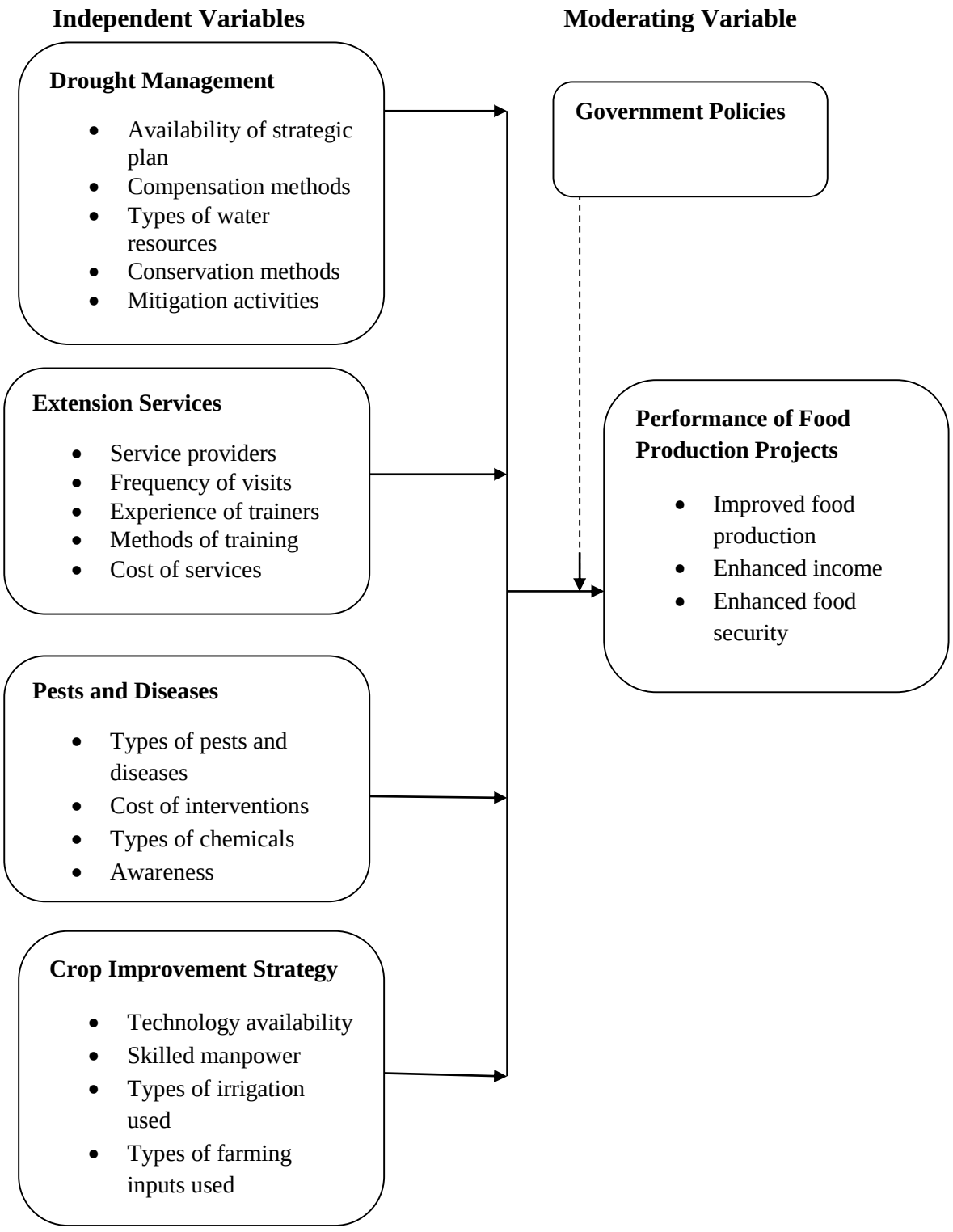

Figure 1: Conceptual Framework

2.9 Summary of Literature Review and Knowledge Gap

Food production is an extensively studied concept in agricultural projects, organizations and governments. As indicated in the literature review, most of the literature discussed food production generally, especially its principles or key elements. Also studied extensively were the challenges hindering sustainable food production especially in developing countries in Africa; this study sought to narrow down the factors influencing performance of food production projects to specific functions that were perceived to be prevalent and significant especially in the Kenyan context, they included drought management, extension services, pests and diseases and crop improvement strategies in Machakos County Kenya. The available literature indicates that there is a gap on impacts of the aforementioned factors, in the context of area of study and in terms of research methodology employed.

The study was backed by the Demographic Theory which shows the relationship between food production and demographic attributes of a particular population of people especially on population increase, which can be used to improve food production together with independent variables which have been discussed. Table 2.1 summarizes the knowledge gaps in the literature review.

Table 2.1: Knowledge Gap

Variable	Author/ Year	Findings	Knowledge Gap
Drought Management and Food Production Projects	Hanasky (2010) Wallace (2002)	Found out that there existed a strong relationship between the mitigation activities and drought management.	There is a need to examine and emphasize this relationship in great detail
Extension Services and Food Production Projects	Gautam (2000) Hathurusinghe (2010)	These studies showed that there is a relationship between knowledge of the officers, training and effectiveness of the extension services	These studies do not indicate clear methodologies which were used to reach these conclusions. On that basis, this study shall design a clear methodology to verify this influence
Pests and Diseases and Food Production Projects	Oerke and Dehne (2004) Parker (2002)	A relationship does exist between the variables (cost of interventions and awareness,) and food production projects.	There is a need to explore these findings in the context of Kenyan food production projects
Crop Improvement Strategies and Food Production Projects	Williams (2000). Tadele (2012) Campbell (2009)	Found out that there existed a strong relationship between Technology availability , Skilled manpower, Consumer safety and food production projects	There is a need to examine and emphasize this relationship in the Kenyan context

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter introduced research methodology and includes research design, target population, sample size and sampling procedure, the data collection methods and procedures. The chapter further displayed the research instruments used, reliability of research instruments, data analysis procedures, the ethical considerations and the operational definition of variables.

3.2 Research Design

A research design is a scheme, an outline or plan which is used to generate answers to research problems as stated by Orotho (2003). This study employed a descriptive survey design. Descriptive design allows the researcher to gather information, summarize, present and interpret data (Zikmund, (2007). The descriptive method involves measurement, classification, comparison and interpretation of data while survey method is suitable as it is used in gathering data from a relatively large number of cases at a particular time.

The selected research design helped the researcher to identify factors which influence performance of food production projects in Machakos County since according to Cooper and Schindler (2004), a descriptive study is concerned with finding out ‘what’, ‘where’ and ‘how’ of a phenomenon. The intention of descriptive research is to gather data at a particular point in time and use it to describe the nature of existing conditions. The descriptive design was also preferred for this study because the questions raised required collecting data through administration of questionnaires and interviewing the respondents and also it was deemed effective as the researcher was able to examine variables under natural conditions in which they were operating as dependent and independent variables.

3.3 Target Population

According to Cox (2010) a target population for a survey is the entire set of units for which the survey data are used to make inferences. Ngechu (2004) states that the population is a well-defined set of people, services, elements or events or a group of things or household being investigated. Target population constitutes the entire or totality of the items under study (Kothari, 2004). This study targeted project managers, farmers, KCEP representatives and Government of Kenya extension service Officers from the Department of Agriculture who were concerned with the project in Machakos County as presented in Table 3.1. The study focused on farms within Machakos Sub-County due to the proximity to the researcher, and a few in Yatta Sub-County for pilot testing of research instruments purposes. The Target Population hence involved 532 farmers from Machakos Town Sub-County, 15 different level project managers, 12 KCEP Representatives and 8 Extension Service Officers making a total of 567 respondents. The data was obtained from KCEP offices Machakos County.

Table 3.1: Target Population

The tabulation of the entire Target Population is shown in Table 3.1.

Category	**Population number**	**Percentage**
Project Managers	15	2.65
Farmers	532	93.82
KCEP Representatives	12	2.12
Extension Service Officers	8	1.41
Total	**567**	**100.00**

KCEP REPORT 2014-2015.

3.4 Sample Size and Sampling Techniques

Sampling is the process of selecting a number of individuals or objects from a population such that the selected group contains elements representative of the characteristics found in the entire group (Orodho and Kombo, 2002). It is the procedure the researcher takes to obtain the sample of the study. The study applied both probability and non-probability sampling techniques to create a sampling frame i.e. stratified sampling and simple random sampling techniques respectively. Stratified sampling technique is a probability sampling technique wherein the researcher divides

the entire population into different subgroups or strata, then randomly selects the final subjects proportionally from the different strata. The researcher therefore divided the target population into various strata based on their involvement in the project. This ensures that the strata is non-overlapping as having overlapping sub-groups would grant some individuals higher chances of being selected as subjects of the study. From each of the strata, the researcher applied simple random sampling to the homogenous strata in order to obtain representative samples.

A method of proportional allocation was adopted in which samples sizes from each strata were considered as proportional to the sizes of the strata. The following equation was used to determine sample size:

Where;

i = Stratum

$P\,i$ = Proportion of the population included in the stratum i

n = Total sample size

N = Population size

Then, the total number of selected elements from stratum i is $n.P\,i$

The sample size was determined by:

$$n = \frac{z^2 pqN}{e^2\,(N-1) + z^2 pq}$$

Where e is the error for this study, taken as 10%; p is the population reliability, taken as p = 0.5; $z\alpha/_2$ is the normal reduced variable at 0.05 level of significance and z =1.96. The sample size is therefore:

$$n = \frac{\mathbf{1.96^2(0.5)(0.5)\times 567}}{\mathbf{0.1^2(567-1)+1.96^2(0.5)(0.5)}} = 82$$

Table 3.2: Sample Size

The sample size of the study is given in Table 3.2.

Category	Population	Sample Proportion	Sample Size
Project Managers	15	0.03	3
Farmers	567	0.94	76
KCEP Representatives	12	0.02	2
Extension Service Officers	8	0.01	1
Total	**567**		**82**

3.5 Research Instrument

A questionnaire is an appropriate instrument for data collection. Kirakowski (2000) defines a questionnaire as a method for the elicitation, and recording and collecting information. The questionnaires are to feature questions that provide quantitative data for statistical analysis. The benefits of using a questionnaire is because it is an easy tool to collect data and large amounts of information can be collected within a short period of time. The questionnaire design followed the objectives of the research, with the first part capturing the demographic characteristics of the respondents. The questionnaires were self-administered since they had adequate instructions with a simple and easy to apprehend language. The researcher prepared and delivered the questionnaire to the respondents. Due to variance in availability of respondents, the researcher employed the "drop off and pick later" method of administering questionnaires. Drop off and pick later method results in high response rate and reduces researcher presence bias (Cooper and Schindler 2003).

3.6 Pilot Testing

Charles (1995), observes that administering questionnaires to two different tests under the same conditions and population for comparative results leads to consistence, reliable and observable results. A total of 10 questionnaires were administered to 10 respondents who were selected from the population and were not part of the actual study in Machakos Town Sub-County but were selected from a target population with similar characteristics from Yatta Sub-County in order to ensure reliability and validity of the research instruments. The reason was to find out if the instruments are workable and the two sets of questionnaires were administered under the same conditions.

3.7 Reliability of Research Instrument

According to Mugenda and Mugenda (1999), reliability is a measure of the degree to which a research instrument yields consistent results or data after repeated trials. To enhance the reliability of the instruments, a pre-test was conducted; the aim of pre-testing was to gauge the clarity and relevance of the instrument items so that those items found to be inadequate for measuring variables would be discarded or modified to improve the quality of the research instruments.

This was done in order to ensure that the instrument captured all the required data. The procedure for extracting an estimate of reliability was obtained from the split half-method. The method involves dividing each instrument into two halves (odd and even items) and then calculating the Pearson's Correlation Coefficient(r) between the responses (scores) of the two halves. The scores for all odd and even numbered items for each of the selected respondents in the pilot study were computed separately. If the Coefficient of 0.7 was obtained, then the reliability was accepted (Mugenda, 2008).

3.8 Validity of the Research Instrument

McMillan and Schumacher (2001) recommended that researchers should conduct a pilot study before beginning studies. Validity is concerned with ideas the research design fully addresses, the research questions and objectives the research is trying to answer and address. To check validity, expertise from the supervisor was taken into consideration to ensure that the instruments were constructed correctly, have the right content, and if the instruments accurately represent the variables under the study in line with the stated purpose and study objectives.

The internal validity which involved controlling the extraneous variables in the structure were done through the administration of a questionnaire; as such, the researcher sought assistance from the supervisor in order to help improve content validity of the instrument.

3.9 Data Collection Procedures

A research permit was obtained from the National Council for Science, Technology and Innovation (NACOSTI), a copy of which was presented to the project management for authorization to interview respondents involved in the study. Research assistants were recruited and trained in administering questionnaires for data collection. The researcher then contacted Farm Leaders, Project Management Offices, Government of Kenya extension service offices and KCEP representatives to set a period of time within which the questionnaires were administered and interviews conducted.

First part of the data collection was the pilot study after which the researcher administered the questionnaires and carried out the interviews with the help of the trained assistants. The respondents were also trained on how to use the data collection instruments, purpose of the study and the ethical considerations.

3.10 Data Analysis Methods

The researcher then verified collected questionnaires and examined whether they were dully filled. Researcher performed the data editing, coding, data entry and data cleaning activity in order to check the consistency of the data collected from the respondents by various tools. The researcher then employed quantitative methods of analysis from the questionnaire. The data was analyzed using IBM's Statistical Package for Social Sciences version 21.

The researcher used simple descriptive statistics to interpret the results. This included frequency distribution, mean, standard deviation and percentages. The study also sought to establish a correlation between the variables using Pearson's Product-Moment Correlation. The Pearson product-moment correlation is a measure of the linear correlation between two variables X and Y, giving a value between +1 and −1 inclusive, where 1 is total positive correlation, 0 is no correlation, and −1 is total negative correlation. It is used as a measure of the degree of linear dependence between two variables. The formula below was applied:

$$r = \frac{N\sum XY - (\sum X)(\sum Y)}{\sqrt{N\sum X^2} - (\sum X)2 \;\; \sqrt{N\sum Y^2 - (\sum Y)2}}$$

Where $-1 \leq r \geq 1$

N are a selected number of respondents in a given strata;

Y corresponds to a select variable

X corresponds to a second variable

3.11 Ethical Considerations

At the initial contact with the respondents, the researcher explained to the respondents the relevance of the study and why the questionnaires were administered. An introductory letter to the respondents was obtained from the University of Nairobi and County Government of Machakos. Researcher also obtained authorization letter from the National Commission for Science, Technology and Innovation (NACOSTI).Two significant ethical issues which were considered in the research process were consent and confidentiality in order to assure the respondents that the study was purely academic. The respondents were advised that the study was voluntary and that they could withdraw at their own will at any moment during administration of the questionnaire and their confidentiality would be guaranteed by not disclosing their names or personal information on the questionnaire or the research document.

Only relevant details which would help in answering the research questions were included. The study adhered to the University of Nairobi plagiarism policy which defines plagiarism as “the action or practice of taking someone else work or idea and passing it off as one’s” (University of Nairobi, 2013). Utmost care was taken to acknowledge literature used from other scholars and various sources of data through referencing.

3.12 Operational Definition of Variables

This section analyzed the operation definition of variables on factors; drought management, extension services, pests and diseases and crop improvement strategies influencing performance of food production projects in Machakos Town sub-county as shown in Table 3.3.

Table 3.3: Operational Definition of Variables

Objectives	Independent Variables	Indicators	Measurement Scale	Tools of Analysis	Statistical Analysis
To assess drought management strategies influencing performance of food production projects in Machakos Town Sub-county	Drought Management	Availability of strategic plan. Compensation methods. Types of water resources. Conservation methods. Mitigation activities.	Nominal Ratio	Percentages Means	Descriptive
To assess influence of extension services on performance of food production projects in Machakos Town Sub-county	Extension Services	Service providers Frequency of visits Knowledge of officers Training methods Cost of services	Nominal Ratio	Percentages Means	Descriptive
To examine influence of pests and diseases on performance of food production projects in Machakos Town Sub-County.	Pests and Diseases	Types of pests and diseases Cost of interventions Types of chemicals Awareness	Nominal Ratio	Percentages Means	Descriptive
To assess influence of crop improvement strategies on performance of food production in Machakos Town Sub-County.	Crop Improvement Strategies	Technology availability Skilled manpower Types of irrigation used Types of farming inputs used Food storage facilities	Nominal Ratio	Percentages Means	Descriptive
	Dependent Variable				
	Performance of Food Production projects	Improved food production Enhanced income Enhanced food security	Nominal Ratio	Percentages Means	Descriptive

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION AND INTERPRETATION

4.1 Introduction

This chapter contains data analysis, presentation and interpretation of data. The demographic information on the respondents findings are represented following objectives of the study.

4.2 Questionnaire Response Rate

The study targeted a sample size of 82 respondents out of which 75 respondents filled and returned questionnaires and a response rate of 91% was obtained (Table 4.1).

Table 4.1: Response Rate

Response rate	Frequency	Percentage
Responded	75	91
Non-response	7	09
Targeted	**82**	**100**

From Table 4.1, the response rate obtained was excellent and representative and conforms to Mugenda and Mugenda (1999) report which stipulated that a response rate of 50% is adequate for analysis and a response rate of 60% is good and a response rate of over 70% is excellent.

4.3 Demographic Data Analysis

In this section, the researcher sought to get information on the respondent's gender, age, highest academic qualification, and experience in terms of the years they have spent in the farming industry that is, in different sectors including agribusiness, farm administration and even other industries but related to agriculture.

4.3.1 Distribution by Gender

The respondents were asked to indicate their gender in the brackets in order to establish their gender. The findings of gender are shown in Table 4.2.

Table 4.2 Gender Distribution

Gender	Frequency	Percentage
Male	50	60.97
Females	32	39.03
Total	**82**	**100**

The findings in Table 4.2 show that majority (60.97%) of the respondents were male while 39.03% were female. This depicts that men form a larger representation of respondents in this particular project. There were few women working in administration while the rest worked in the field.

4.3.2 Distribution of Respondents by Age

The respondents were asked to indicate their age brackets in order to establish their ages. The findings are presented in Table 4.3

Table 4.3 Distribution of Respondents by Age

Age Bracket	Frequency	Percentage
21 – 30 years	33	40.24
31 – 40 years	28	34.15
41 – 50 years	15	18.30
Above 51 years	6	07.31
Total	**82**	**100.00**

The study found that 40.24% of the respondents were aged between 21 to 30years, 34.15% were aged between 31 to 40 years while 18.13% were aged between 41 to 50 years. 6 of the 86 respondents were above the age of 51 years. This shows that majority of the respondents were in the informative age and were knowledgeable in the subject being researched on.

4.3.3 Distribution of Level of Education

The study sought to determine the level of education of the respondents as shown in Table 4.3.

Table 4.4 Level of Education

Level of Education	Frequency	Percentage
KCSE	35	43
College Diploma	22	27
Bachelor's Degree	13	16
Master's Degree	12	14
Total	**82**	**100**

From the findings, 35(43%) of the respondents had Secondary School as their highest level of Education, 13(16%) of the respondents had a bachelor's degree as the highest level of education while another 22(27%) had a Diploma as the highest level of education. 12 of the respondents had a Master's degree. This shows that majority of the respondents were adequately equipped with the required education level and intelligence to understand and respond to the questions as asked in the research instruments.

4.3.4 Experience Level of Years Spent in Food Production

The experience of the respondents in years spent in farming and food production industry was deemed to be very important as it would help in factual justification of responses the study sought to solve. From the respondents experience, 18 (21.95%) of the respondents had experience of below 5 years; 35 (42.68%) of the respondents had experience of 6 - 10 years whereby 22 (27.01%) of the respondents had experience of 16 – 20 years. 7 (8.54%) of the respondents had vast experience of 21 years and above. This implies that most of the respondents interviewed possessed the necessary knowledge and experience required for the study.

4.4 Food Production in Machakos County

The study used the statements as indicated in Table 4.5 in order to analyze and draw factual conclusions on these perceptions. The study assessed the different perceptions held by the respondents in order to find out the factors influencing food production projects in Machakos Town Sub-County. Table 4.5 displays the findings.

Table 4.5 Food Production in Machakos County

Statement	Mean	Standard Deviation
Implementation of food projects can lead to increased food production levels in Machakos County	3.994	0.548
There is significant change in income (farmer's) acquired with the implementation of food production projects	3.379	0.743
Food production projects largely lead to enhanced food security in Machakos County	3.313	0.720

Table 4.5 shows that majority of the respondents were of the opinion that implementation of food production projects can lead to increased food production as shown by a Mean of 3.994. This was followed by a Mean of 3.379 of respondents who agreed with the statement that there is significant change in the farmer's income acquired with the implementation of food production projects. The respondents moderately agreed (Mean = 3.313) that food production projects largely lead to enhanced food security in Kenya.

The respondents were also questioned on whether they perceive that the implementation of food production projects can lead to reduced food prices across the country; the findings are displayed in Table 4.6.

Table 4.6 Food Production Projects and Food Prices

Response	Frequency	Percentage
Yes	52	63
No	30	37
Total	**82**	**100**

From the study findings, majority (63%) of the respondents agreed with the statement indicating that implementation of food production projects can lead to reduced food prices across the county and even largely to the whole country. The 37% of respondents who disagreed with the statement were of the opinion that it takes more than food projects to comfortably cushion the country's increasing food prices.

4.5 Drought Management and Food Production in Machakos County

The study employed four key statements in order to analyze whether drought management had influence on food production projects in Machakos Town Sub-County. The findings are shown in Table 4.7.

Table 4.7 Drought Management and Food Production in Machakos County

Statements	Mean	Standard Deviation
There is an effective strategic plan to manage drought and its effects on food production projects	3.984	0.779
The type of water resources in the county determines the effectiveness of drought management	3.969	1.024
Compensation methods adopted in the county in relation to losses due to drought are timely and dependable	3.092	0.960
Drought mitigation activities adopted are relevant to the food production situation in the county	3.900	0.654

Results in Table 4.7 indicate that the respondents strongly (Mean = 3.984) agreed that there is an effective strategic plan to manage drought and its effects on food production projects, majority also moderately (Mean = 3.969) agreed that the type of water resources in the county determines the effectiveness of drought management, some of the respondents cited innovativeness and technology as being more practical determinants. On the statement that the compensation methods adopted in the county in relation to losses due to drought are timely and dependable, most of the respondents (Mean = 3.092) dis-agreed with the statement, the study also found out that most of these respondents were actually victims of the compensation process. Results also indicated that majority (Mean = 3.900) of the respondents agreed that drought mitigation activities adopted are relevant to the food production situation in the county.

The respondents were asked to indicate the most effective method of water conservation currently being used in the County. The findings are displayed in Table 4.8.

Table 4.8 Water Conservation Methods

Response	Frequency	Percentage
Dams	22	61
Water Reservoirs	50	27
Recycling Plants	10	12
Total	**82**	**100**

The findings shown in Table 4.8, show that majority 50(61%) of the respondents reported that water reservoirs are the most effective method of water conservation, 22(27%) of the respondents reported that dams were more effective while 10(12%) of the respondents who have used recycling plants believed in their effectiveness of recycling plants.

4.6 Extension Services and Food Production in Machakos County

The respondents were requested to indicate extension service provider they have interacted with in the County. Their responses are given in Table 4.9.

Table 4.9 Most Extension Service Sought

Response	Frequency	Percentage
Pest Control	25	30
Crop Diseases Officer	23	28
Soil Science Officer	18	23
Plant Cross-breeding	10	12
GMO Officers	6	7
Total	**82**	**100**

The findings presented in Table 4.9 show that, majority 25(30%) of the respondents have sought pest control extension services in their farming activities, 23(28%) of the respondents have sought services of a Crop Disease Officer. The respondents who were concerned with soil content 18(23%) have sought extension services from Soil Science Officer. GMO Officers were the least 6(7%) sought by the respondents.

The information obtained was to gain information on agri-based Extension Services and its influence on food production projects in Machakos County, Kenya. The results are shown in Table 4.10.

Table 4.10 Agri-Based Extension Services and Food Production Projects

Statements	Mean	Standard Deviation
Extension service providers usually visit the project farms as frequently as required	3.548	0.916
The extension officers are knowledgeable in relation to their specific area of service	3.348	0.793
Training techniques used by the extension officers are effective and adoptable	3.442	0.893
The training content being taught is relevant and appropriate to the problems being addressed	3.397	0.822

The respondents were asked to indicate whether extension service providers usually visit the project farms as frequently as required. The highest number of respondents (Mean =3.548) strongly disagreed with the opinion. It was found out that extension officers are on average knowledgeable in relation to their specific area of service, since moderately agreed by (Mean = 3.348) of the respondents. On whether training techniques used by the extension officers were effective and adoptable, majority (Mean = 3.442) agreed with the statement but added that this also goes hand in hand with the method of training; the statement on the training content being taught is relevant and appropriate to the problems being addressed, a good number of the respondents moderately (Mean = 3.397) agreed with the statement.

The respondents were asked to indicate whether all the issues being experienced in food production in the county are being represented by the different extension service providers. The findings are displayed in Table 4.11**.**

Table 4.11 Extension Service Effectiveness and Food Production Projects

Response	Frequency	Percentage
Yes	45	55
No	37	45
Total	**82**	**100**

From the findings, a few of the respondents (45%) indicated that not all the issues being experienced in food production in the County are being represented by the different extension service providers. This group of respondents opinioned that the deteriorating situation in terms of lack of food was evidence of this. Majority 45(55%) of the respondents however agreed with the statement.

4.7 Crop Pests and Diseases and Food Production

The information obtained from the question was to give information on the influence of crop pests and diseases on food production projects in Machakos Sub-County. The results are shown in Table 4.12.

Table 4.12 Crop Pests and Diseases

Statements	Mean	Standard Deviation
The overall cost of the method a to deal with crop pests and diseases determines its adoption	3.750	1.068
Awareness of the type of crop pests and diseases raising concerns determines the intervention to be taken	3.000	0.922
Crop pests and diseases are a frequent concern to food production projects in Machakos County	3.375	0.823

The findings show that the respondents strongly agreed that the overall cost of the method on how to deal with crop pests and diseases determines its adoption (Mean = 3.750), awareness of the type of crop pests and diseases raising concerns determines the intervention to be taken was also strongly agreed (Mean = 3.000) by majority of the respondents. Crop pests and diseases are a frequent concern to food production projects in Machakos Town Sub-County was moderately agreed at (Mean = 3.375), and this group of residents were of the opinion that weather conditions were more of a concern.

The respondents were requested to indicate what determines the type of chemical used in Agriculture in order to address the concern of crop pests and diseases according to them. Their responses are given in Table 4.13.

Table 4.13 Determination of Control Agri-Chemicals

Response	Frequency	Percentage
Cost	20	24
Availability	12	15
Experience	19	23
Effectiveness	14	17
Environmental Effects	17	21
Total	**82**	**100**

The findings show that majority (24%) of the respondents were of the opinion that cost of the agri-chemicals determined the type of chemical used to address the concern of crop pests and diseases, (15%) cited availability of the chemicals whereas (23%) and (21%) cited experience and environmental effects respectively as major determinants.

The respondents were also requested to indicate to what extent they adopted technology in order to address the concerns of pests in the farms. Their responses are given in Table 4.14.

Table 4.14 Technology and Pest Control

Response	Frequency	Percentage
No Extent	15	19
Small Extent	25	30
To Some Extent	28	34
High Extent	14	17
Total	**82**	**100**

The findings in Table 4.14 show that some of the respondents (30%) had limited technology to address the issues of pests and diseases to a small extent while majority (34%). Some of the respondents at (19%) and (17%) have adopted necessary technology to combat crop pests and diseases to no extent and to high extent respectively.

4.8 Crop Improvement Strategy and food production in Machakos County.

The questionnaire sought to gain information on Crop Improvement Strategy and food production in the County. The results are shown in Table 4.15.

Table 4.15 Crop Improvement Strategy

Statements	Mean	Standard Deviation
The current inter-crop breeding technology has improved food production in Machakos County	3.938	0.561
Plant genetics development is being influenced by availability of skilled labour	3.452	0.863
The type of irrigation method being employed determines the level of particular food crop production	2.900	0.555
Increase or decrease of food crop quality production depends on the type farming fertilizer used	3.264	0.651

Table 4.15 shows that, most (Mean = 3.938) of the respondents disagreed with the statement that the current inter-crop breeding technology has improved food production in Machakos Town Sub-County. As for plant genetics development being influenced by availability of skilled labour, the respondents strongly agreed (Mean = 3.452) some of them talked about the need for opening a training institution just for this in Machakos County. On the statement that the type of irrigation method being employed determining the level of particular food crop production, the study found out that the respondents who disagreed (Mean = 2.900) with the statement were for example, of the opinion that the increase in food production requires more than an irrigation method but other elements too including fertilizers and quality of seeds. A good number of the respondents strongly agreed (Mean = 3.264) that increase or decrease of food crop quality production depends on the type farming fertilizer used.

The respondents were asked to indicate their opinion on the most effective food crop storage facility. The results are shown in Table 4.16.

Table 4.16 Preferred Crop Storage Facility Determinants

Response	**Frequency**	**Percentage**
Building Materials	12	15
Location of facility	23	28
Crop being stored	28	34
Frequency of use	19	23
Total	**82**	**100**

The findings in Table 4.16 indicate that a good number, (34%), of the respondents were of the opinion that the type of crop being stored determines the type of storage facility to be put up. Some of the respondents (28%) viewed location of the storage facility as a major determinant whereas (23%) and (15%) opinioned that frequency of use and building materials were more of determining factors when putting up a crop storage facility.

4.9 Regression Analysis

The relationship of the extent of factors which influence food production in Machakos Town Sub-County was sought and done via regression analysis where means and standard deviation are the variables used in the study. The regression model was:

$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon$

Y = Financial Performance of Agribusiness projects

β_0 = constant

$\beta_{1\text{-}4}$ = Regression Coefficients

X_1 = Drought Management

X_2 = Extension Services

X_3=Crop Pests and Diseases

X_4=Crop Improvement Strategy

ε = error term

Table 4.17: Model Goodness of Fit Statistics

R	R Square	Adjusted Square	R Std. Error Estimate
0.792	0.638	0.592	0.043

Table 4.17 shows that there is a good linear association between dependent and independent variables used in the study. This is shown by a correlation (R) coefficient of 0.792. The determination coefficient as measured by the adjusted R-Square presents a moderately strong relationship between dependent and independent variables given a value of 0.638, this depicts that the model accounts for 63.8% of the total observations while 36.2% remains unexplained by the regression model.

CHAPTER FIVE
SUMMARY OF FINDINGS, DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The chapter contains summary of findings, discussion, conclusions and recommendations. The findings are presented, summarized and discussed in order to draw informed conclusions. The recommendations are made on what needs to be done in order to improve on the problem of the study.

5.2 Summary of the Findings

The study findings are presented following the objectives of the study.

5.2.1 Performance of Food Production Projects in Machakos County.

The study showed that majority (Mean=3.994) of the respondents were of the opinion that implementation of food projects can lead to increased food production by this was followed by (Mean = 3.379) who agreed with the statement that there is significant change in income the farmer's income acquired with the implementation of food production projects. The respondents however, moderately agreed that food production projects largely lead to enhanced food security in Kenya. The study also ascertained that implementation of food production projects can lead to reduced food prices across the county and even largely to the whole country even though some of them 48(37%) disagreed with the statement.

5.2.2 Drought Management and Food Production in Machakos County

The findings show that most (Mean 3.984) of the respondents strongly agreed there is an effective strategic plan to manage drought and its effects on food production projects. Majority also moderately (Mean = 3.969) agreed that the type of water resources in the county determines the effectiveness of drought management, some of the respondents however highlighted that innovativeness and technology were more practical determinants. A good number of the respondents opinioned against the statement that the compensation methods adopted in the county in relation to losses due to drought are timely and dependable; the study also found out that most of these respondents were actually victims of the flawed compensation process. Results also

indicated that majority (Mean = 3.900) of the respondents agreed that drought mitigation activities adopted are relevant to the food production situation in the county. The most preferred method of water conservation in the area are water reservoirs though dams and recycling plants also work well.

5.2.3 Extension Services and Food Production in Machakos County.

The findings show that majority 25(30%) of the respondents have sought pest control extension services in their farming activities, 23(28%) of the respondents have sought services of a Crop Disease Officer whereas the respondents who are concerned with their soil content have sought the extension services of a Soil Science Officer. GMO Officers were the least sought by the respondents. The study also found that extension service providers usually visit the project farms as frequently as required, the highest number of respondents (Mean =3.548) strongly disagreed with the opinion. This ascertained that extension officers are moderately knowledgeable in relation to their specific area of service, as moderately agreed by a number of the respondents whereas, whether training techniques used by the extension officers were effective and adoptable, majority (Mean = 3.442) agreed with the statement but added that this also goes hand in hand with the method of training; the statement on the training content being taught is relevant and appropriate to the problems being addressed, a good number of the respondents moderately (Mean = 3.397) agreed with the statement. Some of the respondents however opinioned that not all the issues being experienced in food production in the county are being represented by the different extension service providers; this group of respondents opinioned that the deteriorating situation in terms of lack of food was evidence of this.

5.2.4 Crop Pests and Diseases and Food Production in Machakos County.

The findings show that the respondents strongly agreed that the overall cost of the method to deal with crop pests and diseases determined its adoption whereas, awareness of the type of crop pests and diseases raising concerns determines the intervention to be taken was also strongly agreed (Mean = 3.000) by majority of the respondents; and then Crop pests and diseases are a frequent concern to food production projects in Machakos County was moderately agreed at (Mean = 3.375), this group of residents opinioned that weather conditions were more of a concern. Most of the respondents also indicated that cost of the agri-chemicals highly determined the type of chemical

used to address the concern of crop pests and diseases, a good number then cited availability of the chemicals whereas 19(23%) and 17(21%) cited experience and environmental effects respectively as major determinants of their choice of agrichemical to use in their farms. From the findings, some of the respondents 25(30%) have adopted a suitable technology to address the issues of pests and diseases to a small extent, majority to some extent at while some of the respondents at have adopted necessary technology to combat crop pests and diseases to a high extent.

5.2.5 Crop Improvement Strategy and Food Production in Machakos County.

The findings show that most (Mean =3.938) of the respondents disagreed with the statement that the current inter-crop breeding technology has improved food production in Machakos County. As for plant genetics development being influenced by availability of skilled labour, the respondents strongly agreed with this as some of them talked about the need for opening a training institution just for this in Machakos County. On the statement that the type of irrigation method being employed determines the level of a particular food crop's production, the study found out that a lot of the respondents disagreed with the statement citing points like the increase in food production does not rely on an irrigation method but other elements too including fertilizers and quality of seeds. A good number of the respondents strongly agreed (Mean = 3.264) that increase or decrease of food crop quality production depends on the type farming fertilizer used. Other findings from the study indicate that a good number of the respondents, 28(34%), were of the opinion that the type of crop being stored determined the type of storage facility to be put up. Some of the respondents viewed location of the storage facility as a major determinant whereas other respondents opinioned that frequency of use and building materials were more of determining factors when putting up a crop storage facility.

5.3 Discussion of the Findings

The study findings are discussed following research objectives.

5.3.1 Drought Management and Food Production in Machakos County.

The study shows that there is an effective strategic plan to manage drought and its effects on food production projects which is a major determinant of the success of food production projects in this area considering its semi-aridness. Although some of the respondents pointed out that innovativeness and technology in terms of managing the water resources in the County, it was evident from the results that the type of water resources in the County determines the effectiveness of drought management. This echoes Wallace's previous study on drought which highlighted that responding to drought after the impacts have taken their toll is commonly referred to as crisis management. It is known to be untimely, poorly coordinated and ineffective (Wallace, 2002). A good number of the respondents were against the statement that the compensation methods adopted in the County in relation to losses due to drought are timely and dependable. The study also found out that most of these respondents were actually victims of the flawed compensation process which was bureaucratic and plagued with corruption and other malpractices.

Drought mitigation activities adopted are relevant to the food production situation in the County of Machakos was evident and practical as the study found out. The application of different water preservation and conservation strategies goes a long way in ensuring the success of the food production process. This goes hand in hand with Alexandratos and Bruinsma report that in the aforementioned Countries, which have a great variety of climatic conditions, crop composition and watering techniques, irrigation water withdrawals range between 96 km3 in Sub-Saharan Africa which has to be consistent (Alexandratos, Bruinsma, 2012). The most preferred method of water conservation in the area of study is water reservouirs though dams and recycling plants also work well.

5.3.2 Extension Services and Food Production in Machakos County.

It is important that agricultural extension service is oriented towards strengthened vertical and horizontal integrating links alongside the commodity production chains (Mária et al, 2012). Maria's findings compliments the results of this study where

different extension services were sought by the farmers which was good but not enough if not oriented towards a particular service - majority of the respondents have sought pest control extension services in their farming activities, some have sought out the services of a Crop Disease Officer whereas the respondents who are concerned with their soil content have sought out the extension services of a Soil Science Officer. GMO Officers were the least sought out by the respondents.

It was also found out that extension service providers usually visit the project farms as frequently as required, the highest number of respondents strongly disagreed with the opinion and went ahead to indicate that the extension service officers only come when called and they do not do proper and effective follow up visits as required by the guidelines of the profession. The study also ascertained that extension officers are averagely knowledgeable in relation to their specific area of service, as moderately agreed by a number of the respondents whereas, whether training techniques used by the extension officers were effective and adoptable, majority agreed with the statement but added that this also goes hand in hand with the method of training; on the statement about the training content being taught being relevant and appropriate to the problems being addressed, a good number of the respondents moderately agreed with the statement. The respondent's opinions can be addressed by considering this view from one of the studies where among academics working in this field, some have recently argued that agricultural extension needs to be reinvented as a professional practice. Other authors have abandoned the idea of extension as a distinct concept and prefer to think in terms of "knowledge systems" in which farmers are seen as experts rather than adopters (Hathurusinghe, 2010).

The role of agriculture extension services for the food production development has been reconsidered recently. Their tasks are not limited to "traditional" agricultural activity, but it extends to a number of other interventions (Anderson, 2007), aimed at qualifying agricultural products, fostering farm diversification and other strategies incorporated in the new philosophy of rural development and rural innovation. Some of the respondents strongly agreed that not all the issues being experienced in food production in the County are being represented by the different extension service providers. This group of respondents agreed that the deteriorating situation in terms of lack of food was evidence of this.

5.3.3 Crop Pests and Diseases and Food Production in Machakos County.

Owing to the intensive nature of the agricultural landscape and limited genetic diversity of many crops (Parker 2002, Harrington 2003), crop production is vulnerable to diseases and damage by insect pests. The study ascertained that a good number of respondents strongly agreed that the overall cost of the method to deal with crop pests and diseases determined its adoption whereas, awareness of the type of crop pests and diseases raising concerns determined the intervention to be taken, was also strongly indicated by the farmers interviewed in this study.

Crop pests and diseases are responsible for more than 50% of the potential yield of agricultural crops world- wide, though loss values are quite variable according to the crop and geographical location of the crop (Oerke and Dehne, 2004). This was evident in the study where crop pests and diseases were found to be a frequent concern to food production projects in Machakos County as agreed by majority of the respondents. The farmers pointed out that more needs to be done especially by concerned authorities since the some procedures of crop pests and diseases control involve the use of chemicals that can destroy the soil meant for food production. Most of the respondents also indicated that cost of the agri-chemicals highly determined the type of chemical used to address the concern of crop pests and diseases. A good number of respondents cited availability of the chemicals whereas other respondents cited experience and environmental effects respectively as major determinants of their choice of agrichemical to use in their farms.

The findings show that some of the respondents have adopted a suitable technology to address the issues of pests and diseases to a small extent, majority to some extent while some of the respondents at have adopted necessary technology to combat crop pests and diseases to a high extent. The study also confirmed that the type of technology adopted depended on the pest or diseases concerned as the first before the cost and maintenance were considered.

5.3.4 Crop Improvement Strategy and Food Production in Machakos County.

Most respondents disagreed with statement on current inter-crop breeding technology has improved food production in Machakos Town Sub-County. This was found to be a

concern since inter-crop breeding is one of the scientifically proven ways of improving food production in Africa as stated by Campbell- the use of plant genetic resources (PGR) in crop improvement, followed by adoption, cultivation and consumption or marketing of the improved cultivars by farmers is one of the most sustainable methods to conserve valuable genetic resources for the future, and simultaneously to increase agricultural production and food security (Campbell, 2009). As for plant genetics development being influenced by availability of skilled labour, the respondents strongly agreed with this as some of them talked about the need for opening a training institution just for this in Machakos County; as much as the government of Kenya is doing something about this as shown in KARI's report where it stated that. The push to build capacity and an enabling regulatory infrastructure for GM technology in Kenya has gained momentum in recent years in a process initially driven by the science and research establishment. It is considered to be among the more forward-leaning and facilitative biotechnology laws in Africa, where Kenyan proponents of the technology see the legislation as a means of accelerating the process of research, development, and deployment of transgenic crops. Public opinion is still divided on the risks and benefits of genetic modification, and competing political priorities may slow full implementation of legislation (KARI Report, 2007).

On the statement that the type of irrigation method being employed determines the level of a particular food crop's production. It was found that many respondents disagreed with the statement citing points like the increase in food production does not rely on an irrigation method but other elements too including climatic conditions, weather patterns, fertilizers and quality of seeds. A good number of the respondents strongly agreed that an increase or decrease in food crop quality production depends on the type farming fertilizer used. Other findings from the study indicate that the type of crop being stored determined the type of storage facility to be put up. Some of the respondents viewed location of the storage facility as a major determinant whereas other respondents opinioned that frequency of use and building materials were more of determining factors when putting up a crop storage facility.

5.4 Conclusions of the Study

It was concluded that factors which influence performance of food production projects in Machakos Town Sub-County should be addressed and implemented in order to improve food security situation being experienced in the Country. It was concluded from the findings that effective strategic plan to manage drought and its effects on food production projects should be participatory in terms of involving all the stakeholders concerned in their formulation. Compensation methods adopted in the County in relation to losses due to drought should be timely and dependable and not delayed as is the current situation in Machakos. Drought mitigation activities adopted and water conservation methods were found to have an effect on food production projects.

It was also concluded that Extension Service providers have an effect on food production projects in terms of the diversified services they offer (pest control, crop disease, soil science service, GMO officers), frequency of visits, experience and expertise they have to the training methods and knowledge transfer they offer. It was also concluded that the knowledge and expertise of the extension service officers should be expounded in order to match the current and changing environment especially on crop diseases. Crop pests and diseases have a direct and negative influence on food production projects in Machakos County as concluded in this study. Most of the respondents also indicated that cost of the agri-chemicals highly determined the type of chemical used to address the concern of crop pests and diseases. It was concluded that availability of the chemicals, experience of previous use and negative environmental effects are major determinants of their choice of agrichemical to use in their farms that can affect food production projects. From the findings, suitable technology to address the issues of pests and diseases was considered and adopted by majority of the respondents which shows that it has an effect on food production especially if done well; the study also ascertained that the type of technology adopted depended on the pest or diseases concerned as the first before other consideration of cost and maintenance were considered.

It was also concluded that the current inter-crop breeding technology has not improved food production in Machakos County hence negatively affecting the food production projects. The study found out that the crop improvement strategies (plant genetics, GM technology, cross pollination) have been stifled by lack of agri-science based

institutions, skilled scientists on the crop improvement area, negative public opinion and legislation to guide the implementation of GMO based food production projects. It was lastly concluded that farm fertilizer was not affordable and available enough to positively have an effect on the food production projects. The type of food crop storage facilities should be researched carefully on so as to avoid spoilage and wastages hence increase food reserves and boost food security in the Country.

5.5 Recommendations of the Study

The recommendations made from the study are outlined below.

5.5.1 Drought Management and Food Production in Machakos County.

It is recommended that effective strategic plan to manage drought and its effects on food production projects should be sound and participatory in order to ascertain its sustainability and effects. The water conservation methods being practiced should be more diversified and technologically supported so as not only to increase water volume but also the quality of the water whereas compensation procedures should be devolved to the county authorities for faster processing which will promote quick loss recovery so that the farmers can go back to farming in a short time.

5.5.2 Extension Services and Food Production in Machakos County.

It also recommended that the extension service providers should increase their knowledge base and make their training content and methods as current as possible in order to achieve better results. It is also recommended that each food production project should be assigned an extension service officer from the planning stage to completion of the project in order to monitor and evaluate the project's farming needs and employ his/her services when needed as valuable data is recorded.

5.5.3 Crop Pests and Diseases and Food Production in Machakos County.

It is also recommended that in every food production project environmental assessment analysis should be done in relation to the type of crop they want to farm .This would provide substantial useful information on what crop pests and diseases they might be exposed to. The study also recommends that the technology being used to deal with the crop pests and diseases should be affordable, effective and environmental friendly. The use of dangerous chemicals and pesticides which damage human health and soil

composition should be prohibited in the area. It is proposed that the government should support the farmers by subsidizing pesticides and other methods of controlling crop pests so that they are affordable and available, this will make the project implementers not to use crude methods that have been proven to be time consuming, ineffective and unsafe.

5.5.4 Crop Improvement Strategy and Food Production in Machakos County.

It is recommended that both National and the County government of Machakos should invest heavily on the science of crop improvement including setting of scientific institutions with laboratories and farm fields, green houses for GMOs and training of existing farmers in order to find a way of introducing more crops which are healthy, nutritious, safe and drought resistant.

5.6 Suggestions for Further Research

The study conducted shows that further research can be undertaken in related areas. The following suggestions for further research are given.

i. A study should be done in another agri-based industry for example fishing industry.
ii. A study should be done to ascertain the extent to which GMO technology can be implemented especially in arid and semi-arid areas in order to improve food security.
iii. A similar study can be done in a different parts of the Country in order to compare the findings.

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APPENDICES

APPENDIX I: LETTER OF INTRODUCTION

Winfred Mwende Kamene,
P O Box 30470-00100,
Nairobi.

Dear Sir/Madam,

REF: Study on Factors Influencing Performance of Food Production Projects In Kenya: A Case Of Kenya Cereal Enhancement Project and Climate Resilient Agricultural Livelihoods, Machakos Town Sub-County, Machakos County.

I am a post graduate student pursuing Masters of Arts degree in Project Planning and Management option at University of Nairobi. I hereby kindly request you to fill in this questionnaire which will enable the researcher to obtain important information for the research as aforementioned above. The information offered will be treated with the utmost confidentiality and will not be unduly disclosed. The information will only be used as pertaining to this study and not otherwise.

Your assistance and cooperation will be greatly appreciated.

Yours faithfully

Winfred Mwende Kamene
Reg. Number: L50/77876/2015

APPENDIX 2: QUESTIONNAIRE FOR RESPONDENTS

Instructions: Please tick in the relevant box and fill in the blank spaces.

SECTION A: GENERAL INFORMATION

1. Gender

   Male ☐ Female ☐

2. Indicate your age bracket

   a) 21 – 30 years ☐

   b) 31– 40 years ☐

   c) 41 – 50 years ☐

   d) Above 51 years ☐

3. Highest Academic Qualifications

   KCSE ☐

   COLLEGE DIPLOMA ☐

   BACHELORS DEGREE ☐

   MASTERS DEGREE ☐

4. Years Spent In Food Production

   Please check in the box that best displays how many years you have been in this sector

   Below 5 years ☐

   6 – 10 years ☐

   11 – 15 years ☐

   16 – 20 years ☐

   21 years and above ☐

SECTION B: Performance of Food Production Projects in Kenya

5. Below are statements on food production projects in Kenya; please indicate the degree to which you agree using the following scale by ticking in the relevant box and fill in the blank spaces:

   {Tick (√) the appropriate column} **(1)** Strongly disagree **(2)** Disagree **(3)** Moderately agree **(4)** Agree **(5)** Strongly Agree

Food Production in Kenya	**1**	**2**	**3**	**4**	**5**
Implementation of food projects can lead to increased food production levels in Machakos County					
There is significant change in income (farmer's) acquired with the implementation of food production projects					
Food production projects largely lead to enhanced food security in Kenya					

6. Do you perceive that the implementation of food production projects can lead reduced food prices across the country?

   Ye s ☐

   No ☐

If No, why? Please give one reason.

.....

.....

SECTION C: Drought Management and Performance of Food Production Projects in Machakos County.

Below are statements on drought management and its influence on food production projects in Machakos County, Kenya; please indicate the degree to which you agree using the following scale by ticking in the relevant column.

{Tick (√): (1) Strongly disagree (2) Disagree (3) Moderately agree (4) Agree (5) Strongly Agree

Drought Management in Machakos County	**1**	**2**	**3**	**4**	**5**
There is an effective strategic plan to manage drought and its effects on food production projects					
The type of water resources in the county determines the effectiveness of drought management					
Compensation methods adopted in the county in relation to losses due to drought are timely and dependable					
Drought mitigation activities adopted are relevant to the food production situation in the county					

In your own opinion, which is the most effective method of water conservation currently being used in the county?

Dams ☐

Water Reservoirs ☐

Recycling Plants ☐

SECTION D: Extension Services and Performance of Food Production Projects in Kenya.

Kindly indicate which extension service provider you have interacted with

Pest Control ☐

Crop Diseases Officer ☐

Soil Science Officer ☐

Plant Cross-breeding ☐

GMO Officers ☐

Below are statements on agri-based Extension Services and its influence on food production projects in Machakos County, Kenya; Please indicate the degree to which you agree using the following scale by ticking the relevant box and fill in the blank spaces by ticking the appropriate column. {Tick (√):

(1) Strongly disagree (2) Disagree (3) Moderately agree (4) Agree (5) Strongly Agree

Extension Services in Machakos County	1	2	3	4	5
Extension service providers usually visit the project farms as frequently as required					
The extension officers are knowledgeable in relation to their specific area of service					
Training techniques used by the extension officers are effective and adoptable					
The training content being taught is relevant and appropriate to the problems being addressed					

Are all the issues being experienced in food production in the county being represented by the different extension service providers?

Yes ☐

No ☐

If No, why? Please give one reason.

……

……

SECTION E: Crop Pests and Diseases and Performance of Food Production Projects in Machakos County

Below are statements on crop pests and diseases and food production in Kenya; please indicate the degree to which you agree using the following scale by ticking the relevant box:

{Tick (√) (1) Strongly disagree (2) Disagree (3) Moderately agree (4) Agree (5) Strongly Agree

Crop Pests and Diseases	1	2	3	4	5
The overall cost of the method a to deal with crop pests and diseases determines its adoption					
Awareness of the type of crop pests and diseases raising concerns determines the intervention to be taken					
Crop pests and diseases are a frequent concern to food production projects in Machakos County					

The type of chemical used to address the concern of crop pests and diseases is determined by?

Cost ☐

Availability ☐

Experience ☐

Effectiveness ☐

Environmental Effects ☐

To what extent has technology been adopted to address the concerns of pests in the farms?

No Extent ☐

Small Extent ☐

To Some Extent ☐

High Extent ☐

Which technology is this?

……..……

……

SECTION F: Crop Improvement Strategies and performance of food production projects in Machakos County.

Below are statements on Crop Improvement Strategy and food production in Kenya; Please indicate the degree to which you agree using the following scale by ticking relevant column:{Tick (√) (1) Strongly disagree (2) Disagree (3) Moderately agree (4) Agree (5) Strongly Agree

Crop Improvement Strategy	1	2	3	4	5
The current inter-crop breeding technology has improved food production in Machakos County					
Plant genetics development is being influenced by availability of skilled labour					
The type of irrigation method being employed determines the level of particular food crop production					
Increase or decrease of food crop quality production depends on the type farming fertilizer used					

In your opinion, the most effective food crop storage facility depends on?

Building Materials ☐

Location of facility ☐

Crop being stored ☐

Frequency of use ☐

Thank you very much you for your participation and cooperation.

APPENDIX 3: PLAGIARISM REPORT

FACTORS INFLUENCING FOOD PRODUCTION IN MACHAKOS SUB-COUNTY: A CASE OF KENYA CEREAL ENHANCEMENT PROJECT AND CLIMATE RESILIENT AGRICULTURAL LIVELIHOODS, MACHAKOS COUNTY, KENYA

ORIGINALITY REPORT

%14	%10	%2	%6
SIMILARITY INDEX PAPERS	INTERNET SOURCES	PUBLICATIONS	STUDENT

PRIMARY SOURCES

1	www.cdc.gov Internet Source	%1
2	**Error! Hyperlink reference not valid.** Internet Source	%1
3	www.bankofagricultureng.com Internet Source	%1
4	www.moaf.gov.bt/moaf/?wpfb Internet Source	%1
5	www.undp.org/content/dam Internet Source	%1
6	http://www.scribd.com/doc Internet Source	%1
7	http://www.adb.org/sites	

	Internet Source	%1
8	http://www.fao.org Internet Source	< %1
9	Submitted to Saint Paul University Student Paper	< %1
10	http://oar.icrisat.org Internet Source	< %1
11	Submitted to Monmouth University Student Paper	< %1
12	Submitted to University Malaysia Pahang Student Paper	< %1
13	Submitted to Saint Paul University Student Paper	< %1
14	Submitted to Africa Nazarene University Student Paper	< %1
15	Carrão, Hugo, Gustavo Naumann, and Paulo Barbosa. "Mapping global patterns of drought risk: An empirical framework based on sub-national estimates of hazard, exposure and vulnerability", Global Environmental Change, 2016. Publication	< %1
16	http://www.cropsreview.com Internet Source	< %1

17 Submitted to University of Nairobi
Student Paper
< %1

18 Submitted to Kenyatta University
Student Paper
< %1

19 Submitted to Higher Education Commission Pakistan
Student Paper
< %1

20 Submitted to Kenyatta University
Student Paper
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21 De Rosa, Marcello, Luca Bartoli, and Giuseppe La Rocca. "Testing Extension Services through AKAP Models", The Journal of Agricultural Education and Extension, 2014.
Publications
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22 Hawkins, Timothy G., Michael J. Gravier, David Berkowitz, and William A. Muir. "Improving services supply management in the defense sector: How the procurement process affects B2B service quality", Journal of Purchasing and Supply Management, 2015.
Publications
< %1

23 Green Manure/Cover Crop Systems of Smallholder Farmers
Student Paper
< %1

24 Submitted to Kenyatta University
Student Paper
< %1

25 Submitted to University of South Florida

	Student Paper	< %1
26	Submitted to Kenyatta University Student Paper	< %1
27	Submitted to African Population Health Research Centre Student Paper	< %1
28	http://www.iatp.org Internet Source	< %1
29	Submitted to Ghana Technology University College Student Paper	< %1
30	Submitted to University of Nairobi Student Paper	< %1
31	Submitted to Higher Education Commission Pakistan Student Paper	< %1

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