INFLUENCE OF ADOPTION OF AGRICULTURAL TECHNOLOGY ON FOOD SECURITY IN YALA TOWNSHIP LOCATION, SIAYA COUNTY, KENYA

BY

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A RESEARCH PROJECT REPORT SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTERS OF ARTS IN PROJECT PLANNING AND MANAGEMENT OF THE UNIVERSITY OF NAIROBI

2014
DECLARATION

This research report is my original work and has not been presented in any university for any award.

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I dedicate this work to my mother Anne Akinyi, my siblings and my late father.
ACKNOWLEDGEMENT

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<td>CPP</td>
<td>Crop Protection Products</td>
</tr>
<tr>
<td>GM</td>
<td>Genetically Modified</td>
</tr>
<tr>
<td>HPIK</td>
<td>Heifer Project International-Kenya</td>
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<tr>
<td>IDA</td>
<td>International Development Association</td>
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<td>NCPB</td>
<td>National Cereals and Produce Board</td>
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<tr>
<td>NGO</td>
<td>Non Governmental organization</td>
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<td>R&amp;D</td>
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ABSTRACT

In Siaya County, 37% of the county’s population is food insecure with about 58% rural inhabitants living below the absolute poverty. Food security has remained a challenge. Yala Township Location in Gem Sub County, which is the focus of the study, was the Location of choice because it has been a beneficiary of the Millennium Villages project (MVP). The purpose of the study is to examine the influence of agricultural technology adoption on food security in Yala Township Location. The study was centered on the following research objectives: To identify the extent to which the adoption of technologically enhanced inputs has influenced food security in Yala Township Location; To determine the extent to which adoption of quality crop has influenced food security in Yala Township Location; To identify the extent to which value addition on farm produce has influenced food security in Yala Township Location and To determine the extent to which agro-forestry has influenced food security in Yala Township Location. Descriptive survey research design was used in the study for a Target population of 6, 421 farming households in Yala Township Location. The proposed sample size was 364 respondents from Nyamninia, Jina, Marenyo, Sauri and Anyiko sub locations each with 13, 15, 18, 11 and 4 villages respectively. A questionnaire was used to collect both quantitative and qualitative data. The sample size of the study was 364 respondents. The split half technique of assessing reliability was used for the study. Data was analyzed using the Statistical Package for Social Sciences (SPSS, Version 17) to generate quantitative data and qualitative data. Correlation data analysis technique was organized in key thematic areas in line with the objectives of the study to enhance more understanding on the description of the quantitative findings. A systematic analysis and interpretation was undertaken to form the results. Multiple regression analysis was used to show the interrelationship between the variables in the conceptual framework. Findings of the study revealed that: majority 207(61.1%) of farmers in Yala Township Location did not adopt inorganic fertilizers as one of the technologically enhanced inputs. 202(59.6%) did not apply crop protection products on their farms. Majority of farmers 170(84.15%) who adopted crop protection products were satisfied with crop yields, indicating that application of crop protection products improved the quantity of yields. Majority of farmers 322(95%) did not practice irrigation; 15(4.5%) farmers who practiced irrigation were satisfied with yields. Majority of farmers 202(59.6%) did not practice soil conservation measures. Majority of farmers 311(91.8%) practiced value addition on farm produce. Majority 322(95%) of farmers in Yala Township Location who practiced value addition on farm produce didn’t go without food because there wasn’t enough, implying that there was enough food to be eaten courtesy of value addition on farm produce. Finally, majority 219(64.6%) of farmers in Yala Township Location practiced agro-forestry. Majority 210(62%) farmers who practiced agro-forestry did not borrow food from a friend or neighbour, indicating that they had enough food to eat as a result of practicing agro-forestry. Based on the study findings, the study recommends that: farmers should be encouraged to adopt the application of inorganic fertilizer in their farms in order to enhance the quantity of crop yield. A multi-prolonged awareness creation campaign strategy about the significance of irrigation should be initiated in Yala Township Location. Farmers should be advised to consistently practice value addition on farm produce in order to reap its benefit of increasing the longevity of crop life. Farmers should be encouraged to adopt agro-forestry in order to maintain the soil value which by extension manifests on boosting crop yield. Implementations of these recommendations would assist in redeeming food insecurity widely witnessed in Yala Township Location.
CHAPTER ONE
INTRODUCTION

1.1 Background of the study

More than 870m people globally do not have a secure source of food. In 1996 leaders at the World Food Summit in Rome set a goal of reducing the number of food-insecure people to 400m by 2015. (The Economist Intelligence Unit Limited, 2013). With an average of just 2.5 million people a year emerging from food insecurity during the last two decades, this target clearly will be missed. (Global Food security index, 2013). But although the scope of the problem, particularly in the developing world, remains vast, gains have been made, largely through poverty alleviation and innovations that improve market access, increase a household’s ability to purchase food and boost the availability of more nutritious crops (The Lancet, 2013).

According to the United states Department of Agriculture, International food security assessment, for 2013-2023 done by Meade et al., (2013), it is evident that by 2023, the number of food-insecure people is projected to increase nearly 23 percent to 868 million, slightly faster than population growth. As a result, the share of the population that is food insecure is projected to increase from 20.4% to 21.5%. The nutritional target is projected to increase 28 percent by 2023, meaning that food insecurity in these countries is expected to intensify over the next 10 years. Despite improvements over the years, Sub-Saharan Africa is projected to remain the most food-insecure region in the world (FAO, 2013).

Since the mid-1970s, the African continent has been the only region that has been unable to feed its own population. South Africa could face a plight similar to other sub-Saharan African countries. Currently there are approximately 14 million people in South Africa who are vulnerable to food insecurity and 1.5 million children under the age of 6 years who are stunted by chronic malnutrition (The Presidency, 2008). In the 2010/2011 financial year food security was reprioritized as one of the top priorities for South African government (Demetre et al., 2009). This is in line with South Africa’s millennium development goal which aims to halve the proportion of people who go hungry over the period 1990 and 2015 and to halve poverty and unemployment by 2014. The Department of Agriculture, Forestry and Fisheries (DAFF)’s major
role is, among others, to ensure that opportunities are created to encourage South African citizens to participate in agriculture and produce to reduce food insecurity in the country. The department has since initiated a number of programmes that are meant to contribute positively to food security in the country. The Food and Agricultural Organisation (FAO) report for 2008 indicates that international estimates of people experiencing chronic hunger increased dramatically over the period 1990 to 2007. According to the report the increase in numbers of chronically hungry people was due to increased food prices worldwide as a result of lower production of staple food around the world such as cereals. The price of oil also contributed to the high food prices in many parts of the world.

The United States (U.S.) has been pivotal to the crucial role of agricultural R&D in alleviating global hunger and addressing pervasive food security concerns. Moreover, as well as being directly useful to farmers around the world, many new ideas and innovations developed by U.S. scientists have been taken up at home and abroad by other scientists, spurring further rounds of innovation (International Food Policy Research Institute, 2000). Thus the global food-security consequences of U.S. agricultural R&D are realized in two important ways. First, U.S. agricultural R&D has fueled productivity growth in U.S. agriculture, which, given the importance of U.S. production in global food and feed staples such as corn, wheat, and soybeans, has been a significant element of growing food supplies globally (FAO, 2012). Second, R&D and technology spillovers from the United States to the rest of the world have had important implications for growth in supply of food and feed in the rest of world. Productivity growth in the United States and globally have been the main driver and have contributed enormously to growth in supply of food and fiber (Alston et al., 2000).

Israel, a desert nation once challenged by its arid geography and a population explosion, has developed a range of agriculture and water technologies that are already helping to feed the world and could provide solutions to many of these problems (Kam, 2011). For decades, Israeli agriculture experts have been sharing their expertise with some of the poorest regions on earth, creating sustainable self-sufficiency in food and water supplies. In recent years, Israeli expertise has been heavily in demand in India, Africa and China, home to more than half the world’s population. Israel’s cow yields amplify why (Kam, 2011). Israel is a world leader in agricultural
research and development which have led to dramatic increases in the quantity and quality of the country's crops. The drive to increase yields and crop quality has led to the development of new seed and plant varieties, as well as to innovations such as a soil conditioner substance (vermiculite) which, when mixed with local soils, boosts crop yields, and drip irrigation (Israel Central Bureau of Statistics, 2011).

In Israel, Netafim company pioneered the drip irrigation revolution, but has since widely expanded its offerings to include sprinklers, pipes, irrigation equipment, agricultural machinery, and more, many of them equipped with sensors that can read temperature, humidity, nutrient levels in the soil, whether a plant needs water, and other important data. The systems are controlled by software run from a server communicating with sensors in the field wirelessly, with the software providing instructions to each part of the system as to how much and when water should be dispensed (Shamah, 2013).

Over 50 years since its independence, India has made immense progress towards food security. Indian population has tripled, but food-grain production more than quadrupled: there has thus been substantial increase in available food-grain per capita (Chand, 2013). Today, India ranks second worldwide in farm output. Agriculture and allied sectors like forestry and fisheries accounted for 16.6% of the GDP in 2009, about 50% of the total workforce. (FAO, 2010) Irrigation in India refers to the supply of water from Indian rivers, tanks, wells, canals and other artificial projects for the purpose of cultivation and agricultural activities. In country such as India, 64% of cultivated land is dependent on monsoons (FAO, 2010).

In less than 30 years, Brazil has turned itself from a food importer into one of the world's great breadbaskets. It is the first country to have caught up with the traditional “big five” grain exporters (America, Canada, Australia, Argentina and the European Union). It is also the first tropical food-giant; the big five are all temperate producers (The economist, 2010). The increase in Brazil's farm production has been stunning. Between 1996 and 2006 the total value of the country's crops rose from 23 billion reais ($23 billion) to 108 billion reais, or 365%. Brazil increased its beef exports tenfold in a decade, overtaking Australia as the world's largest exporter. It has the world's largest cattle herd after India's. It is also the world's largest exporter of poultry, sugar cane and ethanol. Since 1990 its soya bean output has risen from barely 15m tonnes to over 60m. Brazil accounts for about a third of world soya bean exports, second only to
America. Brazil supplies a quarter of the world's soya bean trade on just 6% of the country's arable land (The economist, 2010).

Egyptian agriculture was transformed over the last century in large measure as a result of technological change. Technological changes included the switch from basin to perennial irrigation, mechanization, application of pesticides and chemical fertilizers, breeding new seed varieties, and, in the 1980s, the beginning of the use of drip irrigation and plastic greenhouses. At the core of these changes lay the shift from basin to perennial irrigation. Basin irrigation depended on the annual Nile flooding, usually in August and September. The floodwaters soaked the low-lying land, providing moisture for a single crop after they receded. The silt borne by the river renewed and enriched the soil. The area irrigated by the river's high waters was extended with canals and dikes.

Nigeria has the ambition of diversifying her economy from crude petroleum dependency. The country also faces a looming food security crisis with a growing population becoming increasingly dependent on imported foods. At the same time, the once dominant subsistence-oriented farm economy is at risk of gradual marginalization (Odjugo, 2010). Nigeria is pursuing a policy of investment in small farmers as the core of its food security strategy (Chinedum, 2011). The National Special Programme for Food Security (NSPFS) promoted technologies that enabled small farmers to increase productivity and income significantly by introducing double and triple cropping. It also helped develop rural communities by enhancing access to extension, credit, and marketing services and nutrition and health education. This integrated approach is now being implemented nationwide, with benefits for the economy as a whole, as well as for participating farmers. Nigeria has already achieved its MDG1 target and is on track to achieve its WFS target by 2015 (FAO, 2009). The development vision for 2020 by Nigeria’s government conceptualizes a transformation in agriculture that would ensure food security, the right to sustainable development for all and adaptation to the climate change challenge. The government's transformation programme is meant to wean Nigeria off food imports by boosting domestic food production (Chinedum, 2011). 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.
In Tanzania, IDA’s River Basin Management & Smallholder Irrigation project addressed water-related environmental concerns at the national level, with focus on particular problems in the two largest basins. It targeted improving water access and use by low-income smallholder farmers in 15 irrigation schemes through better water management, higher quality infrastructure, and improved stakeholder participation in water management (World Bank, 2004). About 5,317 farming families have benefited from improved irrigation and drainage facilities. Annual household incomes increased from US$425 to US$1,500 in Pangani river basin; and from US$350 to US$1,100 in Rufiji. Average rice yields in project areas more than doubled (World Bank, 2004).

In Kenya, the lack of rainfall or much scarcer rains have affected the region southeast of Nairobi. Maize harvests have been drastically reduced and about 400 farmers have grown cassava instead of the usual crop (Le Monde, 2011). Cassava needs less water than maize, as well as fewer pesticides. In order to avoid poisoning by cyanide (in the tubers), selected harmless varieties are distributed to farmers by the Kenya Agricultural Research Institute (KARI); the project is funded by the European Union. Another group of 560 farmers in the village of Mbuvo, south of Nairobi, were harvesting their first crop of cassava by the end of July 2011. They formed a cooperative in charge of collecting, weighing, washing, and peeling the tubers of cassava, before transforming them into a white powder that is dried on large wooden mats. The derived products are cassava flour, chips, animal feed, and meals made with cassava leaves (UNCTAD, 2013). The cooperative’s objective was to cultivate 300 hectares in 2012 thanks to the use of machinery, and later on, to export the products to southern Sudan, Germany, and the United Kingdom (Le Monde, 2011.)

In addition to cassava, KARI has been supporting the cultivation of another traditional drought tolerant crop, sorghum, in Eastern, Nyanza and Coast Provinces. In 2011, about 3,000 farmers were selling their production to local brewers. Food security has become a top priority and KARI’s research and extension work aimed at finding appropriate solutions in close collaboration with the farmers, particularly those working in a drought-prone environment (Le Monde, 2011).
1.2 Statement of the Problem

Food insecurity in the Sub-Saharan countries expected to intensify over the next 10 years and is projected to remain the most food-insecure region in the world by 2023, according to the International Food Security Assessment, 2013-2023 done by Meade et al., (2013). The current food insecurity problems are attributed to several factors, including the frequent droughts in most parts of the country, high costs of domestic food production due to high costs of inputs especially fertilizer, displacement of a large number of farmers in the high potential agricultural areas following the post-election violence which occurred in early 2008, high global food prices and low purchasing power for large proportion of the population due to high level of poverty (KARI, 2012).

Yala Township Location in Gem Sub County, which is the focus of the study, was the Location of choice because it has been a beneficiary of the Millennium Villages project (MVP) and with the largest market within Yala Division. The MVP deployed broad package of interventions in each village including distribution of fertilizers, improved planting material, agroforestry as well as agricultural extension for all villages for a period of five years after which the project was expected to be self-sustaining. About 11 million people in Kenya are undernourished even as Kenya celebrates 50 years of independence, the United Nations Food and Agriculture Organization estimates, with three in every four Kenyans having faced hunger in the last three years (FAO, 2013). Eastern Africa and the Sahel region had the highest incidence of people with stunted growth and of being underweight. This was attributed to higher prices with consumer shifting to cheaper, less-nutritious foods when prices are raised (The Business Daily Africa, 2013).

According to the Siaya County Agriculture Sector Development Strategy-SCASDS, (2013-2017), the Agriculture sector directly contributes 26% of the GDP and another 25% indirectly. Food security and poverty remains a major challenge, Siaya County absolute poverty is over 47% while 37% of the county’s population is food insecure with about 58% rural inhabitants living below the absolute poverty. Despite farmers in Siaya County having an average farm size of 1.02 Hectares, adoption of agricultural technologies has not been expeditious enough, even with successful practical examples of Irrigated rice fields in The Dominion Farms.
The County relies on rain-fed crop production which is sporadic in nature, consequently leading to seasonal food shortages and dependence on imported supplies from other counties and the neighbouring country of Uganda. However, promotion of Traditional High Value Crops, will be the most suitable enterprise for the County. Despite the moderate land sizes with potential for higher crop yields, low household incomes are still a major problem in this county. This is important, taking into consideration that the region has an average of 48% poverty level (SCASDS, 2013-2017). In general food insecurity in the County is linked to inadequate use of inputs, use of poor agricultural technologies, high dependency on rain-fed agriculture, low purchasing power, poor infrastructure and environmental degradation. The SCASDS envisions that farmers should engage in the production of crops like sorghum, millets, sweet potatoes, rice, groundnuts, cassava among others; since these crops are more suitable than commonly grown maize as the soils have sufficient fertility for their growth. This study therefore sought to investigate the influence of adoption of agricultural technologies on food security in Yala Township Location, Siaya County.

1.3 Purpose of the study

The purpose of the study was to examine the influence of agricultural technology on food security in Yala Township Location, Siaya County.

1.4 Objectives of the study

The study was guided by the following objectives:

i. To identify the extent to which the adoption of technologically enhanced inputs influence food security in Yala Township Location.

ii. To determine the extent to which adoption of quality crop technology influence food security in Yala Township Location.

iii. To identify the extent to which value addition on farm produce influence food security in Yala Township Location.

iv. To determine the extent to which agro-forestry influence food security in Yala Township Location.
1.5 Research questions

Based on these objectives, the following research questions were formulated:

i. To what extent does the adoption of technologically enhanced inputs influence food security in Yala Township Location?

ii. To what extent does the adoption of quality crop technology influence food security in Yala Township Location?

iii. To what extent does the adoption of value addition on farm produce influence food security in Yala Township Location?

iv. To what extent does the adoption of agro-forestry influence food security in Yala Township Location?

1.6 Significance of the study

Information obtained from the study would be significant to the farmers, extension agents, county Government planners, researchers and policy makers in various ways:

Policy makers would utilize the outcome of the study to improve existing policies to support agricultural technologies that increase household food security for marginalized farmers in order to meet the objectives of the Poverty Reduction Strategy (PRS).

The outcomes of the study would benefit entrenched authorities in the devolved counties, especially the Siaya County in that strategies may be put in place that enable the farmers play an active and motivated participatory role in decision making, planning, implementation and evaluation of best agricultural technologies that increase food security.

Other researchers and scholars would utilize the study as a reference material as it would reveal the influence of adoption of agricultural technology on food security in Yala Township Location.

1.7 Limitations of the study

Majority of farmers who were the main respondents were semi illiterate and aged. The researcher overcame this limitation by explaining to farmers the questions in the questionnaires. Another
limitation of the study was lack of guarantee of participation of households included in the study. The researcher overcame this by explaining the importance of the study to household members.

1.8 Delimitations of the study

The study targeted crop farmers using agricultural technology and were able to respond to the questionnaire. The study investigated the influence of adoption of agricultural technology on food security. The study was conducted in Yala Township Location which is one of the locations in Gem sub-county bordered by Central Gem Location, East Gem Location, Khisa West Location and Vihiga sub-county on the east.

1.9 Basic assumptions of the study

The following assumptions were made in the study: All respondents would be cooperative, honest and provide required data to address the research problem and to enable legitimate generalizations to be recommended. Agro ecological zone for the targeted population would be homogeneous with no physical / ecological factors playing a role in determining use of agricultural technologies. The study was also conducted under the assumption that there were insignificant variations in soil characteristics that could adversely affect crop yields.

1.10 Definition of Significant Terms

**Agricultural technology:** application of techniques to control the growth and harvesting of Crop products.

**Crop protection products:** also known as pesticides or agrichemicals comprise of natural and synthetic chemicals used to control insects, diseases and weeds in food crops and plants.

**Agro-forestry:** is an integrated approach of using the interactive benefits from combining trees and shrubs with crops.
Food security: is a condition that "exists when all people, at all times, have physical and economic active and healthy life", according to the Food and Agriculture Organization (FAO). Household food security exists when all members, at all times, have access to enough food for an active, healthy life.

High food security—Households had no problems, or anxiety about, consistently accessing adequate food.

Marginal food security—Households had problems at times, or anxiety about, accessing adequate food, but the quality, variety, and quantity of their food intake were not substantially reduced.

Low food security—Households reduced the quality, variety, and desirability of their diets, but the quantity of food intake and normal eating patterns were not substantially disrupted.

Irrigation: Involves the diversion of water from one area into a relatively small area for the purpose of supplementing available water for crops (FAO, 2001). The techniques of diverting the water include use of gravity through canals/pipes and lifting water through the use of pumps for application in the fields through various irrigation methods with the objective of increasing crop production (FAO, 2001).

Quality crop technology: this is the use of technology that ensures a crop stand that is not exposed to moisture stress or soil erosion.

Value addition: A deliberate activity which changes the form of the raw agricultural produce into a more refined or usable form thus increasing its value.
1.11 Organization of the study

The study was organized into five chapters. The first chapter detailed background of the study, purpose of the study, statement of the problem, objectives of the study, justification of the study, significance of the study, limitations and delimitations of the study, and definition of terms used in the study. The second chapter reviewed relevant literature that provided a framework which the data collected was contextualized. Chapter three covered the research methodology that was applied to collect, process and analyze data. Chapter four presented data analysis, presentation and interpretation. Chapter five provided the summary, discussions, conclusions and recommendations for further research.
CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter highlights the literature review, theoretical and conceptual frameworks related to the agricultural technology adoption and food security. The chapter also explores the concept of agricultural technology and its influence on yields.

2.2 Concepts of agricultural technology and food security

Despite many years of capital investment in agricultural research and technology development in Kenya, poverty and hunger still threaten human survival and livelihood. About 50% of rural household live below the poverty line. Information from the Kenya Agricultural Research Institute (KARI) indicates that many viable technologies that have been developed are currently not being applied by the farmers. This has led to farmers achieving as low as 6% of what is potentially possible (Salasya et al., 1998). For instance, in Kakamega district, while the potential yield of maize was 50-60 bags per hectare by research station standards, the average yield on farms was a meager 3 bags per hectare. This is one of the districts where between 50-60% of the population live below the poverty line (GoK, 1998). This particular example shows the magnitude of the problem facing poor households in accessing available technologies which can substantially alleviate food insecurity and poverty.

2.3 Adoption of technologically advanced inputs on food security

Worldwide, one-third of growth in cereal production can be attributed to fertilizer use. The contribution of inorganic fertilizer to yields and, subsequently, increased agricultural productivity is not disputed (Bumb, 1995).

In Africa, average fertilizer use is very low even by developing country standards: an average of 13 Kilograms per hectare (kg/ha) of arable land in Africa versus 94 kg/ha in all developing countries (Duflo, et al, 2008; Dercon and Christiaensen, 2007). In spite of low adoption rates, yield responses and economic returns to fertilizer use are often thought to be high. Duflo, et al,
For example, experimentally documented a mean seasonal return of 36 percent for Kenyan farmers using fertilizer in Busia District.

Given relatively low fertilizer uptake rates and diminishing returns, it is surprising that recent micro econometric studies found low yield response to fertilizer application (Yu et al., 2010; Asrat, et al, 2010). This may be partially explained by low levels of complementary input adoption and by widespread technical inefficiency. Fertilizer loses its effectiveness when soil organic matter falls below minimum levels, hence zones with serious soil degradation may have low capacity for fertilizer use. Land degradation due to soil fertility depletion in Ethiopia can cause significant decreases in agricultural productivity (Yesuf et al., 2005).

Only about 20 percent of the land in Kenya was considered medium to high potential agricultural land (Tabu et al, 2007). With high population growth, particularly in the agriculturally productive areas, farmers are forced to cultivate suboptimal agricultural land and use the same plots of land season after season without replenishing the soils through fallowing (Drechsel et al., 2001) analytically showed the strong significant relationship between population pressure, reduced fallow periods and soil nutrient depletion, much like what is happening in Kenya.

With evidence from Western Kenya, Marenya and Barrett, (2009) showed that fertilizer profitability is contingent upon soil fertility levels, meaning farmers with poor soils are less likely to use fertilizer and get caught in the “trap” of low productivity due to the quality of their soil (i.e., soil structure, pore space, water-holding capacity, ability to release nutrients into the soil). Not enough organic fertilizer exists to “fix” soil nutrient problems in Africa (Morris et al., 2007).

Key reasons for use of CPP include: to decrease and control pests and diseases, to reduce the need for crops and plants to compete with weeds and other invasive plants, to increase the yield of crops or protect biodiversity and to protect and maintain infrastructure such as buildings and roads through pest or weed control. Crop Life Australia, (2012) estimated that CPP increased Australian crop yields by about 40% as well as increasing the value of our production by around $13 billion each year (Crop Life Australia, 2012). Considerable research has been done in Europe regarding the feasibility of substituting mechanical tillage for all or some of the herbicide
applications. In general, mechanical tillage was not as effective in removing weeds with weed dry weight being 5 times higher than with herbicides (Endure, 2007). Less effective weed control means maize yields are lower without herbicides. Research in Italy with mechanical weed control produced maize yields 12.5% lower than chemical spraying (Balsari et al., 1993). Recent research had also shown that the mechanical operations may damage the maize crops resulting in yield loss. For example, harrowing for weed control covered the crop plants with soil for a few days and reduced maize growth (Endure, 2007). Mechanical weeding was found to be much more time consuming than herbicide application. Research in the E.U. estimated that substituting four tillage operations for 2 herbicide applications increased the time needed for weed control by 220% (Endure, 2007). Weeds are controlled with herbicides in all European regions on more than 90% of the maize production area (Meissle, et al., 2010). The maize growing areas in Europe are fertile, rain fed, and warm with large weed seed bank build up. As a result, 50-500 weed seedlings per square meter emerge to compete with the young crop (Sutton et al., 1999). Maize is sown at a low seed rate (8-10 plants per square meter) and young maize plants are especially intolerant of weed competition. Research in Germany showed a 70% reduction in maize yield when weeds were not controlled (Hoppe, 1998). Because of the extensive use of herbicides, maize losses to weeds are only 5% in the EU (Oerke et al., 1994).

In Kenya, future increases in maize production to meet domestic demand will have to rely on improvements in yield per hectare rather than on the expansion of maize production area. Enhanced maize productivity can be achieved by increased use of modern production techniques such as the adoption of hybrid maize varieties (Morris et al., 2007). Small-scale maize production plays a major role in Kenya’s maize economy and adoption of hybrid technology by small-scale farmers would have the potential to address sustainability and supply issues. However, such modern technologies are still rarely used by Kenya’s small-scale farmers, particularly by those in marginal areas.

The formal seed sector in Kenya is among the strongest and one of the best functioning seed sectors in sub-Saharan Africa. This is evidenced by the volume and level of diversity of the seed produced and availed in the market, the existing legislative and regulatory frameworks and the availability of a functioning certification system and procedures for testing and approval of new varieties (Wulf et al., 2006). According to Kenya Plant Health Inspectorate Services (KEPHIS)
Annual report (2010), there was a total of 111 maize varieties submitted for National Performance Testing (NPT) during the 2008–2009 period (Kenya Seed Company, 2010).

Whereas maize production had been generally fluctuating averaging 2 percent over the five years between 2001 and 2005, the marginal growth in production is driven more by use of productivity-enhancing technologies, than by increase in acreage (Smale & Jayne 2003, MoA, 2004). Among agricultural inputs, seed was recognized to have the greatest ability of increasing on-farm productivity since seed determines the upper limit of crop yields and the productivity of all other agricultural inputs (MoA, 2004). This means that to sustain as well as increase production volumes, it will be critical to find mechanisms that guarantee farmers access to high yielding certified seed varieties. Moreover, such a mechanism is paramount for successful variety improvement for sustainable agriculture (Hellin, 2007).

Cassava was widely seen as a potential remedial crop for smallholder farmers in sub-Saharan Africa due to its high productivity and low input requirements. Apart from being a food security crop, it thrives very well in resource-poor areas where land availability is declining (Scott et al., 2000). In Ghana, the annual per capita consumption of cassava is about 155 kg, which is one of the highest in the world (MoFA, 2009). Despite its food security role during periods of acute food shortages, the national average yield of cassava is about 14t/ha with a potential of increasing to over 47 t/ha through increased use of improved varieties and good management practices (MoFA, 2009). From 1997 to 2002, the growth rate of cassava was 6.56 % compared to 4.48 % from 2003 to 2009. Attempts over the years have been geared towards area expansion rather than increasing the yield per hectare (Nweke, 2004; IFPRI, 2007).

Soils in western Kenya and Uganda are predominantly Ferrasols, Acrisols and Nitisols; old weathered soils with small nutrient stocks. Without the use of fertilizers, the rapid depletion of soil nutrient stocks seems unavoidable with the new varieties.

Furthermore, Dercon and Hill (2009) in a recent paper on Ethiopia emphasize the complementarity of fertilizer with improved seeds varieties. They argue that in the case of Ethiopia available improved seeds offer yield gains of a smaller magnitude than Green
Revolution seeds such as IR8 rice in India and leave little scope for further fertilizer induced gains in productivity (Dercon and Hill 2009).

2.4 Adoption of Quality Crop Technology on food security

Hussain and Hunjra, (2004) noted that although irrigation water is only a single factor in poverty alleviation, it plays a disproportionately powerful role. Sally et al., (2003) conclude that smallholder agriculture intensification by improving the management and productivity of land and water in a sustainable manner is a solution for both poverty reduction and agricultural growth in sub-Saharan Africa. An important aspect of irrigation water management in crop production is to increase water productivity which is assessed through gain in crop yield per unit of irrigated water applied. A three-fold increase in irrigated rice yields per volume of water applied over the past two decades has been reported (Hong et al., 2000). The authors further reported a 16 percent increase in rice yields and a consequent 19 percent drop in land area planted to rice during the same period. The high increases in efficiency of production and hence significant savings in water resource are primarily attributed to, among other things, the simultaneous improvement in production practices such as use of suitable crop varieties and efficient fertilizer management. Thus, more efficient water use in agricultural systems is possible and will be achieved if management practices in crop production are improved as well (Fereres et al., 1992). The interactive effect of water and nutrient ions on crop growth and yield is an important consideration in any research aimed at improving biological and economic productivity in irrigation schemes. The greatest crop response to nitrogen has been observed to occur when water is not limiting.

Barau et al., (1999) stressed greater emphasis on irrigation development as a means of increasing food and raw material production as well as promoting rural development. Similarly, (Hussain, et al, undated) pointed out that agricultural water/irrigation has been regarded as a powerful factor for providing food security, protection against adverse drought conditions, increased prospects for employment and stable income, and greater opportunity for multiple cropping and crop diversification. Furthermore, (Hussain et al., undated) posit that access to reliable irrigation can enable farmers to adopt new technologies and intensify cultivation, leading to increased productivity, overall higher production, and greater returns from farming. This, in turn, opened
up new employment opportunities, both on-farm and off-farm, and could improve income, livelihoods, and the quality of life in rural areas. Generally, access to good irrigation allows poor people to increase their production and income, and enhances opportunities to diversify their income base, reducing vulnerability caused by the seasonality of agricultural production as well as external shocks. Thus, access to good irrigation has the potential to contribute to poverty reduction and the movement of people from ill-being to well-being (Hussain et al., undated). Manzungu & van der Zaag (1996) postulated that one of the strategies to reduce the incidence of food insecurity in smallholder communal areas which was also advocated for by the aid organizations, policymakers, academics and lay people is a production technology appropriate for low rainfall environments. The technology was on the form of smallholder irrigation schemes. Development of smallholder irrigation schemes increases the potential for more production by counteracting mid-season dry spells and some periodic dry spells. A cost benefit analysis performed by Sithole, (1995) indicated that irrigation increased household food security in the marginal to poor rainfall areas. The study also revealed that irrigation did not only improve the food security position of the level of the irrigators, but also the rest of the community benefited from these schemes. Sithole, (1995) also revealed that the incomes of the irrigators were higher than the incomes of the non irrigators.

The process of erosion leads to the gradual destruction of the soil's properties (Zachar, 1982; Cassol& Lima, 2003; Bertoni & Lombardi Neto, 2008), since it not only carries away soil particles but also nutrients, organic matter and pesticides (Bronick & Lal, 2005; Bertol et al., 2007), preventing or retarding the normal plant development (Montgomery, 2007). Soil erosion is directly influenced by climate, soil type, topography, land use and management. Human influence on the environment through farming activities accelerates erosive action, causing great damage. The accelerated erosion process occurs when the natural balance between soil loss and recovery is affected, with a variety of adverse effects, including economic losses (Morgan, 2005).

Soil loss by erosion tends to increase production costs in the medium and long term, with an increasing demand for liming and fertilizer applications and reduced operational efficiency of machines, incurring costs to control the situation (Uri, 2000; Bertoni& Lombardi Neto, 2008). This set of factors resulted in a drop in the soil's productive potential, which eventually led to a
drop in the land value (Knowler, 2004). Anthropogenic changes have often resulted in significant modifications of the soil productivity, either for better or worse (Knowler, 2004) and this has often obscured the dialog concerning soil conservation. There had been an inability to differentiate periodic investments for current production from investments targeting alterations in the basic soil structure (Ruttan, 2002). For Bennett, (1939), soil conservation was an issue of religion (faith and ethics) and economics (business and investment-return comparison). Following the same reasoning, Crosson, (2007) considered conservation to be a question of values: an investment to maintain the level of production, reduce the deterioration of productivity and increase productive potential. However, land cannot be considered in isolation. It only becomes productive when combined with work, capital, production materials and a management system (Uri, 1999; Chavas, 2001). A microeconomic analysis identified a variety of combinations of production factors, although for many agricultural producers, these factors can be fixed.

Thus, soil conservation programs involved intertemporal, interspatial and interpersonal comparisons (Pagoulatos et al., 1989; Popp et al., 2001), as well as differences between production levels and trends (Barbier, 1997; Bergsma, 2000). Barlowe, (1986), highlighted variations in future agricultural yields with and without investment in soil conservation. He stated that, if soil conservation is defined as the effort to modify a trend in soil productivity so as to make it better than it otherwise would be; this implied in a different distribution of investments and annual production than in cases in which the conservationist approach were not adopted. However, his analysis was carried out exclusively in terms of expected annual yield, and is valid only in these terms, since it does not take account of the possibility of land valuation as a result of the stabilization of productivity. If the land market were perfect, future differences in productivity would be directly reflected in current land value.

One important reason for conserving the soil was to increase earnings (Saliba, 1985; Pagoulatos et al., 1989). Due to the time lag between investment and production that conservation almost always involves, reliable comparisons should always be based on the current value and future costs (Hoag & Yong, 1986). This in turn necessarily involved a rate of interest or depreciation, which is always difficult to correctly assess (Wu et al., 1997). The balance between current values of investment and future earnings is a measure of the profitability of the conservation
program chosen (Bennett, 1940; Chavas et al., 1983; Uri, 1999), and therefore, in the majority of cases, is an extremely important if not decisive factor.

For many farmers, the rate of depreciation is a matter of intuition, not calculation and estimation. This explains the well-established fact that they prefer immediate returns, rather than future profits. But soil conservation, or the lack of it, is not based solely on profitability.

2.5 Adoptions of value addition on food security

Value addition to farm produce is key strategy to commercialize farming for small holder farmers in Africa. Processing, perishable farm produce reduce bulkiness, diversify consumption and enhance acceptability and marketability, increases shelf life hence contribute significantly to household food security and income generation since wastage is minimized (Ememwa et al., 2008). Ramirez (2001) found that value adding activities accounted for a 350 % increase in household incomes. In addition, value adding proved useful as a poverty reduction tool if it leads to increased on and off farm rural employment and income. Root and tuber crops such as cassava (Manihot esculenta Crantz) and sweet potato (Ipomea batatas) provide readily available sources of calories for much of the world’s population (Sue-Azam et al., 2003). These crops are widely cultivated in western Kenya and consumed mainly after boiling, roasting and/or chewed raw (KARI Annual report, 2005). Cassava and sweet potato are bulky and highly perishable.

Huntrods, (2009) further noted that in developing countries, sweet potatoes use has diversified considerably over the last four decades, having great potential as a source of local value-added products and ingredients. Some examples included food products like noodles and desserts; animal feed; and some industrial products such as flour, starch and pectin for local and export markets. Furthermore, sweet potato flour can be fermented to make products like soy sauce and alcohol, or if immediately cooked, it can be further processed into wine, vinegar and nata de coco, or “on-the-go,” a dessert popular in the Philippines and in Japan.

In Kenya, sweet potato is an important food crop utilized by most household and available almost year round. Therefore, it has the potential of bridging the food gap due to diversified processing utilization technologies that have been developed (Nungo et al., 2007). The sweet
potato root is consumed either in fresh, boiled or roasted forms among many rural farmers in Kenya (Owori and Hagenimana, 1998). The orange fleshed /yellow varieties not only contain high calorific value but are also rich in proteins and minerals (calcium, iron, riboflavin and thiamine). They also contain high levels of β-carotene, which is a precursor for Vitamin A (Nxumalo, 1998; Kamau, 2004). Sweet potato generally contains more starch than the potato, and the starch has properties that are especially useful in many food products and manufacturing processes (Huntrods, 2009).

2.6 Adoption of Agro-forestry on food security

Agro-forestry may represent a cost effective and sustainable complement, or in some cases a substitute, to the use of inorganic fertilizer, especially if fertilizer costs rise in the future (Ajayi, et al., 2008). Agro-forestry as practiced in Malawi is termed ‘fertilizer tree systems’. Selected tree and shrub species are planted either sequentially (during fallow) or contemporaneously (intercropped) with an annual food crop. This helps maintain soil cover, improves nutrient levels, increases soil organic matter improves water filtration, and provides a secondary source of food, fodder, fiber and fuel (Garrity, et al., 2010). Leguminous agro-forestry species are generally used due to their ability to fix atmospheric nitrogen in the soil in a form available to plants. In addition to offering potential food security benefits, agro-forestry goes some way towards countering deforestation, Kenya is estimated to have lost 6.5% of its forest cover between 1990 an 2010 (FAO, 2010).

Commonly used forms of Agro-forestry are Permanent tree intercropping, Sequential tree fallow, and Annual relay intercropping and biomass transfer. Permanent tree intercropping well researched agroforestry species is G. sepium. Trees are planted in rows and pruned 2 or 3 times a year. The resulting biomass is incorporated into the soil, improving topsoil nutrient levels and carbon content (Akinnifesi, et al., 2010; Garrity, et al., 2010). The most comprehensive testing of this system in Malawi was undertaken by Akinnifesi et al., (2006) in a ten year trial at Makoka Agricultural Research Station, Southern Malawi. The authors found that G. sepium intercropping increased yields by 300 percent on average over unfertilized control trials. This approach also outperformed mono cropped maize fertilized with half the recommended inorganic nitrogen. Although the trees require labor and space, labor poses little constraint in densely
populated Malawi, and the practice of pruning leads to a space efficient arrangement (Akinnifesi et al., 2010).

The benefits of sequential tree fallow can materialize not only through improved maize yields, but also through the potential for higher total calorie yields when edible legumes are used (C. cajan or groundnuts, for instance). Snapp and Silim (2002) reported on participatory trials involving 46 farmers in central and southern Malawi. They found that total calorie production could be boosted by 28 percent through the use of C. cajan rotations. In Annual relay intercropping, Key species used for this technique are the same as those used for sequential tree fallow: T. vogelii, S. sesban and C. cajan. The major advantage of this approach is that farmers do not have to fallow, or wait for an initial period of tree establishment. High population densities and very small farm sizes means that extended fallow periods are impractical in many parts of Malawi (Harrawa et al., 2006). The use of nutrient accumulating Tithonia diversifolia, G. sepium and Leucaena leucocephala in biomass transfer are reported to increase maize yields by 216, 140 and 86 percent, respectively, in Malawian field trials (Akinnifesi et al., 2008). However the labor involved in transferring biomass means that the practice is only profitable for higher valued crops such as vegetables (Sanchez, 2002). Agro-forestry thus increases soil quality and hence crop yields, this further ensures food availability and ultimately food security.

2.7 Theoretical framework

This study is inclined to adoption theory, developed by Everett Rogers, a professor of rural sociology in 1962. The diffusion theory, also known as the diffusion of innovations theory, is a theory concerning the spread of innovation, ideas, and technology through a culture or cultures. The theory has been extensively studied by sociologists, psychologists, and anthropologists. Diffusion theory states that there are many qualities in different people that cause them to accept or not to accept an innovation. There are also many qualities of innovations that can cause people to readily accept them or to resist them. According to diffusion theory, there are five stages to the process of adopting an innovation. The first stage is knowledge, in which an individual becomes aware of an innovation but has no information about it. Next is persuasion, in which the individual becomes actively interested in seeking knowledge about the innovation. In the third
stage, decision, the individual weighs the advantages and disadvantages of the innovation and decides whether or not to adopt it.

After the decision, comes implementation, in which the individual actually does adopt and use the innovation. Confirmation is the final stage. After making adopting the innovation, the individual makes a final decision about whether or not to continue using it based on his own personal experience with it. These same stages apply, to varying degrees, to groups of people in addition to individuals.

Rogers defines several intrinsic characteristics of innovations that influence an individual’s decision to adopt or reject an innovation. First, relative Advantage—How improved an innovation is over the previous generation. Second, compatibility—The level of compatibility that an innovation has to be assimilated into an individual’s life. Third, complexity or simplicity—If the innovation is perceived as complicated or difficult to use, an individual is unlikely to adopt it. Fourth, trialability—How easily an innovation may be experimented. If a user is able to test an innovation, its likelihood of adoption would increase. Finally, observability—The extent that an innovation is visible to others. An innovation that is more visible drives communication among the individual’s peers and personal networks and in turn create more positive or negative reactions.

The adoption theory is associated to this study because, the study seeks to investigate the extent to which agricultural technologies have been adopted amongst farmers in Yala Township Location and how it has influenced food security. The theory provided a basis to determine how different farmers’ adoption of the various agricultural technologies in Yala Township location has affected the crop yields and hence the influence on the food security situation.
Source: en.wikipedia.org

Fig 2.1 Adoption process
2.8 Conceptual framework

The study was guided by the following conceptual framework.

**Independent variables**

- Adoption of Technologically enhanced inputs
  - Inorganic fertilizers
  - Crop protection products
  - High yielding varieties

- Adoption of quality crop technology
  - Irrigation
  - Soil conservation measures

- Adoption of value addition on produce
  - Preservation
  - Processing
  - Packaging

- Adoption of Agro-forestry
  - Permanent tree intercropping
  - Sequential tree fallow
  - Annual relay intercropping
  - Biomass transfer

**Intervening variable**

- Government policies and programmes

**Dependent Variable**

- Food security
  - Number of meals per day

Fig 2.2: Self Conceptualized framework (2014)
The framework shows the relationship between various variables influencing food security. The independent variables are the adopted agricultural technologies that ensure food security in Yala Township location. These technologies include: advanced inputs, quality crop, value addition and agro forestry. These variables increase the productivity of crops per hectare hence they directly increase food availability which ultimately improves the food security situation. The intervening variable is the policies and programmes the government undertakes to ensure food security. The Kenya government policies and programmes are in support of the food security improvement and are the intervening variable. The policy interventions are categorized into three; supply related policies, Price related policies- include, Involvement of the NCPB in the purchase of maize form farmers at prices higher than market prices to provide incentive to producers. Income related policies- Government’s enhanced efforts to contribute the costs of social amenities e.g. through the free education programme and reduced costs of health at public health facilities. This enables the population especially the poor to have a little more disposal income to spend on food. The programmes ,Under the Vision 2030, the Government has identified the following flagship projects for implementation in a period of 5 years; Agricultural policy reforms ,Three-tiered fertilizer cost reduction, Branding Kenya farm produce, Establishment of livestock disease free zones and processing facilities, Creation of publicly accessible land registries, Development of agricultural land use master plan and Development of irrigation schemes (KARI, 2012).

2.9 Summary of Literature review

This chapter gives a review of pertinent literature related to the study and the theoretical and conceptual framework. Various agricultural technologies have been discussed and their influence on food security through high yields which directly affects food availability at household level. The study has also analyzed the different policies and programmes the Kenyan government has put in place to protect farmers from food insecurity.

Bumb, (1995) supports the contribution of inorganic fertilizer to yields. Duflo et al., (2008) and Drecon and Christiaensen (2007) indicate that despite low adoption rates of inorganic fertilizer use the yield responses and economic returns of fertilizer use are thought to be high. This study will highlight the contribution of fertilizer use on food security. According to Crop Life
Australia, (2012), considerable research has been done in Europe regarding the feasibility of substituting mechanical tillage for all or some of the herbicide applications. In line with Balsari et al, (1993), research done in Italy with mechanical weed control produced maize yields 12.5% lower than chemical spraying, this study seeks out the contribution of Crop protection products on food security.

Consistent with Smale and Jayne, (2003), marginal growth in maize productivity is driven more by productivity enhancing technologies, rather than by increasing acreage. As maintained by Hellin, (2007), it will be critical to find mechanisms that guarantee farmers’ access to high yielding varieties for sustainable Agriculture. In line with Uri, (2000) and soil loss by erosion tends to increase production costs by increasing demand for liming and fertilizer applications and reduced operational efficiencies of machines. Saliba, (1985) agrees that one important reason for conserving soil is to increase earnings. This study will ascertain the contribution of soil conservation on food security.

Hong et al., (2000) reported a 16% increase in rice yields and a 19% drop in land area planted during the same period following irrigation on the rice fields. Ememwa et al., (2008) and Ramirez, (2001) confirm that value adding activities increase household incomes by 350% and acts as a poverty reduction tool. Garrity et al., (2010) concurs that agro forestry helps maintain soil cover, improves nutrient levels, increase organic matter, improves water filtration and provides a secondary source of food, fodder fiber and fuel. FAO, (2010) indicates the contribution of leguminous agro forestry species to soil fertility through their ability to fix nitrogen in the soil, ultimately improving conditions for crop growth.

Adoption of Agricultural technologies will lead to improved food security this is because use of inorganic fertilizers, crop protection products, high yielding varieties, irrigation, soil conservation measures, drought resistant varieties, value addition and agro-forestry will directly increase the crop productivity per hectare.
CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction
This chapter describes methodology used to conduct the study in order to achieve the desired objectives. The chapter describes the research design, sample size selection, target population, research instruments, data analysis techniques and ethical considerations.

3.2 Research design
Descriptive survey research design was used in the study. This was because, descriptive survey design was appropriate for measuring characteristics of large population (Orodho, 2003). The design enabled the researcher to collect information by administering questionnaires to a sample of individuals. Through the design, the researcher collected both qualitative and quantitative data. This design fitted this study because detailed description of existing situation was required with an intention of justifying current adopted agricultural technologies in Yala Township Location (Cohen et al, 2000). The study used questionnaires to collect data on agricultural technologies which influence food security. Open ended sections of the questionnaire collected data on farmers’ opinion on the technologies they used and food security.

3.3 Target population
The study targeted farming households in Yala Township Location. Yala Township Location is densely populated with an estimated population of 30,398 people and 6,421 farming households. (SCASDS, 2013-2017).

3.4 Sample Size and sampling Techniques
Sampling is the process of selecting elements from a population in such a way that the elements selected represent the population. The sample size and sampling techniques are subsequently discussed.
3.4.1 Sample size

The proposed study targeted 364 respondents as recommended by Krejcie and Morgan (1970). The study employed the proportionate method of selecting samples from a given population. The distribution was based on the population of the farming households in Nyamninia, Jina, Marenyo Sauri and Anyiko Sub locations, in Yala Township Location.

3.4.2 Sampling Techniques

There were five Sub-locations in Yala Township Location, Nyamninia, Jina, Marenyo, Sauri and Anyiko Sub Locations. Respondents were apportioned to Sub-locations based on the number of the farming households that existed in the villages.

The study used simple random sample sampling technique to select 364 individuals from 6421 in the population. In each sub-location, the number of respondents chosen was based on the number of farming households. Simple random sampling enabled the researcher to grant each member of the population an equal and independent chance of being included in the sample (Oso and Onen, 2009). Table 3.1 shows how respondents were sampled.

Table 3.1: Table for Selecting Sample Size

<table>
<thead>
<tr>
<th>Sub location</th>
<th>Target population</th>
<th>Number of villages</th>
<th>Sample size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nyamninia</td>
<td>1198</td>
<td>13</td>
<td>68</td>
</tr>
<tr>
<td>Jina</td>
<td>1289</td>
<td>15</td>
<td>73</td>
</tr>
<tr>
<td>Marenyo</td>
<td>1739</td>
<td>18</td>
<td>99</td>
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<tr>
<td>Sauri</td>
<td>1101</td>
<td>11</td>
<td>62</td>
</tr>
<tr>
<td>Anyiko</td>
<td>1094</td>
<td>4</td>
<td>62</td>
</tr>
<tr>
<td>TOTAL</td>
<td>6421</td>
<td>61</td>
<td>364</td>
</tr>
</tbody>
</table>

In this study, 30% of the villages in each sub-location were randomly selected for sampling (Mugenda and Mugenda, 2003). In Nyamninia, Jina, Marenyo, Sauri and Anyiko Sub-locations 4, 5, 5, 3 and 1 villages were selected respectively. In each of the selected villages, a list of farming households for the villages was used to select the respondents. This was done using the systematic random sampling technique to obtain the village sample. The study used purposive sampling technique to sample at least one sub–chief who was also a farmer in each sub-location. In instances where the sub chief was not a farmer, one village elder was included in the sample. This allowed the researcher to use respondents that had the required information with respect to the objectives of the study (Mugenda and Mugenda, 2003).

3.5 Research instruments

A questionnaire was used to collect both quantitative and qualitative data. 364 questionnaires were administered to respondents; literate respondents had self administered questionnaires while interviews were conducted to illiterate and semi illiterate respondents. The questionnaire was organized into sections to capture all the concepts and answer all the research questions. Section one sought demographic information, section two contained information on the adoption of technologically advanced inputs, section three solicited information on adoption of quality crop, section four captured information on adoption of value addition, section five contained information on adoption of agro-forestry, finally, section six sought information influence of government policies and programmes.

3.5.1 Pilot testing

A pilot study was carried out in the neighbouring Central Gem Location. The location had close proximity to the area of study and shared the same climatic conditions. Nachmias and Nachmias (1996) noted that pilot testing is an important step in the research process because it reveals vague questions and unclear instructions in the instrument. It also captures important comments and suggestions from the respondents that enable the researcher to improve the efficiency of the research instrument and adjust strategies and approaches to maximize response rate. 36 farming households were administered with the questionnaire (Mugenda and Mugenda, 2003). Responses generated by the pilot test was coded, analyzed and interpreted to confirm whether the research questions were answered correctly. The same instruments were administered to same farming
households after four weeks. The results obtained were discussed jointly with University of Nairobi supervisors to determine content validity and to ascertain whether the questionnaire was reliable. Questions that were ambiguous were corrected in order to generate required responses.

3.5.2 Validity of instruments

Validity of research instruments is a measure of the extent to which the instruments measure what they are intended to measure (Kathuri and Pals, 1993). It is the degree to which the results obtained from data analysis actually represent the phenomenon under the study (Mugenda and Mugenda, 2003). The validity of research instruments was established by conducting a pilot study. In this study content validity was determined by consulting the judgment of research supervisors from University of Nairobi. The supervisors, reviewed the instrument, recommended the corrections and verified whether the instruments were able to address the objectives of the study.

3.5.3 Reliability of instruments

Reliability asserts to measure the extent to which the research instrument yields consistent results in repeated trials (Carmines and Zeller, 1979). The split half technique of assessing reliability was used as it only required one testing session. The study preferred the technique because it eliminated errors due to the subjects ease in remembering responses from the first test. Through split half technique, one scale was developed for each variable. The scale was then sub-divided into two halves which were simultaneous i.e odd verses even numbers and then scored separately for each subject. The split half procedure is based upon a correlation between scores obtained on only half of the test. The spearman-Brown Prophecy formula is used to make corrections as follows:

\[ R = \frac{2r}{1+r} \]

Where \( R \) is the corrected reliability

\( r \) is the reliability coefficient from the original calculation
According to Mugenda and Mugenda (2003), a coefficient of 0.8 or more implies that there is a high degree of reliability. In this study, the researcher obtained a correlation co-efficient of 0.83. This implied that the instruments were reliable.

3.6 Data Collection Procedures

The researcher approached the National Council for science and technology for a permit to conduct the research in Yala township location, Siaya County. The researcher then issued a copy of the permit to the sub-county Agriculture Officer who granted autonomy and protection to the research team. 5 research assistants were recruited. Training of research assistants on administration of questionnaires was conducted. Sections of the questionnaires that were not clear to the research assistants were clarified by the researcher. Each research assistant was assigned one sub-location to administer questionnaires to the respective selected sample population. The questionnaires were checked for completeness before data entry.

3.7 Data Analysis Techniques

Once data had been collected, questions in the questionnaire were coded and data analyzed using the Statistical Package for Social Sciences (SPSS, Version 17) to generate quantitative data where tables with frequencies and percentages were produced. Qualitative data was organized in key thematic areas in line with the objectives of the study to enhance more understanding on the description of the quantitative findings. A systematic analysis and interpretation was undertaken to form the results. Multiple regression analysis was used to show the interrelationship between the variables in the conceptual framework.

3.8 Ethical considerations

In my bid to uphold confidentiality and achieve ethics during the research, respondents were given a free-will to participate voluntarily in the study. Respondents were no coerced to provide information required by the researcher. Farmers who were non-adopters of modern agricultural technologies were treated with equal respect in order to redeem the feeling that they were failures. Respondents were assured of confidentiality prior to administration of the data collection tools. Only generalized reports of the data analysis were done and no information
leaked to any source with or without the consent of the respondents. Research benefits were made clear to the respondents in order to achieve their full participation. Traditions beliefs, value systems, taboos were identified and appreciated to ensure respect of Luo culture where the study was conducted.
CHAPTER FOUR
DATA ANALYSIS, PRESENTATION, INTERPRETATION AND DISCUSSIONS

4.1 Introduction

This chapter presents findings of the study which have been discussed under thematic sub-sections in line with the study objectives. The thematic areas include: Questionnaire return rate; Demographic characteristics of the respondents, adoption of technologically enhanced inputs and food security in Yala Township Location, adoption of quality crop technology and food security in Yala Township Location, adoption of value addition on farm produce and food security in Yala Township Location and finally, adoption of agro-forestry and food security in Yala Township Location.

4.2 Questionnaire Return Rate

The study targeted 364 respondents; only 339 respondents were able to respond to the instruments giving a response rate of 93.13%. The study managed to get this high response rate due to proper organization of the field work and the efficiency of research assistants after conducting a successful pilot survey. The high questionnaire return rate was also attributed to the respondents’ cooperation, adequate time allowed for the completion of questionnaires and the consistent follow-ups made by the researcher and research assistants. This return rate was acceptable because it was above 60% return rate recommended by Amin (2005). According to Mugenda and Mugenda (2003), a response rate of 50% is adequate for analysis and reporting, while a response rate of 60% is good and that of 70% and above is very good. The response rate of 93.13% achieved in this study was indeed sufficient for analysis and reporting.

4.3 Demographic Characteristics of Respondents

Respondents in the study were farming households in Yala Township Location. The researcher sought to establish the distribution of respondents’ gender, age, length of stay of farmers in farming, size of farm and highest completed level of education. Respondents’ were therefore asked to provide the necessary demographic data. Results were presented and discussed in the following subsequent sub-themes:
4.3.1 Distribution of Respondents by Gender

Gender refers to socially constructed roles, behavior, activities and attributes that a particular society considers appropriate for men and women. The researcher felt that it was necessary to establish the distribution of respondents by gender in order to gauge whether gender disparity and stereo-typing of gender roles still exist in Yala Township Location. In lieu of this, respondents were asked to state their gender. Their responses were as presented in Table 4.1.

Table 4.1: Distribution of Respondents by Gender

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>182</td>
<td>53.7</td>
</tr>
<tr>
<td>Female</td>
<td>157</td>
<td>46.3</td>
</tr>
<tr>
<td>Total</td>
<td>339</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Source: Field Survey Data (2014)

As witnessed in Table 4.1, out of participants who participated in the study, 182(53.7%) were male while 157(46.3%) were female. Findings of the study show that there were slightly more male farmers than female in Yala Township Location. It can be deduced from the study that farmers in Yala Township are near gender parity, an attribute which shows that stereo-typing of roles among the genders was not common in Yala Township Location.

4.3.2 Distribution of Respondents by Age.

The study sought to determine the ages of respondents who participated in the study. This was considered important as it could reveal information on the age bracket of the respondents who largely took part in the study. Hence, a question was posed to find out the age of respondents in the questionnaire. The results were as reflected in Table 4.2.
Table 4.2: Distribution of Respondents by Age

<table>
<thead>
<tr>
<th>Age Category</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-25</td>
<td>18</td>
<td>5.3</td>
</tr>
<tr>
<td>26-35</td>
<td>84</td>
<td>24.8</td>
</tr>
<tr>
<td>36-45</td>
<td>80</td>
<td>23.6</td>
</tr>
<tr>
<td>46-55</td>
<td>85</td>
<td>25.1</td>
</tr>
<tr>
<td>56 and above</td>
<td>72</td>
<td>21.2</td>
</tr>
<tr>
<td>Total</td>
<td>339</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Source: Field Survey Data (2014)

Out of 339 respondents who participated in the study, minority 18(5.3%) fell within the age bracket of 15-25 years, 84(24.8%) fell within the age category of 26-35 years, 80(23.6%) fell within the age range of 36-45 years, 85(25.1%) fell within the age bracket of 46-55 years. Finally, 72(21.2%) fell within the age category of 56 and above years. Results of the study reveal that majority 249(73.5%) of farmers in Yala Township Location were mature in age ranging between the ages of 26-55 years. These active age enabled farmers to participate effectively on farming activities. It is assumed that the younger the farmer, the more likely he/she is to adopt innovations early in his/her respective life cycle (Rogers, 1995). Older farmers may have a shorter time horizon and be less likely to invest in novel technologies. Alexander and Van Mellor (2005) found that GM corn adoption increased with age for younger farmers as they gain experience and increase their stock of human capital but declines with age for those farmers closer to retirement.

4.3.3 Length of Stay of Farmers in Farming

The researcher sought to establish the length of stay (duration) of farmers in farming. Equipped with this information, the researcher would be in a better position of establishing whether
farmers’ duration in farming impacted on food security. For this reason, respondents were asked to state their length of stay in farming. Their responses were as summarized in Table 4.3.

Table 4.3: Duration of Engagement in Farming

<table>
<thead>
<tr>
<th>Duration of Engagement</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>up to 1 year</td>
<td>34</td>
<td>10.0</td>
</tr>
<tr>
<td>2-3 years</td>
<td>70</td>
<td>20.6</td>
</tr>
<tr>
<td>4-5 years</td>
<td>32</td>
<td>9.4</td>
</tr>
<tr>
<td>6 years and above</td>
<td>203</td>
<td>60.0</td>
</tr>
<tr>
<td>Total</td>
<td>339</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Source: Field Survey Data (2014)

Results obtained in Table 4.3 reveal that, out of 339 respondents who participated in the study, minority 34(10%) had practiced farming in less than 1 year, 70(20.6%) had practiced farming for 2-3 years. 32(9.4%) had pursued farming for 4-5 years while majority 203(60.0%) had engaged in farming for more than 6 years. Based on the results of the study, the researcher concluded that majority of farmers in Yala Township Location had engaged in farming for more than 6 years.

4.3.4 Farm Sizes of Farmers

The researcher was interested in establishing the farm sizes of farmers. Knowledge of farm sizes of farmers could place the researcher in a better position of ascertaining whether it influenced the provision of food security to farmers. For this reason farmers were asked to indicate the sizes of their farms in acres. Findings were as summarized in Table 4.4.
### Table 4.4: Farm Sizes of Farmers

<table>
<thead>
<tr>
<th>Farm Size</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1 acre</td>
<td>288</td>
<td>85.0</td>
</tr>
<tr>
<td>2-3 acres</td>
<td>35</td>
<td>10.3</td>
</tr>
<tr>
<td>more than 3 acres</td>
<td>16</td>
<td>4.7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>339</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

*Source: Field Survey Data (2014)*

Out of 339 farmers who participated in the study, majority 288(85%) owned farm sizes between the range of 0-1 acres, 35(10.3%) owned farm sizes ranging from 2-3 acres while minority 16(4.7%) owned more than 3 acres. Results obtained from the study revealed that few farmers in Yala Township Location practiced farming on a large scale on more than 3 acre parcels of land while majority, practiced farming on small parcels of land ranging between 0-1 acres.

A basic hypothesis regarding technology transfer is that the adoption of an innovation will tend to take place earlier on larger farms than on smaller farms. It has been hypothesized that larger farmers would be more receptive to innovation than their smaller neighbors and that this was largely due to cost issues. Just, Zilberman, and Rausser (1980) and Feder and O’Mara (1981) demonstrated that given the uncertainty and the fixed transaction costs associated with adopting innovations, there may exist a critical lower limit on farm size that prevents smaller farms from adopting. As these costs increase, the critical size also increases. Thus, innovations with large fixed transaction and/or information costs are less likely to be adopted by smaller farmers (Fernandez-Cornejo & McBride, 2002; Fernandez-Cornejo et al., 2007). Breustedt, et al., (2008), in a German study forecasting the adoption of GM oilseed rape, found that farm size had a positive effect on adoption. Marra, et al., (2001) found that farm size had a positive influence on the adoption of Bt cotton in the Southeast United States. Fernandez-Cornejo, et al., (2002), in a US study of the adoption of herbicide-tolerant (HT) soybeans, found that adoption rates increased with the size of the farm operation.
This implied that most farmers could only sustain the provision of adequate food (food security), by adopting agricultural technology that were not cost intensive due to the smaller land sizes. Farmers with larger land sizes could easily adopt cost intensive agricultural technology due to availability of enough space (farm sizes) in which farming could be practiced. The average land holding in Siaya County is 1.02 Ha, SCASDS, (2013-2017).

4.3.5 Distribution of Respondents by Highest Completed Level of Education

The study sought to establish the highest completed level of education of respondents who participated in the study. This was considered important as it could reveal information on the role of education in facilitating the adoption of agricultural technology. In lieu of this, respondents were asked to state their highest completed level of education. Their responses were as depicted in Table 4.5.

Table 4.5: Distribution of Respondents by Highest Completed level of education

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>No formal education</td>
<td>59</td>
<td>17.4</td>
</tr>
<tr>
<td>Primary</td>
<td>134</td>
<td>39.5</td>
</tr>
<tr>
<td>Secondary level</td>
<td>113</td>
<td>33.3</td>
</tr>
<tr>
<td>College/university</td>
<td>33</td>
<td>9.7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>339</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

Source: Field Survey Data (2014)

As depicted in Table 4.5, out of 339 respondents who took part in the study, 59(17.4%) indicated that they had not gone through formal education, 134(39.5%) asserted that their highest completed level of education was primary, 113(33.3%) said that their highest completed level of education was secondary. Finally, minority 33(9.7%) affirmed that their highest completed level of education was college/university. Based on the results of the study, the researcher concluded...
that majority of farmers in Yala Township Location had primary and secondary levels of education. These levels of education provided adequate background for farmers to embrace the modern agricultural technologies in farming.

The human capital of the farmer is also assumed to have a significant bearing on the decision to adopt new technologies. Most adoption studies have attempted to measure human capital through the farmer’s age and their education or years of experience growing the crop (Fernandez-Cornejo et al., 2007). Education of the farmer has been found to have a positive effect on adoption of GM oilseed rape in Germany (Breustedt et al., 2008) and on Bt and HT corn adoption in the United States (Fernandez-Cornejo & McBride, 2002; Marra et al., 2001). It is assumed here that more years of education will increase the probability of adoption, as better educated farmers (farmers with some third-level qualification) can be expected to be more aware of the positive benefits associated with new GM technologies. In addition, if the farm operator has formal agricultural education it is assumed that he/she will be more likely to innovate due to the higher associated skill level. The agricultural system in which the farmer primarily specializes is likely to also influence the farmer’s agricultural experience and human capital. The particular soil type on the farm may also influence the adoption decision and account for any potential regional differences.

4.4 Adoption of Technologically Enhanced Inputs and Food Security in Yala Township Location

The first objective of the study sought to identify the extent to which the adoption of technologically enhanced inputs influences food security in Yala Township Location. In order to achieve this objective, farmers were asked to react to several questions intended to solicit information from them on how technologically enhanced inputs facilitated the provision of food security in Yala Township Location. For in-depth coverage of this theme, the researcher further sub-divided it into various sub-themes which include: adoption of inorganic fertilizers, adoption of crop protection products and adoption of high yielding varieties.

4.4.1 Adoption of Inorganic Fertilizers

Inorganic fertilizers are one of the technologically enhanced inputs which can be embraced by farmers. The researcher was interested in establishing whether farmers in Yala Township
Location applied inorganic fertilizers on their farms. A question which required farmers to qualify whether they used inorganic fertilizers or not, attracted responses depicted in Table 4.6.

**Table 4.6: Application of Inorganic Fertilizer in the Farm**

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>132</td>
<td>38.9</td>
</tr>
<tr>
<td>No</td>
<td>207</td>
<td>61.1</td>
</tr>
<tr>
<td>Total</td>
<td>339</td>
<td>100.0</td>
</tr>
</tbody>
</table>

*Source: Field Survey Data (2014)*

Results captured in Table 4.6 reveal that, 132(38.9%) farmers in Yala Township Location acknowledged that they indeed applied inorganic fertilizers in their farms. However, majority of farmers 207(61.1%) opined that they did not apply inorganic fertilizers on their farms. Findings of the study revealed that majority 207(61.1%) of farmers in Yala Township Location did not adopt inorganic fertilizers as one of the technologically enhanced inputs. Such farmers were deprived from tapping the advantages associated with inorganic fertilizers in boosting crop yields. This confirms the findings of Duflo *et al.*, 2008 that, in Africa, average fertilizer use is very low even by developing country standards. In spite of low adoption rates, yield responses and economic returns to fertilizer use are often thought to be high, Dercon and Christiaensen,(2007)

**4.4.1.1 Satisfaction with Yields when Inorganic Fertilizers were applied**

The researcher further prompted farmers to indicate whether they were satisfied with yields when technologically enhanced inputs like inorganic fertilizers were applied on the farms. This was because the researcher was interested in establishing the effect of inorganic fertilizers on crop yields. Respondents gave various sentiments as summarized in Table 4.7
### Table 4.7: Satisfaction with Yields when Inorganic Fertilizers are applied

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>119</td>
</tr>
<tr>
<td>No</td>
<td>13</td>
</tr>
<tr>
<td>Total</td>
<td>132</td>
</tr>
</tbody>
</table>

**Source:** Field survey Data (2014)

Out of 132 farmers applied inorganic fertilizer on their farms, 119 (90.15%) were satisfied with crop yields when they applied inorganic fertilizers in their farms, 13 (9.85%) were dissatisfied with crop yields when they applied inorganic fertilizers in their farms. While responding to an open ended question in the questionnaire, majority of farmers who asserted that they were satisfied with crop yields upon application of inorganic fertilizers further explained that the number of bags they obtained increased compared to when inorganic fertilizers were not used. This phenomenon confirms that application of inorganic fertilizers impact positively on crop yields, sentiments shared by Bumb, (1995) who asserted that the contribution of inorganic fertilizer to yields and, subsequently, increased agricultural productivity is not disputed. According to Yesuf et al., (2005), fertilizer loses its effectiveness when soil organic matter falls below minimum levels, thus explaining the dissatisfaction with yields with the adoption inorganic fertilizer.

The researcher further cross-tabulated application of inorganic fertilizers with food security (number of meals per day) in order to establish whether their existed any association between the two variables. Results were as captured in Table 4.8.
Table 4.8: Cross Tabulation of Application of Inorganic Fertilizer and Number of Meals per day

<table>
<thead>
<tr>
<th></th>
<th>Number of meals per day</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>3</td>
<td>Total</td>
</tr>
<tr>
<td>Apply inorganic fertilizer</td>
<td>Yes</td>
<td>132</td>
<td>2(0.58%)</td>
<td>130(38.42%)</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>207</td>
<td>197(58%)</td>
<td>10(3%)</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>339</td>
<td>227</td>
<td>112</td>
</tr>
</tbody>
</table>

Source: Field Survey Data, 2014

Out of 339 farmers who participated in the study, 132 (39%) acknowledged that they applied inorganic fertilizer on their farms while majority 207(61%) held a contrary opinion. Out of the 132 farmers who confessed that they applied inorganic fertilizer on their farms, majority 130(38.42%) managed three meals per day, an aspect which signifies food security where as 2 (0.58%) only managed two meals per day. On the other hand, out of 207 farmers who said that they did not apply inorganic fertilizers on their farms, majority 197(58%) took two meals per day, a condition which translates to lack of food security while 10(3%) managed three meals per day. Based on the results obtained from the study, the researcher concluded that application of inorganic fertilizer improved the quantity of crop yields which by extension enhances food security. The researcher further conducted a correlation analysis between the application of inorganic fertilizer and food security in order to establish the relationship between the two variables. Results were as depicted in Table 4.9.
As indicated in Table 4.9, the Pearson correlation co-efficient obtained was 0.0000 which is less than the significant level of 0.01 indicating that application of inorganic fertilizer enables farmers to afford balanced meals in the last 12 months, an indication of food security. This correlation validates findings in Table 4.8 which revealed that 132 out of 339 farmers who applied inorganic fertilizers on their farms managed three meals per day, a scenario which signals food security.

### 4.4.2 Adoption of Crop Protection Products

The researcher was interested in ascertaining whether the adoption of crop protection products facilitated the provision of food security by farmers in Yala Division. For this reason, farmers were asked to indicate whether adoption of crop protection products influenced food security or not. Responses from farmers were as depicted in Table 4.10.
Out of 339 farmers who participated in the study, 202 (59.6%) acknowledged that they applied crop protection products on the farm while 137 (40.4%) did not apply crop protection products on the farm. Findings of the study revealed that majority of farmers 202 (59.6%) did apply crop protection products on their farms.

4.4.2.1 Satisfaction with Yields when Crop Protection Products were applied

After establishing that 202 (59.6%) farmers applied crop protection products in their farms, the researcher went further to probe these farmers in order to establish whether they were satisfied with yields when crop protection products were used. They gave various sentiments as presented in Table 4.11.

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>202</td>
</tr>
<tr>
<td>No</td>
<td>137</td>
</tr>
<tr>
<td>Total</td>
<td>339</td>
</tr>
</tbody>
</table>

Source: Field Survey Data (2014)
As indicated on Table 4.11, out of 202 farmers who applied crop protection products, 170(84.15%) were satisfied with the crop yield in the last harvest while 32(15.85%) were not satisfied with the yield. Findings of the study revealed that majority of farmers 170(84.15%) who adopted crop protection products were satisfied with crop yields, indicating that application of crop protection products improved the quantity of yields. This is in agreement with a study by Crop Life Australia,(2012) which indicated that CPP use increased crop yields by about 40%. In order for the researcher to establish whether crop protection products influenced the provision of food security among farmers in Yala Township Location, the researchers cross tabulated application of crop protection products with number of meals per day which is an indicator of food security. Results were as presented in Table 4.12.

Table 4.11: Satisfied with the yield received in the last harvest when crop protection products were applied

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>170</td>
</tr>
<tr>
<td>No</td>
<td>32</td>
</tr>
<tr>
<td>Total</td>
<td>202</td>
</tr>
</tbody>
</table>

Source: Field Survey Data (2014)
Table 4.12: Cross-Tabulation of Application of Crop Protection Products and the Number of Meals Per day

<table>
<thead>
<tr>
<th></th>
<th>Number of meals per day</th>
<th>2</th>
<th>3</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apply crop protection products</td>
<td>Yes</td>
<td>202</td>
<td>12(3.5%)</td>
<td>190(56.5%)</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>137</td>
<td>110(32%)</td>
<td>27(8%)</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>339</td>
<td>171</td>
<td>168</td>
</tr>
</tbody>
</table>

As indicated in Table 4.12, out of 202 (60%) farmers who acknowledged that they adopted crop protection products in their farms, majority 190 (56.5%) echoed that they afforded three meals per day an indication of food security, only 12 (3.5%) farmers took two meals per day. On the other hand, out of 137 (40%) farmers who did not apply crop protection products on their farms, majority 110 (32%) only managed two meals per day while 27 (8%) managed three meals per day. Findings of the study revealed that application of crop protection products which is one of the technologically enhanced inputs influenced food security. This is justified by the fact that majority of farmers who adopted crop protection products could afford three meals per day while their counter parts who did not apply crop protection products only managed two meals per day. Results of this study concurs with that of ENDURE, (2007) which revealed that mechanical weeding was much more time consuming than herbicide application. Research in the E.U. estimated that substituting four tillage operations for 2 herbicide applications increased the time needed for weed control by 220%.

4.4.3 Adoption of High Yielding Varieties

The researcher enquired from farmers whether they planted high yielding varieties of crops. This was done with a bid of establishing whether high yielding varieties of crops planted by farmers enabled them maximize their harvest and thus by extension guaranteed them food
security. In lieu of this, farmers were asked to indicate whether they planted high yielding varieties of crops. Their responses were as captured in Table 4.13.

### Table 4.13: Adoption of High Yielding Varieties

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>237</td>
<td>70</td>
</tr>
<tr>
<td>No</td>
<td>102</td>
<td>30</td>
</tr>
<tr>
<td>Total</td>
<td>339</td>
<td>100.0</td>
</tr>
</tbody>
</table>

**Source:** Field Survey Data (2014)

As reflected in Table 4.13, out of 339 farmers who participated in the study, 237(70%) acknowledged that they planted high yielding varieties of crops. 102(30%) held a contrary opinion. Results reflected in Table 4.13 reveals that majority of farmers planted high yielding varieties of crops.

#### 4.4.3.1 Satisfaction with Yields when High Yielding Varieties were planted

The researcher went further to probe farmers to indicate whether they were satisfied with harvest when they planted high yielding varieties of crops were used. This was done with the intention of establishing whether the high yielding varieties of crops planted by farmers enabled farmers to maximize their harvest and by extension guaranteed them food security. Results were as depicted in Table 4.14.
Table 4.13: Adoption of High Yielding Varieties

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>237</td>
<td>70</td>
</tr>
<tr>
<td>No</td>
<td>102</td>
<td>30</td>
</tr>
<tr>
<td>Total</td>
<td>339</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Source: Field Survey Data (2014)

As reflected in Table 4.13, out of 339 farmers who participated in the study, 237(70%) acknowledged that they planted high yielding varieties of crops. 102(30%) held a contrary opinion. Results reflected in Table 4.13 reveals that majority of farmers planted high yielding varieties of crops.

4.4.3.1 Satisfaction with Yields when High Yielding Varieties were planted

The researcher went further to probe farmers to indicate whether they were satisfied with harvest when they planted high yielding varieties of crops were used. This was done with the intention of establishing whether the high yielding varieties of crops planted by farmers enabled farmers to maximize their harvest and by extension guaranteed them food security. Results were as depicted in Table 4.14.
Out of 237 farmers who planted high yielding varieties of crops in their farms, 200 (84.39%) were satisfied with the yield while 37 (15.61%) were not satisfied with the yield obtained from the farm. Results obtained from the study revealed that majority of farmers who planted high yielding varieties of crops were satisfied with the harvest they received from the farm. This implies that planting high yielding varieties of crops influenced the provision of food. The findings are in agreement with Morris et al., (2007) which states that enhanced maize productivity can be achieved by increased use of modern production techniques such as the adoption of hybrid maize varieties.

The researcher went further to establish whether planting high yielding varieties of crops had any influence on food security (number of meals per day). For this reason, a cross-tabulation of high yielding varieties of crops with the number of meals taken per day was done. Table 4.15 captures the results obtained from the study.

### Table 4.14: Satisfied with the yield received in the last harvest when high yielding varieties were planted

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>200</td>
</tr>
<tr>
<td>No</td>
<td>37</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>237</strong></td>
</tr>
</tbody>
</table>

*Source: Field Survey Data (2014)*
Table 4.15: Cross-Tabulation of High Yielding Varieties and the Number of Meals Per day

<table>
<thead>
<tr>
<th>Adoption of high Yielding varieties</th>
<th>Number of meals per day</th>
<th>2</th>
<th>3</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>237</td>
<td>13(4%)</td>
<td>224(66%)</td>
<td>237(70%)</td>
</tr>
<tr>
<td>No</td>
<td>102</td>
<td>96(28.3%)</td>
<td>6(1.7%)</td>
<td>102(30%)</td>
</tr>
<tr>
<td>Total</td>
<td>339</td>
<td>109</td>
<td>230</td>
<td>339(100%)</td>
</tr>
</tbody>
</table>

**Source:** Field Survey Data (2014)

Out of 237 (70%) farmers who planted high yielding varieties of crops, majority 224(66%) managed to take three meals per day. On the other hand, 13 (4%) farmers managed to take two meals per day. Majority of farmers who did not adopt high yielding varieties 96(28.3%) were food insecure since they could only afford two meals per day while only 6(1.7%) could afford 3 meals per day. Results depicted in Table 4.15 reveal that adoption of high yielding varieties of crops by farmers guaranteed food security. This can be justified by the fact that majority of farmers who planted high yielding varieties of crops on their farms managed to take three meals per day, a clear indication of food security. Results of this study are in agreement with Morris *et al* (2007) study which concluded that enhanced maize productivity can be achieved by increased use of modern production techniques such as the adoption of hybrid maize varieties. Small-scale maize production plays a major role in Kenya’s maize economy and adoption of hybrid technology by small-scale farmers address food sustainability which by extension results in food security.

4.5. Adoption of Quality Crop Technology and Food Security in Yala Township Location

The second objective of the study sought to determine the extent to which adoption of quality crop technology influenced the provision of food security in Yala Township Location. In order to achieve this objective, respondents were subjected to several questions requesting them to indicate whether adoption of quality crop technology influenced food security. For an in-depth
analysis of this theme, the researcher further sub-divided it into various sub-themes which include: adoption of irrigation and adoption of soil conservation measures.

4.5.1 Adoption of Irrigation

Irrigation is a means of providing water to crops other than relying on the natural rains. It enables farmers to provide water to crops continuously. Through irrigation, farmers ensure that crops are not deprived of the much needed water. The researcher was interested in examining whether farmers in Yala Township Location adopted irrigation on their farms. For this reason, the researcher requested farmers to indicate whether they practiced irrigation on their farms. Results were as captured in Table 4.16.

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>17</td>
</tr>
<tr>
<td>No</td>
<td>322</td>
</tr>
<tr>
<td>Total</td>
<td>339</td>
</tr>
</tbody>
</table>

Source: Field Survey Data (2014)

Out of 339 respondents who participated in the study, 17(5.0%) practiced irrigation while 322(95%) did not practice irrigation. Results of the study revealed that majority of farmers in Yala Township Location 322(95%) did not practice irrigation; only 17(5.0%) farmers practiced irrigation. The findings are concurrent with those of, Fernandez-Cornejo & McBride, (2002); Fernandez-Cornejo et al., (2007) that states; innovations with large fixed transaction and/or information costs are less likely to be adopted by small scale farmers, who are the majority in Yala Township. This explains why most farmers in Yala Township Location did not adopt irrigation due high initial capital investment involved to enable farmers to provide a continuous supply of water to crops.
4.5.1.1 Satisfaction with Yields when Crops were irrigated

The researcher went further to probe farmers who adopted irrigation whether they were satisfied with crop yields. This was done with a bid of establishing whether irrigation impacted on crop yields. Results obtained were as summarized in Table 4.1.

Table 4.17: Satisfied with the yields received in the last harvest when Crops were Irrigated

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>17</td>
</tr>
<tr>
<td>No</td>
<td>322</td>
</tr>
<tr>
<td>Total</td>
<td>339</td>
</tr>
</tbody>
</table>

Source: Field Survey data (2014)

As depicted in Table 4.17, out of 339 farmers who participated in the study, 17(5.0%) were satisfied with yields when crops were irrigated while 322(95%) could not notice any impact on crop yields since they did not adopt irrigation. This observation suggests that most farmers in Yala Township Location did not embrace irrigation. This is contrary to Hussain and Hunjra (2004) which noted that irrigation plays a disproportionately powerful role in boosting crop yield. Furthermore, Hussain et al.,(undated) posit that access to reliable irrigation can enable farmers to adopt new technologies and intensify cultivation, leading to increased productivity, overall higher production, and greater returns from farming. This, in turn, opened up new employment opportunities, both on-farm and off-farm, and could improve income, livelihoods, and the quality of life in rural areas. Generally, access to good irrigation allows poor people to increase their production and income, and enhances opportunities to diversify their income base, reducing vulnerability caused by the seasonality of agricultural production as well as external shocks. Thus, access to good irrigation has the potential to contribute to poverty reduction and the movement of people from ill-being to well-being.
In order for the researcher to establish the significant role played by irrigation on food security, the researcher cross-tabulated adoption of irrigation by farmers with number of meals per day which is an aspect of food security. Results were as captured in Table 4.1.

Table 4.18: Cross-Tabulation of Adoption of irrigation and the Number of Meals Per day

<table>
<thead>
<tr>
<th>Number of meals per day</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Adoption of Irrigation</th>
<th>2(0.5%)</th>
<th>3(4.5%)</th>
<th>Total (5%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>17</td>
<td>15</td>
<td>17</td>
</tr>
<tr>
<td>No</td>
<td>322</td>
<td>306</td>
<td>322</td>
</tr>
<tr>
<td>Total</td>
<td>339</td>
<td>312</td>
<td>339 (100%)</td>
</tr>
</tbody>
</table>

Source: Field Survey Data (2014)

Out of 17(5%) farmers in Yala Township Location who adopted irrigation in their farms, majority 15(4.5%) afforded three meals per day. However, 2(0.5%) farmers only afforded two meals per day. On the other hand, out of 322 (95%) farmers who did not adopt irrigation in their farms, majority 306(90%) afforded only two meals per day while 16(5%) managed three meals per day. Findings of the study revealed that adoption of irrigation by farmers enhanced food security. This can be validated by the fact that majority of farmers who consented that they adopted irrigation on their farms afforded three meals per day, an indication of food security. On the contrary, majority of farmers in Yala Township Location who did not adopt irrigation on their farm only managed two meals per day, an indication that they were deprived of food as a result of non adoption of irrigation on their farms. Findings of this study explain why majority of farmers in Yala Township Location witnessed food insecurity. The researcher recommends that a multi-prolonged awareness campaign on importance of irrigation on food provision should be initiated in Yala Township Location to enable farmers appreciate the need of adopting irrigation on their farms.
4.5.2 Adoption of Soil Conservation Measures

Soil conservation means engaging on ways which enable the soil maintain its quality/value. It is one of the modalities used by farmers to enhance the quality of crop yield. According to Barlowe (1986), soil conservation is defined as the effort to modify a trend in soil productivity so as to make it better than it otherwise would be. The researcher was interested in ascertaining whether farmers in Yala Township Location Practice soil conservation on their farms. For this reason, farmers were requested to indicate whether they practiced soil conservation or not. They gave various sentiments as presented in Table 4.19.

Table 4.19: Practice Soil Conservation Measures in the Farm

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>137</td>
<td>40.4</td>
</tr>
<tr>
<td>No</td>
<td>202</td>
<td>59.6</td>
</tr>
<tr>
<td>Total</td>
<td>339</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Source: Field Survey Data (2014)

Out of 339 farmers who participated in the study, 137(40.4%) acknowledged that they practiced soil conservation measures in the farm. Majority of farmers 202(59.6%) did not practice soil conservation measures. Some of the soil conservation measures practiced by farmers include: grass strips, terraces, contour ploughing, cut off drains etc.

4.5.2.1 Satisfaction with yields when soil conservation measures were used

After establishing that 137(40.4%) farmers in Yala Township Location practiced soil conservation measures, the researcher further prompted respondents in order to ascertain whether the farmers who used soil conservation measures were satisfied with crop yields they obtained from the farms. This was done with a bid of establishing whether soil conservation measures
impacted positively on provision of sufficient food. Results of the study were as depicted in Table 4.20.

Table 4.20: Satisfaction with yields when soil conservation measures were used

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>82</td>
</tr>
<tr>
<td>No</td>
<td>55</td>
</tr>
<tr>
<td>Total</td>
<td>137</td>
</tr>
</tbody>
</table>

Source: Field Survey Data (2014)

As depicted in Table 4.20, out of 137 farmers who practiced soil conservation measures on their farms, majority 82(59.86%) were satisfied with crop yield obtained from the farm whereas 55(40.14%) were not satisfied with crop yield obtained from the farm. Results obtained from the study revealed that practice of soil conservation measures by farmers impacted positively on crop yields. This by extension implied that soil conservation measures practiced by farmers enhanced the provision of food.

In order for the researcher to establish the linkage between soil conservation measures and food security, the researcher cross-tabulated adoption of soil conservation measures with food security (number of meals per day). The results obtained from the study were as presented in Table 4.21.
Out of 137(40%) farmers who confessed that they practiced soil conservation measures on their farms, majority 115(34%) managed three meals per day while 22 (6%) only managed two meals per day. On the same breath, out of 202(60%) farmers who said that they did not practice soil conservation measures, majority 186 (55%) could only afford two meals per day, only 16(5%) managed three meals per day. Based on the findings of the study, the researcher concluded that practice of soil conservation measures by farmers supported production of sufficient food. This is because, majority of farmers who practiced soil conservation measures managed three meals per day, an indication of food security. On the contrary, majority of farmers who did not practice soil conservation measures only managed two meals per day. This is a perfect condition of lack of food security. Findings of this study are in line with the (Saliba, 1985; Pagoulatos et al., 1989) report which revealed that conserving the soil increases its capability of producing more crop yields.

4.6 Adoption of Value Addition on Farm Produce and Food Security in Yala Township Location

The third objective of the study sought to identify the extent to which value addition on farm produce influenced the provision of food security in Yala Township Location. In order to achieve this objective, Farmers were requested to respond to several questions which solicited information from them to indicate the extent to which value addition on farm produce influenced the provision of food security. The researcher sub-divided this theme into sub-themes for ease of

<table>
<thead>
<tr>
<th>Soil conservation measures</th>
<th>2</th>
<th>3</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>137</td>
<td>22(6%)</td>
<td>115(34%)</td>
</tr>
<tr>
<td>No</td>
<td>202</td>
<td>186(55%)</td>
<td>16(5%)</td>
</tr>
</tbody>
</table>

**Source:** Field Survey Data (2014)
understanding. These sub-themes include: practice of value addition on farm produce, influence of value addition on food security.

4.6.1 Practice of Value Addition on Farm Produce

Value additions are preservation strategies/methods adopted by farmers to enable harvested crops stay longer after harvesting until the next season. In order to ascertain whether farmers practiced value addition on farm produce, they were asked to validate whether they practiced value addition on their farm produce or not. They gave various sentiments as illustrated in Table 4.22.

Table 4.22: Practice of Value Addition on Farm Produce

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>311</td>
<td>91.8</td>
</tr>
<tr>
<td>No</td>
<td>28</td>
<td>8.2</td>
</tr>
<tr>
<td>Total</td>
<td>339</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Source: Field Survey Data (2014)

Table 4.22 reveals that, out of 339 farmers who participated in the study, 311(91.8%) consented that they practiced value addition on farm produce while 28(8.2%) asserted that they did not practice value addition on farm produce. Findings of this study revealed that majority of farmers 311(91.8%) practiced value addition on farm produce. Farmers can practice value addition on farm produce through different forms, these include: preservation-sun/air drying, dusting with chemical/ash and smoking. Processing –grinding, blending as well as Packaging-industrial packaging and homemade packaging.

4.6.2 Influence of Value Addition on Food Security

After establishing that majority of majority of farmers practiced value addition on farm produce, the researcher further prompted farmers in order to gauge whether value addition on farm produce enhanced food security. In order to capture this important information, the researcher
cross-tabulated adoption of value addition of farm produces with food security (number of meals per day). Results were as depicted in Table 4.23.

**Table 4.23: Cross-Tabulation of Adoption of Value Addition of Farm Produce and the Number of Meals Per day**

<table>
<thead>
<tr>
<th>Number of meals per day</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Adoption of value addition on farm produce</td>
<td>No 28</td>
</tr>
<tr>
<td></td>
<td>Yes 311</td>
</tr>
<tr>
<td>Total</td>
<td>68</td>
</tr>
</tbody>
</table>

*Source: Field Survey Data (2014)*

Table 4.23 reveals that, out of 311 (91.8%) farmers who adopted value addition on their farm produce, 44 (13%) took two meals per day where as majority 267 (78.8%) managed to take three meals per day, an indication of food security. However 28 (8.2%) farmers did not adopt value addition, only 4 (1.2%) managed three meals a day and 24 (7.0%) could afford two meals a day. Results of the study indicate that adoption of value addition on farm produce by farmers positively impacted on the number of meals taken per day. This implied that value addition by farmers on farm produce influenced food security (number of meals taken per day). Results of this study is in line with findings of Ememwa et al (2008) which concluded that processing, perishable farm produce reduce bulkiness, diversify consumption and enhance acceptability and marketability, increases shelf life hence contribute significantly to household food security and income generation since wastage is minimized.

The researcher further calculated the standard deviation of the different forms of value addition on farm produce in order to gauge whether they had any relationship with food security. Findings were as depicted in Table 4.24
Table 4.24: Descriptive Statistics of the different Forms of Value Addition on Farm Produce

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preservation- sun/air drying</td>
<td>339</td>
<td>1</td>
<td>1</td>
<td>1.00</td>
<td>.000</td>
</tr>
<tr>
<td>Dusting with chemicals/ash</td>
<td>339</td>
<td>1</td>
<td>1</td>
<td>1.00</td>
<td>.000</td>
</tr>
<tr>
<td>Smoking</td>
<td>339</td>
<td>1</td>
<td>2</td>
<td>1.95</td>
<td>.219</td>
</tr>
<tr>
<td>Grinding</td>
<td>339</td>
<td>2</td>
<td>2</td>
<td>2.00</td>
<td>.000</td>
</tr>
<tr>
<td>Blending</td>
<td>339</td>
<td>2</td>
<td>2</td>
<td>2.00</td>
<td>.000</td>
</tr>
<tr>
<td>Industrial Packaging</td>
<td>339</td>
<td>2</td>
<td>2</td>
<td>2.00</td>
<td>.000</td>
</tr>
<tr>
<td>Homemade packaging</td>
<td>339</td>
<td>2</td>
<td>2</td>
<td>2.00</td>
<td>.000</td>
</tr>
</tbody>
</table>

Source: Field Survey Data (2014)

As depicted in Table 4.24, the standard deviation of all forms of value addition practiced by farmers except smoking was 0.000 signifying that the different forms of value addition on farm produce practiced by farmers positively influenced food security in terms of household food availability.

4.7 Adoption of Agro-forestry and Food Security in Yala Township Location

The fourth and last objective of the study sought to determine the extent to which agro-forestry influenced the provision of food security in Yala Township Location. In order to achieve this objective, farmers were subjected to different questions meant to ascertain whether practice of agro-forestry influenced the provision of food security. This theme was further discussed in details under different sub-themes. These include: practice agro-forestry, influence of agro-forestry on food security.
4.7.1 Practice Agro-forestry

The researcher inquired from respondents whether they practiced agro-forestry. This was because; the researcher was interested in establishing whether practice of agro-forestry by farmers in Yala Township Location influenced the provision of food security. To achieve this, respondents were asked to indicate whether they practiced agro-forestry or not. Their responses were as represented in Table 4.25.

**Table 4.25: Practice Agro-forestry**

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>219</td>
<td>64.6</td>
</tr>
<tr>
<td>No</td>
<td>120</td>
<td>35.4</td>
</tr>
<tr>
<td>Total</td>
<td>339</td>
<td>100.0</td>
</tr>
</tbody>
</table>

*Source: Field Survey Data (2014)*

Out of 339 farmers who participated in the study, 219(64.6%) practiced agro-forestry while 120(35.4%) did not practice agro-forestry. Findings of this study revealed that majority 219(64.6%) of farmers in Yala Township Location practiced agro-forestry. On further prompting, farmers asserted that the different forms of agro-forestry they practiced in Yala Township Location include: permanent tree intercropping, sequential tree fallow, annual relay intercropping and biomass transfer.

4.7.2 Influence of Agro-forestry on Food Security

In order to establish the relationship between agro-forestry and food security, a cross-tabulation of agro-forestry with food security (number of meals per day) was conducted. Findings were as depicted in Table 4.26.
As depicted in Table 4.26, out of 219(64.6%) farmers who acknowledged that they adopted agro-forestry on their farms, majority 210(62%) managed three meals per day. Only 9(2.6%) farmers in this cadre afforded only two meals per day. On the other hand, out of 120(35.4%) farmers who did not adopt agro-forestry, majority 102(30%) only managed two meals per day while 18(5.4%) afforded three meals per day. Results of the study indicate that adoption of agro-forestry by farmers positively influenced food security (number of meals per day). This can be justified from the fact that majority of farmers who adopted agro-forestry managed three meals per day while majority of their counterparts who failed to adopt agro-forestry only managed two meals per day. Results of this study validates sentiments of Garrity, et al., (2010) in their study on agro-forestry as practiced in Malawi which revealed that trees and shrub species planted either sequentially (during fallow) or contemporaneously (intercropped) with an annual food crop helped in maintaining soil cover, improved nutrient levels, increased soil organic matter, improved water filtration and provided a secondary source of food, fodder, fiber and fuel. The researcher finally conducted a multi-correlation analysis of all the variables of agricultural technology in order to establish how they influenced food security (number of meals per day). The results were as depicted in Table 4.27.
As revealed in Table 4.27, the value of all the determinants of agricultural technology were 0.000 far below the significant level of 0.05 indicating that all the determinants of agricultural technology i.e application of inorganic fertilizer, application of crop protection products in the farm, irrigation, practice of soil conservation measures in the farm and practice of agro-forestry all positively influenced food security (number of meals per day).

4.8 Adoption of Government Policies and Programmes and Food Security in Yala Township Location

The researcher looked at policies and programmes put in place by the Government in the Ministry of Agriculture which enabled farmers to sustain the production of food in Yala Township Location. These policies and programmes include: extension services, cheaper fertilizer and seed from NCPB, local authority transfer fund, one acre fund, reduced treatment
costs at public health facilities, free education. The details were further discussed in the subsequent sections.

4.8.1 Extension Services and Food Security in Yala Township Location

The researcher examined whether extension services, one of the policies and programmes put in place by the Government influenced the production of food in Yala Township Location. For this reason, farmers were requested to rate the services they had received from the Government in support to food production. They gave various sentiments as presented in Table 4.2.

Table 4.2: Extension Services Received from the Government

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>26</td>
<td>7.7</td>
</tr>
<tr>
<td>Very Poor</td>
<td>313</td>
<td>92.3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>339</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

*Source: Field Survey Data (2014)*

Table 4.2 reveals that majority 313 (92.3%) of farmers in Yala Township Location rated the extension services they received from the Government in support of food production as poor. Only 26(77%) of farmers in Yala Township Location were satisfied with the extension services from the Government in support to food production and rated the services as excellent. As depicted from the findings of the study, majority of farmers in Yala Township Location were dissatisfied with extension services from the Government in support to food production. This implied that the Government demonstrated weak support to farmers in the provision of extension services.

In order to relate the effect of the extension services provided by the Government to farmers, the researcher cross-tabulated extension services provided by farmers with the frequency of missing food. Results were as reflected in Table 4.29
Table 4.29: Cross-Tabulation of Extension Services from the Government and Frequency of Missing Food

<table>
<thead>
<tr>
<th>Extension services from the government</th>
<th>Frequency of missing food</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Almost every month</td>
<td>N/A</td>
</tr>
<tr>
<td>Excellent</td>
<td>0</td>
<td>26</td>
</tr>
<tr>
<td>Very Poor</td>
<td>287</td>
<td>26</td>
</tr>
<tr>
<td>Total</td>
<td>287</td>
<td>52</td>
</tr>
</tbody>
</table>

Source: Field Survey Data (2014)

Out of 26 farmers who consented that extension services they received from the Government was excellent, none missed food on the table. Out of 313 farmers who confessed that extension services they received from the Government were very poor, majority (287) missed food almost every month. The results of the study reveal that extension services provided by the Government had an impact on food production. These can be justified by the fact that all the 26 farmers who rated extension services from the Government as excellent never missed food on the table while 287 farmers who rated the extension services from the Government as very poor missed food almost every month.

4.8.2 Cheaper Fertilizer and Seed from NCPB and Food Security in Yala Township Location

Cheaper fertilizer and seed from NCPB is among the policies and programmes put in place by the Government to support farmers in their endeavor to maximize food production. Farmers were requested to rate the services they had received from the NCPB in terms of provision of cheaper fertilizer and seed. Table 4.30 represents sentiments from farmers.
Table 4.30: Cheaper Fertilizer and Seed from NCPB

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>12</td>
<td>3.5</td>
</tr>
<tr>
<td>Very Good</td>
<td>18</td>
<td>5.4</td>
</tr>
<tr>
<td>Good</td>
<td>19</td>
<td>5.6</td>
</tr>
<tr>
<td>Very Poor</td>
<td>290</td>
<td>85.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>339</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

Source: Field Survey Data (2014)

As witnessed in Table 4.30, out of 339 farmers who participated in the study, 12(3.5%) rated the services provided by NCPB as excellent, 18(5.4%) rated the services provided by NCPB as very good, 19(5.6%) rated the services provided by NCPB as good while majority of farmers 290(85.5%) rated the services provided by NCPB as very poor. Results obtained from Table 4.26 reveals that majority of farmers in Yala Township Location were not satisfied by the services rendered by NCPB in terms of provision of cheaper fertilizer and seeds.

In order to relate the influence of provision of cheaper fertilizer and food from NCPB on the provision of food security in Yala Township Location, the researcher cross-tabulated cheaper fertilizer from NCPB with frequency of missing food. Results were as depicted in Table 4.31.
As reflected in Table 4.31, all the farmers who rated the services rendered by NCPB in terms of provision of cheaper fertilizer and seeds as excellent, very good and good respectively never missed to put food on the table. This is a true manifestation that the services rendered by NCPB assist farmers in maximizing food production. Out of 290 farmers who rated the services rendered by farmers as very poor, majority (270) missed food almost every month, signaling that poor services received from NCPB impacted negatively on food production. Findings of the study revealed that services provided by NCPB to farmers in Yala Township Location directly influence food production.

### 4.8.3 Free Education and Provision of Food Security in Yala Township Location

The researcher further examined the influence of deliberate strategies initiated by the Government to update farmers on the latest technological advancement on crop farming practices through free education. In order to capture this important information, farmers were requested to indicate whether they had benefited from free education provided by the Government through filed extension officers. Results were as depicted in Table 4.32.

<table>
<thead>
<tr>
<th>Cheaper fertilizer and seed from NCPB</th>
<th>Frequency of missing food</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Almost every month</td>
<td>N/A</td>
</tr>
<tr>
<td>Excellent</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>Very Good</td>
<td>0</td>
<td>18</td>
</tr>
<tr>
<td>Good</td>
<td>0</td>
<td>19</td>
</tr>
<tr>
<td>Very Poor</td>
<td>270</td>
<td>20</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>270</strong></td>
<td><strong>69</strong></td>
</tr>
</tbody>
</table>

**Source:** Field Survey Data (2014)
Table 4.32: Benefited from Free Education

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>156</td>
<td>46.0</td>
</tr>
<tr>
<td>No</td>
<td>183</td>
<td>54.0</td>
</tr>
<tr>
<td>Total</td>
<td>339</td>
<td>100.0</td>
</tr>
</tbody>
</table>

**Source:** Field Survey Data (2014)

Out of 339 farmers in Yala Township Location who participated in the study, 156 (46%) acknowledged that they had benefited from free education services provided by the Government through extension officers while majority 183 (54%) had not benefited from free education services provided by the Government. Results obtained from the study indicate that, although there were free education services provided by the Government through field extension officers evidenced by 156 (46%) farmers who confessed that they had received the extension services, majority of farmers 183 (54%) were still deprived from the good teachings received from the free education services because they had not benefited.

The researcher further cross-tabulated free education services with the frequency of missing food in order to establish the linkage between the two variables. This placed the researcher in a better position of relating free education services provided by the Government through field officers with food security. Findings were as captured in Table 4.33.
<table>
<thead>
<tr>
<th>Free education services</th>
<th>Frequency of missing food</th>
<th></th>
<th></th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Almost every month</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excellent</td>
<td>0</td>
<td>85</td>
<td></td>
<td>85</td>
</tr>
<tr>
<td>Good</td>
<td>0</td>
<td>29</td>
<td></td>
<td>29</td>
</tr>
<tr>
<td>Poor</td>
<td>0</td>
<td>45</td>
<td></td>
<td>45</td>
</tr>
<tr>
<td>Very Poor</td>
<td>161</td>
<td>19</td>
<td></td>
<td>180</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>161</strong></td>
<td><strong>178</strong></td>
<td></td>
<td><strong>339</strong></td>
</tr>
</tbody>
</table>

**Source:** *Field Survey Data (2014)*

As reflected in Table 4.33, all the farmers who rated the free education services provided by the Government through field officers as excellent, good and poor respectively never missed to put food on the table. This is classic evidence that free education services provided by the Government through field officers empowered farmers on modern farming practices thereby placing them at a better position of maximizing food production. Out of 180 farmers who rated the free education services provided by the Government as very poor, 161 missed food almost every month. This meant that they missed crucial knowledge through the Government initiated free education programmes which by extension impacted negatively on their endeavor to put food on the table.
CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter contains summary of findings, conclusion, recommendations, contributions to the body of knowledge and suggestions for further research.

5.2 Summary of Findings

The study sought to examine the influence of adoption of agricultural technology on food security in Yala Township Location. Results of the study revealed that there were slightly more male farmers 182(53.7%) than female farmers 157(46.3%) in Yala Township Location. Majority of farmers 249(73.5%) in Yala Township Location were mature in age ranging between the ages of 26-55 years. These active age enabled farmers to participate effectively on farming activities. Majority of farmers in Yala Township Location had engaged in farming for more than 6 years. Findings of the study further revealed that majority of farmers 288(85%) practiced farming on small parcels of land ranging between 0-1 acres. This implied that most farmers could only sustain the provision of adequate food (food security), by adopting agricultural technology that were not cost intensive due to the smaller land sizes. Farmers with larger land sizes could easily adopt cost intensive agricultural technology due to availability of enough space (farm sizes) in which farming could be practiced. Majority of farmers 134(39.5%) and 113(33.3%) in Yala Township Location had primary and secondary levels of education respectively. These levels of education provided adequate background for farmers to embrace the modern agricultural technologies in farming.

The first objective of the study sought to identify the extent to which the adoption of technologically enhanced inputs influenced food security in Yala Township Location. Data analysis and interpretation revealed that majority 207(61.1%) of farmers in Yala Township Location did not adopt inorganic fertilizers as one of the technologically enhanced inputs. Such farmers were deprived from tapping the advantages associated with inorganic fertilizers in enhancing the quantity of crop yields justified by the fact that majority of them could not afford
to take three meals per day. Findings of the study revealed that majority of farmers 202(59.6%) applied crop protection products on their farms. However, 137(40.4%) did not apply crop protection products. Majority of farmers 170(84.15%) who adopted crop protection products were satisfied with crop yields, indicating that application of crop protection products improved the quantity of crop yields. Findings of the study further revealed that 237(70%) farmers acknowledged that they planted high yielding varieties of crops, only 102(30%) farmers held a contrary opinion. Majority of farmers who confessed that they planted high yielding varieties of crops (hybrids) managed three meals per day, a clear indication that high yielding varieties (hybrids) supported the provision of sufficient food (food security).

The second objective of the study sought to determine the extent to which adoption of quality crop technology influenced the provision of food security in Yala Township Location. Data analysis and interpretation revealed that majority of farmers in Yala Township Location 322(95%) did not practice irrigation; only 17(5.0%) farmers practiced irrigation. Results of the study further revealed that: 17(5.0%) farmers who practiced irrigation were satisfied with crop yields. This can be justified by the fact that farmers who practiced irrigation managed three meals per day, a clear indication of food security. Majority of farmers 202(59.6%) did not practice soil conservation measures. Such farmers could only afford two meals per day, an aspect which indicate they lacked adequate food (food insecurity). Out of the 137(40.4%) farmers who practiced soil conservation measures 115(34%) managed three meals per day.

The third objective of the study sought to identify the extent to which value addition on farm produce influenced the provision of food security in Yala Township Location. Data analysis and interpretation revealed that majority of farmers 311(91.8%) practiced value addition on farm produce through preservation-sun/air drying, dusting with chemical/ash and smoking, processing –grinding, blending as well as industrial packaging and homemade packaging. Majority 267(78.8%) of farmers who practiced value addition on farm produce managed three meals per day. This implies that value addition on farm produce had a significant influence on food security (number of meals taken per day).
The fourth and last objective of the study sought to determine the extent to which agro-forestry influenced the provision of food security in Yala Township Location. Data analysis and interpretation revealed that majority 219(64.6%) of farmers in Yala Township Location practiced agro-forestry. Majority 210(62%) farmers who practiced agro-forestry managed to take three meals per day. This implies that practice of agro-forestry by farmers positively influences the provision of food.

5.3 Conclusion

In terms of the stated objectives, the following conclusions were drawn from the study: Majority of farmers 207(61.1%) in Yala Township Location did not adopt inorganic fertilizers as one of the technologically enhanced inputs. Such farmers were deprived from tapping the advantages associated with inorganic fertilizers in enhancing the quantity of crop yields, signaled by the fact that they could not afford three meals per day. 137(40.4%) farmers did not apply crop protection products on their farms. Majority of farmers 202(59.6%) who adopted crop protection products were satisfied with crop yields and were capable of taking three meals per day indicating that application of crop protection products improved the quantity of crop yields. Majority of farmers 237(70%) acknowledged that they planted high yielding varieties of crops. Planting high yielding varieties (hybrids) enabled them to harvest bumper harvest making it possible for them to afford three meals per day.

Majority of farmers in Yala Township Location 322(95%) did not practice irrigation; only 17(5.0%) farmers practiced irrigation. Out of 17(5.0%) farmers who practiced irrigation,15(4.5%) were satisfied with yields justified by the fact that they managed to take three meals per day, a clear indication of food security. Majority of farmers 202(59.6%) who did not practice soil conservation measures only 16(5%) managed to take three meals per day while their counterparts, 137(40.4%) who practiced soil conservation measures, 115(34%) took three meals per day, an indication of food security. This signifies that soil conservation measures impacted positively on food provision by providing an enabling environment in which crops thrive.
Majority of farmers 267(78.8%) who practiced value addition on farm produce managed three meals per day. This indicates that value addition on farm produce significantly influenced food security (number of meals taken per day). Majority 219(64.6%) of farmers in Yala Township Location practiced agro-forestry. 210(62%) Farmers who practiced agro-forestry managed to take three meals per day. This is a clear indication that practice of agro-forestry by farmers impacts positively on food security (number of meals taken per day).

5.4 Recommendations

Based on the findings, the study made the following recommendations:

1. Farmers should be encouraged to adopt the application of inorganic fertilizer in their farms in order to enhance the quantity of crop yield.
2. A multi-prolonged awareness creation campaign strategy about the significance of irrigation should be initiated in Yala Township Location.
3. Farmers should be advised to consistently practice value addition on farm produce in order to reap its benefit of increasing the longevity of crop life.
4. Farmers should be encouraged to adopt agro-forestry in order to maintain the soil value which by extension manifests on boosting crop yield.
5.5 Contribution to the Body of Knowledge

Table 5.1: Contribution of the Study to the Body of Knowledge

<table>
<thead>
<tr>
<th>Objectives</th>
<th>Contribution to the body of Knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. To identify the extent to which the adoption of technologically enhanced inputs influence food security in Yala Township Location</td>
<td>Farmers to adopt application of inorganic fertilizer in their farm in order to enhance the quantity of crop yield</td>
</tr>
<tr>
<td>2. To determine the extent to which adoption of quality crop technology influence food security in Yala Township Location</td>
<td>A multi-prolonged awareness creation campaign strategy about the significance of irrigation be initiated in Yala Township Location</td>
</tr>
<tr>
<td>3. To identify the extent to which value addition on farm produce influence food security in Yala Township Location</td>
<td>Farmers to consistently practice value addition on farm produce in order to reap on its benefit of increasing the longevity of produce life</td>
</tr>
<tr>
<td>4. To determine the extent to which agro-forestry influence food security in Yala Township Location</td>
<td>Farmers to adopt agro-forestry in order to maintain the soil value which by extension manifests on boosting crop yield</td>
</tr>
</tbody>
</table>
5.6 Suggestions for Further Research

This study did not explore certain areas that were equally important. Such areas were left out because the scope of this study warranted. In view of this, the researcher suggests the following areas for further research:

1. Impact of utilization of modern farming practices on alleviation of food shortage in Yala Township Location, Siaya County-Kenya.
2. Effects of farmers training on food productivity. A case of Yala Township Location, Siaya County-Kenya.
3. A replication of this study in a different set-up, preferably rural set-up in order to validate its findings.
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APPENDICES

APPENDIX I

LETTER OF TRANSMITTAL

NANCY CHRISTINE OTIENO,

P.O.BOX 1112,

SIAYA.

20th February 2014.

Dear respondent,

RE : REQUEST FOR QUESTIONNAIRE ADMINISTRATION .

I am a second year Master of Arts student in Project Planning and Management of the University of Nairobi . As part of the requirements of the course; I am undertaking a study on the ‘influence of Agricultural Technology Adoption on food security in Yala Township Location’.

You have been nominated to participate in the ongoing research study as above mentioned. The interview will not take more than 20 minutes and will be incorporated within your routine. Please give us honest and accurate answers if you accept to participate.

Information you provide will be kept confidential. As a sign that you are willing to take part in this study you will sign on the questionnaire before you are asked questions.

Nancy Christine Otieno

Student, University of Nairobi
APPENDIX II:
FARMERS QUESTIONNAIRE

Please answer the following questions either by ticking an appropriate box or by providing a suitable answer where no box is provided.

SECTION I: DEMOGRAPHIC CHARACTERISTICS

1. Gender - Male [ ] Female[ ]
2. What is your age in years? 15-25 [ ] 26-35 [ ] 36-45[ ] 46-55[ ] 56 and above[ ]
3. For how long have you engaged in farming? 0-1 year [ ] Please specify no. of months_________. 2-3 years [ ] 4-5 years [ ] 6 years and above [ ].
4. How many are you in your household? 1-5 [ ] 6-10 [ ] 11 and above [ ].
5. What is the size of your farm? _______________
6. Highest completed level of Education
   No formal Education [ ] Primary level [ ]
   Secondary level [ ] College/University [ ]

SECTION II: ADOPTION OF TECHNOLOGICALLY ENHANCED INPUTS

1. Do you apply inorganic fertilizer on your farm?
   Yes [ ] No [ ]
   a. Which type of inorganic fertilizer do you use?
      DAP [ ] UREA [ ] MOP [ ] NPK [ ] Any other, specify __________________________
   b. If ‘yes’ in question 1, were you satisfied with the yields you received in the last harvest when Fertilizer was applied? Yes [ ] No [ ]
      Please explain________________________________________________________
c. If ‘no’ in question 1 do you think the harvest would have been different if inorganic fertilizer were applied?

   Yes [ ]  No [ ]

Please explain_______________________________________________________________

i) Do you apply organic fertilizer in your farm?

   Yes [ ]  No [ ]

   b. If ‘yes’ in question 1 above were you satisfied with the yields you received in the last harvest when Fertilizer was applied?

   Yes [ ]  No [ ]

Please explain_______________________________________________________________

If ‘NO’ question b above, do you think the use of organic fertilizer would have made you have more yields?

   Yes [ ]  No [ ]

2. In the last 12 months, did food run out before you had money to buy more?

   Yes [ ]  No [ ]

3. In the last 12 months, the food you bought did not last and you did not have money to buy more?

   Yes [ ]  No [ ]

4. Do you apply Crop protection products on your farm?

   Yes [ ]  No [ ]

   a. Which type of Crop protection products did you apply?

       Pesticides [ ]  Herbicides [ ]  Fungicides [ ]  Others_______________________________

   b. At what stage of the crop did you apply the Crop protection products?
Pre- emergence [ ] Post- emergence [ ]

c. If ‘yes’ in question 4 above were you satisfied with the yields you received in the last harvest when crop protection products were applied?

Yes [ ] No [ ]

Please explain________________________________________________________

d. If ‘no’ in question 4 do you think the harvest would have been different if crop protection products were applied?

Yes [ ] No [ ]

Please explain________________________________________________________

5. You could not afford to eat balanced meals in the last 12 months?

Yes [ ] No [ ]

6. The last 12 months, how often did you or other adults in the household ever cut the size of your meals or skip meals because there wasn't enough food?

Yes [ ] No [ ]

7. Do you plant high yielding varieties/hybrids on your farm?

Yes [ ] No [ ]

a. If ‘yes’ in question 7 above were you satisfied with the yields you received in the last harvest when high yielding varieties/hybrids were planted?

Yes [ ] No [ ]

Please explain________________________________________________________

c. If ‘no’ in question 7 do you think the harvest would have been different if high yielding varieties were used?

Yes [ ] No [ ]

Please explain________________________________________________________

8. In the last 12 months, did you ever eat less than you felt you should because there wasn't enough food?
9. In the last 12 months;

   a. Were you ever hungry, but didn’t eat, because there wasn’t enough food?

      Yes [ ]     No [ ]

   b. On average, how many meals does your household have in a day?

      1 [ ]    2 [ ]    3 [ ] Others, Specify___________________________

   c. Have you been forced to reduce the size of your meals?      Yes [ ]     No [ ]

   d. Have you borrowed food from a friend or neighbor?     Yes [ ]     No [ ]

   e. Have you consumed immature crop produce?      Yes [ ]     No [ ]

**SECTION III : ADOPTION OF QUALITY CROP TECHNOLOGY.**

1. Do you irrigate your crops?

      Yes [ ]     No [ ]

   a. Which method of irrigation do you use? (Tick as many as the irrigation methods you use. Responses can be more than one.)

      • Drip irrigation [ ]
      • Channel irrigation [ ]
      • Sprinkler irrigation [ ]
      • Flood irrigation [ ]
      • Others, please specify__________________________________________

   a. If ‘yes’ in question 1 above were you satisfied with the yields you received in the last harvest when crops were irrigated?

      Yes [ ]     No [ ]
Please explain________________________________________________________

b. If ‘no’ in question 1 above, do you think the harvest would have been different if irrigation was applied?

Yes [ ] No [ ]

Please explain________________________________________________________

2. Do you practice soil conservation measures in your farm?

Yes [ ] No [ ]

3. What soil conservation measures are practiced in your farm? (Tick as many as the soil conservation measures you use. Responses can be more than one.)

Grass strips [ ]

Terraces [ ]

Cut off Drains [ ]

Contour ploughing [ ]

Other, specify________________________

a. If ‘yes’ in question 2 above were you satisfied with the yields you received in the last harvest when soil conservation measures were used?

Yes [ ] No [ ]

Please explain________________________________________________________

b. If ‘no’ in question 2 do you think the harvest would have been different if soil conservation measures were applied?

Yes [ ] No [ ]

Please explain________________________________________________________

SECTION IV : ADOPTION OF VALUE ADDITION

1. Do you practice value addition on your produce? (Tick as many as the value addition methods you use. Responses can be more than one.)
2. Which forms of value addition do you practice on your produce?

Preservation - Sun/Air Drying [ ] Dusting with chemicals / ash [ ] Smoking [ ]

Processing - Grinding [ ] Blending [ ]

Packaging – industrial packaging [ ] Homemade packaging [ ]

Others, please specify__________________________________________________________

a. If ‘yes’ in question 1 was the farm produce available in the household for a longer period of time when value addition was practiced?

   Yes [ ] No [ ]

Please explain______________________________________________________________

b. If ‘no’ in question 1 do you think the household food availability would have been different if value addition on produce was practiced?

   Yes [ ] No [ ]

Please explain______________________________________________________________

3. In the last 12 months did you or other adults in your household ever not eat for a whole day because there wasn’t enough food?

   Yes [ ] No [ ]

4. If yes to question 3 How often did this happen?

   almost every month[ ] some months but not every month [ ] or in only 1 or 2 months[ ]

SECTION V : ADOPTION OF AGROFORESTRY.

1. Do you practice Agro-forestry?

   Yes [ ] No [ ]
2. Which form of Agro-forestry do you practice?

Permanent tree intercropping [ ]
Sequential tree fallow [ ]
Annual relay intercropping [ ]
Biomass transfer [ ]

3. a. If ‘yes’ in question 1 above, were you satisfied with the yields you received in the last harvest when agro-forestry was practiced?

Yes [ ] No [ ]
Please explain________________________________________________________

b. If ‘no’ in question 1 above, do you think the harvest would have been different if agroforestry was practiced?

Yes [ ] No [ ]
Please explain________________________________________________________

SECTION VI: INFLUENCE OF GOVERNMENT POLICIES AND PROGRAMMES

1. Which of the following government programmes have you benefited from?

   1. Extension services [ ]
   2. cheaper fertilizer and seed from NCPB [ ]
   3. Local Authorities Transfer Fund-LATF [ ]
   4. Constituency Development Fund–CDF [ ]
   5. free education [ ]
   6. reduced treatment costs at public health facilities [ ]
   7. establishing producer and marketing associations [ ]
   8. One acre fund [ ]

2. On a scale of 1-5 how would you rate the services you have received from the government?
<table>
<thead>
<tr>
<th>GOVERNMENT PROGRAMME</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Extension services</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>cheaper fertilizer and seed from NCPB</td>
<td></td>
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<td></td>
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<tr>
<td>Local Authorities Transfer Fund- Constituency Development Fund</td>
<td></td>
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<tr>
<td>free education</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>reduced treatment costs at public health facilities</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>establishing producer and marketing associations</td>
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<tr>
<td>One acre fund</td>
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</tr>
</tbody>
</table>

3. Are there other ways in which the government assisted you with regard to ensuring you are food secure?

   Yes [ ]    No [ ]

Please explain,
____________________________________________________________
________________________________________________________________
________________________________________________________________
________________________________________________________________

SECTION VII: INFLUENCE OF AGRICULTURAL TECHNOLOGY ON FOOD SECURITY.

1. Are there other ways in which you can be assisted to ensure high agricultural productivity?

   Yes [ ]    No [ ]

2. Please explain.
____________________________________________________________
________________________________________________________________
________________________________________________________________
________________________________________________________________

Thank you for participating
APPENDIX III

INTRODUCTION LETTER

UNIVERSITY OF NAIROBI
COLLEGE OF EDUCATION AND EXTERNAL STUDIES
SCHOOL OF CONTINUING AND DISTANCE EDUCATION

Our Ref.: UON/CEES/KSM/1/3
Telephone: Kisumu 057-2021534

University of Nairobi Plaza,
Oginga Odinga Street
P.O. BOX 925,
KISUMU.

TO WHOM IT MAY CONCERN

RE: NANCY CHRISTINE OTIEGO L50/84293/2012

This is to inform you that the above named Nancy Christine Otieno is a student in the University of Nairobi School of Continuing and Distance Education pursuing Masters Degree in Project Planning and Management in Kisumu Campus.

Nancy has completed her course work and examinations successfully and is currently undertaking research project work “Influence of adoption of agricultural technology on food security in Yala township location, Siaya county, Kenya,” as a pre-requisite for the programme in the second year. She has identified your institution as a resourceful centre for the information she needs for her research work.

We would therefore appreciate if she could be allowed to access information for her study as the data she needs is for academic purposes and not for other things. For further information do not hesitate to contact the undersigned.

Thank you.

DR. RAPHAEL O. NYONJE, PhD
SENIOR LECTURER
DEPARTMENT OF EXTRA MURAL STUDIES
UNIVERSITY OF NAIROBI
KISUMU CAMPUS

ISO 9001: 2008 CERTIFIED
The Fountain of Knowledge Providing Leadership in Academic Excellence

21 March 2014
APPENDIX IV

RESEARCH AUTHORIZATION

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Telephone:+254-20-2213471, 2241349, 310571, 2219420
Fax: +254-20-318245, 318249
Email:secretary@nacosti.go.ke
Website:www.nacosti.go.ke
When replying please quote

Ref: No.

NACOSTI/P/14/0968/2513

Nancy Christine Otieno
University of Nairobi
P.O. Box 30197-00100
NAIROBI.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on “Influence of adoption of agricultural technology on food security in Yala Township Location, Siaya County, Kenya,” I am pleased to inform you that you have been authorized to undertake research in Siaya County for a period ending 4th December, 2015.

You are advised to report to the County Commissioner and the County Director of Education, Siaya County before embarking on the research project.

On completion of the research, you are expected to submit two hard copies and one soft copy in pdf of the research report/thesis to our office.

DR. S. K. LANGAT, OGW
FOR: SECRETARY/CEO

Copy to:

The County Commissioner
The County Director of Education
Siaya County.

APPENDIX V

RESEARCH PERMIT

THIS IS TO CERTIFY THAT:

Ms. Nancy Christine Otieno of University of Nairobi, 0-40600 Siaya, has been permitted to conduct research in Siaya County, Kenya on the topic: INFLUENCE OF ADOPTION OF AGRICULTURAL TECHNOLOGY ON FOOD SECURITY IN YALA TOWNSHIP LOCATION, SIAYA COUNTY, KENYA.

Applicant’s Signature

for the period ending 4th December, 2014

National Commission for Science, Technology & Innovation

CONDITIONS

1. You must report to the County Commissioner and the County Education Officer of the area before embarking on your research. Failure to do that may lead to the cancellation of your permit.

2. Government Officers will not be interviewed without prior appointment.

3. No questionnaire will be used unless it has been pre-tested.

4. Excavation, sampling and collection of biological specimens are subject to further permission from the relevant Government Ministries.

5. The research report must contain at least two (2) hard copies and one (1) soft copy of your final report.

6. The Government of Kenya reserves the right to modify the conditions of this permit including its cancellation without notice.

RESEARCH CLEARANCE PERMIT

CONCLUSIONS: see back page

National Commission for Science, Technology & Innovation
APPENDIX VI

TABLE FOR SELECTING SAMPLE SIZE

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Note.—$N$ is population size.
$S$ is sample size.