DETERMINANTS OF HOUSEHOLD FOOD SECURITY STATUS AMONG THE
SMALLHOLDER FARMING COMMUNITY IN KILIFI SOUTH SUB-COUNTY,
KENYA

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A Thesis In Partial Fulfillment Of The Requirements For The Degree Of Doctor Of
Philosophy In Environmental Studies (Community Development) Of Pwani University

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other
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DEDICATION

I dedicate this work to my wife Mrs Esther N. Macharia and our sons, Emmanuel Chege and Pernuel Justus Njogu.
ABSTRACT

Food security is critical to the economic, social, religious, political and cultural development worldwide. This study goes deeper to investigate the role of household characteristics, food security constraints, extension services and livelihood strategies on food security in Kilifi South Sub-county. This Sub-county is one of the areas where food insecurity incidences are prevalent as a result of unpredictable rainfall patterns, sandy soils and high evaporation rate which as a result leads to numerous undesirable effects, such as frequent crop failure, high food commodity prices and famine. The study adopted survey design. The aim was to identify and analyze the determinants of food security status among the smallholder farming community members in Kilifi South Sub-county. The objectives of this study are (1) to determine the influence of household characteristics on household food security status among the smallholder farming community, (2) to determine the influence of food security constraints on household food security status among the smallholder farming community, (3) to determine the influence of agricultural extension on household food security status among the smallholder farming community and (4) to determine the influence of livelihood strategies on household food security status among the smallholder farming community in Kilifi South Sub-county. The study administered a standard questionnaire to a sample of 384. Sampling was done by use of systematic sampling procedure. Data collected on food security status was analyzed using descriptive and inferential statistics. From the information gathered through personal interviews, (80%) of all the farmers were food insecure. Farmers in the age bracket 36-45 years were more food secure (10%) compared to other age groups. Households with at most 2 members were more food secure (10%), farmers with secondary education were also (10%) food secure while females were more food secure (12%) compared to males. Land ownership through possession of title deeds was found to be significantly (P< 0.1). This is as a result of increase in food security by (7%) with individual land
ownership increasing food security by (11%). The inferential results show that the significant factors are age of the household head was significant with, household size with, education level of the household head with and gender of the household heads, credit from banks, possession of title deeds, land size, early planting, participation in off-farm activities, irrigation, soil and water conservation, agroforestry, indigenous knowledge and agricultural diversification. It was therefore concluded that households with small family sizes; and households with heads that are female, have higher level of education and middle aged are more food secure. To further enhance food security and improve food security status in Kilifi South Sub-county, possession of title deeds, participation in extension and engagement in off-farm activities should be encouraged. The findings of this study would be beneficial to leaders, stakeholders and policy makers in decision making process pertaining suitable interventions in attainment of food security in Kilifi South Sub-county.
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<th>Explanation</th>
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<tr>
<td>CBOs</td>
<td>Community Based Organizations</td>
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<tr>
<td>FAO</td>
<td>Food and Agricultural Organizations</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
</tr>
<tr>
<td>GoK</td>
<td>Government of Kenya</td>
</tr>
<tr>
<td>IFAD</td>
<td>International Fund for Agricultural Development</td>
</tr>
<tr>
<td>IFPRI</td>
<td>International Food Policy Research Institute</td>
</tr>
<tr>
<td>KDP</td>
<td>Kilifi Development Plan</td>
</tr>
<tr>
<td>KFSSG</td>
<td>Kenya Group Food Security Steering Group</td>
</tr>
<tr>
<td>MDGs</td>
<td>Millenium Development Goals</td>
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<tr>
<td>MOA</td>
<td>Ministry Of Agriculture</td>
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<tr>
<td>NGOs</td>
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<td>WHS</td>
<td>Water Harvesting Structures</td>
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<td>WFP</td>
<td>Would Food Programme</td>
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DEFINITION OF TERMS

**Adoption:** The decision to make sustained use of an innovation as best action available for over 10 years. Adoption refers to the farmer’s decisions to incorporate a new technology into the production process. It also refers to diffusion of a new technology within a region or population.

**Diffusion:** the process by which an innovation is communicated through certain channels over time among members of the farming community.

**Food Availability:** means that food is physically present because it has been grown, processed, manufactured, and/or imported. For example, food is available because it can be found in market shops; it has been produced on local farms or in home gardens; or it has arrived as part of food aid.

**Food insecurity:** A situation where people do not have physical and economic access to sufficient, safe, nutritious and culturally acceptable food to meet their dietary needs to lead a healthy and active life.

**Food secure:** When the conditions relating to food availability and accessibility are met.

**Food security constraints:** These are shocks that lead to food insecurity.

**Household:** A household is a group of people living together and eating from the same cooking pot.
**Household head:** Key decision maker in the household whose authority the other members acknowledge.

**Household size:** Is the number of persons living together in one house.

**Livelihood strategies:** The way people act in order to achieve their desired livelihood.

**Participation:** In the context of this study, it means that the smallholder farming communities themselves are involved in identifying the problems they face, determining ways to overcome them, designing realistic plans to achieve these goals, and carrying them out.

**Rainwater harvesting:** Harnessing, collection and concentration of rainwater or its runoff

**Technology transfer:** is the general process of moving information and skills from information or knowledge generators such as research laboratories and universities to clients such as smallholder farming community.

**Terraces:** Refers to narrow strips of land carved out as measures of soil and water conservation for cultivation of crops such as maize and millet.

**Water pan:** This is excavated water storage structure that is square, rectangular or round, used to impound and retain surface runoff from uncultivated grounds or roads.
CHAPTER ONE
INTRODUCTION

1.1 Background

Improved food security plays a critical role in economic development, rural development, reduced hunger and poverty worldwide (Kihara, 2004, Salama et al., 2010). However, food insecurity threatens the sustainability and livelihoods of smallholder farming communities in many parts of the world due to high level of illiteracy and unpredictable rainfall patterns (Adenegan and Adewusi, 2007). In Ghana, 60 percent of the community members of Sekyere-Afram plains district were food insecure as documented by (Aidoo et al., 2013). Similarly, (Misselhorn 2005) reported that 58 percent of the community members in rural areas of Limpopo in South Africa were food insecure and could not feed themselves. In Kenya, Wachira (2014) reported 23 percent of the households face chronic food insecurity while KFSSG (2012), reported 68 percent of rural community of Coastal Kenya to be food insecure due to irregular rainfall and drought. This is also attributed to diminishing food resources due to high population density and household social economic factors.

According to Hudson (2000) improvement of food security does not only depend on individual community member’s willingness but also upon the role of property rights on resources, and collective action at community level. Demographic variables, water harvesting structures, information sources, knowledge, awareness and attitude also influence food security status among the smallholder community members (Busoro et al., 2007). In the year 2000, world leaders committed themselves to the Millennium Development Goals (MDGs) and one aim of the MDGs was to eradicate poverty and hunger, including “reduction by half the proportion of people who suffer from hunger” between 1990 and 2015 (Salama et al., 2010). It was predicted that many people will not reach their MDG targets particularly in
Sub-Saharan Africa where a third of the population is food insecure and there is an actual increase in the number of hungry people due to rapid population growth.

Kenya is a developing country within Sub-Saharan Africa whose economy is predominantly agrarian, where almost half of the GDP 45 percent is contributed by the agricultural sector (Kihara, 2004). This sector creates employment opportunities for over 85 percent of the population. Agricultural sector in Kenya is characterized by subsistence farming with little surplus output and is heavily influenced by weather conditions. Only 20 percent of farm production is supplied to the local market while the balance of 80 percent is used for own consumption, which puts the vulnerable and food insecure community members at risk of starvation. This concern has also been expressed by Kumba et al. (2015) in Kisii Central Sub-county, Kenya. He attributed diminishing land resource due to high population density, continued sub-division of arable land and poverty level of about 54.2 percent as a cause of negative influence on agricultural production and income levels. This problem has, therefore, remained a challenge with about 33 percent of Kenyan population experiencing chronic food insecurity between 2004 and 2008 (FAO, 2005; FAO, 2011). Additionally, according to IFPRI (2012) and WFP (2009) reports, about 10 million people were food insecure in the country by 2012. Inadequate food availability was attributed to insufficient domestic production, low agricultural productivity and high poverty rate of over 50 percent (Glopolis, 2013; FAO, 2008). Other studies have linked household food security status to household socio-economic factors such as the level of education of household heads, crop yields, household size, amount of land owned and household income among others (Walingo et al., 2009; Volege, 2005). Food security is not assured for sizable portion of the population in the Kenyan coast (Klaver and Mwadime, 1998). This is because people rely heavily on maize, cowpeas and cassava which are lacking in dietary quantity quality and variety resulting to nutritional problems among the vulnerable groups such as women and children.
1.2 Statement of the problem

Despite past efforts to improve agricultural production in Kilifi South Sub-county by extension officers and some NGOs, poverty and hunger continue to be felt. Unpredictable rainfall patterns, sandy soils and high evaporation rate have resulted into numerous undesirable effects, including frequent crop failure, high food commodity prices and famine (KFSSG, 2012). Eighty five percent of households in Kilifi South Sub-county are characterized by high levels of undernourishment, hunger and lack of education (KFSSG, 2012). This means that farmers rely on purchased food which is not adequate. This is because the community members are jobless and thus poor. High food prices are a problem of access because community members lack other stable sources of income (Kihara, 2004). Illiteracy and ignorance of better farming technology has resulted to low agricultural production which puts the community in a vicious cycle of poverty. Increased water access and proper farming methods are required in order to improve agricultural production and raise the community members’ socio-economic status. Past studies have shown that household characteristics, food security constraints, livelihood resources as well as livelihood strategies determine food security status of communities. These are important at influencing the adoption of agricultural technologies and thus improve the food security status. However, the determinants of food security status in Kilifi South Sub-county have not been identified since there is scanty information if any. The aim of this study was to bridge this gap with focus being the role of household characteristics, food security constraints, livelihood resources and livelihood strategies in food security status in Kilifi South Sub-county.

1.3 Main objective

The main objective was to analyze the determinants of food security status among the smallholder farming community members in Kilifi South Sub-county.
1.4 Specific objectives

Specific objectives were to determine the influence of:

(i) Household characteristics on household food security status among the smallholder farming community in Kilifi South Sub-county.

(ii) Food security constraints on household food security status among the smallholder farming community in Kilifi South Sub-county.

(iii) Agricultural extension on household food security status among the smallholder farming community in Kilifi South Sub-county.

(iv) Livelihood strategies on household food security status among the smallholder farming community in Kilifi South Sub-county.

1.5 Hypotheses

Ho$_1$ There is no statistically significant influence of household characteristics on food security status among the smallholder farming community in Kilifi South Sub-county.

Ho$_2$ There is no statistically significant influence of food security constraints on food security status among the smallholder farming community in Kilifi South Sub-county.

Ho$_4$ There is no statistically significant influence of agricultural extension on food security status among the smallholder farming community in Kilifi South Sub-county.

Ho$_5$ There is no statistically significant influence of livelihood strategies on food security status among the smallholder farming community in Kilifi South Sub-county.
1.6 Justification of the Study

Most of the research done on food security are general and consider the food security challenges from national points of view. Assessing household food security situation is useful in identifying salient aspects of well-being of community food security. Findings from this research directly contribute toward advancing research in food security in drought prone areas. Additionally, investigating food security situation at the household level could help planners and the policy makers make informed decision regarding food security within society.

1.7 Assumptions of the study

(i) This study assumed that the population distribution of the sample was normal. This means that data conforms to ordinary least squares (OLS).

(ii) The informants were genuine or honest and accurate.

(iii) The information given was true to the best of their knowledge.

(iv) The household heads participating in this study were expected to cooperate fully during the interview exercise and also when filling the survey questionnaires.

1.8 Scope of the Study

The study was confined within Kilifi South Sub-county which includes Bahari, Chonyi and Kikambala divisions.

1.9 Limitation of the Study

The study had limitation of lack of physical records of data collected on community members’ food production, food purchases and food consumption.
CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter focuses on socioeconomic and household characteristics, food security constraints, livelihood resources, livelihood coping strategies and how they influence food security status in Kilifi South Sub-county.

2.2 Theoretical framework

Food security is defined as “when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life” (FAO, 2006). The definition of food security comprises of the elements of availability, access, utilization and stability. Food availability refers to the physical existence of food, be it from own production or from the markets. Access emphasizes on having sufficient resources to obtain appropriate foods for a nutritious diet. Utilization has a socio-economic and a biological aspect. If sufficient and nutritious food is both available and accessible the household has to make decisions concerning what food is being consumed and how the food is allocated within the household. Stability refers to the temporal dimension of nutrition security.

There are several development theories that are used to conceptualize the determinants which influence food security. They include: modernization theory, process approach to development and sustainable livelihood approach.

2.2.1 Modernization theory

Modernization theory is a western model of free enterprise that serves as a guide in development policymaking. Economic growth is central to this perspective and it is believed that developing countries should mimic western developed countries by industrializing,
liberating trade and investment and forming global linkages (Adam, 2003). General economic growth is often cited as a mechanism for reducing food insecurity within a country. It is expected to improve the income and reduce vulnerability to shocks. Modernization theory suggests that access to global food markets and increases in trade will address problems of food availability and accessibility which in turn will bring more income, improved livelihood and reduce hunger (Waller, 2002). Applied to this research, it would follow that access to local food markets and increases in food trade can address the crisis of food access and availability. This is a top-down orientation that assumes that economic growth and technological advancement will trickle down and ignite social and economic progress among the poor. Sen (1999) reported that the socio-economic and political frameworks that led to the countries of the west to develop can be applicable to less developed countries is simplistic and ignores the very socio-cultural fiber of these countries.

2.2.2 Process approaches to development

This is also called the “bottom up” or grass root approach (Rondinelli, 1983; Mosse et al., 2000). The approach defines rural development as a participatory process empowering the rural people to take control of their own priorities for sustainable change (Chambers, 1993; Mulwa, 2004). The rural people should be enabled to act on ways forward to solve the problem of food insecurity. This means using community participation, community institutions and local practices to constitute a sustainable livelihood that will enable the rural people to create and mobilize resources. The aim is to increase economic production or incomes and also increase people’s capacity to initiate actions on their own or influence decisions of development actors (Mulwa, 2004). The main focus should be development of farmers’ technologies with the improving their agricultural production and hence ensure food security. This will also involve funding of agricultural activities such as conducting research on the appropriate extension methods to be used, advancing credit and identifying the right seeds for specific areas.
A study by Scoones & Thompson (1994) revealed that it is also important to create a good environment for non-farm activities because such will expand the rural people’s opportunities to improve their livelihoods. However, it is important to consider a new approach that will consider agriculture at the same level along other rural areas for the construction of viable rural livelihoods and reduce the problem of food insecurity.

### 2.2.3 Sustainable livelihood approach

Sustainable livelihood approaches put the poor smallholder community members at the centre of analysis and aims to identify appropriate interventions for food insecurity. Sustainable livelihoods consider the major factors that affect people’s livelihoods and the relationships that exist among them (Chambers, 1993). The factors expressed through the notion of “livelihood assets” comprise: Human capital (household members, active labour, education, knowledge and skills), Physical capital (livestock, houses and irrigation pumps), Natural capital (access to land, water, grazing, fishing, and wild products), Financial capital (savings/debt, income and credit), and Social capital (kin networks, group memberships, socio-political voice and influence).

Sustainable livelihood approach is rooted in the aim of poverty reduction. Rural households need the following to be food secure: (i) An adequate supply of food, either grown on the farm or bought with earned income and (ii) the right quantity and diversity particularly in the months of food insecurity (Scoones and Thompson, 1998). The interventions used to ensure food security are: livestock production, diversification of local agriculture, soil and water conservation techniques, market gardens, intensification of agriculture and having adequate seed banks. According to Hoddinott (1999), the determinants of household food security, focused on six different interventions and these were: (i) environment, institutional development and village associations. (ii) new technologies, irrigation and credit. (iii) agricultural extension, skills training and literacy; (iv) infrastructure; (v) water and sanitation as they affect food security. In other words, sustainable agriculture contributes towards food
security through its contribution to social and human capital in a significant manner (Scherr and Hazel, 1994).

In conclusion, to ensure sustainable food security status, there is need to improve crop yields through introduction of new and locally appropriate crop varieties and animal breeds; better use of natural capital to increase farm production through soil and water conservation measures and reclamation of degraded land, conducive social and institutional conditions for the spread of the technologies and lastly establishment of political conditions for the introduction of policies aimed at improving food security. Asset ownership plays a great role in influencing livelihoods. Households with a lot of assets such as land, water, livestock and money are better positioned in terms of food security. They are able to withstand the effects of shocks than households with fewer assets. Sustainable livelihood approach also involves participation to increase empowerment of the local people. According to Heller (2003) participation means that people have power to affect decision-making on their own. This involves the use of participatory approaches such as Participatory Rural Appraisal (PRA) and participatory technology development (PTD). Including the locals in the entire process of gathering information, analyzing it, making choices on where to take action, and implement the agricultural innovation decisions is key to the sustainable livelihood framework. It is meant to increase motivation and commitment of the people and lead to a better utilization of the agricultural innovations with the aim of eliminating food insecurity. Culture also plays a role at many levels in sustainable livelihood framework, influencing both the different components in the process and the interaction between them. Therefore, a thorough understanding of culture is essential for the framework to be effective in reducing food insecurity.

This study adopted the sustainable livelihood approach because it considered the major factors that affect people’s livelihoods, and the relationship that exist among them. It was
therefore, necessary to establish the actual interactions between household characteristics, livelihood resources, constraints, coping strategies and food security. Similar previous studies in Kilifi South Sub-county only focused on unreliable rainfall, use of seeds from the previous harvest and overreliance on maize production, hardpans, low livestock holding, chronic poverty and high food prices. The impacts of these factors on food security were looked at singly without focus on their interactions.

2.3 Conceptual framework of the study

Figure 1: Conceptual framework

**Modified From the Basic Sustainable Livelihood Framework**

The conceptual framework shows the relationship among the determinants of food security status. Household characteristics influence both livelihood assets and food security status. Household characteristics include age, household size, education level and gender. Food security constraints influence livelihood assets which in turn influence agricultural extension while livelihood strategies influence food security status. Livelihood assets comprise of human capital, natural capital, social capital, physical capital and financial capital. Livelihood strategies include off-farm activities, soil and water conservation measures, use of indigenous knowledge, agroforestry and agricultural diversification. They are intended to counter the effects of livelihood shocks.
2.4 Influence of Household Characteristics on Household Food Security Status

These include age of the household head, size of the household, education level of the household head and gender of the household head.

2.4.1 Age

Age of the household head is a major determinant of food security status. Their experience generated or eroded confidence (Meena et al., 2002). The age of the household head was expected to impact on his or her labor supply for soil and water conservation, water harvesting for irrigation and hence improved food production (Babatunde et al., 2007). According to another study by Rongoor et al. (2004), the significance of age on farm output was very diverse and in another study by (Kalirajan & Shand 2000; Stefanou & Sexena 2006) it was found that age had a positive influence on productivity.

2.4.2 Household size

This is an important factor in determining food security. Farmers with big household sizes are more likely to be food insecure than farmers with small household sizes. Ayuk (1997) reported that an additional child in a household increased the probability of being food insecure.

2.4.3 Education

Education has a positive effect on food security status. It has helped some farmers to adopt modern technology and thereby increased output. Percy and Cullis (2000), indicates that education acts as an input for crop production and food security. Amudavi (1993), Ndiema (2000); Mose and Rono (2000) in their studies found that education is significant in enhancing awareness and adoption of soil and water conservation practices and hence food security.
2.4.4 Gender

According to Edwards & Demaine (1997), gender of the household head affects agricultural productivity and thus food security. Gender of the household includes the role played by individuals in terms of males or females in providing households’ needs including acquisition of food. Household head could therefore be male or female.

2.5 Influence of Food Security Constraints on Food Security Status

2.5.1 Weather Constraints

A study by Dinar (2008) revealed that the impact of climate variability on food security was identified as a major concern in many parts of the world and particularly in Africa due to predominance of rain-fed agriculture. Various studies on effect of climate variability on food security have been done. According to Dinar (2008), climate variability had adverse effects on dry land crops, irrigated crops, livestock and income. They reported that the green house gas emissions are the causes of climate changes which in turn results to negative impacts such as exacerbation of the scarce resources and in turn increased food insecurity. They continued to state that unpredictable precipitation had long-term effects on the viability of agro-ecosystems and future food availability. In dry areas, the effects of climatic variability are more pronounced and reduced crop yields and livestock results due to droughts. FAO (2008) reported that in rural areas that depend on rain fed agriculture as important part of their food supply, changes in the amount and timing of rainfall within the season and an increase in weather variability were likely to aggravate the precariousness of local food supplies.

Ray (2001) affirmed that climatic constraints had an effect on the stability of food supplies. They noted that increases in the frequency and extreme events such as droughts brought greater fluctuations in crop yields and local food supplies. This brought about transitory food insecurity. In dry areas, the effects of climatic variability were more pronounced and reduced
farm yields due to droughts. FAO (2008) reported that in rural areas that depend on rain fed agriculture as important part of their food supply, changes in the amount and timing of rainfall within the season and an increase in weather variability were likely to aggravate the precariousness of local food supplies.

According to FAO (2010) climatic constraints were the most complex and challenging environmental problems facing the world today. It further reported that these problems were made worse by weather unpredictability, climatic variability, environmental degradation and demand for more agricultural land. Dinar (2008) affirmed that these occurred due to increasing human population. According to him, climate change is any significant change in measures of climate such as precipitation and temperature lasting for a decade or longer. He also observed that climate change resulted from natural factors and human activities such as burning the fossil fuels. World Bank (2008) reported that Kenya was identified to be at the highest risk from climate change, particularly through the impacts of droughts. The World Bank further stated that climate change affected agricultural performance and food security in the last few decades and this resulted in diversion of resources from development planning to emergency response in the country. Repeated rainfall failures and severe droughts from the year 2001-2012 could be the evidence of an early signal of climate change (Dinar, 2008). According to him, these impacts were particularly severe in the vulnerable arid and semi-arid lands (ASALs). He concluded by stating that weather unpredictability depletes water sources leading to resource scarcity.

Davis and Place (2003) reported that insufficient use of yield-enhanced technology and unreliable rainfall patterns were enhanced by climate change variations. They also observed that the poor were the hardest hit by all this because of their vulnerability to the effects of climate change. A study by Japhether et al. (2007) demonstrated that most poor farmers depended on natural resources and rain fed agriculture for their livelihoods, and were least
able to cope with the shocks of alleged climate-induced droughts. According to them, capacity building, financial and technical strategies were mostly employed to help the poor smallholder farming communities to survive in such circumstances.

The climatic constraints especially for the poor put their livelihoods at risk. Ray, (2001) demonstrated that increase in temperature, decline in fresh water availability, rise in sea level, increase in frequency and intensity of extreme weather conditions have undesirable impact on food security. A study by Davis and Place (2008) on effects of pest control reported that climate variability encourages the spread of pests which increase the geographical range of some diseases. They further pointed out that climatic impacts are also referred to as biophysical impacts and these biophysical impacts include changes in rainfall amounts and distribution, leading to an increased frequency and intensity of extreme climatic events such as drought. This led to decline in yields and production and increase in number of people at risk of hunger and food insecurity. Ojwang et al. (2010) observed that the major impact of drought on smallholder farming communities was increased food insecurity and loss of livelihoods. Therefore, they pointed out that this required the farming communities to have weather coping strategies in order to survive in such harsh conditions.

2.5.2 Socioeconomic Constraints

According to Amudavi (1993), these are social and credit inaccessibility constraints which limit the farming community from improving the crops output. These constraints make the situation of food insecurity to be worse. A study by Bohnsted (2000) reported that credit inaccessibility is due to unfavourable credit terms. He further reiterated that unfavourable credit terms hinder farming performance. Another study by Salahuddin (2006), demonstrated that smallholder community farmers need to acquire the necessary collaterals for credit access to invest in their farms. These collaterals are not available to most of the poor community members.
According to Kikonyogo (2000), acquisition of such credit is difficult to the farmers because of high rates of interest on lending, and this has depressed the smallholder farmers’ demand for the credit and thus limited their progress. A study by Bolo (1996) reports that smallholder farmers need to employ techniques such as the use of fertilizers, spray for crops against pests and diseases and quality seeds. Majority of the smallholder farmers cannot afford these farm inputs for lack of credit. Access to credit is important for it can improve the welfare of the smallholder farmers by reducing their vulnerability to weather shocks like erratic rainfall (Binswanger, 1998).

2.5.3 Insecurity of Land Tenure

A study by Jayne et al. (2005) defined the ownership as the possession or holding of the rights associated with each parcel of land. They further reported that a farmer can own land either through inheritance or outright purchase. According to them, access to land is a key strategy to reduce rural poverty, ensure food security and sustainable community development. Hudson (2000) also pointed out that land is considered to be the most important factor to food security. He noted that food insecurity occurred due to insecure land rights and low level of technology that accompanies agricultural production and other related problems commonly found in developing economies. Amsalu (2006), pointed out that persons who have obtained individual title deeds to their farms are more likely to be food secure than those farmers in areas not yet adjudicated.

2.6 Influence of Agricultural Extension on Food Security Status

Extension is an institutional resource. This includes training of farmers which is crucial for making them increase food production and hence food security. Farmer education reduced the ignorance of the new agricultural technologies and this led to improved crop production. Farmer education is done through community participation. According to Amsalu (2006), community participation is an active process by which smallholder farming community members influenced the direction and execution of an innovation with a view to enhancing
their well-being in terms of food sufficiency, income, personal growth or other values that they cherish. The study further stated that participation in extension is aimed at creating public awareness about the existence of agricultural innovations and opportunities which if adopted enhances improved crop and livestock production and hence ensure food security.

According to Ban and Hawkins (1996), the major role of extension is seen as a process of helping farmers to make their own decisions by increasing the number of options from which they can choose, and by helping them to develop insight into the consequences of each option. They further reported that extension play a great role in popularizing farm technologies by working closely with the smallholder farming communities. Nyoro and Jayne (2004) reported that the role of extension includes: Building the capacity of the smallholder farming communities and Community Based Organizations (CBOs) in order for them to pursue their development goals by articulating high quality demand for services. According to them, this is done by offering need-based practical training and close follow up which enables them to compare their farming environment with other farming situations. This in turn, develops farmers’ aspiration for change through adopting different farm technologies that are suitable to their farming system.

![Figure 2: Model showing the role of extension through farmer education in determining the adoption of agricultural innovations and food security status of the households.](image-url)
The arrow sign (→) in the above model indicate the direction of influence

According to Cohen and Uphoff (1990) participation includes people’s involvement in decision-making processes, in implementing programs towards achievement of food security. They further stated that it occupied a central place in development thinking and practice. Governments, funding agencies, donors, and civil society actors such as NGOs, multi-lateral agencies like the World Bank and the International Monetary Fund have all arrived at a consensus that development cannot be sustainable and long-lasting unless people’s participation is made central to the development process. Binswanger (1998) affirmed that active participation of the smallholder farming community is essential to improved democracy and better service. He further stated that participation enhanced social cohesion because communities recognize the value of working in partnership with each other and with statutory agencies. A study by Taub (2008) reported that participation through skill development, enhanced the opportunities for improving food security status, employment and an increase in community wealth and lastly, it gave farmers the opportunity to develop the skills and networks that were needed to address food insecurity.

According to FAO (2008), extension agents or researchers must take into account local constraints and cultural preferences when introducing agricultural innovations such as water harvesting for irrigation. However, Amsalu (2006) demonstrated that a transition to a more sustainable agriculture will not occur without the full participation and collective action of the farming community. This strategy is employed in popularizing and implementing the water harvesting structures.

2.6.1 Extension Services Using Participatory Approaches

FAO (2008) pointed out that, in numerous arid and semi-arid areas of Africa, extension agents and farmers have conducted participatory surveys to identify farmers’ problems and needs and have selected water harvesting practices to test in on-farm trials. These trials and
analysis that extension agents and farmers conduct form the basis of determining whether farmers would adopt water harvesting for irrigation on a wider scale. A study conducted by Fliegel (2001) reported that assessment of the adoption potential of water harvesting structures needs to be carried out. He further explained that this involves determining its biophysical performance, profitability and acceptability by farmers. Another study by Rosegrant and Cline, (1995) stated that the main objectives of such an assessment is improving the efficiency of water harvesting structures, measuring their effectiveness, dissemination and the impact of investment.

Participatory extension approaches emphasizes on the need for empowerment of the smallholder farming community to be paramount. A study by Mugwe et al. (2008), demonstrated that the role of the extension is to facilitate an in-depth situation analysis by the farming community at the onset of their relationship. They reiterated that the moment farming community become aware of the causes to their problems, the extension agents provides skills in form of technical knowledge and agricultural innovations which are aimed at addressing the identified problems. In this case the smallholder farming communities are the final decision makers in goals identification, planning, implementing and evaluating the outcome of their activities. In order to find appropriate technological answers to farming community problems, the extension agents must consider the local constraints and cultural preferences.

2.7 Influence of Livelihood Strategies on Food Security Status

2.7.1 Off-farm Employment
According to Benjamin and Kimhi (2006), the main limitation to purchasing food is inadequate and unstable income resulting from lack of diversification of income sources. He further observed that households in rural areas might improve their food security if they combine subsistence farm and non-farm employment. Another study by Awoyemi (2004)
reported that non-farm employment enabled households to cope with external shocks and deficits in agricultural production. Haggblade et al. (2007) also observed that non-farm employment had also been found to help households increase their subsistence production through increased investment in agriculture which resulted in enhanced food security. However, Binswanger (1998) in his study on effects of non-farm income on food security reported that although non-farm income may be necessary for the improvement of household food security, it is not sufficient. He stated that this is because it is likely to cause changes in tastes/preferences, and hence shifts in food purchasing and in labor and resource allocation patterns. Babatunde and Qain (2008) demonstrated that fears have been expressed about the possibility of reduced agriculture involvement if there is an increase in participation in non-farm activities by rural households. Additionally, they observed that this is particularly in communities where men migrate to seek employment and in areas where non-farm employment opportunities are easily accessible.

According to Joshi, Shresha and Bista, (2003), some labor is lost when non-farm employment is taken up and this result to serious repercussions for subsistence production and thus food insecurity. They further reported that a decrease in food production normally results if the incomes earned from non-farm income are inadequate to meet basic household needs, including food or for hiring of additional labor to replace the labor that has migrated. However according to them, if earning levels allow, and if households are willing, hired labor and other inputs can be used to substitute the family labor released for non-farm activities. Jules (2001) observed that households with non-farm income are also able to take risks they would not otherwise have done without an assured alternative source of livelihood. However, a study by Katz (2002) found out that a shift in labor of a few family members to non-farm employment does not affect family labor in agricultural activities if there are people in the household who can shift their labor to replace those engaged in non-farm income. Non-farm employment activities include trading, fishing, government employed,
crafts, service delivery, burning and selling charcoal and casual labor. Households with non-
farm employment usually take risks they would not have taken without an assured alternative
source of livelihood. A shift in labor of a few family members to non-farm income does not
affect family labor in the farm if there are other people in the household who can shift their
labor to replace those engaged in non-farm employment. However, Dercan, (2002)
demonstrated that in the event of increased non-farm employment, there is reason for
substitution if there is a reduced allocation of cash capital to farming activities. This implies
that many households will rely on the market for family food needs.

Haggblade, et al. (2007) affirmed that if indeed non-farm employment does not negatively
affect the allocation of family resources to subsistence food production, then promoting non-
farm employment opportunities is justified as a means of improving household food security
by increasing the purchasing power while Dessy, Woudou and Oullet (2006) observed that if
non-farm employment affects subsistence production negatively, then there is need to find
out its effect on food security.

2.7.2 Soil and Water Conservation Measures
A study by Kihara (2004) revealed that mitigation against water stress and low crop yields
can only be achieved through soil and water conservation measures. He noted that this is a
strategy considered in dry areas for improving food security. The same view was expressed
by Feder et al. (1985) who reported that soil and water conservation is the solution to water
scarcity and food security.
2.7.2.1 Types of Soil and Water Conservation Measures

2.7.2.2 Terraces:

According to Morgan (1986) terraces are designed to accumulate and retain runoff in the terrace channel so that it will eventually infiltrate. Another study by Cow et al. (1999) demonstrated that terracing changes the landscape.

2.7.2.3 Water pans

Water pans provide water for domestic/livestock use and supplementary irrigation. Mahesha (1996) in his study on effects of climate change on household food security reported that lack of water is the largest constraint to food security in households. He further stated that harvesting rainwater where and when it falls presents opportunities to address both water scarcity and soil degradation at a local level therefore improving the food security situation. Doss (2001) in his study of effects of water harvesting in Ethiopia, reported the positive impacts of water pans on food security. He further reported that establishment of water pans provided opportunities for the local community to diversify their economic activities through the cultivation of high value horticultural crops under drip irrigation systems. Vegetable crops such as tomatoes, okra, amaranthus, and spinach are grown and perform well because of efficient use of water through drip irrigation. Utilizing water harvesting and conservation technologies for crop and livestock production systems greatly reduce community vulnerability to food insecurity hence improve their quality of life.

According to Kaloi et al. (2005), the occurrence of erratic rainfall have created uncertainty for agricultural production and emphasized the need for irrigation. He further reported that the traditional system of irrigation comprises of the use of either rope and buckets to lift and distribute water from shallow open wells or watering cans to lift water from streams. According to him, although the low capital requirement of these traditional technologies
makes them advantageous and affordable, their low delivery capacity and labor intensive nature make them highly unfavorable to coastal conditions.

A study by Hyman et al. (1995) demonstrated that improved water lifting technology with relatively high efficiencies such as motorized pumps, have been tried but have been found to be favorable mostly to large-scale farmers. They further pointed out that for small-scale farmers, who usually irrigate relatively small plots of land and operate relatively small capital, such technologies are unaffordable. A study by Breth (2002) reported that agricultural use of groundwater for irrigation is rising due to availability of pumping technologies. He further stated that use of groundwater for irrigation purposes provide potential employment opportunities particularly during the long dry season and is one of the major livelihood strategies in the coastal areas.

2.7.2.4 Trash lines

According to Hatibu and Mahoo (2000) Trash lines are created across the slope along the contour using previous seasons’ crop residues (millet, maize and sorghum stalks), grasses, litter and other dead vegetative organic materials. Trash lines control surface runoff, soil erosion and enhance infiltration which results in improved crop production resulting in food security enhancement.

2.7.2.5 Unploughed strips

According to Hudson (1987), unploughed strips are aimed at improving food security. They are narrow live barriers comprising naturally occurring grasses and weeds. The contours are then pegged to serve as an initial guide to ploughing. The 0.3–0.5 m wide strips are left unploughed to allow vegetation to establish and to serve as water catchment for infiltration to benefit crops and hence enhance food security. A study by Choudhury and Jansen (1999)
reported that runoff flowing down the slope during intense rain is slowed, and infiltrates when it reaches the vegetative strips.

2.7.3 Irrigation
Irrigation is the application of water to the land for the purpose of supplying moisture essential to plant growth. Namara et al (2005) reported that irrigation has been practiced in Egypt, China and other parts of Asia for a long period of time. He further demonstrated that irrigation is the foundation of civilization in numerous regions.

According to El-Osta (2000), the extent of access to water for irrigation depends on the type of water harvesting structures a farmer chooses to adopt, the size of the water harvesting structures and wealth status. He further affirmed that to access water harvesting for irrigation, action must be based on an understanding of the dynamics of adoption and the critical factors that determine whether smallholder farming community accept or do not accept this technology. A study by Denning (2000) pointed out that the most common water harvesting structures adopted include: zai pits, boreholes, sunken bend or ponds, water pans, and roof catchment. According to him, there is no water harvesting for irrigation that will have a significant impact on the land unless it is adopted by a significant percentage of the intended users. Another study by Ndiema (2002), revealed that adoption or non-adoption of water harvesting for irrigation is a function of the practice proposed, the availability and distribution of the factors of production. He also reported that the water harvesting structures introduced to farmers must appear practical and beneficial to them.

2.7.4 Use of Indigenous Knowledge as a Livelihood Strategy
A study by Osunade and Warren (1992) revealed Indigenous Knowledge has been used for many generations by the people around the world in different ways in order to fight food insecurity. According to Lal (1989), indigenous knowledge is the basis for local level
decision-making in many rural communities on how to achieve food security. He further reported that indigenous knowledge though unique to a given culture or society has value not only for the culture in which it evolves, but also for scientists and planners striving to improve food security in rural localities. Coping strategies to climatic variability include avoiding meals or securing resources. Since rain-fed farmers are already vulnerable to current weather variability and associated shocks, it is essential to help them build their livelihood resilience through coping better with current weather-induced risks as a pre-requisite to adapting to future climatic changes (Bernet et al., 2005). However, the importance of science in reducing disaster risk also needs to be recognized. Combining local knowledge and science may be a way to overcome problems that deal with the effects of climatic variability. This can best be achieved by integrating their indigenous knowledge with science in order to fight food insecurity. Bollier (2009) demonstrated that indigenous knowledge not only preserves the past, but can be vital in ensuring a sustainable future. It has been realized to be important in reducing disaster risk and adaptation to climatic variability. However, the importance of science in reducing disaster risk also needs to be recognized. Combining local knowledge and science may be a way to overcome problems that deal with the effects of climatic variability. The smallholder farming communities take a central position in agricultural activities but their role has been given very little attention in the past, where they are expected to adopt innovations that have been developed by others. What they need is technical guidance so that they can manage challenges in their farming activities. This can best be achieved by integrating their indigenous knowledge with science in order to fight food insecurity.

According to Olatokun and Ayanbode (2008), farming communities through accumulated knowledge passed from generation to generation have known patterns of weather; how and when local natural disasters occurred; how to plan to cope with their impacts on the natural environment, livelihoods and lives. They further reported that many African farming
communities have developed techniques and strategies for forecasting, and managing climatic variability including coping mechanisms to respond to both normal and harsh conditions of their local environments. A study by Nyong et al. (2007) reported that farming communities base their forecasting on observation of the natural environment including flora, fauna and stars and this have enabled them to reduce their vulnerability of climatic variability.

2.7.5 Agroforestry

According to Kidane (2009) agro-forestry consists of growing perennial trees and shrubs in association with agricultural crops and keeping livestock in the same field. It aims to use agro-biodiversity in generating multiple services. A study by Kerkhof (1992) reported that trees and shrubs provide mulching material, green manure, animal fodder, soil erosion control, shade, nutrient cycling and improved soil fertility and also socio-economic benefits e.g. saleable products such as fruits, fuel wood and charcoal, timber for construction and craft materials. Agro-forestry contributes in natural resource conservation and has the potential in the improvement of food security by being wind breakers.

2.7.6 Agricultural Diversification

Agriculture diversification is practised by over 85 percent of the smallholder farmers in developing countries (World Bank 2008). A study by Jema (2008) reported that despite its importance, the agricultural diversification is traditional and subsistence-oriented and it is characterized by poor and declining performance. The study further observed that this is exacerbated by recurrent drought, land degradation, crop and livestock pests and diseases, lack of improved and suitable technologies and poor marketing and service infrastructure which affects food security. Consequently due to the risky environment, the smallholder farmers make decisions and employ various risk mitigating strategies (Briglaurer, 2000). Nystron et al. (2000) demonstrated that some crops are more drought resistant than others, but may offer poorer economic returns. According to them, a diversified portfolio of products
should ensure that farmers do not suffer greatly when the weather is bad. They also reported that diversification can manage price risk, on the assumption that not all products will suffer low prices at the same time.

A study by Patterson et al. (1999) reported that the types of crops that can be grown are affected by changes in temperatures and the length of the growing season. They further stated that, climate change also modifies the availability of water for production. This is experienced in many countries including Kenya where farmers have initiated diversification as a response to climate change. According to Folke et al. (2004), climate variability has negative consequences on agricultural production. He further reported that diversification of crops is a cost-effective method in improving resilience against pests outbreaks and pathogen transmission. A study by Nystrom et al. (2000) demonstrated that the development of resilient agricultural systems is an essential study because many communities depend on the ecosystem services of such systems for their livelihoods. Altieri (1999) & Tilman et al. (2002) reported that many agricultural based economies have few livelihood strategies and many smallholder farmers have little capital to invest in expensive coping strategies, which increases the vulnerability of rural agricultural communities to climatic variability.

Tilman et al. (2002) in their study on effects of climate change on agricultural productivity reported that this affects agricultural production and thus food security among the rural households. They further stated that effects such as changes in nutrient cycling, soil moisture, increased pest occurrences and plant diseases will greatly affect agricultural production and food security.

According to Tilman et al. (2002), agricultural diversification is enhanced by a functioning biodiversity. They observed that biodiversity enhances ecosystem function because different species perform different roles and therefore occupy different niches. According to them,
recognition of biodiversity as an important agent in the maintenance of ecosystem shows its utility in agricultural diversification. A study by Bezabih and Hadera (2006) reported that the economy of the developing countries is characterized by subsistence mixed farming systems, low agricultural productivity and poor access to major markets. According to them, agricultural production in these countries is characterized by high degree of instability due to unpredictable weather conditions ie erratic and variable rainfall. Jema (2000) observed that the unpredictable weather conditions leads to fluctuations in crop yields on one hand and fluctuations in input and output prices on the other. He further argued that agricultural diversification leads to stability of income.

2.7.6.1 Crop Diversification
According to Briglauer (2000), crop diversification is an important effort to increase food security. He further reported that depending on one crop can be disastrous to the smallholder farming community due to slump in the market value of particular crop products which end up reducing their income. A study by Jema (2000) reported that crop diversification is used in order to reduce income variability. He further observed that it enables farmers to avoid these risks and provides a healthy diet to the family. According to him, the primary objective of crop diversification is to promote food security and this means that smallholder farmers have better diet with carbohydrates, proteins and vitamins.

2.7.6.2 Diversified Livestock Farming
Some smallholder farmers diversify agricultural production to include several species of livestock on their farms to reduce food insecurity. A study by Vandermeer et al. (1998) observed that diversifying livestock helps reduce risks, increase profits and improve cash flow. They further argued that producing more than one species can have a synergistic effect such as ensuring food security for households. Gurr et al. (2003) in their study stated that diversification leads to increased production on fixed land, building, labor and capital resources and food security. Vandermeer et al. (1998) noted that diversifying livestock
enterprises utilizes labor resources better. They expound this by stating that labor requirements for beef may be intensive during one season and fall in another season. According to them, during low season when beef requirements are reduced, the excess labor can be employed in poultry production. They also stated that livestock handling and transportation equipment are adapted to the various species. The fixed cost of machinery is better utilized as it is spread over increased livestock production.

According to Gurr et al. (2003), livestock diversification reduces production risk. They further reported that diseases are usually species specific. According to them, if there is an outbreak of one species which requires time, expense, and loss of income to be brought under control, then the other species continues to carry the operation. Fencing will likely have to be adapted as the various species have different fencing requirements.

Gurr et al. (2003) observed that livestock diversification leads to increase in production and improved profits. They further argue that this is particularly true because of the relationship between fixed costs and profit. According to them, fixed costs are a major expense in operating a farm. They explain fixed costs as those expenditures that must be made regardless of the level of production. These include depreciation, interest, land rent, and salaried labor. They further states that as production increases for a fixed level of resources, fixed costs per unit of production are reduced and the profit per unit increases which also increases overall profitability.

According to Matson et al. (1997) and Altieri (1999), more diverse agroecosystems with a broader range of traits and functions will be better able to perform under changing environmental conditions. They further reported the following ways which diversification has been found to protect crop and animal productivity against environmental change. These are; pest suppression, disease suppression and climate variability buffering and migration. A
study by Matson *et al.* (1997) observed that pest suppression is a challenge to farmers and is a very important ecosystem service. However, according to Patterson *et al.* (1999), there are a variety of barriers to pest challenges such as competition, predation and parasitism from other species. They further reported that promoting such barriers to range expansion and pest viability will have an immediate negative impact on pest outbreaks and will help protect agricultural production.

A study by Oerke (2006) reported that losses caused by pests can contribute significantly to declines in crop production and also changes in climate was found to affect plant disease distribution and viability in new agricultural regions. He further observed that many of the crop diseases are as a result of crop pests. However, Krupinsky *et al.* (2002) found out that increasing diversification of cereal cropping systems by alternating crops is another option for managing crop diseases. According to Parry *et al.* (2005), diversified agroecosystems was found important for agriculture as climate variability has increased. He further reported that crop yields are very sensitive to high temperatures and unpredictable rainfall patterns, especially during flower and fruit development stages. A study by Lin (2007) reported that agroforestry systems have been shown to buffer crops from these fluctuations in temperature and unpredictable rainfall patterns. According to the study, agroforestry provide shade which protect crops from lower precipitation and reduced soil water availability because tree cover reduces moisture evaporation and improves soil water infiltration. Agroforestry also acts as wind break for crops.
CHAPTER THREE
METHODOLOGY

3.1 Introduction
This chapter describes research methodology used in this study. It discusses study location, research design, target population, sample size, sampling procedure, research instruments, piloting of the instruments and validity of the instruments. Reliability of the instruments, data collection procedures, data analysis techniques, research ethical considerations, and finally, data management and analysis.

3.2 Study Location
Kilifi South Sub-county comprises of Bahari, Chonyi and Kikambala divisions all located in Kilifi County in Coast region. Kilifi South Sub-county is situated along the Kenyan coastal line (APPENDIX II). The area receives an average annual rainfall of between 400-1250 mm per year which is biannual and unpredictable. Limited research has been carried out on food security in the area. The inhabitants are the Mijikenda community. According to 2009 population census, forty seven percent of the population were males while fifty three percent were females (Kilifi District Development Plan 2012). Kilifi South Sub-county is both arid and semi-arid, with erratic and unreliable rainfall. Most of the areas are generally hot and dry leading to high rates of evaporation. This combined with unreliable rainfall, limits intensive and meaningful land use and related development activities. The long rains last from March to May and short rains from in November to December. The periods falling between June to September and January to February are usually dry. Kilifi South Sub-county was chosen from other sub-counties because of the magnitude of food insecurity (KFSSG, 2012).
3.3 The Research Design

This study used survey design and inferential statistics which are methods of collecting information by interviewing and administering questionnaire to a sample of individuals and then subjecting the data to multiple regressions (Orodho, 2003). This research design is appropriate due to its safeguard against bias and its ability to maximize reliability.

3.4 Target Population

The target population of this study was the rural households of Kilifi South Sub-county. According to Kenya Bureau of statistics population Census (2009), Kilifi South Sub-county has a total population of 28 074 inhabitants comprising of 6 184 households spread across Bahari, Chonyi and Kikambali divisions

3.5 Sampling Procedure

Sampling refers to a selection of a representative sample from a target population to be used in a study to give desired characteristics about the population. This study used systematic random sampling which involved drawing every nth household in the population starting with a randomly chosen household in each of the villages in the three divisions. The nth household was the 5\textsuperscript{th} household. The respondents were the head of the household or any available responsible adult. Kilifi South Sub-county was chosen from other sub-counties because of the magnitude of its food insecurity whose causes have not been researched or documented.

3.6 Sample Size

A sample size of 256 households’ collected based on procedure by Cochran (1963) was used in this study. This was obtained after data cleaning as some of the questionnaires were incomplete.
\[ n = \frac{Z^2 pq}{d^2} \]

Where:
- \( n \) = the desired sample
- \( Z \) = the standard normal deviate at the required confidence level. 
- \( p \) = the proportion in the target population estimated to have characteristics being measured. 
- \( q \) = \( 1 - p \)
- \( d \) = the level of statistical significance set.

\[ n = (1.96)^2(0.05)(0.05)/(0.005)^2 \]
\[ n = 384 \]

### 3.7 Research Instruments

Prior to the commencement of data collection, the researcher obtained all the necessary documents, including a certificate from Pwani University Ethics Review Committee. The main data collection instruments that were used in this study included a questionnaire. This was used for the purpose of collecting primary quantitative and qualitative data. Additionally, the questionnaire was used for the following reasons: its potentials in reaching out to a large number of respondents within a short time, able to give the respondents adequate time to respond to the items, offers a sense of security (confidentiality) to the respondent and it is objective method since no bias resulting from the personal characteristics (Gay, 1992). The questionnaire was divided according to the objectives as the main areas of investigation. The study used primary data questionnaires, oral interviews from respondents on their opinion, preferences, feelings, judgments and attitudes to describe the factors that influence household food security among rural households in Kilifi south Sub-county.

### 3.8 Piloting of The Instruments

A pilot study was conducted as a technique of testing the reliability of the data collection instruments especially the questionnaire and the interview schedules. In this study, a sample of 6 respondents was selected for piloting out of the target population. Piloting helped to identify any unforeseen limitations that could adversely affect the results of the findings of research. Such limitations and challenges were addressed before the actual study started.
bid to mitigate their effects on the study outcome. Piloting of research instruments assisted in increasing their reliability since any defects and possible contradictions, ambiguity or otherwise of the instruments such as the survey questionnaire was identified and corrected before the actual data collection for the study.

3.9 Validity of The Instruments

A panel of three officers in the Department of Agriculture in the sub county was requested to assess the relevance of the content used in questionnaire development. Their recommendations were incorporated in the final questionnaire. The researcher administered the questionnaire twice to selected separate but similar responses to the sample in the study using the test, retest method. The Pwani University supervisors together with other experts from the Crops Department also assessed the instruments to test their adequacy in terms of depth, relevance and clarity. According to Mbeza (2006) validity refers to the extent to which a test or an instrument measures what it is intended to measure. Orodho (2004) defined validity in the sense raised as the degree to which the empirical measure of the concept, accurately measure the concept. Gay (1992) observed that content validity is a matter of judgment by the researcher and professionals in the specific area of study.

3.10 Reliability of The Instruments

The reliability of research instrument covers the extent to which the tool yields the same results on repeated trials hence, the tendency towards consistency found in repeated measurements in what is referred to as the reliability of the research instrument. In this study reliability followed the following steps, the developed questionnaire was given to 6 identical respondents subjects not included in the main study the answered questionnaires were filled manually. After two weeks the same questionnaire was administered to the same group of subjects. Thus, test–retest method was used, the consistency in the answers provided assurance of reliability of the instrument. This showed that questionnaires were reliable and therefore they were used for the final study.
3.11 Data Management and Analysis

Descriptive statistics was used to analyse the data. The resulting statistics formed inferential analysis basis. Regressions were used to validate the findings of the descriptive statistics because it controls other confounding variables at the same time (Kothari, 2004). Significant relationships between categorical variables were also established. Multiple regression measures the relationship between the categorical dependent variable and independent variables which are usually continuous by estimating probabilities (Kothari, 2004).

The regression equation is \[ y = a + B_1X_1 + B_2X_2 + B_3X_3 + B_zX_z \] where \( z \) is the number of independent variables, \( y \) is the dependent variable, \( a \) is the constant and the \( Xs \) are independent variables. The \( Bs \) are listed in a column of coefficients.

Food security = \( \alpha + 82.784(\text{Age}) + 62.836(\text{HH Size}) + 54.455(\text{Educ level}) + 63.995(\text{Gender}) + 33.999(\text{Banks}) + 54.543(\text{Title deeds}) + 67.254(\text{Land size}) + 65.255(\text{Agric extension}) + 72.833(\text{Early planting}) + 42.960(\text{New varieties}) + 39.667(\text{Off-farm activities}) + 48.720(\text{Irrigation}) + 78.253(\text{Soil & water conservation}) + 27.628(\text{Agroforestry}) + 51.533(\text{Indigenous Knowledge}) + 79.746(\text{Agricultural diversification}) \)

The study used Adjusted R Squared of 0.691. That is, 69 percent of a change in the dependent variable can be explained by changes in the independent variables. Before running statistical analysis, variables were examined for the presence of stochastic trends using normality test in order to confirm whether data conforms to ordinary least squares (OLS) assumptions. Using the P-P plots of regression, the data were found to be normally distributed.

According to Legendre (2005), identifying an appropriate food security measure is a difficult issue as not all aspects of food security can be captured by any single outcome measure. This
is because the household composition is variable, and the household is in itself subject to varying interpretations; there may be multiple income sources among adult members of one household who have strong incentives not to reveal to each other the full extent of their individual earning power or assets; the responsibility for the production of food may be shared among the adults; and finally, subsistence production is harvested piecemeal and is neither measured nor recorded. In order to avoid this difficulty; most analyses depend on measuring food consumption. Food security can be analysed in terms of food availability as compared with requirements (Babatunde et al., 2007). They further reported that the net food available after selling the surplus to the market is a function of domestic production at household level. Food security at household level is best measured by food calorie intake (Ojogho, 2010). FAO Recommended Daily Calorie Intake was used to determine food security index as shown below.

Food security index \( Z_n = \frac{Y_n}{R} \)

Where \( Z_n \) is food security index of \( n^{th} \) household

\( Y_n \) is the actual daily calorie intake of the \( n^{th} \) household

\( R \) is the Recommended Daily Calorie Required by \( n^{th} \) household.

If food security index of each household is greater than or equal to 2060 Kilocalories it means that the household is food secure.
The Daily Recommended Calorie Requirement for Kenya is 2060 kcal (National Bureau of Statistics, 2009). Per Capita Daily Calorie Intake was obtained by multiplying the calories intake of each household by its household size. The household Per Capita Daily Calorie Requirement was obtained by dividing the households’ Daily Calorie Requirement by household size.

The total household calorie requirement was obtained by multiplying the total number of adults in each household by the Recommended Calorie Requirement of 2060 kcal. Then, the total energy requirements for different age groups were converted to adult equivalent each group multiplied by the corresponding conversion scale (Table 2). The daily food (Calorie required) was estimated by grouping household members into age groups, then the daily calorie required of each age group was converted into adult equivalent as shown in (Table 1). The daily calorie intake was obtained from the net food available. Food available is the actual food consumed. The content of energy of 1 kg of each type of food consumed was obtained from literature as shown in table 2 below.

Table 1: Recommended Daily Energy Intake and Conversion Factor

<table>
<thead>
<tr>
<th>Age Category (Years)</th>
<th>Average energy allowance per day</th>
<th>Conversion factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;6</td>
<td>750</td>
<td>0.29</td>
</tr>
<tr>
<td>6-15</td>
<td>1200</td>
<td>0.51</td>
</tr>
<tr>
<td>16-30</td>
<td>1500</td>
<td>0.71</td>
</tr>
<tr>
<td>31-50</td>
<td>2350</td>
<td>0.98</td>
</tr>
<tr>
<td>51+</td>
<td>2200</td>
<td>0.9</td>
</tr>
</tbody>
</table>

Table 2: Cereal Equivalent Conversion ratios

<table>
<thead>
<tr>
<th>Food crop</th>
<th>Calorie/kg</th>
<th>Milling ratio</th>
<th>Maize equivalent ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>3590</td>
<td>0.85</td>
<td>1.00</td>
</tr>
<tr>
<td>Cowpeas</td>
<td>3640</td>
<td></td>
<td>0.92</td>
</tr>
<tr>
<td>Sorghum</td>
<td>1350</td>
<td>0.65</td>
<td>0.40</td>
</tr>
<tr>
<td>Cassava</td>
<td>1490</td>
<td>0.85</td>
<td>0.40</td>
</tr>
</tbody>
</table>

Source: Okigbo (1991)

The total quantity of each food (in kilogram) available was then multiplied by the energy content (e.g. total kilogram of maize consumed per week*3590 kcal = total kcal of maize available). The quantity of maize consumed per week was multiplied by 3950 kcal (for each kilogram) and that of sorghum by 1350 kcal per kilogram and milling loss ratios were 0.85 and 0.65 respectively. Then, the total kcals of food ie maize, cowpeas, sorghum and cassava were summed up and then divided by 7 in order to get the Daily Recommended Calorie Requirement. Based on the recommended daily calorie intake of 2060 kcal, it was found that 48 smallholder farmers which is equivalent to 19.2% of the households were food secure and 202 which is equivalent to 80.8% of the smallholder farmers were food insecure. Data was analyzed objectivewise and hypothesiswise using appropriate analysis procedure model as shown in Table 3.
Table 3: Summary of Methods Used in Data Analysis Procedure

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Independent variable</th>
<th>Dependent variable</th>
<th>Method of Analysis and Statistical test</th>
</tr>
</thead>
<tbody>
<tr>
<td>There is no significant influence of household characteristics on food security status in the study area.</td>
<td>Household characteristics</td>
<td>Food security status</td>
<td>Descriptive analysis and Multiple regression</td>
</tr>
<tr>
<td>There is no significant influence of food security constraints on food security status in the study area.</td>
<td>Food security constraints</td>
<td>Food security status</td>
<td>Descriptive analysis and Multiple regression</td>
</tr>
<tr>
<td>There is no significant influence of livelihood resources on food security status in the study area.</td>
<td>Livelihood resources</td>
<td>Food security status</td>
<td>Descriptive analysis and Multiple regression</td>
</tr>
<tr>
<td>There is no significant influence of agricultural extension on food security status in the study area.</td>
<td>Agricultural extension</td>
<td>Food security status</td>
<td>Descriptive statistics and Multiple regression</td>
</tr>
<tr>
<td>There is no significant influence of livelihood strategies on food security status in the study area.</td>
<td>Livelihood strategies</td>
<td>Food security status</td>
<td>Descriptive analysis and Multiple regression</td>
</tr>
</tbody>
</table>

Multiple linear regression was used for data analysis to get the relationship between dependent variables and the dependent variable. Multiple linear regression for Hypothesis 1, Hypothesis 2, Hypothesis 3, Hypothesis 4 and Hypothesis 5 measured the relationship between the food security status (dependent variable) and the household characteristics, food security constraints, livelihood resources and livelihood strategies (independent variables) which were continuous by estimating probabilities. Hypothesis testing for the four objectives was conducted based on sample evidence and probability theory. These hypotheses were tested at the 0.05 level of significance which is a traditional guideline for consumer research project such as the present study. The multiple linear regression analysis allows the prediction of one variable from several other variables. Multiple linear regression assumes that all variables are interval or ratio-scaled. In addition, the dependent variable should be
normally distributed around the prediction line. This assumes that the variables are related to each other linearly. For multiple linear regression there are three components of the output in which we are interested. These are the Model summary, Adjusted R squared and the standard error.

Table 4: Variables and How They Were Measured

<table>
<thead>
<tr>
<th>NO</th>
<th>VARIABLES</th>
<th>MEASUREMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Food security status</td>
<td>Kilocalories</td>
</tr>
<tr>
<td>2.</td>
<td>Age of the respondent</td>
<td>Years</td>
</tr>
<tr>
<td>3.</td>
<td>Size of the household</td>
<td>Number of household members</td>
</tr>
<tr>
<td>4.</td>
<td>Highest education qualification</td>
<td>None, Pry, Sec, tertiary, university</td>
</tr>
<tr>
<td>5.</td>
<td>Gender</td>
<td>Male or female</td>
</tr>
<tr>
<td>6.</td>
<td>Do you get finances from bank</td>
<td>Yes/no</td>
</tr>
<tr>
<td>7.</td>
<td>Land</td>
<td>Acres</td>
</tr>
<tr>
<td>8.</td>
<td>Participate in agric extension services</td>
<td>Yes/no</td>
</tr>
<tr>
<td>9.</td>
<td>Have title deed</td>
<td>Yes/no</td>
</tr>
<tr>
<td>10.</td>
<td>Participate in off-farm activities</td>
<td>Yes/no</td>
</tr>
<tr>
<td>11.</td>
<td>Practice irrigation</td>
<td>Yes/no</td>
</tr>
<tr>
<td>12.</td>
<td>Practice soil and water conservation</td>
<td>Yes/no</td>
</tr>
<tr>
<td>13.</td>
<td>Practice agroforestry</td>
<td>Yes/no</td>
</tr>
<tr>
<td>14.</td>
<td>Use Indigenous Knowledge</td>
<td>Yes/no</td>
</tr>
<tr>
<td>15.</td>
<td>Practice agricultural diversification</td>
<td>Yes/no</td>
</tr>
<tr>
<td>16.</td>
<td>Adopted new varieties</td>
<td>Yes/no</td>
</tr>
<tr>
<td>17.</td>
<td>Practice early planting</td>
<td>Yes/no</td>
</tr>
</tbody>
</table>

3.12 Ethical Considerations

During the exercise, every effort was made to ensure that the household heads were able to perform their daily activities without being disrupted. The researcher explained to the respondents about the research and that the study was for academic purposes only. It was made clear that the participation was voluntary and that the respondents were free to decline or withdraw any time during the research period. Respondents were not coerced into participating in the study. The participants had informed consent to make the choice to participate or not. They were guaranteed that their privacy was to be protected by strict standard of anonymity.
CHAPTER FOUR
RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter presents the results of the study as well as discussions. In the first instance; it gives the population distribution of households in terms of those who were food insecure and food secure in Kilifi South Sub-county. Then it gives interpretation of the analysis as well as discussions of the main findings of the study. The chapter also shows the sample distribution by household characteristics. The results are presented by objectives under the sub-headings generated from them. Discussion of results is done in the light of the literature review. The chapter then concludes with a summary of findings.

4.2 Socioeconomic and Demographic Characteristics of Sampled Households: A Descriptive Analysis.

This section presents the results of the study in terms of food insecure and food secure respondents.

4.2.1 Food Insecurity Incidence
The results in Table 5 presents food insecurity incidence in Bahari, Chonyi and Kikambala divisions.
Table 5: Food Insecurity Incidence in Kilifi South Sub-county

<table>
<thead>
<tr>
<th>Name of division</th>
<th>Food security status</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Food insecure</td>
<td>food secure</td>
</tr>
<tr>
<td>Bahari</td>
<td>32</td>
<td>4.5</td>
</tr>
<tr>
<td>Chonyi</td>
<td>20</td>
<td>6.1</td>
</tr>
<tr>
<td>Kikambala</td>
<td>28</td>
<td>8.4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>80</strong></td>
<td><strong>20</strong></td>
</tr>
</tbody>
</table>

Source: Field survey April-August 2014

In terms of food insecurity, Bahari division has the majority 32%, followed by Kikambala 28% and lastly Chonyi constituency 28%. This may be due to various factors such as soil, attitude of the farmers, weather conditions and institutional factors. Kikambala division had the highest food secure households 8.4%, followed by Chonyi division 6.4% and lastly Bahari 4.4%. Household food insecurity in Kilifi South Sub-county is also caused by inadequate farming area prolonged drought and and poverty (KFSSG, 2011).

4.2.2 Influence of Household Characteristics on Food Security Status

The results in Table 6 present the household characteristics of the sample. This is in terms of age of the household, household size, educational level and gender.
Age is an important characteristic that influences management and distribution of roles in a household (G. o. K, 2009). This is because age plays a great role in defining various roles played by household members, which impacts household decision-making on land use and food security. Respondents were classified as 26 to 35 yrs, 36 to 45 yrs, 46 to 55 yrs, 56 to 65 yrs and above 65 yrs (Table 6). Distribution of age categories among sample population showed that 19.2% of the household heads were between 26-35 yrs, and majority were

<table>
<thead>
<tr>
<th>Household characteristics</th>
<th>Sample</th>
<th>Percentage</th>
<th>Food insecure</th>
<th>Food secure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26-35</td>
<td>48</td>
<td>19.2</td>
<td>14</td>
<td>5.2</td>
</tr>
<tr>
<td>36-45</td>
<td>104</td>
<td>34</td>
<td>24</td>
<td>10</td>
</tr>
<tr>
<td>46-55</td>
<td>32</td>
<td>12.4</td>
<td>8.4</td>
<td>4</td>
</tr>
<tr>
<td>56-65</td>
<td>34</td>
<td>13.6</td>
<td>12.8</td>
<td>0.8</td>
</tr>
<tr>
<td>Above 65</td>
<td>52</td>
<td>20.8</td>
<td>20.8</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>250</td>
<td>100</td>
<td>80</td>
<td>20</td>
</tr>
<tr>
<td>Household size</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At most 2</td>
<td>41</td>
<td>16</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>3-6</td>
<td>82</td>
<td>33</td>
<td>28</td>
<td>5</td>
</tr>
<tr>
<td>7-10</td>
<td>94</td>
<td>38</td>
<td>35</td>
<td>3</td>
</tr>
<tr>
<td>Above 10</td>
<td>33</td>
<td>13</td>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>250</td>
<td>100</td>
<td>80</td>
<td>20</td>
</tr>
<tr>
<td>Educational level</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>85</td>
<td>34</td>
<td>32</td>
<td>2</td>
</tr>
<tr>
<td>Primary certificate</td>
<td>90</td>
<td>36</td>
<td>28</td>
<td>8</td>
</tr>
<tr>
<td>Secondary</td>
<td>75</td>
<td>30</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>250</td>
<td>100</td>
<td>80</td>
<td>20</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>105</td>
<td>42</td>
<td>34</td>
<td>8</td>
</tr>
<tr>
<td>Female</td>
<td>145</td>
<td>58</td>
<td>46</td>
<td>12</td>
</tr>
<tr>
<td>Total</td>
<td>250</td>
<td>100</td>
<td>80</td>
<td>20</td>
</tr>
</tbody>
</table>

Source: Field survey April-August 2014
between 36-45 yrs which is 34%. These results are similar to those of Kumba et al. (2015) who found that majority of farmers in Kisii central Sub-county were aged between 30 to 50 years. Similar findings were reported by Ogeto et al. (2013) in Nakuru County.

Similarly, studies conducted in Malawi and Uganda by Nyambose and Jumbe (2013) and Turyahabwe (2013) indicated that the average age for household heads in farming communities was 41.1 and 40 years respectively. Analysis of the relationship between household food security and age showed that the age bracket 36-45 years were more food secure (10%) while the age brackets 26-35, 46-55 and those aged above 65 years were 5.2%, 4% and 0% food secure respectively. The research is in agreement with Babatunde et al. (2007) who found out that middle aged household heads were energetic and were able to cultivate larger farms and obtain off-farm jobs for extra income compared to older and weaker ones. Similarly, Muindi et al. (2016) and Teklewold et al. (2006) reported that young household heads adopted new farming technologies easier compared to older farmers. They further attributed the trend to fear of the unknown. This is because older people fear the risk of unexpected events whilst young farmers tend to be more flexible in their decisions to adopt new ideas and technologies more rapidly hence improved productivity leading to better food security status.

Households containing at most two members were 10% food secure while households containing above 10 members were 2% food secure. These findings are similar to those of Adepoju et al. (2015) who found that increase in household size led to significant reduction of food security status of farmers in Osun state, Nigeria.

Education level influences farmers’ or household heads’ access to information as well as their ability to understand technical aspects of innovations which largely affects production decisions (Rahman, 2003; Bogale & Shimels, 2009). This in turn influences productivity, access to food and living standards. Results from the study indicate that the household heads
who had attained secondary school education were 30% while those with primary certificate were 36%. This implies that most household heads in the area were illiterate. This trend can be attributed to the role of education in enhancement of decision making skills hence better adoption and utilization of new technologies and innovations hence improved food production. Similar findings have been reported by Kirimi et al., (2013), Olayemi (2012) and FAO (2003) respectively.

Gender of household head is an important factor in households because it influences farm organizations, income earning opportunities hence food security. The present study indicates that 58% of the households were headed by women while 42% of the households were headed by men. The higher percent of women headed farming households can be attributed to scenarios where male family members leave rural households to try and find waged labour in urban centres to increase family income (FAO, 2003). Female headed households (12%) were more food secure compared to male headed households (8%). The findings are similar to the study carried out by Kassie et al. (2012), who found that female headed households were 87% food secure compared to male headed households.

4.2.3 Influence of Food Security Constraints on Household Food Security Status

The constraints addressed in this study were weather, socioeconomic, land tenure insecurity and land size. These are presented and discussed below.

4.2.3.1 Weather Constraints on Food Security Status

The mean annual rainfall in (mm) in Kilifi Sub-County between 2008 and 2013 is given in Table 7.
Table 7: Mean Annual Rainfall and Temperature Obtained From Mtwapa Meteorological Weather Station

<table>
<thead>
<tr>
<th>YEAR</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rainfall mm</td>
<td>960</td>
<td>1091</td>
<td>1340.7</td>
<td>936.5</td>
<td>800.5</td>
<td>1292.8</td>
<td>1428.7</td>
</tr>
<tr>
<td>Temperature °c</td>
<td>26.2</td>
<td>24.8</td>
<td>27</td>
<td>26.9</td>
<td>26.8</td>
<td>26.7</td>
<td>26.6</td>
</tr>
</tbody>
</table>

Source: Field survey April-August 2014

The mean annual rainfall for the eight years was 1148 mm and with a range of 800 to 1340 mm; and out of the total years only two years were below 1000 mm. Therefore total rainfall is not the most limiting but associative factors such as soil properties and ambient temperature. This may interfere with the crop yields leading to inadequate food for the households. Long and short rains are received between April and June, and October and November respectively. The temperatures in Kilifi South are relatively high mostly from 25 to 27 degrees celcius. This leads to high rate of evapotranspiration which results in water stress in the soil. Most of the area is covered by sandy soil which has low retention ability of water. Due to high temperature, unpredictable rainfall and the type of soil (sandy), the effect is low yields. However, the temperatures seem to be relatively stable with a range of 24.8 to 27%.

4.2.3.2 Socioeconomic and land constraints on food security status

Analysis of the influence of credit on food security indicate that 45% of the households got credit from banks, 43% from microfinance and 12% of the households from friends and family members. Access to credit is important in the food security equation and other factors being equal, income rich households may be more food secure than otherwise. The results
indicate that 11% food secure households obtained credit from banks (Table 8). The same view was expressed by Meena et al. (2002) who reported that household access to credit was associated with an elasticity of 0.07 providing further support to the role of social support in influencing food security by providing access to food or production resources.

Table 8: Socioeconomic and land Constraints and Their Effect on Food Security Status

<table>
<thead>
<tr>
<th>Climatic constraints</th>
<th>Sample</th>
<th>Percentage</th>
<th>Food insecure</th>
<th>Food secure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>Financial distribution by sources</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Banks</td>
<td>112</td>
<td>45</td>
<td>34</td>
<td>11</td>
</tr>
<tr>
<td>Microfinance</td>
<td>108</td>
<td>43</td>
<td>35</td>
<td>8</td>
</tr>
<tr>
<td>Friends and family members</td>
<td>30</td>
<td>12</td>
<td>11</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>250</td>
<td>100</td>
<td>80</td>
<td>20</td>
</tr>
<tr>
<td>Possession of title deed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>86</td>
<td>34</td>
<td>27</td>
<td>7</td>
</tr>
<tr>
<td>No</td>
<td>164</td>
<td>66</td>
<td>53</td>
<td>13</td>
</tr>
<tr>
<td>Total</td>
<td>250</td>
<td>100</td>
<td>80</td>
<td>20</td>
</tr>
<tr>
<td>Land type ownership</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Individual</td>
<td>92</td>
<td>47</td>
<td>36</td>
<td>11</td>
</tr>
<tr>
<td>Family</td>
<td>118</td>
<td>37</td>
<td>31</td>
<td>6</td>
</tr>
<tr>
<td>Rent</td>
<td>40</td>
<td>16</td>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>250</td>
<td>100</td>
<td>80</td>
<td>20</td>
</tr>
<tr>
<td>Land size</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-2 acres</td>
<td>184</td>
<td>74</td>
<td>59</td>
<td>2</td>
</tr>
<tr>
<td>3-5 acres</td>
<td>46</td>
<td>18</td>
<td>16</td>
<td>3</td>
</tr>
<tr>
<td>6-10 acres</td>
<td>20</td>
<td>8</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td>Total</td>
<td>250</td>
<td>100</td>
<td>80</td>
<td>20</td>
</tr>
</tbody>
</table>

Source: Field survey April-August 2014

The analysis of the influence of land ownership on food security indicate that 34% were having title deeds while 66% didn’t have the title deeds, 47% had individual land ownership, 37% family ownership and 16% had rented land for farming. Security of land tenure is important factor in agricultural production and food security. The results indicate that the household owning the land individually were 11% food secure while the households who owned land as family property were 6% food secure (Table 8). This implies that individual
land ownership creates confidence in making positive investment decisions. This sentiment was also expressed by Hoddinott (1999) who reported that land tenure security influence farmers’ profit margins and land use decisions and thus food security. They reported 13% of the farmers in Ethiopia were food secure while the rest were food insecure.

The analysis of the influence of cultivated land size on food security show that, 74% of the households had 1 to 2 acres of land, 18% had 3 to 5 acres and lastly 8% had 5 to 10 acres of land. Cultivated land size is an important resource expected to be associated with a household’s food security status. According to the results, the households with 6 to 10 were 15% food secure while those with 1 to 2 acres were 2% food secure. A study by (Grootaert and Narayan, 2004) reported that as the cultivated land size increases there is a high possibility that the household gets more output in food production and thus food security. They reported that 13% of the households were food secure while the rest 87% were food insecure

4.2.4 Influence of Agricultural Extension on Household Food Security Status

Table 9 illustrates the sample of responses from the respondents in terms of participation in agricultural extension and technologies promoted. The results of agricultural extension is presented and discussed below.
Table 9: Livelihood Resources and Their Effect on Food Security Status

<table>
<thead>
<tr>
<th>Variables</th>
<th>Sample</th>
<th>Percentage</th>
<th>Food insecure</th>
<th>Food secure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>Participated in extension</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>196</td>
<td>78</td>
<td>61</td>
<td>17</td>
</tr>
<tr>
<td>No</td>
<td>54</td>
<td>22</td>
<td>19</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>250</td>
<td>100</td>
<td>80</td>
<td>20</td>
</tr>
<tr>
<td>Technologies promoted by extension</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Early planting</td>
<td>149</td>
<td>60</td>
<td>49</td>
<td>11</td>
</tr>
<tr>
<td>New varieties</td>
<td>101</td>
<td>40</td>
<td>31</td>
<td>9</td>
</tr>
<tr>
<td>Total</td>
<td>250</td>
<td>100</td>
<td>80</td>
<td>20</td>
</tr>
</tbody>
</table>

Source: Field survey April-August 2014

The results indicate that 78% of the households participated in agricultural extension while 22% did not (Table 9). The results also reveals that 17% of the households participating in agricultural extension were food secure while 3% of the households who did not participate in extension were food secure. A similar study conducted by Ray (2001) reported that 28% food secure households participated in extension in Wareng district Kenya.

Analysis of the influence of agricultural technologies revealed that 11% food secure households practiced early planting while 9% planted new varieties. A similar study by Rondinelli (1983) indicate that 8% of the food secure households in Ethiopia practiced early planting while 27% food secure households were planting new varieties.
4.2.5 Influence of Livelihood Strategies on Household Food Security Status

The results in Table 10 below show the influence of off-farm activities as a livelihood strategy.

Table 10: Influence of off-farm activities as a livelihood strategy on household food security status

<table>
<thead>
<tr>
<th>Variables</th>
<th>Sample</th>
<th>Percentage</th>
<th>Food insecure</th>
<th>Food secure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selling fish</td>
<td>74</td>
<td>30</td>
<td>28</td>
<td>2</td>
</tr>
<tr>
<td>Commercial motorcycling</td>
<td>10</td>
<td>4</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Selling charcoal</td>
<td>68</td>
<td>24</td>
<td>16</td>
<td>8</td>
</tr>
<tr>
<td>Kiosks and green grocer</td>
<td>93</td>
<td>42</td>
<td>31</td>
<td>11</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>250</td>
<td>100</td>
<td>80</td>
<td>20</td>
</tr>
</tbody>
</table>

Source: Field survey April-August 2014

The study revealed that although kiosks and green grocers were kept by households in the area more than the other off-farm activities the number was low. Kiosks and green grocers were kept by 42%, selling fish 30%, commercial motorcycling 4% and selling charcoal 24% (Table 10). Households keeping kiosks and selling green grocer were 11% food secure, those selling fish were 2% food secure, the ones operating commercial motorcycling were 2% food secure while those selling charcoal were 8% food secure. This shows that although off-farm activities are not promising, they are important component of livelihood strategies. This is similar to a study by Reandon and Timmer, (2014) who reported that 48% of the rural households cited diversification of off-farm activities as playing a great role in ensuring the food security. The results of influence of soil and water conservation measures as a livelihood strategy on food security status is shown in Table 11.
Table 11: Influence of soil and water conservation measures as a livelihood strategy on household food security status

<table>
<thead>
<tr>
<th>Variables</th>
<th>Sample</th>
<th>Percentage</th>
<th>Food insecure</th>
<th>Food secure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Types of soil and water conservation measures</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>adopted</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contour terraces (Fanya juu)</td>
<td>96</td>
<td>36</td>
<td>25</td>
<td>11</td>
</tr>
<tr>
<td>Water pans</td>
<td>30</td>
<td>12</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Trash lines</td>
<td>77</td>
<td>32</td>
<td>31</td>
<td>1</td>
</tr>
<tr>
<td>Boreholes</td>
<td>19</td>
<td>9</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Unploughed strips</td>
<td>27</td>
<td>11</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>250</td>
<td>100</td>
<td>80</td>
<td>20</td>
</tr>
</tbody>
</table>

Source: Field survey April-August 2014

Analysis of the effects of soil and water conservation measures on food security status indicated that households which adopted contour terraces were more food secure (11%) compared to other measures adopted (Table 11). Households using water pans and trash lines were 4% and 1% food secure while households using boreholes and unploughed strips were 3% and 1% food secure respectively. The higher food security status in households that adopted contour terraces can be attributed to reduction of slope length by contour terraces leading to reduced slope gradient, velocity of runoff and soil erosion rates hence improved water infiltration, less soil degradation and improved crop yields (Tenge, de Graaff and Hella, 2004). These findings are similar to those of Volege (2005) who found that increase in using soil and water conservation measures are significant in the improvement of food security status.

The study revealed that although contour terraces were the technology that had been adopted by households in the area more than the other targeted technologies the level of adoption was
low (Table 11). Contour terraces were adopted by 36% of the respondents, water pans 12%, trash lines 32%, boreholes 9% and unploughed strips 11%. According to Walka et al., (2013), poor adoption and maintenance of introduced technologies can be attributed to site specificity of socio-economic and biophysical factors. The actual and long term financial profitability of the technologies influences the process of accepting and replication (Rogers & Shoemaker, 1971). Additionally, poverty levels, age, education levels, frequency of extension agent visits in the area and land tenure also plays a great role in determining the level of technology adoption (Shiferaw and Holden, 1999; Anley, Bogale and Haile-Gabriel, 2006; Muindi et al., 2016). The influence of irrigation as a livelihood strategy on household food security status is shown in Table 12.

### Table 12: Influence of Irrigation as a Livelihood Strategy on Household Food Security Status

<table>
<thead>
<tr>
<th>Variables</th>
<th>Sample</th>
<th>Percentage</th>
<th>Food insecure</th>
<th>Food secure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Types of irrigation practiced</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drip irrigation</td>
<td>69</td>
<td>28</td>
<td>20</td>
<td>8</td>
</tr>
<tr>
<td>Gunny bags for kitchen gardening</td>
<td>23</td>
<td>9</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Watering with buckets</td>
<td>86</td>
<td>34</td>
<td>30</td>
<td>4</td>
</tr>
<tr>
<td>Use of hose pipe from tank</td>
<td>33</td>
<td>13</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>Water pump</td>
<td>39</td>
<td>16</td>
<td>14</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>250</td>
<td>100</td>
<td>80</td>
<td>20</td>
</tr>
</tbody>
</table>

Source: Field survey April-August 2014

Analysis of the influence of irrigation on food security revealed that drip irrigation was practiced by 28%, ganny bags by 9%, watering with buckets 34% while use of hose pipe and water pumps were 13% and 16% respectively (Table 12). The study also revealed that the households practicing drip irrigation were 8% food secure, those using ganny bags were 3%
food secure, the households using buckets were 4% food secure while those using hose pipe and water pump were 3% and 2% food secure respectively. Studies on irrigation by Hartz (1993) reported that irrigation can impact positively or negatively on the growth and yield of vegetables depending on its efficiency in the use of the available water in Nigeria. They affirmed that 35% of the farmers using drip irrigation were food secure and this is attributed by this type of irrigation being water efficient and gives good results when used in a greenhouse. Table 13 shows the influence of Indigenous Knowledge as a livelihood strategy on the household food security status.

**Table 13: Influence of Indigenous Knowledge as a livelihood strategy on the household food security status**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Sample</th>
<th>Percentage</th>
<th>Food insecure</th>
<th>Food secure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Use of Indigenous Knowledge</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Response to erratic rainfall</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planting fast growing crops.</td>
<td>36</td>
<td>14</td>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td>Traditional water Conservation</td>
<td>20</td>
<td>48</td>
<td>47</td>
<td>1</td>
</tr>
<tr>
<td>Planting traditional seeds</td>
<td>66</td>
<td>20</td>
<td>7</td>
<td>13</td>
</tr>
<tr>
<td>Deep planting</td>
<td>44</td>
<td>18</td>
<td>14</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>250</td>
<td>100</td>
<td>80</td>
<td>20</td>
</tr>
<tr>
<td>Response to increased pest incidences</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crop rotation</td>
<td>71</td>
<td>28</td>
<td>20</td>
<td>8</td>
</tr>
<tr>
<td>Integrated pest management</td>
<td>97</td>
<td>39</td>
<td>20</td>
<td>8</td>
</tr>
<tr>
<td>Seeds from farmers own collection</td>
<td>67</td>
<td>27</td>
<td>23</td>
<td>4</td>
</tr>
<tr>
<td>Shifting cultivation</td>
<td>15</td>
<td>6</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>250</td>
<td>100</td>
<td>80</td>
<td>20</td>
</tr>
<tr>
<td>Response to increased heat on crops</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weather smart crops</td>
<td>212</td>
<td>85</td>
<td>65</td>
<td>15</td>
</tr>
<tr>
<td>Mulching</td>
<td>38</td>
<td>15</td>
<td>15</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>250</td>
<td>100</td>
<td>80</td>
<td>20</td>
</tr>
</tbody>
</table>

Source: Field survey April-August 2014
The study found out that 14% of the households planted fast growing crops, 48% practiced traditional water conservation while 20% planted traditional seeds and 18% practiced deep planting (Table 13). The analysis also revealed that 2% of the households were food secure, 1% of the households practicing traditional water conservation were food secure while those planting traditional seeds and deep planting were 13% and 4% respectively. A similar study by Mishra and Rai (2013) revealed that majority (58%) of the rural households in Himalaya relied on traditional seeds for their livelihoods and 34% were food secure.

The analysis of the influence of response to increased pest incidences revealed that 28% practiced crop rotation, 39% practiced integrated pest management, 27% planted seeds from their own collection and 6% practiced shifting cultivation (Table 13). From the results 8% of those practicing crop rotation were food secure, 8% of the households practicing integrated pest management were food secure while the households relying on their own farm collection were 4% food secure and lastly none of the households practicing shifting cultivation were food secure. Another study by Morgan (1995), reported that crop rotation and integrated pest management were practiced by most households. From his study 56% of the household practicing integrated pest management were food secure.

Analysis on the response to increased temperature on crops indicate that 85% of the households planted weather smart crops while 15% practiced mulching (Table 13). The results revealed that 15% of the households which planted weather smart crops were food secure while those practicing mulching were 5% food secure. A similar study conducted by Reddy et al., (2007) revealed that 10% of the farmers who planted weather smart crops were food secure while those who practiced mulching were 8% food secure. Table 14 shows the influence of agroforestry as a livelihood strategy on household food security status.
Table 14: Influence of Agroforestry as a Livelihood Strategy on Household Food Security Status

<table>
<thead>
<tr>
<th>Variables</th>
<th>Sample</th>
<th>Percentage</th>
<th>Food insecure</th>
<th>Food secure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td><strong>Agro-forestry technologies</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scattered tree planting</td>
<td>167</td>
<td>69</td>
<td>56</td>
<td>13</td>
</tr>
<tr>
<td>Boundary tree planting</td>
<td>41</td>
<td>16</td>
<td>11</td>
<td>5</td>
</tr>
<tr>
<td>Fruit trees planting</td>
<td>30</td>
<td>13</td>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td>Timber wood planting</td>
<td>10</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>250</td>
<td>100</td>
<td>80</td>
<td>20</td>
</tr>
</tbody>
</table>

Source: Field survey April-August 2014

The multi-functionality of the agroforestry systems has been realized in households for decades. The analysis of the influence of agroforestry on food security revealed that 69% of the households planted scattered trees, 16% planted trees at the boundary, 13% planted fruit trees and 2% planted trees for timber (Table 14). The results indicate that 13% of the households practicing scattered tree planting were food secure, 5% of those who practiced boundary tree planting were food secure. In addition, 2% of the households planting fruit trees were food secure. A similar study by Mishra & Rai (2013), revealed that 64% of the households in Himalaya practiced scattered tree planting in their farms and 26% were reported food secure. Table 15 shows the influence of agricultural diversification as a livelihood strategy on household food security status.
Table 15: Influence of Agricultural Diversification as a Livelihood Strategy

<table>
<thead>
<tr>
<th>Types of livestock</th>
<th>Sample</th>
<th>Percentage</th>
<th>Food insecure</th>
<th>Food secure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cows</td>
<td>38</td>
<td>16%</td>
<td>13%</td>
<td>3%</td>
</tr>
<tr>
<td>Sheep</td>
<td>32</td>
<td>13%</td>
<td>11%</td>
<td>2%</td>
</tr>
<tr>
<td>Goats</td>
<td>91</td>
<td>33%</td>
<td>32%</td>
<td>7%</td>
</tr>
<tr>
<td>Poultry</td>
<td>89</td>
<td>35%</td>
<td>27%</td>
<td>8%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>250</td>
<td>100%</td>
<td>80%</td>
<td>20%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Types of crops</th>
<th>Sample</th>
<th>Percentage</th>
<th>Food insecure</th>
<th>Food secure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>155</td>
<td>62%</td>
<td>54%</td>
<td>8%</td>
</tr>
<tr>
<td>Cassava</td>
<td>23</td>
<td>9%</td>
<td>7%</td>
<td>2%</td>
</tr>
<tr>
<td>Sorghum</td>
<td>4</td>
<td>2%</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Cowpeas</td>
<td>47</td>
<td>19%</td>
<td>12%</td>
<td>7%</td>
</tr>
<tr>
<td>Coconut</td>
<td>21</td>
<td>8%</td>
<td>7%</td>
<td>1%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>250</td>
<td>100%</td>
<td>80%</td>
<td>20%</td>
</tr>
</tbody>
</table>

Source: Field survey April-August 2014

Successful diversification often results in a more and varied mix of activities at farm enterprises. The analysis of the influence of agricultural diversification on food security revealed that 16% of the households kept cows, 13% kept sheep, 33% kept goats and 35% kept poultry. Additionally, 62% relied on maize, 9% on cassava, 2% on sorghum, 19% on cowpeas and 8% relied on coconut (Table 15). The study revealed that the households which kept poultry were 8% food secure and those who planned maize and cowpeas were 8% and 7% food secure respectively. A study conducted by Quiroz & Valdies (1995) found that 24% of the households practicing agricultural diversification in Himalaya were 15% food secure.

4.3 Determinants of Food Security Status: An Inferential Analysis

Results of multiple regressions on determinants of food security status were as presented in Table 16.
Table 16: Multiple Regressions of Determinants of Food Security status

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficients (B)</th>
<th>Std error</th>
<th>t</th>
<th>P  values</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Household Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>82.784</td>
<td>9.927</td>
<td>1.382</td>
<td>0.004</td>
</tr>
<tr>
<td>Household size</td>
<td>62.836</td>
<td>9.817</td>
<td>1.323</td>
<td>0.001</td>
</tr>
<tr>
<td>Education level</td>
<td>54.455</td>
<td>7.561</td>
<td>1.563</td>
<td>0.004</td>
</tr>
<tr>
<td>Gender of household head</td>
<td>63.995</td>
<td>13.251</td>
<td>1.731</td>
<td>0.002</td>
</tr>
<tr>
<td><strong>Source of credit</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Banks</td>
<td>33.999</td>
<td>6.164</td>
<td>0.408</td>
<td>0.006</td>
</tr>
<tr>
<td><strong>Land Ownership</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Possession of title deed</td>
<td>54.543</td>
<td>7.965</td>
<td>1.329</td>
<td>0.000</td>
</tr>
<tr>
<td>Land size</td>
<td>67.254</td>
<td>8.141</td>
<td>1.426</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Extension</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participation in extension</td>
<td>65.255</td>
<td>7.342</td>
<td>1.710</td>
<td>0.005</td>
</tr>
<tr>
<td>Early planting</td>
<td>72.833</td>
<td>1.947</td>
<td>1.403</td>
<td>0.005</td>
</tr>
<tr>
<td>Adopted new varieties</td>
<td>42.960</td>
<td>11.291</td>
<td>0.425</td>
<td>0.110</td>
</tr>
<tr>
<td>Participation in off-farm activities.</td>
<td>39.667</td>
<td>1.658</td>
<td>0.418</td>
<td>0.007</td>
</tr>
<tr>
<td><strong>Livelihood strategies</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Practice irrigation</td>
<td>48.720</td>
<td>1.556</td>
<td>0.406</td>
<td>0.009</td>
</tr>
<tr>
<td>Practice soil and water</td>
<td>78.253</td>
<td>3.225</td>
<td>1.653</td>
<td>0.001</td>
</tr>
<tr>
<td>conservation</td>
<td>27.628</td>
<td>1.512</td>
<td>1.808</td>
<td>0.004</td>
</tr>
<tr>
<td>Practice agroforestry</td>
<td>51.533</td>
<td>4.357</td>
<td>1.804</td>
<td>0.004</td>
</tr>
<tr>
<td>Use indigenous knowledge</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Practice agricultural</td>
<td>79.746</td>
<td>4.263</td>
<td>1.675</td>
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</table>

Dependent variable: Food security status, $R^2=0.691$, $F=1.731$, $df=15$

Source: Filed survey April-August 2014

The relationship of age of the household head and food security status was found to be significant ($P=0.004$). The relationship between the dependent variable and independent
variables was strong ($R^2=0.691$). Middle age (36-45 years) headed households were found to be more food secure 10% compared to those headed by older people (0%). These results imply that if household heads advance in age, food security status of the household reduces. These findings agree with those of Kalirajan and Shand (2000) who reported that, the presence of middle aged household heads improved information absorption and dissemination in Australia hence improved food security.

Similarly, Teklewold et al. (2006) and Muindi et al. (2016) in Ethiopia and Kenya respectively observed that farmers who were above 49 years were most likely to have lower adoption rates of new technologies, because older people fear the risk of unexpected events whilst young farmers tend to be more flexible in their decisions to adopt new ideas and technologies more rapidly hence improved agricultural production and food security. However, the findings contradicted those of Haluet et al. (2007) and Babbie (1973) who reported that old farmers have accumulated years of experience in farming activities increased production and consequently more food secure. According to this study, where food security is driven by interventions and extension, the younger farmers are bound to do better than the older ones. In contrast, experience prevails where interventions and extension are not the prime movers.

Household size had significant relationship with food security status ($P=0.001$). The relationship between the dependent variable and independent variables was strong ($R^2=0.691$). An increase in household size would likely make the household to be food insecure. In addition, it implies that as the number of household members decrease, the food security status of the household increase. Large family size in Kilifi South Sub-county has significant relationship with much greater risk of poverty and hence food insecurity. These findings agree with those of Bogale (2008) in Ethiopia who reported that large family size is expected to negatively affect household in terms of attaining food security. This agree with
the results of this study which showed that small households are more food secure than large households which have more people to feed and indirectly reduces income per head, expenditure per head and per capita food consumption. In Kilifi South sub-county, households depend on less productive agricultural land and therefore, increasing household size would result in increased demand for food. This demand however, cannot be matched with the existing food supply from own production and this ultimately end up with the household becoming food insecure. Despite the validity of these results the size by number could be camouflaged by the number versus age structure.

The relationship between education level of the household head was found significant \((P= 0.004)\) and is positively related to food security status. The relationship between the dependent variable and independent variables was strong \((R^2=0.691)\). The results imply that as household heads advance in education, the food security status increases. These findings are in agreement with studies conducted in Kenya by Kirimi et al. (2013) & Muindi et al. (2016) who reported that, education enhances skills and ability to make decisions, which can enable access to better economic opportunities or better utilization of information including use of technology and farming practices to improve agricultural production hence food security. According to the results educational attainment by the household head could lead to awareness of the possible advantages of modernizing agriculture by means of technological inputs; enable them to read instructions on inputs packs and diversification of household incomes which, in turn, would enhance households' food supply. This study revealed that those who have attained secondary school education are best for uptake of technologies.

In addition, the relationship between gender of the household head and food security was significant \((P= 0.002)\). The relationship between the dependent variable and independent variables was strong \((R^2=0.691)\). As the number of females increase, the food security status increase. These findings are in agreement with a study conducted by Edwards and Demaine,
(1997) who reported that gender of the household head affected the food security status in Wareng district, Kenya. The world is giving gender a lot of attention as an important factor in agricultural and other economic development activities and the results of this study indicated gender as a significant factor in agricultural development and food security.

All the socioeconomic characteristics had a positive relationship with food security status. Age of the household head, household size, education level of the household head and gender had positive significant ($P \leq 0.01$) relationship with food security status. Therefore the null hypothesis that there is no significant influence of household characteristics on food security status among the smallholder farming community in Kilifi South sub-county is rejected.

The relationship between credit from banks and food security was found significant and positive ($P = 0.006$). The relationship between the dependent variable and independent variables was strong ($R^2=0.691$). The farmers who borrowed money from banks to buy farm inputs were more likely to be food secure. This finding was consistent with the study conducted by Sikwela (2008) in Zimbabwe and another study by Bogale (2009) who reported that food production can be increased extensively through the use of farm inputs. Access to credit would build the capacity to produce more through use of fertilizers and improved seeds.

The relationship between the possession of title deed and food security status was significant and positively related ($P = 0.000$). The relationship between the dependent variable and independent variables was strong ($R^2=0.691$). The results indicate that food security increases proportionally with acquisition of individual title deeds and land increase. These findings agree with a study conducted by Deininger (2003) who reported that secured
property rights give sufficient incentives to the farmers to increase their efficiencies in terms of productivity and ensure food security. This was supported by Jayne et al., (2005) who reported that access to land with title deed is a key strategy to reduce rural poverty, ensure food security and sustainable community development. Possession of a title deed in the farmers’ names is a form of security that could enable them to enhance their food security status through accessing credit to purchase farm inputs. Majority of the respondents in Kilifi South Sub-county undertake farming in a family owned land without title deeds and this makes it difficult to improve crop production and therefore making them being food insecure. This is a major problem facing many farmers and this makes them remain in poverty. It is also difficult to invest in heavy projects because one is uncertain about the fate of the project in case family conflict arises due to unclear land ownership.

Land size was found to significantly and positively influence food security status in Kilifi South Sub-county \( (P= 0.000) \). The relationship between the dependent variable and independent variables was strong \( (R^2=0.691) \). These findings are consistent with the outcome of a study conducted by Amudavi (2007) who showed significant relationship between farm size and household food security in Kenya. It was also supported by research findings of Buyinza and Wambede (2008) who reported that farmers with big farms were more likely to be food secure. This is because they can diversify and produce more food. The size of land is a proxy for wealth. However some farmers in Kilifi South sub-county own small pieces of land majority of which are not adjudicated and are mostly food insecure. Food production can only be increased by expansion of areas under cultivation because large farms enable households to produce more and also diversify hence enhancing food security status.

Food security constraints had a positive relationship with food security status. Banks, possession of title deed, type of land ownership and land size had positive significant relationship with food security status. Therefore the null hypothesis that there is no
significant influence of food security constraints on food security status among the smallholder farming community in Kilifi South sub-county is rejected.

The relationship between the participation in extension and food security status was significant ($P= 0.005$) and are positively related to food security status. The relationship between the dependent variable and independent variables was strong ($R^2=0.691$). These results are consistent to those of Cohen and Uphoff (1990) who reported that extension services act as a means for advice on agricultural productivity and hence promote household food security. This is supported by Binswanger (1998) who reported that participation in extension includes people’s involvement in decision-making processes, in implementing programs towards achievement of food security. The results indicate that most of the farmers who participated in extension were food secure. When majority of the farming community receive extension services it is expected that the level of food insecurity will reduce by a reasonable margin.

Early planting was found significant and positively influencing food security status ($P= 0.005$). The relationship between the dependent variable and independent variables was strong ($R^2=0.691$). These findings agree with a study conducted by Fliegel (2001) who reported that smallholder farmers do early planting after using traditional ways of determining when rains would come. These include traditional trees shedding their leaves and also bloom in a particular characteristic. It is also possible to tell whether rains would be heavy or light depending on the direction of winds. These findings also agree with an outcome of a study conducted by Amsalu (2006) who reported that since rain-fed farmers are already vulnerable to current weather variability and associated shocks, it is essential to help them build their livelihood resilience through coping better with current weather-induced risks as a pre-requisite to adapting to future climatic changes. Early planting takes advantage of the first rains by crops utilizing the moisture in the soil and mature faster than when planted late. The results indicate that farmers who planted early were food secure. It is
therefore advisable for farmers in dry areas to always take advantage of early planting since it promotes the household food security.

Extension and early planting had a positive relationship with food security status ie participation in extension and early planting had positive significant ($P \leq 0.01$) relationship with food security status. Therefore the null hypothesis that there is no significant influence of livelihood resources on food security status among the smallholder farming community in Kilifi South sub-county is rejected.

Off-farm activities were found significant and positively influencing food security status ($P = 0.007$). The relationship between the dependent variable and independent variables was strong ($R^2=0.691$). This is consistent with the findings of Lemba (2013) who reported that food security is enhanced through strategies which build the capacity of institutions to increase household access to, and management of natural resources. This is due to decrease of food in the household. The findings are also consistent with a study conducted by Chinn 1979 & Lal (1984) who observed that households with off-farm income are also able to take risks they would not otherwise have done without an assured alternative source of livelihood. It also agrees with a study by Awoyemi (2011) who found that farmers’ level of off-farm income was an important factor affecting the food security status among households.

Irrigation was found significant and positively influencing food security status ($P= 0.009$). The relationship between the dependent variable and independent variables was strong ($R^2=0.691$). This is consistent with a study by Lemba (2013) who reported that use of irrigation and soil and water conservation measures are the main strategies used to enhance food security. The extent of access to water for irrigation depends on the type of water harvesting structures a farmer chooses to adopt, the size of the water harvesting structures and wealth status. This outcome is consistent with the outcome of a study conducted by
Narayamamoorhty (1997) who pointed out that drip method of irrigation help in saving irrigation water, increase water use efficiency, decreased tillage requirement, higher quality products, and increased crop yields and higher fertilizer use efficiency. Other variables such as gunbag, buckets, horsepipe from tank and water pump were not significant.

The relationship between soil and water conservation was found to be significant ($P=0.001$) and positively related to household food security status. The relationship between the dependent variable and independent variables was strong ($R^2=0.691$). The results imply that as household heads increase the practice of soil and water conservation, food security status increases. These findings are in agreement with a study conducted by Ray (2001), who reported that on-farm trials and the analysis that extension agents and farmers conduct together, form the basis of determining whether farmers will be food secure or not. This is supported by Ojogho (2010) who found that the benefits of contour terraces motivated smallholder farmers to construct them in their farms. The results indicate that there is need to promote contour terraces among the farmers because they are economical and suitable in areas such as Kilifi South Sub-county. This is because they conserve water at the point of consumption and operating costs are negligible.

Agroforestry was found to be significant and positively influencing food security status ($P=0.004$). The relationship between the dependent variable and independent variables was strong ($R^2=0.691$). Scattered planting, boundary planting of trees and home gardening are the most commonly practiced form of agro-forestry. Scattered tree planting helps in providing shade to crops during dry spells and provide fuel wood. These findings agrees with the study conducted by Kidane (2009) who reported that scattered planting of trees protect crops from strong winds.
As far as boundary planting of trees is concerned, trees are planted along the boundary to mark the property rights and at the same time providing fire wood. This finding is consistent with the findings of a study conducted by Kidane (2009) in Kenya who stated that boundary tree planting act as wind breaks to reduce the effects of strong winds on ploughed land and also protect crops from being flattened by the wind apart from providing poles and timber.

Use of indigenous knowledge was found to be significant and positively influence food security status in Kilifi South Sub-county ($P=0.004$). The relationship between the dependent variable and independent variables was strong ($R^2=0.691$). These findings agree with a study conducted by Rao et al. (2010) who reported that indigenous knowledge is vital in ensuring a sustainable future in dry areas. Indigenous knowledge helps the small scale farmers to store their traditional seeds well without being damaged by pests. Even though the extension agents are promoting the hybrid seeds, the local farmers plant traditional seeds because they withstand dry spells. It has been realized to be important in reducing disaster risk and adaptation to climatic variability. Traditional seeds survive well though it would be advisable to try crop breeding so that researchers can come up with the best breeds for dry areas and this would help in fighting food insecurity.

Agricultural diversification was found to be significant source of livelihood in Kilifi South Sub-county ($P=0.003$). The relationship between the dependent variable and independent variables was strong ($R^2=0.691$). As far as animals and crops diversification is concerned, goats, poultry, maize, cassava and cowpeas were found to improve food security status. These findings agree with a study conducted by Gurr et al. (2003) who observed that diversification of both animals and crops leads to increased food production and improved profits hence improvement of food security status. Livestock like goats enterprises utilizes labour resources better. However, they do not agree with those of Altieri (1999) who reported that labour requirements for beef may be intensive during one season and fall in another
season and therefore inversly related to food security. This is mostly during famine when households are forced to dispose off their goats and poultry at depressed prices in order to purchase grain for consumption.

Participation in off-farm activities had significant ($P\leq 0.01$) relationship with food security status. Therefore the null hypothesis that there is no significant influence of off-farm activities on food security status among the smallholder farming community in Kilifi South is rejected. Practicing irrigation had significant ($P\leq 0.01$) relationship with food security status. Therefore the null hypothesis that there is no significant influence of irrigation on food security status among the smallholder farming community in Kilifi South sub-county is rejected. Practicing soil and water conservation measures had significant ($P\leq 0.01$) relationship with food security status. Practicing agroforestry had significant ($P\leq 0.01$) relationship with food security status. Therefore the null hypothesis that there is no significant influence of practicing agroforestry on food security status among the smallholder farming community in Kilifi South sub-county is rejected. Use of Indigenous Knowledge had significant ($P\leq 0.01$) relationship with food security status. Therefore the null hypothesis that there is no significant influence of use of Indigenous Knowledge on food security status among the smallholder farming community in Kilifi South sub-county is rejected. Practicing agricultural diversification had significant ($P\leq 0.01$) relationship with food security status. Therefore the null hypothesis that there is no significant influence of practicing agricultural diversification on food security status among the smallholder farming community in Kilifi South sub-county is rejected.

### 4.4 Summary of Findings

The findings indicate that household factors: Age of the household head, education, size of the household and gender are all determinants of food security status. Households headed by middle aged people (36-45) years were more food secure compared with the rest of the age
groups. Households with small family size (< 2 people) were also more food secure compared to those with large family size (> 2 people). The findings also indicate that possession of land, type of land ownership, land size, participation in extension and early planting are determinants of food security status. However, according to the findings, adoption of new varieties was found not significant and therefore not a determinant of food security status. This is attributed to the fact that majority of the respondents did not indicate having adopted any new varieties but replanted seeds from previous harvest. Additionally, the findings indicate that participation in off-farm activities, practicing irrigation, agroforestry, soil and water conservation measures, indigenous knowledge and agricultural diversification are determinants of food security status. Practicing soil and water conservation measures resulted in increased food security. The findings also indicate that indigenous knowledge resulted to improved food security status but not to the expected levels. This means the current demand for food cannot be met with application of indigenous knowledge alone. A multi-pronged approach is recommended.
CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

This chapter presents conclusions and recommendations of the study. The conclusions are made objectivewise as shown in the text below:

Objective one sought to find out whether household characteristics are determinants of food security status among smallholder farmers in Kilifi South Sub-county. The conclusion is that households with small family sizes; and households with heads that are female, have higher level of education and middle aged are more food secure.

Objective two sought to find out whether household food security constraints are determinants of food security status among smallholder farmers in Kilifi South Sub-county. The conclusion is that household heads who obtained credit from banks, those with individual type of land ownership and those with (6-10 acres) of land are more food secure.

Objective three sought to find out whether agricultural extension is a determinant of food security status among the smallholder farmers in Kilifi south Sub-county. The conclusion is that household heads who participated in agricultural extension were more food secure.

Objective four sought to find out whether livelihood strategies are determinants of food security status among smallholder farmers in Kilifi South Sub-county. The conclusion is that households with heads participating in off-farm activities; and practicing irrigation, soil and water conservation, agroforestry, indigenous knowledge and agricultural diversification are more food secure.
5.2 Recommendations:

Several recommendations can be made in this study. In order to improve the food security status among the smallholder farming communities in Kilifi South sub-county, the county government which is in the forefront of rural development should target the early adopters that is, those aged from 26 to 45 years who are 48.4% and those with primary and secondary education because they are strong and also able to implement the agricultural innovations. The county government should also consider those with 25 years and below together with those aged above 45 years (late adopters) who are in total 51.6% of the population and give them special attention and more time to adopt agricultural innovations. In addition, the county government should empower men to enable them play a great role in enhancing food security and sensitize the importance of education for fast adoption of agricultural innovations. The results of this study further confirm it is very important to conduct stakeholder analysis before initiation of interventions or projects.

Smallholder farmers in the study area should be encouraged to access credit, which attracts interest rates that march their agricultural production. This will make them be in a position to purchase more farm inputs, increase the land for cultivation through renting and thus plant more to increase the harvest and make the households food secure. The repayment period should be based on actual production cycle to fit in with the farming calendar. In this case, the maize growing calendar starts in March and ends in June while the second maize season is from October to December. Therefore there is need for acquisition of title deeds to promote individual land ownership in the study area and indirectly enhance food security.

The county government should consider improving the adoption of agricultural technologies by increasing the number of extension officers in the study area since participation of smallholder farmers in extension was found to be positive. This will boost food production and hence improve food security status of the smallholder farmers.
The county government should promote off-farm income generating activities such as hawking, fish selling, commercial motorcycling and charcoal selling because this study has shown they enhance food security. Promotion of trades for enhancing food security must be purposeful and they should be controlled in order to ensure continuous flow of income even during the drought season. Other livelihood strategies such as soil and water management techniques, use of indigenous knowledge, agroforestry and agricultural diversification should also be promoted because they enhance food security. Therefore, to ensure success, an integrated and multi-pronged approach is the surest way towards food security and a minimum intake of 2260 kcal per day.

5.3 Further Research

Further studies are required to evaluate the contribution of drip irrigation as a livelihood intervention because it is an intervention that contributed significantly to food security. Areas of concern were cited as water quality and water budget analysis. If this research is conducted it will benefit the coastal geographical region.

Similar research should be carried out in other counties in coast province since they fall in the same geographical region.

Soil conservation was found to be positive whereby farmers practiced various methods depending on their ability. The methods should be ranked according to effectiveness and cost benefits.

Credit was found to be positive though expensive to the smallholder farmers. There is need for further research on various credit facilities including table banking in the study area in order to come up with the best interest rates for comparative analysis.
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APPENDIX I: QUESTIONNAIRE

Survey Questionnaire to the Households

This questionnaire is intended to collect information on the determinants of food security in Kilifi Sub-county. The information collected will be used for academic purposes.

SECTION A: Background information on the household head

1 Name of respondent

2 Constituency

3 Date of interview

SECTION B: Demographic characteristics of the household head

(a) Demographic characteristics of the household head

4. Age in years (i) 15-25 (ii) 26-35 (iii) 36-45 (iv) 46-55 (v) 56-65 (vi) Above 65

5. Size of the household (i) 2 (ii) 3-6 (iii) 7-10 (iv) Above 10 members

6. Highest educational qualification

   (i) Primary certificate { } (ii) Secondary school { }

   (ii) University { } (iv) None { }

7. Gender of the household head (i) Male { } (ii) Female { }

SECTION D: Food security constraints

This part contains questions on the constraints facing your food security such as climatic, socio-economic and livelihood survival skills.
Socio-economic constraints

<table>
<thead>
<tr>
<th>No</th>
<th>Constraints</th>
</tr>
</thead>
</table>
| 8.  | Have you gone for any training?  
|     | a) Yes     b) No                               |
| 9.  | Do you get your finances from any of these?  
|     | a) Banks  
|     | b) Micro finance  
|     | eg Smep, Faulu, KWFT, a) Merry go round,  
|     | d) shylok  
|     | e) Friends and family members                  |

Land Constraints

<table>
<thead>
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<th>Constraints</th>
</tr>
</thead>
</table>
| 10. | Do you have land?  
|     | a) yes     b) no                                |
| 11. | Are you staying in a place with official approval? ie With title deed? |

SECTION E: Livelihood resources

Extension

12. Do you participate in any agricultural extension? (i) Yes  
(ii) No

13. Which technologies in relation to climate change do extension agents promote among the smallholder farmers?  
 a) Early planting  
 c) Newvarieties

SECTION F Livelihood strategies

14. Secondary occupations (Tick as appropriate)

(i) Selling fish  
(ii) Commercial motorcycling  
(iii) Selling charcoal  
(iv) Operating kiosk and green grosser

15. Do you practice soil and water conservation measures for farming purposes? (i) yes  
(ii) no

If yes, which of the following water harvesting structures have you adopted?

(i) Contour terraces

(ii) Water pans
(iii) Trash lines

(iv) Boreholes

(v) Unploughed strips

16. Do you practice irrigation? (i) yes (ii) no

If yes, what type of irrigation have you been practicing?

(i) Drip irrigation

(ii) Gun bag for kitchen gardening

(iii) Watering with buckets

(iv) Use of horse pipe from tank

**Use of Indigenous Knowledge**

17. Do you use Indigenous Knowledge?

If yes, how do you respond to erratic rainfall?

(i) Planting fast growing crops  (ii) Timely planting  (iii) Traditional water conservation practices  (iv) Planting traditional seeds  (v) Deep planting  (vi) Nothing

18. How do you respond to increased pest incidences?

i) Crop rotation  (ii) Integrated pest management practices  (iii) Selection/avoidance of selected crops  (iv) Shifting cultivation  (v) Nothing

19. How do you respond to increased heat on crops?

i) Planting weather smart crops  (ii) Planting in cool areas, near river banks  (iii) Mulching  (iv) Nothing

**Agroforestry technologies**

20. Do you practice agroforestry? (i) yes (ii) no

If yes, what agro-forestry technologies do you practice?

(i) Scattered tree planting  (ii) Boundary planting  (iii) Home garden  (iv) Fodder bank  (v) Fruit trees  (vi) Timber wood
**Agricultural diversification**

21. Do you practice agricultural diversification?  (i) yes  (ii) no

If yes, what types of livestock do you keep?

(i) Cows       (ii) Sheep       (iii) Goats       (iv) Poultry

What type of crops do you plant?

(i) Maize       (ii) Cowpeas  (iii) Cassava  (iv) Sorghum  (v) Fruits
Appendix II: The map showing the location of Kilifi South Sub-county

Source: Author 2013
APPENDIX III: RAINFALL DATA FROM MTWAPA METEOROLOGICAL STATION

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<th>Month</th>
<th>2008</th>
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<th>2010</th>
<th>2011</th>
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### Mean Annual Temperatures of Kilifi South Sub-County Per Month from 2008-2014

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ETHICS REVIEW COMMITTEE
ACCREDITED BY THE NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION (NACOSTI, KENYA)

CERTIFICATE OF ETHICAL APPROVAL

THIS IS TO CERTIFY THAT THE PROPOSAL SUBMITTED BY:

JAMES MACHARIA CHEGE

REFERENCE NO:
ERC/PhD/004/2014

ENTITLED:
Determinants of Sustainable Household Food Security Status among the Smallholder Farming Community in Kilifi District, Kenya

TO BE UNDERTAKEN AT:
Kilifi, Kenya

FOR THE PROPOSED PERIOD OF RESEARCH
HAS BEEN APPROVED BY THE ETHICS REVIEW COMMITTEE
AT ITS SITTING HELD AT PWANI UNIVERSITY, KENYA
ON THE 11th DAY OF APRIL 2014

CHAIRMAN

SECRETARY

LAY MEMBER