ASSESSMENT OF HOUSEHOLD LAND SIZE AND LAND USE FOR SUSTAINABLE FOOD AND LIVELIHOOD SECURITY IN A MAIZE FARMING SYSTEM OF UVUU SUB-LOCATION, MAKUENI COUNTY

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DECLARATION

This thesis research project is my original work and has not been presented for a degree in any other University.

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This thesis research project has been submitted with my approval as the University supervisor.

21st September, 2022

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DEDICATION

To my wife, Winfred Kaloki, daughter, Lynette and son, Philip Mbithi Junior for your understanding and support throughout my study period.

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ABSTRACT

Globally, agriculture is the supplier of food and a source of livelihood to many farmers. The sector is an important component of Makueni County economy as it employs about 78 percent of the county population. However, it is greatly challenged by declining land sizes, a situation that is occasioned by unregulated land subdivision. It is evident that food security is a widespread challenge all over the country and especially in the Arid and Semi-Arid Areas. The government is striving to feed its citizens amidst a growing population. The study assessed the current household land size and use and their impact on food and livelihood security, evaluated the factors influencing household land size and use, documented inter-generational transmission of land rights and use and recommended planning interventions for sustainable food and livelihood security in the maize farming system of Uvuu Sub-location. Both secondary and primary data was collected for the study and various data collection techniques were employed. In total; 140 households were interviewed, 5 key informants interviewed and 3 focus group discussions held.

The study established that there was significant difference in the land size of the households who were food secure and those who were food insecure, $p = 0.017$ is less than $\alpha = 0.05$. There also exists an association between household land size and livelihood security. The chi-square test gives a p of 0.000 which is less than $\alpha = 0.05$. The study further established that there is a significant relationship between the area of land allocated to maize and its production, $p = 0.000$ is less than $\alpha = 0.05$. Some of the factors affecting household land size and use include; culture/traditions, off-farm income, education level, topography, land ownership, settlement patterns and land quality among others. Intergenerational transmission of land rights and use was evident in the sub-location as inheritance was the most common form of land acquisition. Some of the recommendations include: teaching the residents on the dangers of further land subdivision, land consolidation, curb land selling and reorganization of the settlements. The proposed minimum land size for sustainable food and livelihood security is set at 5 acres. This land size according to the respondents was ideal for them to: undertake agricultural diversification, carry on inheritance purposes, practice large scale farming and was fit for the family needs.

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LIST OF ABBREVIATIONS

AEZ	Agro – Ecological Zone
ASAL	Arid and Semi-Arid Lands
ASDSP	Agricultural Sector Development Support Program
AWSC	African Women Study Centre
CBS	Central Bureau of Statistics
CIDP	County Integrated Development Plan
CoK	Constitution of Kenya
DFID	Department for International Development
DEB	District Education Board
EEA	European Economic Area
ECA	Economic Commission for Africa
FAO	Food Agriculture Organization
FDRE	Federal Democratic Republic of Ethiopia
FGDs	Focus Group Discussions
GDP	Gross Domestic Product
GIS	Geographic Information System
Ha	Hectare
HRS	Household Responsibility System
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
IJCEE	International Journal of Civil and Environmental Engineering
IJEN	International Journal of Engineering and Sciences
KAPAP	Kenya Agricultural Productivity and Agri-business Programme
KAPP	Kenya Agricultural Productivity Programme
km	kilometer
KNBS	Kenya National Bureau of Statistics
LDSB	Land Development and Resettlement Board
LM	Lower Midland Zones
SEKU	South Eastern Kenya University
SPSS	Statistical Package for Social Sciences
UM	Upper Midland Zones
WFP	World Food Programme

CHAPTER ONE
INTRODUCTION

1.1 Overview

Globally, agriculture is the largest land user. This land use occupies over a third of the terrestrial surface of the earth. It also utilizes vast quantities of water especially irrigation fed agriculture. Agriculture provides the required food commodities, employment opportunities and ensures optimal utilization of land (Lai et al., 2015). With a vast land area of approximately 3 billion hectare, the African Continent has about 1.3 billion hectare of agricultural land with only 252 million hectares being arable (FAO, 2013). Agriculture is indeed the engine of growth in Africa. However, agricultural production is mainly done by small scale farmers for subsistence. This results to high yield gaps, which among other factors including diminishing land sizes constrain the attainment of sustainable farming and livelihood sources (Macauley, 2015).

Agricultural sector is critical for inclusive development as it generates food and economic wealth for the poorest segment of the world population. Through re-investment of the generated wealth; infrastructural improvements, quality education and better health care is ensured thus improving the livelihoods of the people. (Lai et al., 2015). The importance of the agricultural sector cannot be overemphasized in sub-Saharan Africa where the growth generated by the sector is eleven times more effective in poverty reduction as compared to the growth of any other sector (IFAD, 2013). The importance of the sector in the region is also postulated by Diao et al., (2010), who point out that, majority of the rural population in sub-Saharan Africa rely on agriculture either directly or indirectly for their sustenance.

The growth and development of the agricultural sector is paramount to the overall economic and social development in Kenya. The sector provides employment for majority of the rural population and the urban populace working on the agro-processing industries, ensures food security for the country and generates incomes. In association with manufacturing, service sector and distribution, agriculture contributes about 27 percent to the country's Gross Domestic Product (GDP) (Kenya, 2010a). Indeed, agriculture is a major contributor to GDP, employment and livelihood in the country. The sector is a backbone of the country as; it is the highest foreign exchange earner and it is projected to drive the country's growth towards the realization of the

Kenya Vision 2030 (Kenya Institute for Public Policy Research and Analysis, 2017). However, the sector is dominated by small scale farmers with about 75 percent of the food produced being solely consumed by the individual households. The production levels of these small scale farmers are challenged by among other problems; rapid population growth which impact negatively on the available land for farming (Diao et al., 2010).

Based on the prevailing agro-ecological zones, different crops do well in different areas. The main area in the country where maize is planted in large scale is Kitale and other parts of the former Rift Valley Province. In the other areas of the country, maize is mainly grown for the household level subsistence with a few having a surplus for sale. Being a dominant food crop in Kenya, the production of maize is a critical activity due to its importance in the food chain. Maize production is mainly done under rain fed conditions with a few exceptions of the irrigation schemes introduced by the Government to increase production. This activity has been affected by several factors among them productivity and total planted area. The possibility of expanding cultivated land under maize production is challenged by the fact that land is gradually diminishing as a result of the increased population sizes against a constant land supply (Wokabi, 2000).

As per the Makueni County Integrated Development Plan (CIDP) (2017), agriculture is the backbone of the county economy. About 78,382 people who account for 26.2 percent of the employed labor force are engaged in small scale agriculture and pastoral activities. These two subsectors comprise of the most important sources of subsistence and employment based on the large rural populations of the county. They account for a big percentage of agricultural production and support an agro-based manufacturing sector hence contributing to the economy of the county.

In many of the developing countries, ensuring food security remains a major challenge. This is quite an irony as, as documented by FAO (2002), the global food production is adequate for everyone. Thus, despite a 70 percent population increase, global agriculture generates 17 percent more calories per person today than it produced 30 years ago. The main challenge however is the fact that majority of the population in the world either lack sufficient land to grow or income to purchase the prerequisite food commodities. According to FAO et al., (2013), about 852 million

people in the developing countries are undernourished. In these countries, there is a high prevalence of undernourishment which is currently estimated at 14.9 percent of the populace. As a result of the exponential growth in population, there is a lot of pressure on the available land resources. This pressure has led to numerous land subdivisions presumably for ancestral inheritance. This practice leaves very small land parcels for agricultural production to the point whereby, the activity is no longer economically viable. As a result, most of the people in the rural areas suffer from perennial famine since the little quantities of food produced can hardly sustain the households till the next harvest season (Obonyo et al., 2016).

1.2 Statement of the Research Problem

As documented by Makueni County Integrated Development Plan (2013) environmental degradation and population are the main development challenges experienced in the county. These two issues have led to increased food insecurity levels in the county which are mainly suppressed by relief food. The high fertility rates and the dominance of young population in the county indicate prospects of an increasing population in the next generations. With the current state of diminishing land sizes, the main challenge for the county will be to grow adequate food commodities to feed this increased population.

Agriculture is the most important component in the county economy, with maize being the main staple food for the populace. The agricultural sector engages about 78 percent of the county population. However, the significance of the sector is greatly challenged by the declining land sizes, a situation that is being occasioned by unregulated land subdivision exercises to the extent that the resultant land sizes are not realistic for any meaningful agricultural production. These subdivisions have been fueled by the increased population densities in the county especially in the relatively high potential agricultural areas. For instance, the population density of Uvuu sub location stands at 1,029 persons per sq. km. It is indeed the mostly densely populated sub location in the entire Makueni County. The increased population has led to increased demand for land for farming and settlement. As a result, vegetation cover and forests have been cleared to pave way for farming activities and settlements, an exercise that has triggered massive environmental degradation in the area. In addition, the increased demand for settlement space has reduced the available land for farming thus impacting negatively on the food and livelihood security.

As observed by Wambua (2013) the situation of food insecurity in Makueni County is characterized by considerable seasonal fluctuations. In the high potential areas of Mbooni and Kilungu hills, he noted some reliability in food production due to the relatively favorable climatic conditions in those areas. However, this reliability is being threatened by the declining land sizes. For some farmers in Uvuu Sub – location, the farm sizes are so small such that, whatever is produced gets consumed right at the farm. In this regard, nothing is left for storage till the next harvest season. These households are then forced to purchase food commodities to supplement their consumption.

With the increasing population densities, the pressure on land will always be there. The existence of cultural traditions which require land to be shared among the heirs after the death of the farmer greatly aggravates the pressure. In addition, with the constitutional requirement and the court ruling which entitles every child to inheritance of family property regardless of gender, this pressure will definitely be increased. This pressure results to unregulated land subdivision, leading to uneconomical farm sizes. As much as the traditions are what define us as Africans and property inheritance by all children is a constitutional requirement, it would be of no use to subdivide land to unproductive sizes. Efforts to discourage division of land to uneconomical sizes for agricultural production need to be put into place. However, what is economical in one agro ecological zone might not be economical in another. In this regard, studies need to be carried out to establish the minimum economical land size for agricultural production hence the basis of this study.

This research sought to assess the effects of declining household land sizes and uses for sustainable food and livelihood security in a maize farming system of Uvuu Sub location. It examined the factors that influence household land size and use and explored possible planning interventions to help attain food security against the immense pressure on land resources.

1.3 Research Questions

This study pursued to respond to the following research questions:

a) What are the current household land sizes and uses in Uvuu Sub-location?

b) How does household land size and use affect food and livelihood security in Uvuu Sub-location?

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c) What factors determine the size and use of household land Uvuu Sub-location?

d) How has land changed ownership since establishment of Uvuu Sub-location?

e) What planning interventions can ensure sustainable food and livelihood security of farming households in Uvuu Sub-location?

1.4 Research Hypothesis

The study had three research hypotheses:

1. Relationship between household land size and food security

   a. Alternative Hypothesis

Ha: Households that are food secure have significantly larger land parcels than households that are food insecure.

   b. Null Hypothesis

Ho: Households that are food secure have no significantly larger land parcels than households that are food insecure

2. Relationship between household land size and livelihood security

   a. Alternative Hypothesis

Ha: Households that have farm based livelihood security have significantly larger land parcels than households that are livelihood insecure.

   b. Null Hypothesis

Ho: Households that have farm based livelihood security have no significantly larger land parcels than households that are livelihood insecure.

3. Land Use Allocations and Enterprise Yield

   a. Alternative Hypothesis:

Ha: Farm enterprises with big land allocations produce more yields.

   b. Null Hypothesis:

Ho: Farm enterprises with big land allocations do not produce more yields.

1.5 Objectives

The study had overall and specific objectives.

1.5.1 Overall Objective

The overall objective of the study was to assess household land size and use for sustainable food and livelihood security in a maize farming system of Uvuu Sub-Location, Makueni County.

1.5.2 Specific Objectives

The specific objectives of the study were to:

a) Examine the current household land size and its impact on food and livelihood security in Uvuu Sub-location.

b) Establish the current land uses and their impact on food and livelihood security in Uvuu Sub-location.

c) Analyze the factors that influence the size and use of household land in Uvuu Sub-location.

d) Interrogate the inter-generational transmission of land rights and land use in Uvuu Sub-location.

e) Recommend planning interventions that can create a sustainable household land size, food, and livelihood security in Uvuu Sub-location.

1.6 Assumptions

This study assumed that, in Uvuu Sub-location, there is a correlation between the land size owned by a particular household and maize production within the household. It also assumed that farm enterprises with large land allocations produce more yields as compared to their counterparts with small land allocations.

1.7 Justification and Significance of the Study

Food security is one of the four Government agendas to be achieved by the year 2022 alongside manufacturing, health and housing. Sufficient food production is thus critical in the realization of this agenda. In addition, achieving freedom from starvation and consuming adequate and quality food is a fundamental right for every person as stipulated in the Constitution of Kenya (2010) article 43 (1) (c). Addressing the hindrances in attaining food security would help in the realization of this constitutional right. Small scale farmers comprise of the largest food producers in Kenya. However, given the rapidly growing population against the gradual decline in land sizes, there is very limited potential of increasing farm productivity through area expansion. As a result, the possibility of producing enough food to feed the growing

population is greatly challenged. In this regard, a policy framework to protect the subdivision of agricultural land into uneconomical plots needs to be put into place. This can only be achieved if a realistic economical farm size is established for each agro-ecological zone. This study strived to establish the possible minimum land size required to ensure sustainable production of maize in Uvuu sub location. It also aimed at proposing appropriate measures aimed at maintaining the established minimum farm size.

In addition, agriculture is the economic backbone in Makueni County. Studying on the issues affecting agricultural production would help identify the bottlenecks in achieving optimal production. The county is situated in the Arid and Semi-Arid Lands (ASALs) of the country and as documented by Musambayi (2013) the communities that reside in the ASAL areas are more susceptible to food insecurity in comparison to those in the high agricultural potential areas. Researching on the impacts of household land sizes and uses would enable the findings to be replicated in other similar rural areas.

1.8 Scope of the Study

This study was undertaken in Uvuu Sub-location. The Sub-location is located in Kithungo/Kitundu Ward, Mbooni Sub-County, Makueni County. With a population density of 1,029 persons per square kilometer, Uvuu sub-location is the most densely populated sub-location in Mbooni Sub-County. This density is quite high when compared to the county population density of 119 persons per square kilometre. The sub-location covers an approximate area of 3.87 sq. km. The study focused on the relationship between land size, land tenure and land uses on food and livelihood security of the households within the sub-location.

1.9 Limitations of the Study

The study was carried out against limitations of finances. Otherwise, with adequate financial capabilities, the study would be conducted in all the rural areas of Kenya. This would help to establish the different dynamics on farm land sizes, land use, food and livelihood security in the rural areas as they form the country's food baskets. As a result, conclusive recommendations would be made on the ideal land sizes suitable for the different rural areas in the country with respective to their agro-ecological zones.

1.10 Definition of Terms

Land fragmentation: There are various definitions of land fragmentation. Obonyo et al., (2016) defined land fragmentation as the exercise of farming on several spatially disjointed plots either rented or owned by the same farmer. Van Dijk (2003) outlined four scenarios under which land fragmentation could be defined namely: number of users, internal fragmentation, ownership fragmentation and fragmentation resulting from overlap of use and ownership of the land. Dovring et al., (1960) in Karagwa (2010) defined land fragmentation as the division of land into several distinct plots.

Food security: The World Food Program (2018) defines food security as the state where all people at all times are able to access sufficient, safe and nutritious food so as to maintain a healthy and active life. According to FAO, et al., (2013) food security occurs when everyone, every time has economic, physical and social access to sufficient, nutritious and safe food. Based on those two definitions, four parameters namely availability, accessibility, stability and actual consumption should be applied when measuring food security.

Livelihood security: This consists of adequate and sustainable access to income and other resources needed to support a household in meeting its basic needs like food, education, health and personal needs (USAID, 2009).

CHAPTER TWO
LITERATURE REVIEW

2.1 Overview

This section presents analyses of secondary materials regarding the topic under investigation. It addresses several aspects of the relationship between land size and use on food and livelihood security. It elaborates on the factors affecting land size and use as well as the inter-generational transmission of land rights and use. It also highlights various theoretical frameworks that the study was pegged on. In addition, it identifies some of the planning interventions that could be applied to mitigate against the diminishing agricultural land sizes. The chapter concludes by providing a conceptual framework to guide the study.

2.1.1 Importance of Maize Production

Globally, maize forms one of the most important cereal crops either as food commodities for human consumption, animal feeds or as a raw material for industries. It is indeed one of the leading crops in the world grown on an area of about 142 million hectares producing a total of 637 million tons of cereal. In Nepal for instance, maize was planted in an approximate area of 849,892 Ha yielding on average, 2.02 tons per hectare (CBS, 2006). In Zambia, maize is the staple food with majority of the small scale farmers being engaged in maize production.

In sub-Saharan Africa (SSA), maize is one of the main staple food crops. It is cultivated in various farming systems and agro-ecological zones. In this region, maize is a staple food to a large number of the populace with varying socio-economic backgrounds and food preferences. African countries constitute 16 out of the 22 world countries where maize has the largest proportion of calorie intake in the national diet. Maize contributes almost 50 and 20 percent of the calories and proteins consumed in Eastern and Southern Africa (ESA) as well as in West Africa respectively. In this regard, about 208 million people depend on maize for food security and as a source of livelihood (Macauley, 2015).

Maize is a staple food in Kenya and a main source of carbohydrates to a big proportion of the population in the country. It provides a large percentage of calories intake to majority of its consumers both in the urban and rural areas. Though majority of them retain a significant proportion of their produce for their substance, small –

scale farmers are the major players in maize production. Approximately 75 percent of the total maize production is produced by about 3.5 million small scale farmers with about 1000 large scale farmers accounting for the remaining 25 percent. The national average maize production is approximately 1.8 tons per hectare, yields that are about a twentieth of the internationally attained yields (Nyoro, 2000). The per capita maize consumption ranges between 98 - 100 kilograms. This translates to about 2700 thousand metric tons per year (Nyoro et al., 2004).

2.1.2 Land Fragmentation and Maize Production

Researchers have identified land fragmentation as a major cause of the reduction in agricultural production. According to Tan et al., (2018), in a study undertaken to establish if fragmented land sizes have higher production costs in China, found out that, fragmentation of land was a major catalyst of crop production inefficiencies. This inefficiency was linked to the costs of production resulting from inefficient resource allocation namely; wasted space along borders, inability to use certain types of machinery, suboptimal use of factor inputs and inadequate monitoring. Mwebaza and Gaynor, (2002) supports this perceptive on the influence of land fragmentation on production. They point out that land fragmentation is indeed a major hindrance to efficient production system. According to them, this inefficiency is brought about by the fact that the uncoordinated continuous land subdivision leads to small land sizes which become uneconomical to operate in the long run. In addition, economies of scale and farm mechanization is hindered.

The proponents of land fragmentation on the other hand, view it as a positive situation as farmers are able to cultivate various agro-ecological zones, optimize cropping activities schedules and minimize the risks associated with production (Bentley, 1989). Land fragmentation give farmers an opportunity to grow several crops who's ripening times differ. This enables them to focus their labor on specific plots at different times, thus evading labor intension periods as well as labor bottlenecks in individual households (Todorova and Lucheva, 2005). Mwebaza and Gaynor, (2002) also highlighted various advantages of land fragmentation. They argued that, fragmented land characterized by different biophysical features permits farmers to lessen various risks like, flood, drought and fire. It also allows farmers to diversify crops and eases seasonal labor bottlenecks.

Kadiji et al., (2017) differentiate between four types of land fragmentation. These are: land ownership fragmentation, land use fragmentation, separation of use and ownership as well as internal fragmentation. They also outlined various causes of land fragmentation as; inheritance rules, land distribution and redistribution and risky peasant agriculture.

From the foregoing perspectives, there are both positive and negative impacts with regard to land fragmentation. With the culture of inheritance and property succession, this practice might be practiced for a long time. However, measures need to be put in place to ensure that, these subdivision practices are coordinated and the resultant farm sizes are economically operational so as to achieve sustainable food and livelihood security. King and Burton (1982) outlined six parameters of land fragmentation namely; land size, size and shape of the parcel, number of parcels owned by a household as well as the spatial distribution of the parcels. At least one of these six parameters need to be captured when measuring land fragmentation. In this regard, this study utilized land size and number of parcels owned by a household as the indicators of measuring land fragmentation in Uvuu Sub-location.

2.1.3 Food and Livelihood Security

As documented by Maxwell and Wiebe (1998), food security is a subset of livelihood security. A livelihood secure household has the sufficient resources to ensure its food security. Livelihood security also comprises of the ability to access the required means for food production or generation of income to attain dietary needs. There exists a very close association between food and livelihood security as both are realized when both the poor and vulnerable groups in the society have sustainable livelihoods. According to Iram and Butt (2004), food security is a broad concept that considers a myriad of issues regarding nature, food accessibility as well as quality and security of food supply. Food security exists when all people, every time can economically and physically access safe, nutritious and adequate food to meet their dietary needs. Thus, availability, access and utilization are the main parameters applicable in measuring food security. Wambua (2013) notes that, food insecurity emanates from lack of any of these three aspects either through farm production or market purchase.

To majority of the rural population, the production of food either for subsistence or for sale is a basic livelihood source and also a vital source of food commodities. The ability of a household to purchase the required food quantities for their consumption is also a key determinant of food access. This however, depends largely on the ability of the household to create income. Thus, the quantity and quality of food consumed by a household is positively related to its food production capacity or its income level (USAID, 2009). On the other hand, the livelihood security of a household is affected by its food security situation. It is with no doubt that households with poor access or food utilization tend to suffer more from illness. Consequently, their labor productivity is impaired and hence their ability to undertake livelihood activities. In addition, the treatment costs associated with these illness eats into the households' pockets, hence impacting negatively on their livelihoods.

2.2 Household Land Size and its Effect on Food and Livelihood Security

Niroula and Thapa (2005) while studying on the effects of land fragmentation and the lessons learned from land amalgamation in South Asia established that the farmlands were drastically being fragmented, a situation that accelerated their degradation and constrained the development of agricultural activities. The changes in the number of farms and the distribution of farm sizes, as measured by Simpson index in Northeastern Jiangxi Province, China didn't impact on the total production costs per unit output. These changes resulted to shift between the cost categories. They established that farmers with many small farm sizes used more labor and less modern technologies as opposed to their counterparts with less large farms. They concluded that to reduce the total production costs per unit produced required reduction of the average distance to parcels and increment of farm sizes (ibid).

In most of European, Indian and China countries, individual farming is impossible due to the small land sizes. Unlike in the developing countries where an inverse relationship between farm size and production is experienced, in Europe, modern farming technologies are only applicable in large production blocks. In this regard, the parcel owners of the small farms rent out their lands to become part of the large agricultural holdings (Sklenicka, 2016). The tenants who rent the small neighboring plots tend to take lesser care of the parcels as compared to their owners. In the long run, the productivity of the farms is reduced, an aspect that negatively affects food and livelihood security (ibid).

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As observed by Mwebaza and Gaynor (2002) in Kadiji et al., (2017) small land parcels discourage the development of the prerequisite infrastructure like transportation, irrigation, communication and drainage which is critical for optimal agricultural production and enhanced livelihoods. In addition, there are instances where banks are reluctant to take small, scattered land parcels as collateral. This hinders farmers from acquiring credit for investments. Indeed, farmland is greatly devalued simply through subdivision, especially when the process is unregulated.

In a contemporary rural livelihood, the landholding size of a farmer was the main indicator of well-being (Gurung, et al 2016). They argued that larger farm holdings produced adequate food and household income. This phenomenon assured food and livelihood security for these households in the entire year compared to the households with relatively smaller farm sizes. In this regard, increasing farm sizes either through land consolidation or extending farming activities into new areas would help contribute to household food and livelihood security as well as aid in eradication of poverty (Dixon et al. 2001).

A study done by Thapa (2007) on the correlation between farm size and productivity in Nepalese Mid-Hills established an average land holding including forest/fallow land as 0.56 hectares and 0.50 hectares for cropland only. He also observed a significant decline in land holding size as the average land holding reduced from 2.8 acres in 1981 to 2 acres in 2001. He however observed a contrary correlation between farm size and productivity. This observation suggested that small farms are relatively more productive than big ones as small farms tend to use family labor thus reducing monitoring and supervision costs.

The theory of inverse relation between farm size and production is not however applicable in Vietnam as established by Dao (2013) as he analyzed technical efficiency of crop farms in the Northern region of Vietnam. These findings were echoed in Bangladesh by Rahman (2009) who observed a detrimental effect of diminishing land sizes on productivity and efficiency as a 1.0 percent land fragmentation increase decreased rice output by 0.05 percent while efficient reduced by 0.03 percent.

Jayne et al (2003) carried out a study in five Sub-Saharan countries to understand small holder income and land distribution and its consequences on poverty reduction

strategies. They found out that there was a significant correlation among landholding size, household income and education levels. This, according to them was a clear indication that majority of households with small farm sizes have limited potential of breaking out of poverty. The situation was further aggravated by the unavailability of high-return off-farm activities. Off-farm income shares tend to be highest for the small scale land owners and reduce as farm sizes increase. This indicates the critical role of farm sizes as a livelihood source for majority of rural dwellers. They concluded that an addition to land access results to a relative increase in income.

In South-western Nigeria, the model farmland size is less than three hectares across board hence the low production levels in in the area (Adeniyi and Ojo, 2013). Most of the farmers operate on small farm sizes, mainly less than one hectare. This farm size is uneconomical to operate as the produce can hardly meet the household needs let alone having a surplus for sale. In Rwanda, the average household size stands at 0.72 hectares fragmented in four parcels of 0.18 hectares on average (Ali and Deininger, 2013). In Malawi, small scale farmers face food insecurity due to among other factors lack of enough farming land (Matchaya, 2007).

The case is not different in East Africa as the available land is much subdivided into small uneconomical plots. For instance in Ethiopia, the farm sizes range from as low as 1.0 Ha per household. The situation is however slightly better in Tanzania, Uganda and Kenya with an average farm size of 2.0 Ha, 2.5 Ha and 2.5 Ha respectively. These land parcels are relatively larger than the African mean land holding of 1.6 Ha. They are however very low compared to those of North America, Latin America and Europe which approximate to 121 Ha, 67 Ha and 27 Ha respectively (Jayne et al., 2006).

According to Chauvin et al., (2012) land is one of the main parameters in the attainment of food and livelihood security. They however observed that agriculture in Kenya was mainly undertaken by small scale farmers who at most operated two hectares piece of land. The German Development Corporation in Kenya (2017) also made a similar observation as they note that the agricultural sector in the country is dominated by small scale farmers and about 75 percent of the country's food production is mainly consumed at the household level. Kenya (2010) points out that the arable land in the country is overly segmented into very small sizes which are not

economical for any meaningful agricultural production. Thus, these small land sizes constrain the production of food and become a catalyst to food and livelihood insecurity specifically for the poor rural households. Kassie et al., (2012) while conducting a research in 88 villages within five districts of maize farming systems in Kenya concluded that the likelihood of being food secure increased with farm size and the level of education of the household head.

Mwavali, (2009) highlights that the decreasing agricultural production experienced in Vihiga District resulted from land fragmentation practices, an aspect that contributed to socio-economic impacts of food insecurity to the household, amplified disputes amongst neighbors and reduced income. Obonyo et al., (2016) while researching on land fragmentation and food insecurity in Ugunja Sub-County, in Siaya County, observed very small landholdings whose low production couldn't sustain the households till the next harvest hence severe perennial famines in the area. Kiplimo and Ngeno (2016) while studying the impact of land fragmentation on farm level efficiency, established a close relationship between the total average land size, production scale and farm output. While carrying out a research on the effect of land fragmentation on production and food security in three major regions of Kenya, Musambayi, (2013) found a significant correlation between land fragmentation and food security, a situation that was brought about by unregulated subdivision of agricultural land hence reduced farm productivity.

A study on the parameters prompting agro pastoral and pastoral household susceptibility to food insecurity in the dry areas, a case of Kajiado and Makueni Counties by Amwata et al., (2016) established a significant direct correlation between land size and household food security. They postulated that, all others factors held constant, households with large farm sizes were more likely to be food secure due to the much farm yields realized from every harvest. Mbuthia et al., (2017) established that in Kitui County, landholding was a key factor of food security for a household. They argued that households with relatively large farms tend to be more food secure as they could access food throughout the year compared to the households with relatively small farm sizes whose harvest lasted for just a few months. They however observed a continuous trend of land fragmentation to unreasonable sizes to support any meaningful agricultural production.

2.3 Household Land Use and its Effect on Food and Livelihood Security

As documented by ECA (2004) food security is a factor of the land resources available to a household and its capability to gather resources for food production and/or distribution. Zhang et al., (2012) points out that optimal land use allocation is aimed at improving the efficacy of land use types as it specifies the most appropriate use of land. (Pitakpongjaroen and Wiboonpongse, (2015) explains that the pressure emanating from the decline in high potential agricultural land forced farmers in Thailand to switch from traditional methods of food production to mono-crops with high retail prices so as to improve their economic wellbeing. They concluded that in determining farm household income as well as ensuring food and livelihood security, farmers had to practice crop diversification and cultivation of perennial fruit plants.

Walangitan, et al., (2012) while studying land use and allocation optimization to achieve sustainable agriculture in Lake Tondano found out that households who apportioned a large farming area to one crop harvested better yields to maintain their livelihoods in comparison to those who did mixed crop farming at equal plot sizes. In Bangladesh, majority of the poor farmers shifted from the cultivation of rice to aquaculture leaving the few rich farmers who are able to successfully manage rice farming (Gurung et al. 2016). They noted various strains on the poor famers in adapting to the shift and the changes in the use of land. They thus recommended diversification of farming systems and intercropping by all rural households as a way of realizing food and livelihood security. They further recommended that land productivity, family nutrition and household income would be increased through diversification of rice cropping systems in alternation with high-value crops and other cereals (ibid).

Ebanyat, et al., (2010), while undertaking a study in Eastern Uganda on drivers of land use change and household determinants of sustainability in smallholder farming systems established a significant increases in the cultivated lands by households while some land uses like grazing and ranging were declining and in some instances, eventually disappearing. Households tend to allocate land to a certain crop based on the projected income from the crop. In this regard, the highest land allocated went to cotton as it could fetch high yields in the markets. The second in allocation was subsistence food crops. The insecurity in the Teso area of Eastern Uganda was also a contributor to the reduction in livestock keeping (ibid). Farmed area size has a direct

correlation on farm output in all farm types (Kansiime et al., 2017). Allocating larger land parcel to a specific crop type results to higher returns. Moreover, specialized farm types didn't yield much crop income as compared to off farm and diversified types. Livelihood strategies are different with regard to the income proportion resulting from farming, the total cultivated area as well as proportion of land allotted to various agricultural activities other than off-farm income (ibid).

The Germany Development Cooperation (2017) reported that as a result of population pressure coupled with unmanageable land use patterns, there has been a lot of pressure on the available productive land, Kenya is forced to import basic food commodities at very high cost. Thus, farm use allocations of a household greatly impact on its food and livelihood security. Carter and Wiebe, (1990) in Ali and Deininger (2013) outlined that in Kenya, profits per acre increase monotonically with farm size. They however noted that the output per acre and size relationship is U-shaped with a minimum at about 5 hectare. They concluded that this relationship could partially be attributed to crop composition as maize and beans are gradually replaced with pasture or cash crops as the predominant crop at a farm size of about 12-25 hectare.

Ogecho and Hunja (2016) while studying land use cover changes and their implication on food production in Keumbu region, Kisii County found out that only about 15-17 percent of the total land area in Kenya could support rain-fed agriculture with only 7-8 percent being classified as high potential land. The rest of the land in the country is either arid or semi-arid. They observed that the food situation in the country was being worsened by the preference of cash crops over food crops in the agricultural high potential areas. In addition, the construction of houses and other nonfood uses of farm lands reduced the available lands for food production thus reducing food supply (ibid).

2.4 Factors Affecting Household Land Size and Use

The main elements that affect household land size and use include: population growth, inheritance practices, inequalities in land access, land tenure among others as outlined below:

2.4.1 Population Growth

Willy and Wawuda (2014) explains that population growth challenges revolves around food – water - environment nexus, unemployment, agricultural productivity, land fragmentation and the role of agriculture in food provision and employment creation for the enhancement of livelihood. In the African continent, land is becoming extremely scarce in many areas (Cotula et al., 2004). This scarcity could be attributed to the pressure emanated from the increased competition for land resources amongst different land users including farmers, herders, urban elites and investors. The ever increasing population has greatly aggravated the pressure on land resources (ibid).

Headey and Jayne, (2014) explain that in the high potential areas in sub-Saharan Africa, there is severe pressure on land as small farms were becoming smaller and are projected to decrease further as the population increases. The Government of Malawi (2001) noted a significant decline of the land holdings per household from 1.53 hectares in the year 1968 to 0.8 hectares in 2000 as a result of the increased densities. As documented by ECA (2008), the increasing population size in rural Ethiopia forced households to farm on very small land sizes. For instance, about 29 percent of grain farmers operated less than 0.5 hectares per household between the year 2006 and 2007. Muyanga and Jayne, (2012) suggest that small farm sizes are as a result of higher population densities. Their research findings showed that a 100 persons per km^2 rise in population density is associated with a decrease in cropped area by 8 percent and 9 percent smaller farm sizes.

Approximately, 50 percent of the rural population in Kenya live in areas with a population density of over 250 persons per square kilometer with 40 percent of the population residing on 5 percent of the arable land in the country. This has resulted to gradual decrease in farm size, leading to reduced agricultural productions (Willy and Wawuda, 2014). Obonyo et al., (2016) observed scarcity of land for food production in Kenya. They explained that this situation was brought about by the significant increase of the number of people in need of land for building. As a result, most agricultural farmlands in the country especially in the high potential areas are small spared land portions within the homesteads.

Ogechi and Hunja (2012) established that population increase in Keumbu, Kisii County resulted to the conversion of the little available farm land into settlements. In

this area, settlements were slowly taking precedence over agriculture as additional land was being set aside for the construction of houses to cater for the increasing family sizes. Mwavali (2009) indicated that land fragmentation in Vihiga District was as a result population pressure coupled by the culture of inheritance.

2.4.2 Inheritance practices

Hristov (2009) while studying the impact of highly fragmented land on the productivity and profitability of farms, the case of Macedonia vegetable growers found out that the traditional practice of inheritance were fathers transferred property to their heirs across generations led to increasingly smaller land sizes. Holden and Mace (2003) observed a culture of patrilineal succession and inheritance in most societies in Sub Saharan Africa. In these societies, all properties, land included is successively shared among the heirs. Bremner, (2012) highlights that African farms are projected to decline further due to subdivision of agricultural land by the farmers amongst their children. The predominance of small farm sizes in the South Western part of Nigeria is as a result of the traditional land inheritance practices where every family member is entitled to a share of the farmland as inheritance.

As documented by Obonyo, et al., (2016), globally, some of the land tenure methods practiced are; purchasing, inheritance, renting and offering land as a gift. This practice encourages the subdivision of land into uneconomical small farm sizes hence affecting farm productivity. Mbuthia, et al. (2017) established that in Kitui County, farm sizes were reducing due to cultural practices of land inheritance amongst children. Majority of the households owned very small land parcels as they subdivided their lands and offered them to their children as inheritance or sold a few small portion to get some income.

2.4.3 Land Tenure

Securing land rights for all impacts positively on food security and helps attain broader development outcomes (USAID, 2016). Secure land rights present an incentive for farmers to invest more on the lands thus increasing agricultural production. Feder and Onchan (1989) observed that as a result of land titling in Thailand, there was increased investment, yield and input use. In Ethiopia, they observed that titling led to increased land productivity by 40-50 percent in Tigray region. Thus, farmers with secure tenure optimally utilize their lands and are at liberty

to make management decisions on well to utilize their land parcels for immediate and long-term household needs. Though all rural households in Africa depend on land to farm their food commodities, lack of land tenure rights is a major constraint in agricultural production (Masuku et al., 2014). This challenge is echoed by Salami et, al., (2010) who observed that the uncertainties with regard to land tenure and inadequate access land is one of the most serious constraint on small scale farming in East Africa.

Hristov (2009) observed that ineffective land market activities in Macedonia aggravates land fragmentation issue and results to very small land parcels. Underdeveloped agricultural sector and food insecurity are some of the consequences of the challenges associated with tenure system (Espinosa, 2014). These challenges include insecurity of land tenure, unequal access to land and lack of appropriate mechanism to transfer land rights and consolidate plots. He concludes that secure land tenure offers a conducive environment for food security.

2.4.4 Inequalities in Land Access

As noted by Muyanga (2013) in some parts of the World, countries with relatively low population densities and high resource endowments, have pronounced inequalities in accessing land resources. Jane et al., (2006) noted that in most of all the countries in sub-Saharan Africa, there are significant pronounced inequalities with regard to distribution of the available land. In these countries, households in the top per capita quartile own about 5 to 15 times more lands than the households in the bottom quartile. For instance, in Kenya, the average farm sizes for the bottom and top land quartiles were 0.58 Ha and 6.69 Ha respectively.

2.4.5 Household Characteristics

Walker et al., (2002) point out that the main determinants of household land use decisions are the household's farm size, labor availability, economic ability, prevailing socio–economic and political environment as well as the need for survival. Thus attaining food and livelihood security isn't the only key determinant to a household's decisions with regard to land use allocations. Deadman, (2005) reports that several household characteristics influence the types of agricultural activities a household engages in. These characteristics include; capital resources and labor availability. He goes further to conclude that land use allocation decisions are a factor

of performance of past crops, available household resources and characteristics of the household's property.

A household's demographic characteristics like; the household head's education level, consumer units as well as family and wage labor greatly influence land use decisions (Pichon, 1997). Leonard et al. (2011) observed that taking into account the local environmental conditions, the age of the farmer, household size and structure affect the intensity of land use and extent of farm operations. Exogenous forces among them household - level characteristics which include social history, personal attributes and cultural identity influence the utilization of household resources (Browder, 2002).

2.4.5 Other Factors

Pichon, (1997) established that duration of settlement (farm age), soil fertility, household resource endowments and topographical location of the farm greatly influence household's land use decisions. Large scale cattle farmers allocated massive lands under pasture and small lots to crop production. Households with small farm lots used their land more intensively and would clear the neighboring forests for long term crops. Families with larger farms on the other hand cleared less proportion of forests. Feeding families and earning income from crops are the main determinants of land use allocations as farmers need to complement their food requirements and gain income from cash crops (Santiphop, et al., 2012). In addition, low production costs, market demand for better returns, resource availability, increasing commercialization and easier to sell crops affect household land use allocations.

McCracken et al., (2002) notes that environmental factors, household demographic and labor changes over time, economic trends as well as the prevailing Government policies influence the various agricultural strategies implemented by individual families on land use transactions. As documented by Briassoulis (2009) several societal and biophysical factors play a critical role in a household's land use decisions. She explains that several interdependent economic, demographic, organizational, socio-cultural, institutional and technological factors influence land managers decisions to either maintain or change the prevailing land utilization. Ayamga et al., (2016) notes that, land documentation and tenure security duration influences a household's decision of investing on land. Socio-economic factors which include; education and income levels, demographic characteristics, tenure security

and farm inputs were the main contributors to the differences in land use activities between households (Kodiwo, 2012).

Perz, (2001) highlights that the farmer's historical background, institutional and neighborhood contexts, demographic variables as well as off-farm incomes greatly influenced the prominence of land uses. In Africa, continuous farm and structural change is compounded by a several factors (AGRA, 2016). The upsurge interest in land by urban dwellers and influential rural population have resulted to changes in farm sizes in the rural areas. Rapsomanikis, (2015) explains that policy measures like government subsidies and regulations restricting rural-urban migration coupled with urbanization and rural population growth against a static farm land affects land sizes.

2.5 Inter-Generational Transmission of Land Rights and Use

Hristov (2009), notes that land is a limited, non-renewable resource which is considered as a financial security and livelihood source and is transferrable from one generation to another. Cooper (2010) explains that inheritance is the main means of transferring physical properties across generations in many Sub-Saharan Societies. As documented by Balogun and Akinyemi (2017), the Yoruba culture in Nigeria dictates that after the farmer's demise, his possessions, including land, are divided amongst the children. This state of affairs was also observed in south-western Nigeria by Adeniyi and Ojo (2013) who found out that the prevalence of small farms was as a result of the traditional land inheritance practices which entitled every family member to a share of the farmland. They concluded that these land inheritance traditions resulted to unregulated land subdivision and wastage of arable lands in case of absentee farmers.

Obonyo et al., (2016) notes that ancestral tenure is the main form of tenure system in Ugunja Sub-County, Siaya County. This could be explained by the fact that land inheritance as a form of land acquisition accounted for 68.3 percent of the population who owned land, purchase stood at 26.3 percent, leasing at 2.7 percent while land offered as a gift accounted for 1.5 percent of the population. They concluded that customary practices are one of the main contributing factors to land fragmentation. Muyanga (2013) established that the many land subdivisions in the high potential agricultural areas in the country were as a result of the customary land transfer practices from parents to male children. More so, the Kenyan constitutional

requirement that advocates for equal consideration of all children irrespective of their gender during inheritance of family assets is likely to aggravate the land fragmentation problem.

2.6 Possible Planning Interventions

Alemu et al., (2017) recommends population growth control programs and adoption of legislation on land use. They further allude that diversification of agricultural activities, practicing of mixed use farming and strengthening of off farm activities, will aid in solving the food insecurity problem. Tan (2005) recommends that amalgamation of small disjointed plots into a few bigger parcels increases agricultural production. He argued that land consolidation causes a shift from labor-intensive farming methods to mechanized agriculture, reduces cost of production, enhances efficiency of technical and input use and contributes to improvement of soil quality. Gurung et al., (2016) recommends adoption of mechanized form of production to increase rice productivity in Bangladesh. They further recommend technical training, crop diversification, adoption of crop production technology and provision of technological services as critical in enhancing farm productivity hence increase yields.

In Rwanda, a National Land Policy was put in place to help in addressing the agricultural production problems associated with small land sizes due to land fragmentation. The policy proposed among other measures; land consolidation to achieve economical plot sizes and prohibition of land subdivision below one hectare (Ali and Deininger, 2013). Ensuring efficiency in production and adoption of technology for optimal farm yields is essential since there exists an indirect correlation between land size and food and livelihood security. This will help to address the productivity challenges associated with small farm sizes. In Bangladesh for instance, Rahman (2009) found out that owning key resources like land, draft animals and family labour significantly increases efficiency. Thus, empowering the rural communities to own these key production resources will significantly help in addressing the food insecurity problems.

Obonyo et al., (2016) recommend reviewing of settlement policies to encourage land consolidation so as to increase food production. They further recommend family planning sensitization programs to control population growth hence reduce pressures

on land. In Makueni County, there are interventions in place aimed at ensuring food security. Some of these strategies include: the Agricultural Sector Development Support Program (ASDSP) and Kenya Agricultural Productivity and Agribusiness Program (KAPAP). Established in 2010, ASDSP aimed to transform the agricultural sector in the country to a commercially-oriented sector thus ensure food security. It is supported by the Kenyan and Swedish Governments. In Makueni County, this program acts as a platform to bring together the players in the agricultural sector and promotes capacity building amongst the farmers. If effectively operational, this program could help ensure a food secure county (Kenya, 2016). In 2004, the Kenyan Government and the World Bank started KAPAP, the second phase of the Kenya Agricultural Productivity Program (KAPP). It has enabled several trainings of farmers on issues like pesticide and fertilizer use as well as soil conservation measures. Farmers have also been able to adopt climate risk adaptation measures like value addition - mango value chain (ibid).

2.7 Theoretical Framework

From literature, several theories exist that explain the possibility of a relationship between household land size and use and food and livelihood security. Some of those theories are; the needs theory, Schultz inverse relationship theory and the law of diminishing returns.

2.7.1 The Needs Theory

The theory postulates that farmers tend to be primarily responsive to the immediate population's biological needs. In this regard, farm output is gained through a little effort as observed by the farmer but is focused to the immediate need of feeding the household (Tuener et al., 1993). The theory explains that an increase in population – land ratio forces farmers to employ more technical and labor inputs so as to realize the needed increased production. In this regard, the output per unit area of land increases. Indeed, population growth exerts pressure on land, a phenomenon that requires certain measures to be put in place to ensure production matches the population failure to which, food insecurity will be experienced (ibid).

2.7.2 Schultz Inverse Relationship Theory

Published in 1964, this theory deals with land holding sizes and productivity. The theory specifies that the number of parcels resulting from subdivision of a big lot only

reduces the plot sizes but doesn't reduce production. The proponents of the theory argue that subdivision motivates farmers who end up improving their overall farming techniques by increasing use of fertilizers, using certified seeds and practicing zero grazing techniques for livestock production. The overall profits and yields are improved in the long run. However, the opponents of the theory postulate a different scenario. According to them farm fragmentation results to small land sizes and low yields especially when farmers didn't embrace the fragmentation exercise. This scenario would specifically arise when little effort is done to improve the farmers' education level and technology adaptation or the fragmentation results to farm deterioration.

2.7.3 The Law of Diminishing Returns

This law stipulates that increasing one productive resource while holding constant one other productive input, there will be increased output but with successively smaller increments to a point of yielding marginal contributions to total product. Thus, the use of a variable input while holding other resources constant is discouraged. This implies that the use of technology on a fixed land parcel for instance may increase production to a certain level then the output starts to diminish. Thus, despite the fact that increasing other factor inputs will increase crop production, the constrained land size may hinder optimal crop outputs after sometime.

2.8 Policy, Legal and Institutional Framework

This segment outlines the policy, legal and institutional framework that governs land, land use, and agricultural production in Kenya.

2.8.1 Policy Framework

The policies that address land and food security in the country include: Sustainable Development Goals (SDGs); Science, Technology and Innovation Strategy of Africa; Kenya Vision 2030; National Land Policy and the Strategy for Revitalizing Agriculture as discussed below:

2.8.1.1 Sustainable Development Goals (SDGs)

The SDGs were formulated to build upon and replace the Millennium Development Goals (MDGs) formulated in the year 2000, to lapse in 2015. SDG number two which aims at ending hunger, achieving food security, improving nutrition and promoting sustainable agriculture is very vital for this study. This goal has several targets and

indicators for measuring the success of the world population towards freedom from hunger. Target 2.3 aims at doubling the agricultural productivity and incomes of small scale farmers through among other issues security of tenure and equality in land access. This SDG has indeed provided a framework of improving food production towards realizing global food security and improving livelihoods through income levels (United Nation, 2018).

2.8.1.2 Science, Technology and Innovation Strategy of Africa (STISA, 2024)

The state of continued food insecurity in Africa directly affects 239 million people, with 30 – 40 percent of the children under the age of 5 years continuing to suffer from prolonged under nutrition (African Union, 2014). The Comprehensive Africa Agriculture Development Program (CAADP) was initiated to help in the development of agriculture and rural economy. This was meant to help in poverty alleviation and spurring social and economic transformation in the continent. In 2013, the Heads of State, Government of African Union among other stakeholders adopted a declaration to end hunger in the continent by the year 2025. The African Union drafted the STISA with six priority areas of intervention as part of the strategy to end hunger. Eradication of hunger and achieving food security forms the number one priority of the strategy (Africa Union, 2014)

2.8.1.3 Kenya Vision 2030

Adopted in June 2008, the vision 2030 is a blue print for the development of the country. The vision aims to transform the country into an industrializing middle income state which provides better quality life to every citizen in a secure and clean environment. It is anchored on three pillars namely; economic, political and social pillar. Agriculture is one of the key sectors under the economic pillar and has been identified as vital in the achievement of the projected annual economic growth rate. Transforming smallholder agriculture from subsistence farming to modern, innovative and commercially-oriented agriculture is envisaged to achieve the projected growth rate. The transformation is to be accomplished through among other strategies; transforming key agricultural institutions to promote agricultural growth, introduction of land use policies for optimal utilization of medium and high potential lands, improving markets for small scale farmers, developing more irrigable areas in the ASAL regions and value addition on farm produce (Kenya 2007).

2.8.1.4 National Land Policy, Sessional Paper No. 3 of 2009

Under segment 89 of the policy, rights to land can be acquired through inheritance. The policy thus upholds land inheritance as a form of land acquisition. It alludes that despite the enactment of the Law of Succession Act, meant to harmonize the existing succession systems, transmission of land rights is largely characterized by customary and religious systems. This largely discriminates against women and children. Section 190 of the policy recognizes the critical role played by land in food production. However, the gradual conversion of high agricultural potential areas to urban areas impedes the attainment of food security for the country. The policy recognizes the importance of sustainable land use practices in attaining food security. Thus, unregulated land subdivision among other land related issues need to be addressed. Section 121 identifies the impact of population growth on land sizes as coupled with high demand for land; population pressure has resulted to unwarranted land fragmentation into uneconomical sizes. Section 122 calls on the Government to safeguard the land by ensuring all subdivisions are done with respect to the specified guidelines for different ecological zones. However, the measures needs to actualize this haven't been put into place (Kenya, 2009).

2.8.1.5 Strategy for Revitalizing Agriculture

The Strategy for Revitalizing Agriculture (SRA) was launched by the Government as a response to the Economic Recovery Strategy (ERS). The vision of the Government as set out in the SRA was transforming the Kenyan agricultural sector into a commercially oriented, profitable, regionally and internationally competitive activity which provides better quality and gainful employment to the citizens. To achieve this vision, a framework for improving agricultural productivity needs to be put in place. The SRA gave policy measures with regard to the actions that had to be undertaken in all the subsectors in agriculture (Kenya, 2010c). In addition, the strategy set out to have an average growth of the real output of the agricultural sector from 3.1 percent in 2003 to 5 percent in 2007. Development of the agricultural sector as set out in the strategy was considered the best in poverty reduction as agriculture forms the main source of livelihood for the poor rural dwellers (ibid).

2.8.2 Legal Framework

The pieces of legislation that address land and agricultural production in the country include but not limited to: the Constitution of Kenya, 2010, the Land Act and Agricultural Act. The relevant articles and sections are as outlined below:

2.8.2.1 The Constitution of Kenya, 2010

Article 43 (1) (c) makes it a fundamental right for every citizen to have freedom from hunger by accessing to sufficient and quality food. Thus, measures of attaining food security need to be put in place for the attainment of this constitutional right. Article 60 (1) calls for equitable, productive, effective and sustainable ownership, use and management of land resources in the country. The Constitution also outlines several principles to guide in the utilization of land resources. Some of these resources include; security of land rights, equity in land access and sustainable management of land resources (Kenya, 2010b). In this regard, measures of controlling unregulated land subdivision need to be put in place so as to ensure the resultant sub plots are realistic for economical agricultural production.

2.8.2.2 The Land Act, No. 6 of 2012

The issue of minimum and maximum land sizes is outlined in Section 159 of the Land Act. However, the section does not specify the acreages to qualify as minimum and maximum land sizes. It only states that the minimum and maximum land holding shall be subject to the provision of article 66 (1) of the Constitution of Kenya. This article does not however state the minimum and maximum land sizes (Kenya, 2012). With the immense pressure on the high potential agricultural land in the country, these minimum and maximum land holdings need to be urgently set. This will aid in the protection of these lands against uneconomical farm sizes resulting from unregulated subdivision.

2.9 Conceptual Framework

From literature, there is a substantial association between farm size and production. Some researchers have presented a positive correlation between household land size and food security, with others presenting an indirect relationship between the two. Population pressure, land tenure, inequalities in land access and household characteristics are some of the factors that affect household land size and use. Inheritance is the most common means of land acquisition in sub-Saharan Africa, a

phenomenon that exemplifies the existence of inter-generational transmission of land rights. An attempt has also being made to outline some of the possible planning interventions to help attain food and livelihood security. However, there is no literature on the viable farm sizes in a maize farming, the basis of this research. The conceptual framework that will guide the study is as represented in Figure 1.

Figure 1: Conceptual Framework

| INDEPENDENT VARIABLE | INTERVENING VARIABLES | DEPENDENT VARIABLE |

HOUSEHOLD LAND SIZE

- ❖ Population growth
- ❖ Inheritance practices
- ❖ Land tenure
- ❖ Land availability
- ❖ Available household resources
- ❖ Off – farm income

FOOD AND LIVELIHOOD SECURITY

HOUSEHOLD LAND USE ALLOCATION DECISIONS

- ❖ Resource availability
- ❖ Household characteristics
- ❖ Market demand for the farm produce
- ❖ Environmental conditions
- ❖ Technological factors
- ❖ Soil fertility
- ❖ Topography
- ❖ Land quality

Source: Author, 2019

2.10 Conclusion

From literature there exists a relationship between household land size and use and food and livelihood security. Based on research carried out at different parts of the world, researchers have advanced both positive and negative relationships between household land size and food security. Literature has also established a positive relationship between land allocation and food production as farm operations with the highest land allocations tend to produce more. Population growth, inheritance practices, land tenure, inequalities in land access and household characteristics are some of the factors that influence household land size and use. Land inheritance is the most common means of land acquisition in sub-Saharan Africa, an exercise that exemplifies the existence of inter-generational transmission of land rights. Some of the interventions recommended to address the food security problems associated with land size and use include; land consolidation, prohibition of land subdivision below the set minimum land size, population growth control programmes, technology adoption for optimal farm production and adoption of legislation on land use.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Overview

This chapter covers different stages that were implemented in executing the study. It outlines the research design adopted and specifics the target population and sampling plan for the study. The chapter highlights the types of data collected, data collection methods, analysis and presentation as well as the study's ethical considerations for the study.

3.2 Research Design

The research constituted three phases namely: conceptual, narrative and interpretation. The conceptual phase entailed deriving the research problem, questions, hypothesis and objectives with the help of the reviewed literature. The narrative phase entailed the process of planning for the research as the researcher had established the area of study where the surveys were conducted. Data needs, research procedures and techniques employed in data collection, analysis and presentation were also identified. The interpretation phase come after the data collected had been cleaned and analysed. At this stage, the researcher strives to answer all the research objectives. Hypothesis testing, which is an important part of this phase has also been undertaken. The researcher establishes the possibility of a relationship between land size and food livelihood security as well as land use allocation and farm gross margins.

3.3 Target Population

The target population for the research comprised of all the: household; community, opinion, religious and political leaders, professionals and administrators in Uvuu sub-location, Makueni County. From each category of the target population, a representative sample was picked.

3.4 Sampling Plan

The sub-location to be studied was Uvuu Sub Location in Makueni County. With a population density of 1029 persons per sq. km, Uvuu Sub Location has the highest density in the entire Mbooni Sub-County. The choice of the sub location with the highest density is meant to observe how these high population densities interact with land size, food and livelihood security. The lists of households as provided by the

village headmen were used as the sampling frame for the study. The sampling size has been calculated using the formula:

$$N = \frac{t^2 \times pq}{m^2}$$

Where:

N = Sample size

t = Confidence level, 95% confidence level, whose standard score is 1.96

m = Absolute precision or accuracy (5%)

p = Estimated prevalence to the diminishing parcel situation which is equivalent to 90% of the total population

q = 1-p

$$N = \frac{1.96^2 \times 0.9\,(1\text{-}0.9)}{0.05^2}$$

$$= \underline{138}$$

Thus, approximately a total of 140 households were interviewed for the study. Based on the number of households per village, proportionate random sampling was employed to establish the exact number of respondents from each village. Stratified random sampling was then used to select the households for the survey. Stratification was based on household headship i.e male, single and widowed headed households. From the three categories, proportionate random sampling was employed to establish the exact number to be interrogated from each stratum. The specific households to be interviewed were then selected using systematic random sampling. Moreover, extreme case sampling was used so as to isolate five farmers with the smallest land sizes and five with the largest land sizes within the sub-location. This was done to gather their experiences and recommendations on future land sizes and land use allocations.

The area Assistant Sub-County administrator, chief and assistant are the administrators that were interviewed. The professionals in the sub-location including teachers, medical staff, pastors and county physical planners and surveyors / land adjudicators were interviewed. The key informants for the study were the County Lands Officer, Agricultural Officer and sub-county Physical Planner who were selected using purposive sampling. Three focus group discussions also were held and

comprised of representatives from the adult age groups; 18-35years, 35-65 years and over 65 years. The attendance lists for the FDGs have been annexed to the report.

3.5 Methods of Data Collection

Qualitative and quantitative data was gathered and several methods were employed to allow for data authentication hence improve validity of the findings. Both primary and secondary data constituted the data sources for the study while the methods of data collection were; document examination, case study reviews, photography, individual and group interviews, observations, round table discussions, instrument administration and oral history.

3.5.1 Document Reviews

Existing literature explaining possible relationship between household land sizes, land use, tenure and fragmentation with food and livelihood security were reviewed. In addition, maps on temperature, rainfall, soil types and dominant crop cover as well as population census reports on population size and structure of the study area have been reviewed. Best case scenarios of other countries and areas with land subdivision and fragmentation problems coupled with high population growth in the rural areas have also been studied to help draw lessons on the best options of addressing the problems.

3.5.2 Interviews

With the aid of well-formulated questionnaires and interview schedules, the researcher obtained data on; existing land sizes, prevailing subdivision and fragmentation practices and use allocations to various crops, from the households, professionals, administrators and religious leaders. This was done through face to face interviews of the stratified randomly selected respondents. Focus group discussions and key informant interviews were also conducted with the help of open ended interview guides. This enabled the researcher to obtain unfiltered thoughts and ideas of the respondents. The round table discussions held with the area administrators comprising of village elders, assistant chief and chief assisted in supporting the gathered data on food security and livelihood trends within the sub location. It also aided in establishing land related conflicts, institutional issues on land and possible solutions to the identified issues.

3.5.3 Observation

Observation was used as a tool for purposeful and selective watching and listening. This aided in the verification of the data obtained from the respondents and that obtained from secondary sources. In this study, observation was used to examine land use trends, patterns and land sizes. The researcher formulated an observation checklist on all data needs so as to ensure all essential data that can be gathered by observation is obtained. The checklist contained relevant vital elements of the study like farmlands, farm boundary markers, vegetation cover, crop characteristics, farmlands, household compound sizes and layout amongst others.

3.5.4 Photography

Based on the photography checklist, images were taken to help further validate the data. Digital cameras were used to take pictures of the current status of land uses, sizes, physical infrastructure status etc. The still images depicted the actual images on the ground and aided in the visualization of land subdivision status. Comparing the current and past images helped discern the changes that have taken place over time.

3.6 Methods of Data Analysis

The study adopted various methods to analyze the collected data. Measures of central tendency and frequency distributions were produced using Statistical Package for Social Sciences (SPSS). With the right data sets, correlations were carried out to aid in ascertaining the nature and magnitude of the relationships between household land sizes and uses on food and livelihood security. The stated hypotheses were tasted using statistical tests like Chi-Square and T-tests. Additionally, analysis of available documents and photographs was undertaken to assess the relationships of various variables. Qualitative data was analysed using case and cross-case analysis. .

3.7 Data Presentation Plan

All the collected data was analysed using both qualitative and quantitative analyses techniques. The findings were reported both graphically and descriptively. Graphical presentation involved use of pie- charts, tables and graphs. Text narratives which provide interpretations of the findings were used to present descriptive data. The household questionnaires were coded and subjected to descriptive statistics. The descriptive statistics allowed the researcher to calculate frequencies, percentages, and averages. The results were presented in tables, charts, graphs and figures. Qualitative

data derived from questionnaires, interviews and observation checklist was organized into themes. This information was then presented in narrative forms and discussions.

3.8 Ethical Considerations

The study observed key ethical considerations and it was conducted scientifically. Secrecy and confidentiality of the collected information bound the researcher. The findings are meant for this study's purpose. Any publications will be required to follow the consent regulations governing research in the world. The research was based on objectivity, honesty, confidentiality, social responsibility, non-discrimination and respect for intellectual property.

3.9 Conclusion

Uvuu Sub-Location households, administrators, religious leaders and professionals constituted the target population for the study. In total, 140 households were interviewed, three focus group discussions; for the youths, men and women were held and key informants were interviewed. The households selected for the study was sampled using a stratified random sampling method and from each stratum, proportionate simple random sampling was used. Systematic random sampling was then employed to select households that were interviewed. Purposive sampling was undertaken to select the key informants for the study. The methods of data collection employed included document reviews, observation, interviews, photography and instrument administration. The collected data was analyzed and presented in appropriate formats.

CHAPTER FOUR
STUDY AREA

4.1. Overview

This chapter highlights the location, physiographical features, population and demographic factors, socio-economic characteristics, land and land use, physical and social infrastructure of Uvuu sub-location in relation to Makueni County.

4.2 Location

Uvuu location is located in Kithungo/Kitundu Ward, Mbooni Sub-County, Makueni County. Spatially, Makueni County covers an approximate area of 8,034.7 sq, km. the county borders Machakos County to the North, Taita Taveta County to the South, Kitui County to the East and Kajiado County to the West. It is situated between Latitude 1º 35´ and 30 00' South and Longitude 37º10´ and 38º 30´ East (Makueni County Government, 2013). Uvuu sub-location borders Kaliani to the East and North East, Kitundu Sub location to the South and Mutitu Sub location to the West and Norh West (Map 4). The study area covers an approximate area of 1.7 sq. km.

Table 1 shows the area coverage of the various administrative units in Makueni County

Table 1: Area Coverage

No.	Administrative Unit	Size (km^2)
1.	Makueni County	8,034.7
2.	Mbooni Sub-County	979.31
3.	Kithungo/Kitundu Ward	86.27
4.	Uvuu Sub-Location	1.7

Source: Makueni County Integrated Development Plan, 2013

Maps 1 – 4 illustrates the location of the sub-location in the national, regional and local context.

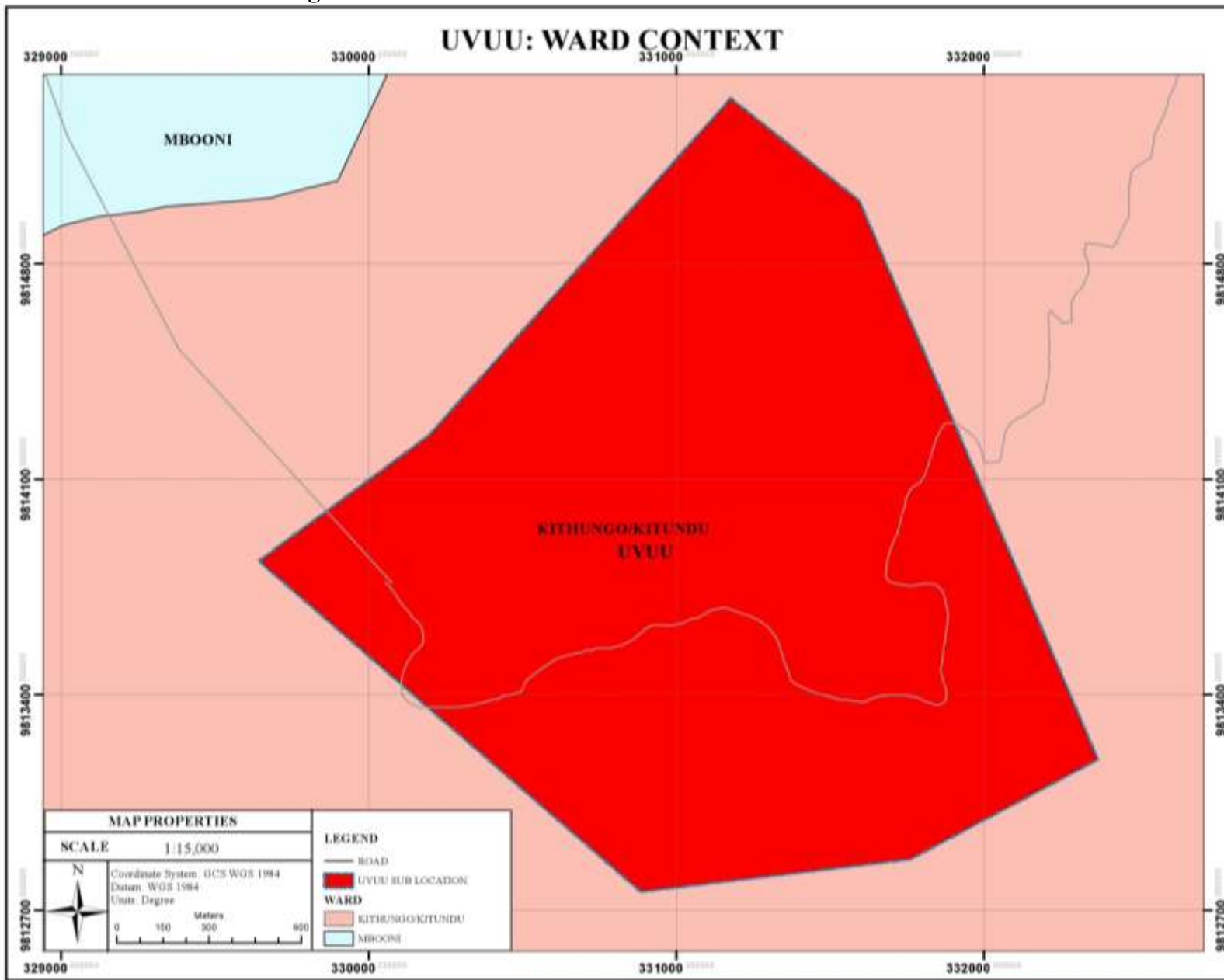**Map 1: National Context of the Study Area**
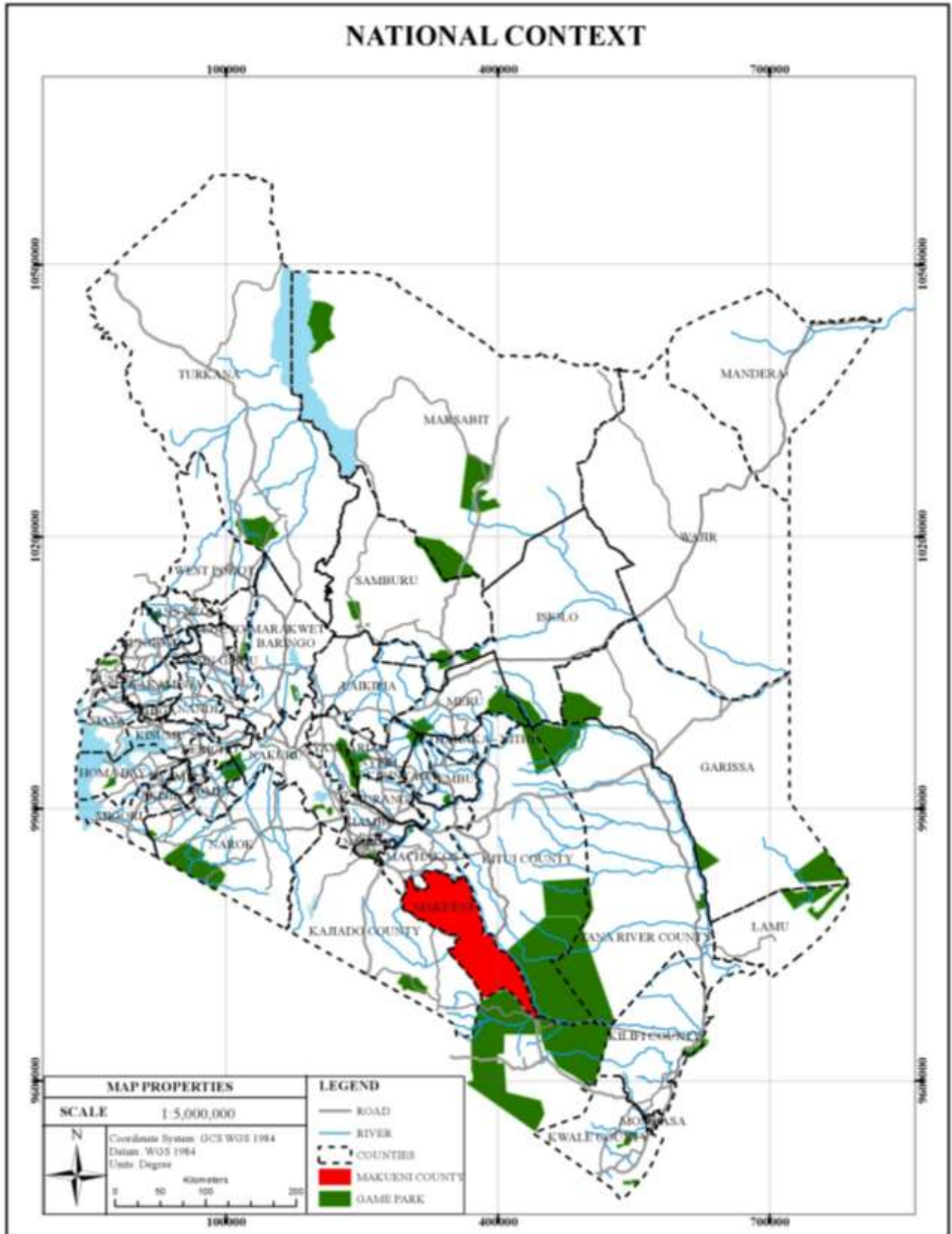
Source: Kenya GIS Data

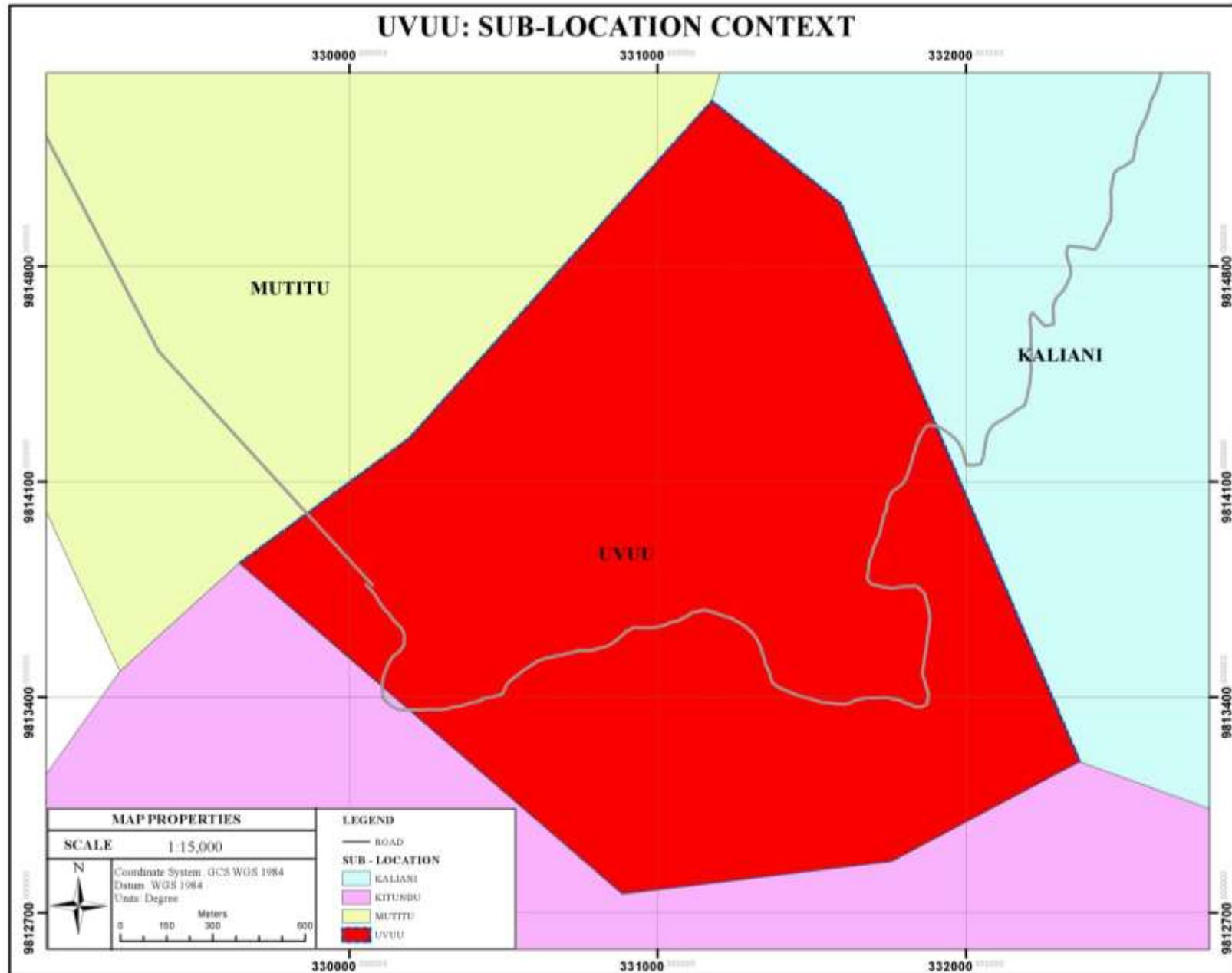**Map 2: Uvuu Sub-Location in Mbooni Sub-County Context**

Source: Kenya GIS Data

Map 3: Uvuu Sub-Location in Kithungo / Kitundu Ward Context

Source: Kenya GIS Data

Map 4: Sub-Location Context

UVUU: SUB-LOCATION CONTEXT

MUTITU

KALIANI

UVUU

MAP PROPERTIES

SCALE	1:15,000

N

Coordinate System: GCS WGS 1984
Datum: WGS 1984
Units: Degree

Meters
0   150   300   600

LEGEND

—— ROAD

SUB - LOCATION

- KALIANI
- KITUNDU
- MUTITU
- UVUU

Source: Kenya GIS Data   41

4.3 Physiography and Natural Environment

This segment outlines the physical and topographical characteristics as well as the ecological and climatic conditions of the study area.

4.3.1 Physical and Topographical Features

As documented in Makueni CIDP (2013) the county is situated within the ASAL region of the former eastern province of the Republic of Kenya. Mbooni and Kilungu Hills in Mbooni and Kaiti Sub-counties respectively and the volcanic Chyullu Hills at the county's South West border are the major physical features in the County. Uvuu Sub location is however located along the slopes of Mbooni Hills. The county has a low-lying terrain which rises up to 600m above sea level in Tsavo National Park. Athi River, which is a perennial river is the main river in the county. It is fed by several tributaries namely: Thwake, Kaiti, Kiboko, Mtito Andei and Kambu rivers. There are also other streams flowing from Kilungu and Mbooni hills with their flow getting uneven downstream. These rivers present a great potential for irrigation fed agriculture.

4.3.2 Ecological Conditions

Since the county is located within the country's ASAL region, it is characterized by arid and semi-arid conditions with some areas being susceptible to recurrent droughts. The lower side of the county is the driest and receives an annual rainfall of 300mm to 400mm. With such erratic rainfall patterns, maize, the major staple food in the county can hardly be sustained. Makueni County is classified into several agro – ecological zones as outlined in Table 2.

Table 2: Agro ecological Zones of Makueni County

No.	Zone	Location	Characteristics
1.	UM 2: Major coffee zone	Located at altitude 1400m – 1700m	Receives an average rainfall of 980mm – 1200mm annually
2.	UM 3: Marginal coffee zone	Located at altitude 1400m – 1830 m	Receives on average an annual rainfall of 950mm – 1050 mm
3.	UM 4: Sunflower maize zone	Located at altitude 1520m – 1770m	Receives on average an annual rainfall of about 800mm – 950 mm.
4.	UM 5: Livestock	Located at altitude	Receives an average annual

	Sorghum zone	1460m – 1710 m	rainfall of 600mm – 750 mm
5.	LM 3: Cotton zone	Located at altitude 1160m – 1350 m	Receives an average annual rainfall of about 800mm – 900 mm
6.	LM 4: Marginal Cotton Zone	Located at altitude 1160m – 1280 m	Receives on average 700mm – 850 mm of rainfall annually
7.	LM 5: Lower Midland Livestock & Millet Zone	Located at altitude 790m – 1220 m	Receives about 650mm – 750 mm of average rainfall annually

Source: Kenya, 2016: Page 26

Locally, the Agro-Ecological Zones are generally categorized as the upper, middle and lower zones. The upper zone includes Mbooni and Kilungu Sub – Counties and is popular for milk, avocado, maize and vegetables production. The middle zone encompassing of Wote area is appropriate for mango, maize, beans and oranges production. The lower zone, constituting of Kibwezi area is ideal for pastures and beef cattle production. Uvuu sub-location is located in AEZ, UM 3 or the upper zone as broadly locally understood.

4.3.3 Climatic Conditions

There are two rainy seasons in the county, the short and the long rains. The long rains are experienced in March and April with the short rains occurring in the months of November and December. Mbooni and Kilungu sub-counties being the hilly parts of the county, have the highest rainfall amount of 800-1200mm per year. This presents a great potential for rain fed agriculture. The highland areas of Mbooni and Kilungu hills are usually cold with temperatures as low as 20.2^0C which rises up to 24.6^0C. The lowland areas to the South are very hot with temperature as high as 35.8^0 C. This situation causes high evaporation thus worsening the harsh climatic conditions.

4.4 Population and Demographic Characteristics

This section outlines the population size, population structure, population density and the demographic characteristics of the sub location with respect to the county statistics.

4.4.1 Population Size

Currently, Makueni County is projected to have approximately 991,621 people, up from 884,527 people during the 2009 Kenya Housing and Population Census. The county's population growth rate of 1.4 percent is significantly lower than the national growth rate which stands at 2.6 percent. A significant segment of the county population which is equivalent to 67 percent of the total population lives in the rural areas. As per the Kenya Housing and Population Census of 2009, Uvuu sub-location had a population size of 1,737 people. Using the county population growth rate which is 1.4 percent, the population size of the sub-location stands at 2,294 people in 2019. Table 3 outlines the size of population for the County, Sub-County and Uvuu sub-location in 2009, and the projected population in 2019.

Table 3: Size of Population

Geographical Unit	Population Size	
	2009	**2019**
Makueni County	884,527	991,621
Mbooni Sub – County	184,624	243,808
Uvuu Sub-location	1,737	2,294

Source: KNBS, 2009

Thus, Uvuu sub-location population is 0.9 percent and 0.2 percent of the Sub – County and County population respectively. The sub-location has a total of 371 households as per the 2009, housing and population census.

4.4.2 Population Structure

A spread-out population pyramid characterizes Makueni county population. The young age groups have the highest proportion of the population as compared to the older age groups. The domination of young population could be attributed to the high fertility rate in the county which stands at 5 children per woman. Life expectancy is also relatively higher at 67 years compared to the national one which stands at 62 years.

4.4.3 Population Density

The county has significant variations in population density across its six sub-counties. This could be attributed to the diverse climatic and socio economic conditions in the sub-counties. The population density of the county stands at 119 persons per square

kilometre. Mbooni Sub County has a population density of 218 persons per square kilometre while Uvuu sub location has a population density of 1,029 persons per square kilometre. This density is significantly very high than the County and Sub-County population densities.

4.4.4 Birth and Mortality Rates

Births and deaths are the major demographic processes in areas with insignificant migration. The crude birth rate ('000) in the county is 36.2 while the total fertility rate in the county stands at 5.1 children per woman (Kenya, 2017a). The mortality rates in the county are slightly lower than the national rates (Table 4). However, crude death rate is slightly higher in the county than in the country.

Table 4: Mortality Rates of Makueni County

No.	Category	Rate	National Statistics
1.	Infant mortality	53/1000	54/1000
2.	Under five mortality	61/1000	79/1000
3.	Maternal mortality	400/100,000	495/100,000
4.	Crude death rate	11.9/1000	10.4/1000

Source: Makueni, 2016: page 2

4.5 Socio-Economic Characteristics

Erratic rainfall patterns characterize the county leading to massive crops failures hence perennial famines which are cushioned through relief food. The main economic activities in the county include agriculture which is mainly done for subsistence, dairy farming and beekeeping. A small proportion of the population is also involved in some off farm income generating activities like trade and employment whether formal or informal. Maize, fruits, beans, green grams, cassava, pigeon beans, cotton and sorghum are some of the crops grown. The county is one of the producers of the best quality fruits in the country with mangoes, oranges, bananas, paw paws and avocadoes being the main fruits produced (Kenya, 2013).

As documented in the CIDP, the county has multiple cultures. The Akamba who speak the Kamba language (Kikamba) are the main inhabitants in the county. The towns along the Nairobi - Mombasa highway are characterized by a cosmopolitan way of life. The Catholic is the main religious denomination with about 290,300

faithfulls. Different protestant denominations have a total of 557,700 faithfulls; Islam has 4,900 with the other faiths being represented by 12,200 people (Kenya, 2013).

4.6 Land

Land is a critical factor in food production. The quantity and quality of land resources is a major contributor to the amount of food produced to feed a given household. This section outlines land size, use and ownership in the county context which reflects the situation in Uvuu Sub-location.

4.6.1 Land Size

Approximately, 74 percent of the county land is arable. This percentage is equivalent to about 5,042.69 km^2. The mean land holding size of the county which stands at 1.58 Ha is relatively higher in comparison to the national mean land holding of 0.97 Ha. The county is characterized by both small and large scale farms. The average farm size for the small scale farmers is about 3.44 Ha and 30.4 Ha for large scale farms (Kenya, 2013).

4.6.2 Land Use

Most of the land in the county is under agricultural production. This could be attributed to the fact that to the majority of the population, agriculture is the main livelihood source. The sector contributes about 78 percent of all household income. There is a high potential for horticulture and dairy farming in Mbooni West and Kilungu Sub Counties, a situation that is mainly attributed to the favorable climactic conditions. The lowland areas are best suited for fruit and cotton production as well as livestock rearing (Kenya, 2013).

4.6.3 Land Ownership

Approximately, 19.8 percent of the land owners have title deeds. This is equivalent to about 186,814 land owners. In comparison to the national statistics, the possession of land ownership documents in the county is quite low. Nationally, about 39.4 percent of land owners have tittle deeds (Kenya, 2013).

4.7 Physical Infrastructure

Physical infrastructure includes energy, water and sanitation, transportation and telecommunication facilities.

4.7.1 Transportation

There are three main modes of transportation in Makueni County namely: road, railway and air. In Uvuu sub-location, road transport is the only existing mode of transport though other modes are still accessible.

4.7.1.1 Road Transport

The road network in the county is relatively good. However, most of the roads have earth surface type a scenario that makes them inaccessible during the rainy season. The county has estimated road coverage of 3,203.5 Km. Bitumen roads takes up 453.8Km; gravel 555 Kms while surface roads take up 2,198.6Kms. The bitumen roads are the Nairobi - Mombasa highway (A104) which runs from Konza to Tsavo River, Salama – Mukaa - Nunguni road, Katumani – Wote - Makindu Road, and Itangini –Tawa - Kikima Road. The County Government has constructed two major bus parks in Emali and Nunguni towns (Kenya, 2017a). During the rainy season, most roads within Uvuu sub location become impassable though the County Government has upped its efforts in their routine maintenance.

4.7.1.2 Railway Transport

The standard gauge railway which runs from Mombasa to Nairobi is strategically located within the county with three major stations, Emali, Kibwezi and Mtito Andei in the county. The railway runs from Old Konza railway station to old Man-eaters railways station (Kenya, 2017a). To access the train services from the study area, one can board at Emali station.

4.7.1.3 Air Transport

The only air strip in the county is located in Makindu town. The airstrip is however underdeveloped but has the potential to be upgraded. There are also private air strips along Athi River, around Kiboko, at Mikululo and at a David Shedrick site. There are no air strips near the study area (Kenya, 2017a).

4.7.2 Water and Sanitation

This section outlines the sources of water for the residents of Makueni County and the types of sanitation for their waste disposal.

4.7.2.1 Water Supply

Rivers, protected springs, boreholes, water pans and surface dams are the main water sources for the county. About 12,671 households have access to piped water with 27,752 households being able to access potable water. The current water demand in the county stands at 22,113m^3/day. However, the developed sources have a capacity to produce an average of 13,607m^3/day. This presents a water deficit of 8,507m^3/day (Kenya, 2017a).

4.7.2.2 Sanitation

The major towns in the county do not have sewer connections for their liquid waste disposal. Being entirely a rural area, the residents of Uvuu Sub-location have embraced the use of pit latrines for their human waste disposal with about 90 per cent of the households having access to pit latrines.

4.7.3 Energy

Through the rural electrification programme, there has been a significant expansion of electricity coverage in the county. Currently, over 2,000 rural households are connected to the national grid. About 69 percent of the households use paraffin for lighting, a situation that could be attributed to the low level of electricity connectivity. Electricity and solar comes in as the subsequent lighting energy sources at 5.9 percent 3.8 percent respectively. Approximately 84.8 percent of the population use firewood as a cooking energy source with 11.1 percent using charcoal. This massive use of fuel wood for cooking has detrimental effects to the environment (Kenya, 2017a).

4.7.4 Posts and Telecommunications

The county has only one registered private courier service provider. However, the public service vehicles plying various routes offer private courier services. There are about 13 and 7 post offices and sub-offices respectively located in different geographical areas in the county. In addition, community, regional and national radio services are available, though the county has poor television signal. There are several cyber cafes located at the major urban centres and about 85 percent of the population has access to mobile phones (Kenya, 2013).

4.8 Social Infrastructure

This section highlights the various institutions (educational and health) in Makueni County.

4.8.1 Educational Facilities

The county has a total of 1,819 primary schools which comprises of 914 Government owned and 68 privately owned schools. There are 398 secondary schools and two public university campuses in Wote and Mtito Andei. In addition, land has been set aside for a 3rd campus in Mbooni. There is a research centre at Kibwezi as well as an extra mural centre located in Wote for the University of Nairobi. Lukenya University, a private university is located at Kibwezi West Sub County. There are a several middle level colleges with campuses in the county. These include; Riccatti College in Wote town, Kibwezi teachers training college and two medical training colleges in Wote and Makindu towns (Kenya, 2017).

4.8.2 Health Facilities

The county has a total of 156 public health facilities including nine Level 4 hospitals, 21 level three hospitals and 125 dispensaries. In addition, there are 2 private hospitals, 36 clinics and 27 dispensaries distributed across the county (Kenya, 2017a).

4.9 Conclusion

The climatic conditions in Uvuu sub-location are not very favorable for agricultural production since the area is located in the country's ASAL region. Though there are several streams that emanate from Mbooni Hills, there are no major water bodies in the sub location. However, irrigation fed agriculture can still be realized through drilling of boreholes, rain water harvesting and other alternative water sources. Applying the law of diminishing returns, irrigating a fixed land size will generate marginal returns at some point. Thus, relatively larger land parcels would be viable for increased food production. However being one of the high potential agricultural areas in the county, increased population densities have exerted immense pressure on the available land resources. Coupled with the culture of land inheritance, the farm sizes have gradually being decreasing with time. With the setting aside of land in Mbooni Sub - County for the construction of a university, the pressure on land will be aggravated as land will be used for the construction of student accommodation facilities and other support facilities. This call for the need to develop policies and regulations on land subdivision to ensure maintenance of economical land sizes for the attainment of food security.

CHAPTER FIVE
RESEARCH FINDINGS

5.1 Overview

The research looked at the impacts of reducing land sizes and uses on sustainable food and livelihood security. It investigated how the present land sizes and uses affect food and livelihood security and proposed the estimate land holding size for the sustenance of the households in this maize farming system. The information was gathered from administration of household questionnaires to the residents of Uvuu Sub-Location, key informants interviews, observations, conducting of focus group discussions and photography. This section compiles the findings of the study from the primary data.

5.2 Respondents Characteristics

This section outlines the respondents' features with regard to their age, gender and marital status.

5.2.1 Age

For the household questionnaires, a total of 140 respondents from the 7 villages of the sub-location were interviewed. The study respondents comprised of the household heads or their spouses and thus, were aged 18 years and above. A significant number of the respondents were aged 61 years and above representing about 35 percent of the respondents (Figure 2).

Figure 2: Age of Respondents
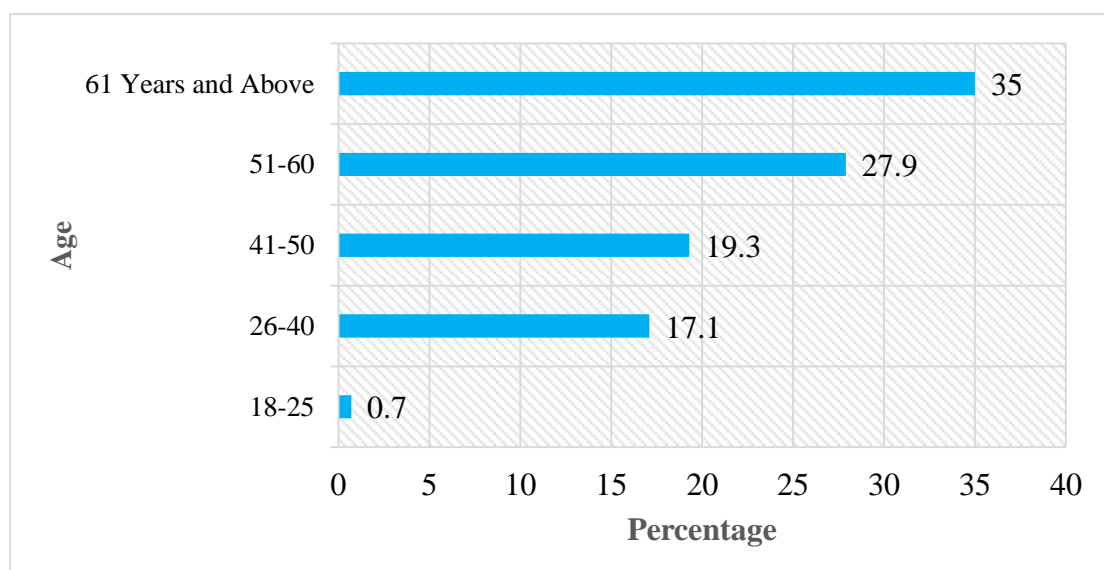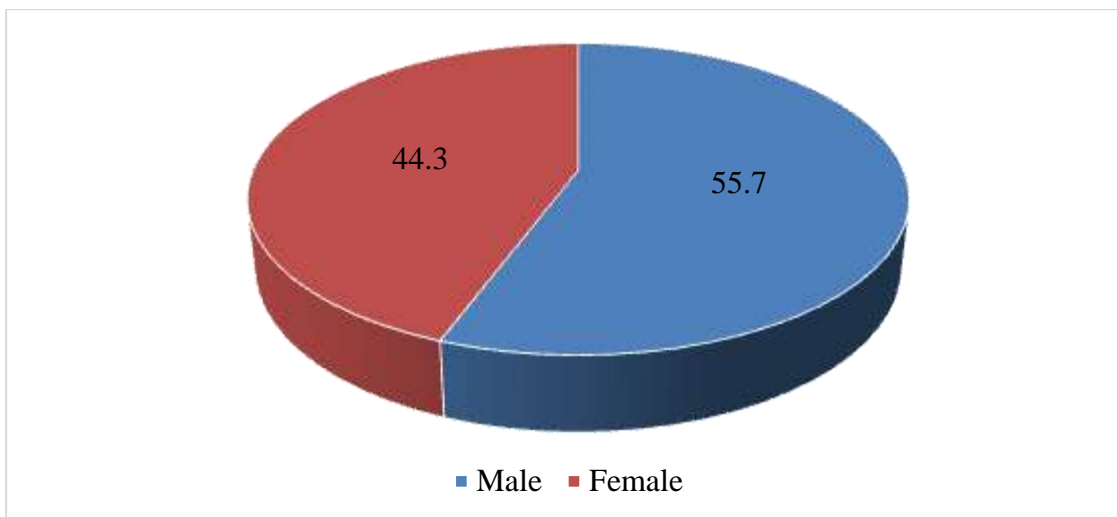

Source: Field Survey, 2020

The respondents aged between 51-60 years followed at 27.9 percent. This is an indication of a high life expectancy within the sub location, a phenomenon that could be attributable to proper eating habits and improved access to health care after the roll out of Makuenicare by H.E Governor Kivutha Kibwana.

5.2.2 Gender

About 56 percent of the respondents are males compared to 44 percent of female respondents. This is an indication of the existence of male dominance in decision making with regard to the household business. However, this dominance is not that pronounced as the ratio fits perfectly in the gender ration requirements as stipulated by the Kenyan Constitution, 2010.

Figure 3: Gender Characteristics

Source: Field Survey, 2020

5.2.3 Marital Status

Approximately 70 percent of the respondents are married compared to 20.7 percent, 4.3 percent, 3.6 percent and 1.4 percent who are widowed, single, separated and divorced respectively (Table 5). The single respondents consisted of the young males who had constructed their homesteads away from their parents' compound but were yet to be married. They formed part of the lists of households provided by the village head men thus forming part of the study.

Table 5: Marital Status

Marital Status	Frequency	Percent	Valid Percent	Cumulative Percent
Married	98	70	70	70
Single	6	4.3	4.3	74.3
Widowed	29	20.7	20.7	95
Divorced	2	1.4	1.4	96.4
Separated	5	3.6	3.6	100
Total	140	100	100	

Source: Field Survey, 2020

5.3 Household Characteristics

This section highlights the household size, education level and the various economic activities engaged in by the sub-location households.

5.3.1 Household Size

In Uvuu Sub-location, the household size ranges from 1 to 12 members with an average household size of 5. Households with 5 family members are the majority representing about 30 percent of the respondents. Those with 1, 10 and 12 family members are the least representing 2.1 percent, 2.1 percent and 0.7 percent respectively. As tabulated in table 6 below, majority of the households have a family size of between 4-6 accounting for about 63.6 percent of the respondents. Household with 10-12 members account for about 4.7 percent of the respondents.

The sub-location's average household size of 5 corresponds to the county's household size of 5. The relatively big household size could be as result of high life expectancy and fertility rates in the entire county. These relatively large household sizes implies many mouths in need of food thus affecting the food security of individual households. In addition, since tradition requires land to be subdivided to individual heirs, the big household sizes affects the land sizes of subsequent farms.

Table 6: Household Size

HH Size	Frequency	Percent	Valid Percent	Cumulative Percent
1	3	2.1	2.1	2.1
2	11	7.9	7.9	10
3	13	9.3	9.3	19.3
4	27	19.3	19.3	38.6
5	42	30	30	68.6

6	20	14.3	14.3	82.9
7	6	4.3	4.3	87.1
8	10	7.1	7.1	94.3
10	3	2.1	2.1	96.4
11	4	2.9	2.9	99.3
12	1	0.7	0.7	100
Total	**140**	**100**	**100**	

Source: Field Survey, 2020

5.3.2 Educational Level

The parents' literacy levels are relatively low with about 75 percent and 68 percent of the fathers and mothers respectively having attained primary education. Only about 3 percent and 2 percent of the fathers and mothers respectively have attained tertiary education (Table 6). A significant section of the mothers have no education as represented by 14 percent of the representative sample. The literacy levels increases with children as more of them attain secondary and tertiary education. However, a big percentage of the sub-location population has attained primary education. This could be as a result of relatively younger families with most of the children being still in primary schools.

Table 7: Education Level

| Category	Education level in percentage (%)				
	None	Pre-Primary	Primary	Secondary	Tertiary education
Father	3	2	75	17	3
Mother	14	2	68	14	2
1st Child	2	1	58	32	7
2nd Child	3	2	59	29	7
3rd Child	4	6	53	32	5
4th Child	2	0	65	26	7
5th Child	3	7	55	28	7
6th Child	0	5	69	16	10
7th Child	0	0	60	27	13
8th Child	0	0	50	50	0
9th Child	0	0	60	40	0
10th Child	0	0	100	0	0

Source: Field Survey, 2020

Educational levels within a household directly affect the kind of occupation opportunities to be engaged in. For instance, those with tertiary education tend to engage in off-farm income generating as opposed to those with none, pre-primary and primary education who are forced to engage in farming activities and any occasional manual jobs available. In this regard, households whose members have attained high levels of education tend to be more food and livelihood secure compared to their counterparts with low education levels.

5.3.3 Occupation

Farming is the main economic activity for both the father and mother as represented by 72 percent and 87 percent respectively. The number of fathers and mothers engaged in formal employment is very low as represented by 8 percent and 2 percent respectively (Figure 4). This is a translation of the low literacy rates reported within the parents. However, the dominance of faming as the main occupies lessens with children as formal employment and engaging in business tend to dominate.

Figure 4: Occupation
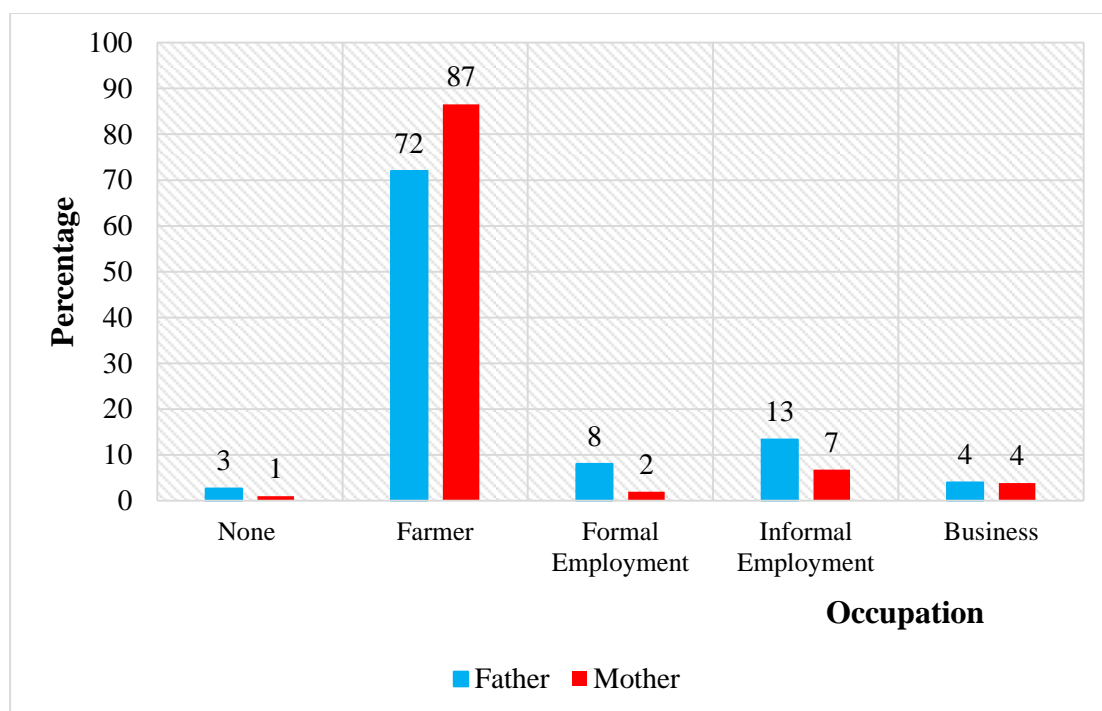
Source: Field Survey, 2020

5.3.4 Economic Activities

Farming is the main economic activity in the sub location representing about 85.9 percent of the respondents (Figure 5). This explains the importance of agriculture for

both food production and enhancement of livelihoods in the sub-location. Other economic activities include; formal employment, business, informal employment and casual laborers as presented in the figure below.

Figure 5: Main Economic Activity
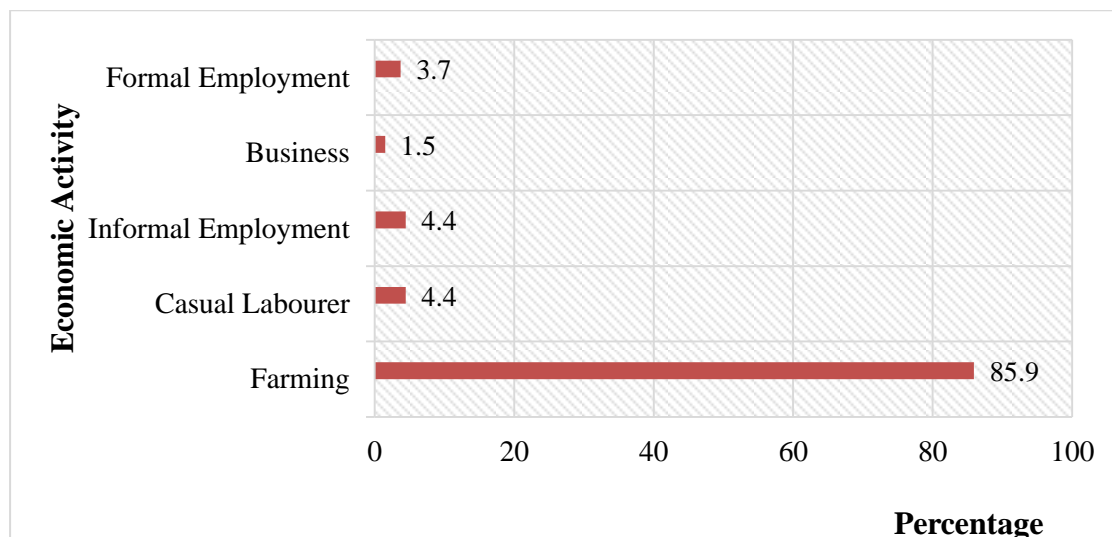
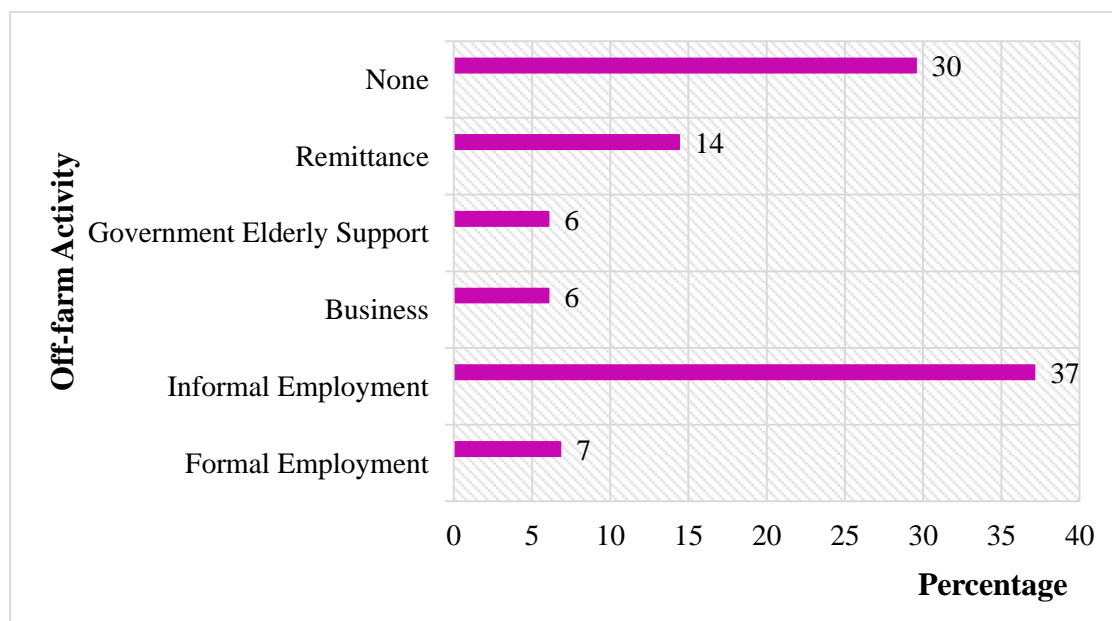
Source: Field Survey, 2020

Despite the dominance of agriculture as an economic activity, majority of the population engage in other income generating activities away from the farm as represented by 70 percent of the respondents. These activities include; businesses as well as formal and informal employment.

Figure 6: Off-Farm Income Generating Activities

Source: Field Survey, 2020

About 6 percent of the population who comprise of the old age cohort depend on the government support for the elderly while 14 percent depend on remittances from their children and other relatives. Engaging in off-farm income generating activities help avail additional income to the households. This puts them in a favorable position and are able to access quality and adequate food. However, a significant proportion of the population which is equivalent to about 30 percent of the respondents don't engage in any off farm activities. This situation is projected to negatively affect their livelihoods. With the reduction of farm yields as a result of diminishing land sizes coupled with other factors, these households are more likely to go hungry as they don't have access to any income required to purchase food commodities.

5.4 Research Findings per Objective

The findings of the research per the set objectives are as outlined below:

5.4.1 Household Land Size and its effect on Food and Livelihood Security

This objective investigated land ownership status with regard to the original and current family sizes as well as the existing food production situation. It further evaluates the effects of the existing land sizes on food and livelihood security.

5.4.1.1 Household Land Size

Land ownership in Uvuu Sub-location is very high as about 98.6 percent of the households own land compared to only 1.4 percent who don't own land as seen in the table below:

Table 8: Land Ownership

Own Land	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	138	98.6	98.6	98.6
No	2	1.4	1.4	100
Total	140	100	100	

Source: Field Survey, 2020

Majority of the households who own land own only one piece representing about 80 percent of the respondents. Approximately 15 percent, 3 percent and 2 percent own 2, 3 and 4 pieces of land respectively as shown in the figure below. This is an implication that land fragmentation in the sub-location with regard to the number of

land parcels owned isn't that pronounced as majority of the households own only one parcel.

Figure 7: Number of Land Pieces Owned
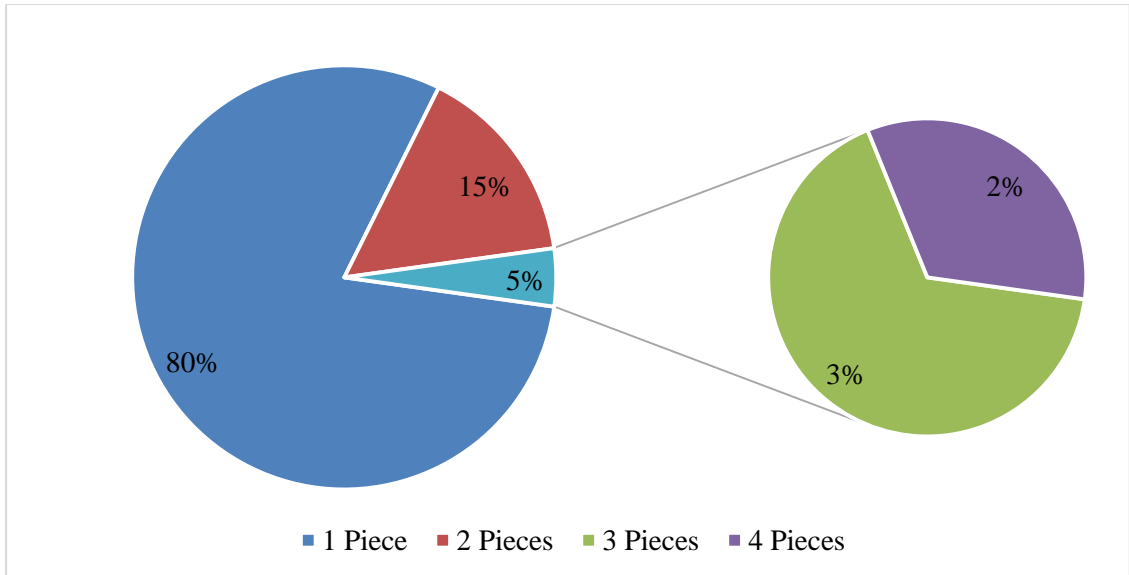
5.4.1.2 Tenure Security

Land in the sub-location is held under freehold tenure with inheritance being the most form of land acquisition representing about 85 percent of the respondents. The residents within the sub-location benefitted from the titling process which was launched by the County Government of Makueni. As a result, all the households interviewed had title deeds for the land parcels they own.

Figure 8: Mode of Land Acquisition
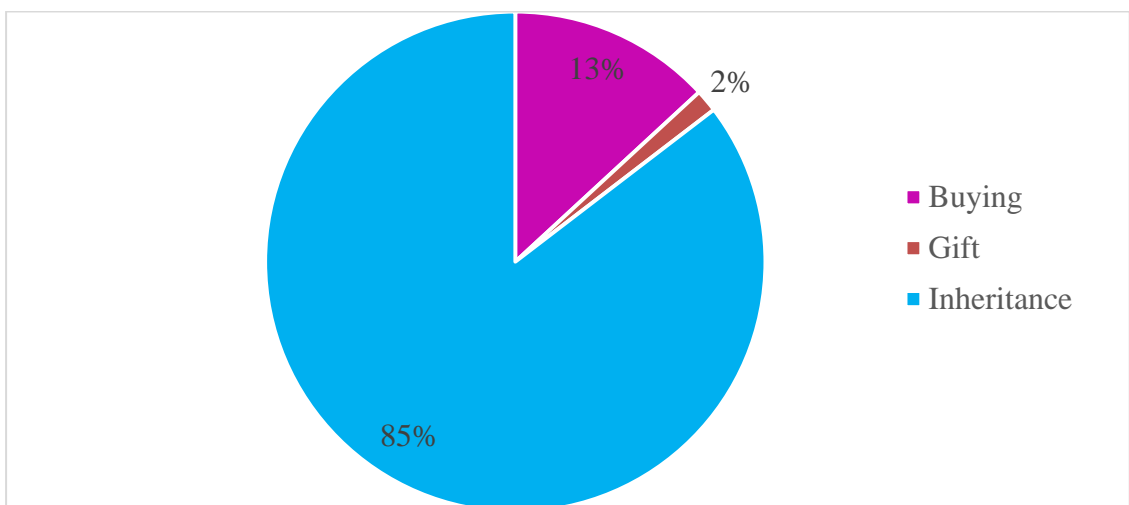
5.4.1.3 Average Land Sizes

The Focus Group Discussions held revealed that, originally, the land sizes in the sub-location were relatively big as compared to the current situation which was necessitated by the existing traditions of inheritance where parents are required to subdivide their lands to their respective heirs. By the time of the study, several generation had settled in the area, and the land sizes had significantly reduced to cater for this increased population.

Administration of household questionnaires highlighted that, the land sizes of the parents ranged between 0.5-50 acres with a standard deviation of 15.62 and a mean of 10.6 acres. This indicates existence of significantly small land sizes for the parents. This could be attributed to the fact that several generations had already settled in the sub-location thus land had subsequently been subdivided for inheritance purpose. On the other hand, the current land sizes ranges from 0.13 − 23 acres with a standard deviation of 11.3 and a mean of 3.9 acres. This represents a significant drop of 63 percent in average household land sizes between the two. Conducting a paired sample test for the parents' land size and the current land size indicates different means of 10.6 acres and 3.9 acres respectively. According to the test, a moderate positive correlation of 0.345 exists between the parents and current land size and a significance of 0.000

Table 9: Comparison between Parents' and Current Land Sizes

Paired Samples Test									
		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Current Land Size (Acres) Parents Land Size Before Subdivision	-6.70	15.62	1.32	-9.315	-4.095	-5.08	139	.000

Source: Field Data Analysis, 2020

The paired sample test presented in table 9 above indicates that the mean difference of -6.70 between the parents and the current land size is statistically significant since sig.

is less than alpha (sig. = 0.000 and alpha = 0.05). Thus, there is a significant difference between the parents and the current land sizes.
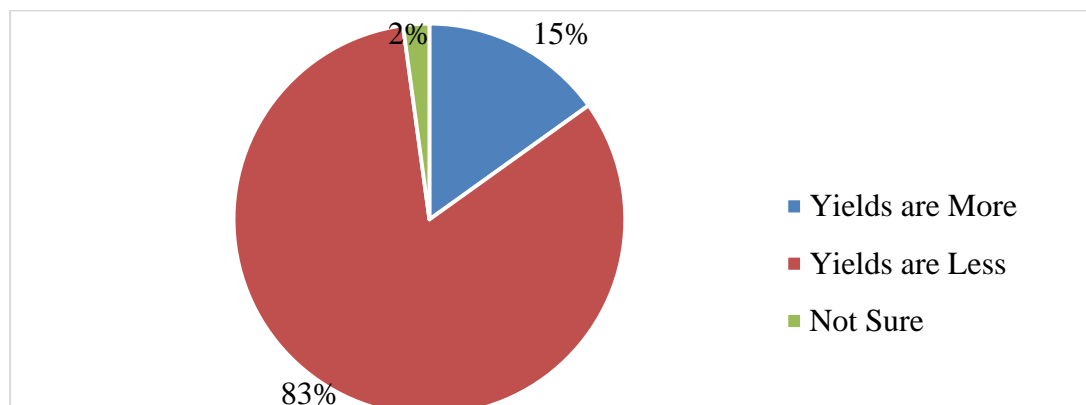
5.4.1.4 Farm Yields

Agriculture is the main economic activity in the sub-location as about 85.9 percent of the respondents are engaged in agricultural activities. Some of the main crops grown include maize, beans, coffee, vegetables and fruits (bananas, avocadoes, mangoes). The residents also practice livestock rearing with cows, goats, sheep and chicken being the main livestock reared.

About 70 percent, 50 percent and 85 percent of the households harvest less than 1,000kgs of maize, beans and vegetables respectively with only about 10 percent, 3 percent and 1 percent harvesting over 2,000kgs of the produces respectively. The gradual reduction and subsequent disappearance of grazing fields have resulted to the reduction of the number of livestock reared. Over 90 percent of the households have 1-5 cows and a few goats. The number of chicken is however significantly high since they don't utilize much space. Milk production is low as the average milk produced per household stands at 5 litres a day. This could be as a result of the livestock breeds reared. Production of eggs is also very low with much of the produce being consumed at the household level or used as part of the chicken production.

When asked to explain how the current farm yields compare with the previous ones before the subsequent land subdivisions, about 83 percent of the respondents highlighted that the yields are lower by three quarters – 40 percent, half - 35 percent or a quarter – 25 percent. Approximately, 15 percent indicated that the yields had increased a situation that could be as a result of several factors among them; adoption of modern farming methods like use of fertilizers, certified seeds and the adoption of irrigation fed farming. About 2 percent of the respondents were not sure of any changes in yield.

Figure 9: Comparison of Yield Before and After Land Subdivision

Source: Field Survey, 2020

5.4.1.5 Existing Food Situation

The current farm yields are adequate to about 44 percent of the respondents as they can last for at least 12 months post-harvest. For 24 percent of the households, the food harvested can only last them up to nine months while for 15 percent and 17 percent, the food can only last them up to 6 and 3 months respectively (Figure 10).

Figure 10: Duration of Food Availability
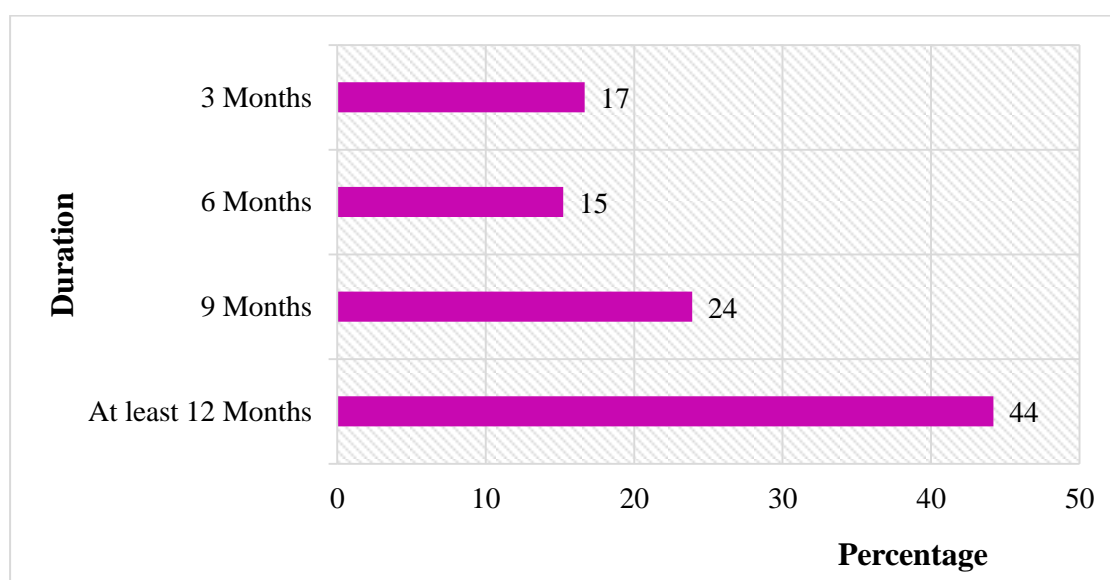
Source: Field Survey. 2020

The same percentages are translated to the food scarcity situation. As about 44 percent are food secure as the amount of food harvested can last them up to at least 12 months. About 24 percent deal with mild food scarcity as the amount of food harvested lasts them up to 9 months (Figure 11).

Figure 11: Intensity of Food Scarcity
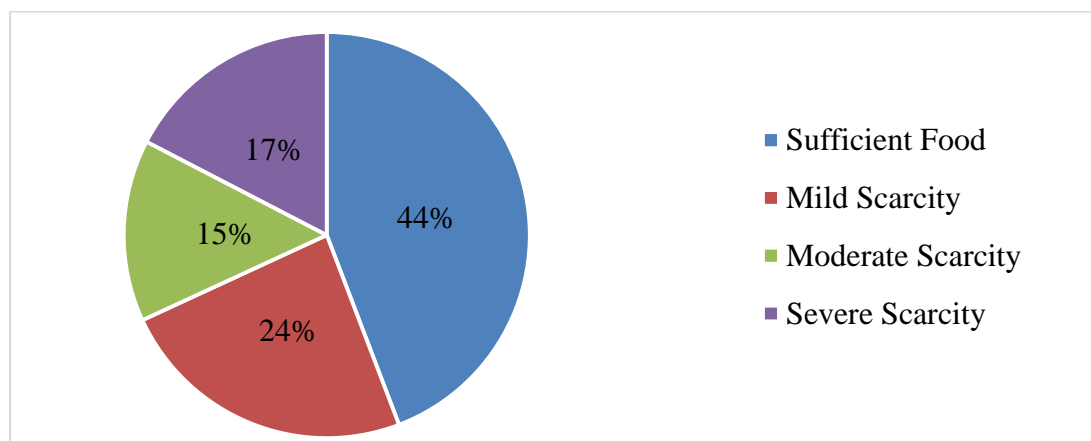
Source: Field Survey, 2020

A significant proportion of the population struggle with severe food scarcity as represented by 17 percent of the respondents as the harvested food can only last only 3 months post-harvest while 15 percent suffer from moderate scarcity with the food stores lasting up to 6 months. Households that experience food insecurity are forced to either buy or borrow the required food commodities to supplement the deficit. Purchasing of food products eats up into the already strained household finances thus negatively affecting their livelihoods. In some instances the households are forced to skip meals to avoid constant expenditure on food items.

5.4.1.6 Effect of Existing Land Sizes on Food and Livelihood Security

Theoretically, there seems to exist a relationship between land sizes and agricultural production. Households with relatively bigger farm sizes are more likely to harvest more yields compared to those with small farms, holding all other factors constant. Out of the 83 percent of the respondents who reported a reduction on farm yields, about 35 percent of them attributed it to the reduced land sizes. Other reasons postulated for this drastic change in farm yields included poor farming methods, reduced soil fertility, climate change and pests and diseases (Figure 12).

Figure 12: Reasons for Change in Farm Yields
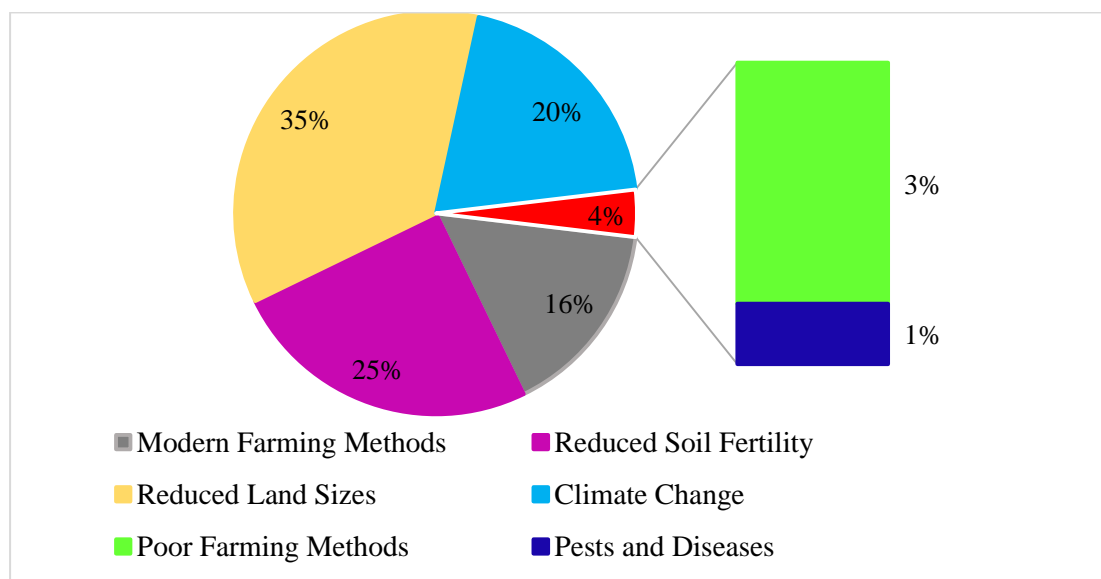
Source: Field Survey, 2020

This results implies that the reducing farm sizes has the greatest effect on agricultural production when compared to the other factors. In additions, over 90 percent of the respondents retaliated that indeed small land parcels lead to low crop yield. Conducting a Pearson correlation analysis to examine the relationship between household land size and maize production revealed a very weak non-significant relationship; $r = 0.187$, $p = 0.027$. This implies that a large household farm land doesn't necessarily translate to more maize production as others production factors like the size of land allocated to maize sets in.

The average income generated from the sale of maize ranges from Kshs. 900 – 162,000 with a standard deviation of 25,199.377 and a mean of 16,754.93. About 30 percent of the residents consume all their produce within the household and don't have any surplus to sell to the market. This negatively affects the households' livelihoods as they can hardly afford other basic household necessities. The few households earning over Kshs. 100, 000 from the sale of maize own over 20 acres of land and constitute 2.8 percent of the respondents. This is a clear indication that the

size of land has direct effect on the amount of maize produced as well as the income generated from the sale of the same. However, conducting a Pearson correlation analysis to examine the association between household land size and the average annual income from the sale of maize gave a non-significant positive correlation of 0.017 ($r = 0.107$, $p = 0.841$). Though, it's a weak relationship, increasing the household land size would slightly increase the average annual income from the sale of maize.

5.4.2 Effects of Land Uses on Food and Livelihood Security

Several factors come into play when determining household land use allocations. Some of these factors include; the crop's profitability and its importance as a food item. The main crops originally grown were maize and beans but with time, other crops begun to be incorporated in the farms. These crops include; coffee which is basically a cash crop, vegetables like kales and tomatoes; fruits likes bananas and avocados as well as tubers; cassavas and sweet potatoes. This gradual introduction of other crops like the vegetables, fruits and tubers has positively impacted on the residents' food and livelihood security. These crops mutually supplement the meals from the original beans and maize produce. In most of the farms, there are no distinct land use allocations for the various crops grown since the land sizes are relatively small. In this regard, mixed cropping characterize majority of the farms with maize, beans, bananas, commercial trees and other crops being grown on the same area.

Plate 1: Mixed Cropping

Source: Field Survey, 2020

This mixed cropping tend to negatively affect productivity as the crops grown compete for the available nutrients. This impacts negatively on the food and livelihood security of the farmers as the little maize produced isn't able to sustain them till the next harvest and can't afford any surplus to sale to the market. For the households with relatively larger land parcels, there exists distinct areas for various crops safe for the few trees planted for fuelwood.

5.4.2.1 Land Use Allocations

In most of the households the production of maize is allocated the biggest share of farm land. This could be explained by its importance as a staple food in the community and the favorable climatic conditions for its production. A Pearson correlation analysis conducted to measure the association between the area allocated to maize production and maize yields revealed a weak positive non-significant relationship (r = 0.027, p = 0.749) as shown in the table below:

Table 10: Relationship between area Allocated to Maize and Production

Correlations

		Area under Maize	Maize Yields
Area under maize crop	Pearson Correlation	1	.027
	Sig. (2-tailed)		.749
	N	140	140

Source: Field Data Analysis, 2020

Thus, there is no statistically substantial difference in the production of maize between famers who have allocated larger areas to maize and those who have allocated smaller parcels to the same crop. This implies that, other factors affecting the production of maize sets in. These factors include; poor farming methods, soil fertility, lack of certified seeds and poor rainfall patterns. However, since the relationship is a positive one, an increase in the amount of land allocated to maize production would lead to an increase in its production, irrespective of how small the increase it. Plate 2 below shows a section of a maize farm.

Plate 2: Maize Farming

To examine the relationship between area of land allocated to maize production and food security, and independent sample test was conducted. The variables uses for the analysis were area of land allocated to maize and skipping of meals due to lack of food. Levene's significance, 0.519 is more than alpha (0.05) thus the test satisfies the assumption of equal variances. The T-test for equality of means indicates a sig. of 0.792 which is greater than 0.05 (Table 11). Thus, there is no significant difference in food security for households who have allocated large farm sizes to maize production and those who have allocated relatively smaller sections to the same.

This situation could be explained by the fact that, maize is not the only food commodity consumed thus the other commodities can be used as supplements. In addition, about 50 percent of the population engage in other income generating activities off-farm, thus they are in a position to acquire any required additional food commodities.

Table 11: Area of Land Allocated to Maize and Food Security

		Levene's Test for Equality of Variances		t-test for Equality of Means							
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference		
									Lower	Upper	
Area allocate to maize	Equal variances assumed	.417	.519	.265	136	.792	2.178	8.22465	-14.087	18.442	
	Equal variances not assumed			.246	24.529	.808	2.178	8.85174	-16.071	20.426	

Independent Samples Test

Source: Field Data Analysis, 2020

5.4.3 Factors Influencing Household Land Size and Use

Several factors have been established to influence household land size and use in the sub-location. These factors include; household size, off-farm income, cultural traditions, education level, topography, land quality and settlement patterns.

5.4.3.1 Household Size

Uvuu Sub-location has the highest population density in Mbooni Sub-County. These large household sizes translates to relatively high population densities. These densities result to reduced land sizes as parents subdivide their parcels to their sons. In addition, there have been increased settlements as a result of the big household sizes. These settlements reduce the land available for agricultural production hence impacting negatively on the food and livelihood situation of the households. Moreover, the household size influences land use allocations as for instance, with many mouths to feed, households are forced to allocate bigger sections of their land to food production. The households with small sizes have the privilege of allocating big proportions of their farms to commercial farming.

5.4.3.2 Culture/Traditions

Traditions dictate that fathers are required to subdivide their land to their sons as part of their inheritance. This practice subsequently leads to uneconomical farm sizes. About 67 percent of the residents revealed that there exists cultural traditions and practices with regard to land use and inheritance. Some of these practices include; non-entitlement of women to land inheritance, prohibition on the sale of inherited land and pressure on fathers to give land pieces to their sons (Figure 13).

Figure 13: Cultural Practices on Land Use and Inheritance
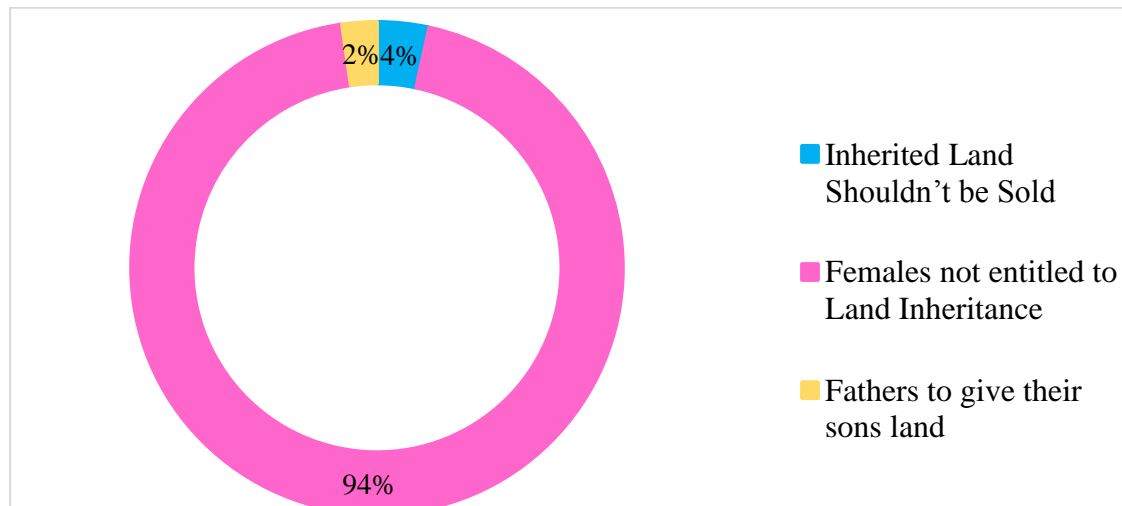
Non-entitlement of women to land inheritance constitutes the main cultural practice as represented by 94 percent of the respondents. Females are required to get married and till their husbands' lands, an arrangement that would be okay as long as they are still married to their husbands. However, challenges set in, once they got separated from their husbands and have children to fend for. The prohibition on the sale of inherited land has its advantages and disadvantages as well. For one, it helps maintain an economical land size as it's a way of protecting the land from the household members who are tempted to sale it off to cater for certain household expenditures. This practice would however imply that less land is available to the households with small farm sizes and with the capacity to acquire additional lands. It would also lead to idle land in situations where the owners are not in a position to put them into optimal use. The practice of pressuring fathers to give land for their sons as part of the inheritance results to uneconomical land sizes in the long run as this practice is passed on from one generation to another.

5.4.3.3 Off- Farm Income

About 50 percent of the respondents are involved in other income generating activities away from the farm. These activities include; businesses as well as formal and informal employment. The income generated from these activities can be used to purchase or rent out additional farms for the production of various crops. These households tend to have relatively bigger farm sizes. In addition, since the income generated can be used to buy any food supplements required, these households are at liberty to allocate their pieces of land to the best uses rather than being forced to produce food commodities.

5.4.3.4 Education Level

Households with members who have attained tertiary level of education tend to have access to better job opportunities. This off-farm income generating activities enables the households to acquire additional land parcels and add onto the inherited ones.

5.4.3.5 Topography

The sub-location topography is relatively steep, a phenomenon that has greatly influenced land use allocation decisions. The highest areas have been preserved for the construction of settlements while the steepest landscapes have been allocated to

the growing of trees. The less steep areas on the other have been allocated for the cultivation of various crops like coffee, maize, bananas and beans.

Plate 3: Topographic Characteristics

Source: Field Survey, 2020

5.4.3.6 Land Ownership

In instances where farmers cultivated on rented farms, there were reports of people not taking good care of the farms, something that affected the overall food production. In addition, farmers were constrained when making decisions with regard to land use allocations on family or rented lands as such choices were dependent on the rent duration.

5.4.3.7 Settlement Patterns

Scattered homesteads characterize the settlements patterns within the sub-location. This could be explained by the fact that, once sons are given their share of the family properties including land, they tend to construct the homes away from their parent's compound. The scattered homes however limit the space available for farming. Since settlements increase with increased population densities, more and more land is cleared to pave way for the construction of homesteads. However, clustering of structures within the compound at the household level is evident as seen in plate 4 below:

Plate 4: Settlement Patterns

Source: Field Survey, 2020

5.4.3.8 Land Quality

The most fertile areas are allocated to crop production with the less fertile ones being used as grazing areas. In addition, swampy areas and areas prone to flooding are left uncultivated and used as grazing fields as seen in the plate below.

Plate 5: Flood Zones

Source: Field Survey, 2020

5.4.4 Inter-Generational Transfer of Land Rights and Use

Within Uvuu Sub-location, inter-generational transfer of land rights was evident. Household interviews revealed that inheritance was the main mode of land acquisition representing about 85 percent of the respondents. When asked if they had undertaken land subdivision, 98 percent who agreed to have subdivided their land said they did so for inheritance purposes. In addition, about 92 percent of the respondents supported further land subdivision mainly for inheritance purposes. Based on these findings, it is evident that land inheritance has been a practice for generations making most of the fathers feel obligated to carry on the practice. This was echoed by the oldest members within the community who revealed that land rights were transferred by passing them to the upcoming generations, a practice that had been undertaken for several generations.

Initially, the sub-location was basically a grazing area for herders. Crop farming was later introduced after establishment of the first settlements. The main crops grown were maize and beans. These are still the most dominant crops though several others like bananas, avocadoes and coffee have been introduced over the years. As a result of the reduced land sizes, the initial numbers of livestock couldn't be sustained. Farmers

have incorporated modern farming methods like zero grazing to ensure sustainable livestock production.

5.4.5 Possible Policy Options to Achieve Sustainable Food and Livelihood Security

From the household interviews, the recommended ideal land size to achieve sustainable food and livelihood security in the sub-location ranges between 1 -20 acres with a mean of 4.9 acres. About 30 percent of the respondents recommended an ideal land size of 5 acres. A minimum land size of 5 acres was echoed by the key informants as well as the focus group discussions. This land size is about an acre more than the current mean land holding of 3.9 acres. The additional 1.1 acres is projected to ensure production of adequate farm produce both for subsistence and sale. The income from the sale of the excess produce would help in enhancing the residents' livelihoods. In addition, a minimum 5 acre farm would facilitate agricultural diversification, hence help in the attainment of food security.

The respondents proposed several interventions aimed at achieving this minimal land size. These interventions include:

a) Teaching the residents on the problems of land subdivision

About 88 percent of the respondents were comfortable with further subdivision of their land parcels with only 12 percent objecting to it. The proponents of further land subdivisions cited propagating inheritance practices and reducing family and land conflicts as the main reasons for the same. The identified land subdivision problems include; lowering farm yields, poor management, conflicts and uneconomical parcels (Figure 14).

Figure 14: Problems of Land Subdivision

Small Unproductive Parcels — 38
Results to Conlicts — 9
Poor Farm Management — 4
Lower Farm Yields — 48
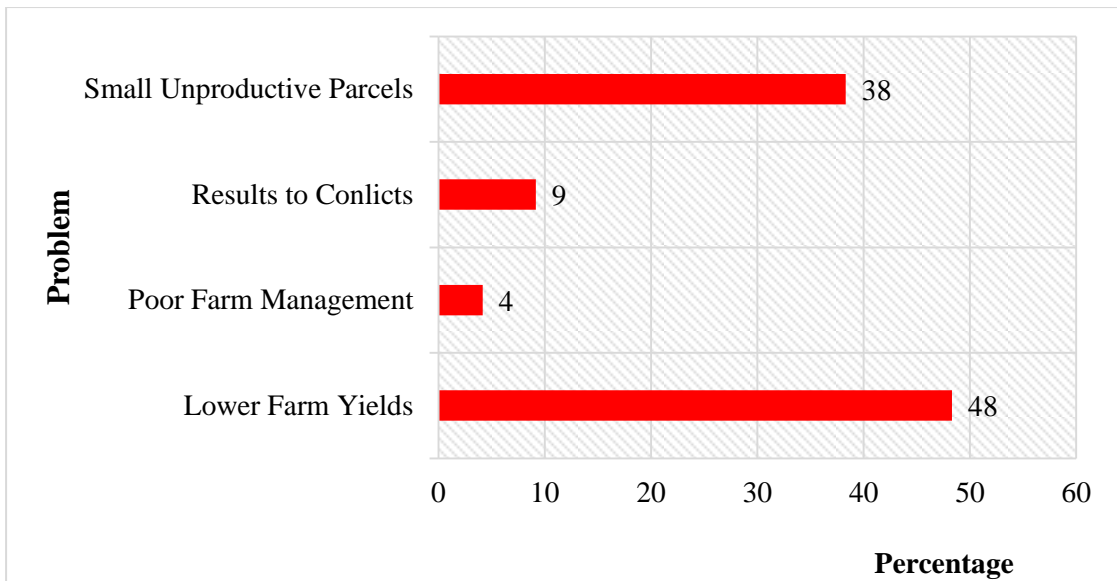
Source: Field Survey, 2020

The people need to be made aware of the eminent dangers as a result of land subdivision as this will help them make informed decisions regarding the same. This could be done with the aid of future settlement scenarios on how further land subdivision would affect future agricultural production. The opponents of the recommended several proposals to curb land subdivision. These include; abolishing land subdivision, educating children as a way of empowering them to engage in off-farm activities or acquire their land parcels, abolishing individual land ownership practices, farming together and sharing the produce as well as provision of employment opportunities by the government (Figure 15).

Figure 15: Proposals to Curb Land Subdivision
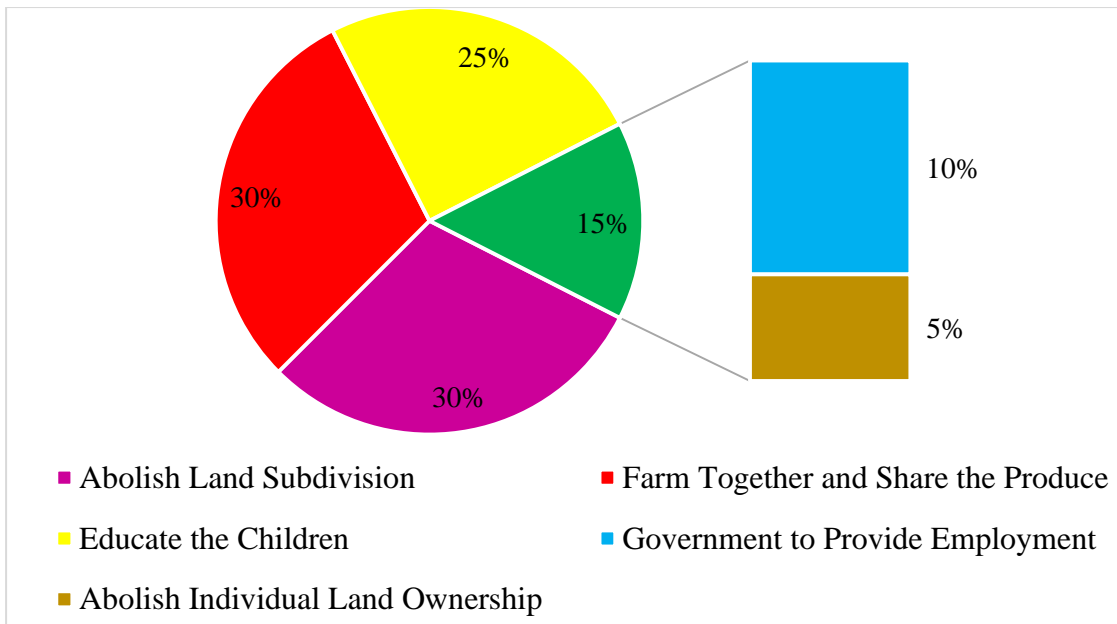
Source: Field Survey, 2020

b) **Land consolidation**

This would entail encouraging farmers to cultivate jointly and share the produce as opposed to individual land ownership.

c) **Curb land selling**

Though land subdivision is mainly undertaken for inheritance purposes, there are a few individuals who do it for sale. Sale of family land is mainly undertaken as a way of raising money for school fees or hefty bills. In some instances, the youth sale of the land formally transferred to them by their parents. This has forced parents to result to informal land allocations. Prohibiting the sale of land unless it is very necessary will help maintain economical land sizes.

d) **Reorganizing the settlements**.

The scattered homesteads that characterize the settlement patterns of the sub-location are unsustainable in the long run. The respondents proposed for different settlement patterns. They proposed construction of homesteads along the roads and leaving the rest of the farms for cultivation and adoption of clustered settlements.

5.5 Hypothesis Testing

This section highlights the empirical results regarding the assessment of land size and use on food and livelihood security.

5.5.1 Household Land Size and Food Security

a. Alternative Hypothesis

Ha: Households that are food secure have significantly larger land parcels than households that are food insecure.

b. Null Hypothesis

Ho: Households that are food secure don't have significantly larger land parcels than households that are food insecure

An independent sample test was conducted to examine the significance of the association between household land size and food security. The variables used to undertake the test were total owned family land and skipping of meals in the last three months due to food shortage.

Table 12: Household Land Size and Food Security

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Total Owned Family Land (acres)	Equal variances assumed	5.852	.017	1.002	136	.318	2.751	2.745	-2.677	8.179
	Equal variances not assumed			.556	19.984	.584	2.751	4.949	-7.573	13.075

Source: Field Data Analysis 2020

As presented in table 12 above, Levene's sig, 0.017 is less than 0.05. There is thus a positive relationship between land size and food security.

Decision: Reject the null hypothesis as there is significant relationship between land size and food security.

Conclusion: The null hypothesis is rejected as, households that are food secure have significantly larger land parcels than households that are food insecure.

5.5.2 Household Land Size and Livelihood Security

a. Alternative Hypothesis

Ha: Households that have farm based livelihood security have significantly bigger land parcels than households that are livelihood insecure.

b. Null Hypothesis

Ho: Households that have farm based livelihood security don't have significantly bigger land parcels than households that are livelihood insecure.

A chi-square test of association was undertaken to test the correlation between land size and livelihood security. The total land owned by the household and the average income from the sale of maize were used as the variables. The value of the chi-square statistic is 2319.353, 1947 degrees of freedom and a p of 0.000 as outlined in table 13.

Table 13: Land Size and Livelihood Security

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2319.353[a]	1947	.000
Likelihood Ratio	551.645	1947	1.000
Linear-by-Linear Association	.041	1	.840
N of Valid Cases	140		
a. 2039 cells (100.0%) have expected count less than 5. The minimum expected count is .01.			

Source: Field Data Analysis, 2020

Since 100 percent of the cells have expected count of less than 5, the p value was used to determine the significance of the association between land size and livelihood security.

Decision: The null hypothesis is rejected as there is a significant association between land size and livelihood security, p = 0.000 is less than α = 0.05.

Conclusion: Adopt the alternative hypothesis (**Ha**). Thus, households that have farm based livelihood security have significantly bigger land parcels than households that are livelihood insecure.

5.5.3 Land Use Allocations and Enterprise Yield

   c. **Alternative Hypothesis:**

Ha: Farm enterprises with big land allocations produce more yields.

d. Null Hypothesis:

Ho: Farm enterprises with big land allocations do not produce more yields.

A chi-square test of association was conducted to test the relationship between land use allocations and yields. The land allocated for maize production and total maize yields were used as the variables for the test. The value for the chi-square statistic is 1021.605, a 722 degrees of freedom and a p of 0.000.

Table 14: Land Use Allocations and Enterprise Yield

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1021.605[a]	722	.000
Likelihood Ratio	360.022	722	1.000
Linear-by-Linear Association	.103	1	.748
N of Valid Cases	140		
a. 780 cells (100.0%) have expected count less than 5. The minimum expected count is .01.			

Source: Field Data Analysis, 2020

The p value was used to determine the relationship since one of the assumptions of chi-square had been violated (100 percent of the cells had an expected count less than 5).

Decision: The null hypothesis is rejected as there is a significant association between land allocated to maize and production, $p = 0.000$ is less than $\alpha = 0.05$.

Conclusion: Adopt the alternative hypothesis. Hence, farm enterprises with big land allocations produce more yields.

5.6 Conclusion

Majority of the respondents were aged 51 years and above which constituted about 62.9 percent of the respondents. This could be as a result of the high life expectancy experienced in the county. The household size varies between 1 – 12 members with an average household size of 5. Approximately, 85.9 percent of the respondents engage in farming activities signifying the dominance of agriculture in the sub-location. Approximately 50 percent of the residents engage on off-farm income generating activities which include business and formal and informal employments.

About 16 percent and 4 percent depend of family remittances and government support for the elderly respectively.

Land ownership in the sub-location is relatively high as about 98.6 percent of the respondents own land with inheritance being the most common mode of acquisition representing 85 percent of the respondents. Over the years, there has been a substantial decrease in household land size. For instance, the mean land holding for the parents was 10.6 acres, this has since dropped to a current of 3.9 acres. This reduction on farm lands have impacted negatively on agricultural production resulting to decreased yields. However, there exists no significant relationship between land size and food security. The factors affecting land size and use in the sub-location include; household size, culture and traditions, educational level, topography, land ownership, settlement patterns and land quality. A minimum land size of 5 acres was proposed as the ideal land size of ensuring food and livelihood security. Several measures were then recommended to maintain this ideal land size. These measures include; teaching the residents the dangers of land subdivision, land consolidation, curb land selling and reorganization of the settlements.

CHAPTER SIX
SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

6.1 Overview

Agriculture is the main economic activity in Uvuu sub-location and employs about 86 percent of the population. It is the main food producer and a source of livelihood for majority of the households. It is indeed the biggest employer in the sub-location. All the exports from the sub-location comprise of agricultural products mainly; coffee, bananas and avocados. The significance of the agricultural sector is projected to continue in the future especially growing of maize since it's a stable food in the community. Despite its undoubtable significance, this sector is affected by a number of challenges among them reducing farm sizes.

6.2 Findings

6.2.1 Impact of Land Size on Food and Livelihood Security

This objective assessed household land size, land tenure and the current food situation. Land ownership in the sub-location is relatively high as about 98.6 percent of the respondents own land with inheritance being the most common mode of acquisition representing 85 percent of the respondents. Over the years, there has been a significant decrease in household land size. For instance, the mean land holding for the parents was 10.6 acres, this has since dropped to a current of 3.9 acres representing a 63 percent decrease. About 85.9 percent of the residents engage in farming activities. This signifies the dominance of agriculture as an economic activity within the sub-location. As a result of the decreased land sizes over the years, the yields harvested from the various agricultural enterprises is relatively low. The decrease of farm yields as a result of reduced farm sizes was echoed by about 35 percent of the respondents.

The findings of the research correspond to the literature reviewed. Many scholars have attributed the reduction in agricultural production with the reducing land size. Theoretically, land as a factor of production will definitely affect the amount of agricultural produce, though other factors may come into play. However, conducting an independent sample test to establish the relationship between land size and food security revealed that there wasn't any significant difference in the land size of the farmers who were food secure and those who were not, p of 0.584 which is greater

than alpha (0.05). However, there exists a correlation between household land size and livelihood security; p of 0.000 which is less than α = 0.05.

6.2.2   Effects of Land Uses on Food and Livelihood Security

Overall land uses in Uvuu sub location were found to include: Crops and Animal husbandry (Agriculture), Land for settlement (Homesteads/Residential), Churches (Religious), Schools (Education), and Local shopping centres (Commercial), Local administration offices (Public use). Coffee processing factory (Light industry). It was equally established through this study that there were two significant land uses at household level, which included land for settlement at 5-10 percent and agriculture at 90-95 percent of total household land.

This objective examined how farm land use allocations affected food and livelihood security. Some of the crops grown include; maize, beans, bananas, avocadoes and coffee. The study established that there was no significant land use allocations for the several crops grown as most of the farmers had a land size of less than 2 acres (the average land size in the sub-location is 3.9 acres). These small farms have forced farmers to practice mixed cropping with the desire to achieve something from the various crops grown. However, scientifically, mixed cropping impacts negatively on agricultural production since the various crops end up competing for the few available nutrients. Thus, the residents' food and livelihood security is affected.

On average, maize farming was allocated the largest proportion of the farm with beans and other legumes bean planted within the maize farms. The chi-square test of association undertaken to test the existence of a relationship between the land allocated to maize and its productivity gave a p of 0.000 which is less than α = 0.05. Thus, there is indeed a significant association between the amount of land allocated to maize and maize production. Animal husbandry was also noted as practiced in the area through zero grazing, with cows at 70 percent, goats at 20 percent and chicken at 10 percent representing the variety of animals reared in Uvuu.

6.2.3 Factors Affecting Household Land Size and Use

Several factors were established as the influencers of household land size and use in the sub-location. These factors include; household size, culture/traditions, off-farm income, education level, topography, land ownership, settlement patterns and land quality. The findings of the study collaborates with the review of literature.

6.2.4 Intergenerational Transfer of Land Rights and Use

Land inheritance was the highest form of land acquisition as represented by about 85 percent of the respondents. The household interviews further revealed that, about 98 percent had undertaken land subdivision for inheritance purposes. In addition, about 92 percent of the respondents supported further land subdivision mainly for inheritance purposes. It is evident that land inheritance has been a practice for generations making most of the fathers feel obligated to carry on the practice. This was echoed by the oldest members within the community who revealed that land rights were transferred by passing them to the upcoming generations, a practice that had been undertaken for several generations.

The literature review disclosed that, African traditions requires fathers to divide their properties, land inclusive to their sons. This has resulted to inter-generational transmission of land rights. The findings of the research confirmed the existence of these customs in Uvuu Sub-location. However, the practice of inter-generational transmission of land rights is projected to lead to massive decline in farm size and even result to landlessness in the long-run. Transmission of land uses over the generations have also been undertaken with young generations taking over the uses from their parents. However, with the decrease in land sizes some activities like large scale livestock rearing is getting absolute.

6.2.5 Possible Policy Options

The research set to establish a minimum land size to ensure sustainable food and livelihood security in the maize farming system of Uvuu Sub-location. Household interviews recommended an ideal land size of between 1-20 acres and an average land size of 3.9 acres. About 30 percent of the respondents recommended a minimum land size of 5 acres. According to the respondents, this land size was ideal for them to; undertake agricultural diversification, carry on inheritance purposes, practice large scale farming and was fit for the family needs. The key informants and focus group discussions recommended an ideal land size of 5 acres.

The respondents made several recommendations aimed at attaining and maintaining the ideal land size for sustainable food and livelihood security. These recommendations include; teaching the residents on the dangers of further land subdivision, land consolidation, curb land selling and reorganization of the

settlements. Some of the policy recommendation postulated by the review of literature include; land consolidation, adoption of modern technology for optimal yields, initiate programs on population growth control and formulate legislation on land use. The research recommendations are in line with the proposals by various scholars.

6.3 Conclusion

6.3.1 Impact of Land Size on Food and Livelihood Security

There is no established relationship between household land size and food security. This was confirmed by the T-tests conducted which indicated that there wasn't any significant difference on land size for households that were food secure and those that were food insecure. The factors that tend to directly impact on food security are; education level, occupation as well as engagement in off-farm income generating activities. These three factors affect the purchasing power of the residents as they don't have to necessarily grow their food. However, a correlation exists between land size and livelihood security as the households with relatively large land sizes earn more income from the sale of their produce as opposed to those with small farms. These earnings greatly enhance their livelihoods.

Provision of bigger farms will thus help in the promotion of livelihood security in Uvuu sub location. It can be noted therefore that, current trend/trajectory in land subdivision in Uvuu is totally unsustainable. A decrease of 63 percent between parents' average household land size and current household land size underscores this statement. Other additional factors on top of land size are equally playing a key role in determining food security for example adoption of modern farming techniques, off-farm incomes, education levels etc.

6.3.2   Impacts of Land Uses on Food and Livelihood Security

In most of the households the production of maize is allocated the biggest share of farm land. A Pearson correlation analysis conducted to measure the association between the area allocated to maize production and maize yields revealed a weak positive non-significant relationship (r = 0.027, p = 0.749). Thus, there is no statistically significant difference in the production of maize between famers who have allocated larger areas to maize and those who have allocated smaller parcels to the same crop. However, since the relationship is a positive one, an increase in the amount of land allocated to maize production would lead to an increase in its

production, irrespective of how small the increase is. Moreover, the independent sample test conducted to test the relationship between area of land allocated to the production of maize and food security indicated a no significant relationship; a sig. of 0.792 which is greater than 0.05. Mixed cropping and livestock husbandry were also noted as being practiced in Uvuu sub location to supplement food and incomes from maize farming. One can therefore conclude that proper land use allocations in Uvuu sub-location is key in the enhancement of food and livelihood security

6.3.3   Factors Affecting Housing Land Size and Use

Household size, culture/traditions, off-farm income, education level, topography, land ownership, settlement patterns and land quality are some of the factors that influence household land size and use in the sub-location. This was in total agreement with the findings highlighted in the literature review concerning the same.

Off-farm income has used by many to overcome deficiencies in food and livelihood security. Equally, low education especially among family heads has impacted negatively on agriculture. Worth noting also is the fact that the hilly/sloppy topography that characterize almost all of Uvuu sub location was found to be an hindrance to mechanization. Soil erosion affects quality of land in Uvuu Sub location due to the uneven relief that characterize it. The big need of land for settlement is also affecting overall available land for agriculture. Negative traditions such as belief that women don't deserve to inherit land from their fathers exist in Uvuu sub location and is equally playing a leading role in determining land sizes and uses in Uvuu sub location.

6.3.4 Intergenerational Transfer of Land Rights and Use

Since inception of the sub-location, there has been inter-generational transfer of land rights and use. In fact, the main mode of land acquisition is inheritance as fathers are required to divide their land to their sons as a way of passing on the practice. This practice has resulted to subsequent reduction in land size. If left untamed, it is projected to render many landless and with no means of livelihood in the long run. Transmission of land use has been affected by the declining land sizes as the current land sizes can't support large scale livestock rearing.

In conclusion therefore, one can deduce that inheritance was, is and will be the main mode of intergenerational transfer of land rights and use in Uvuu sub location. In

addition, recent High court of Kenya ruling on equal rights for both gender to inherit property (including land) from parents may face some resistance due to traditional believes and practices in Uvuu sub location, where women aren't supposed to inherit land from their parents.

6.3.5 Possible Policy Options

Achieving the recommended ideal land size of 5 acres will require adoption of various proposals. These include: teaching the residents on the dangers of further land subdivision, land consolidation, curb land selling and reorganization of the settlements. To attain food security, the three factors that directly affect it need to be addressed which are; education level, occupation and engaging in off- farm income generating activities. These three factors affect the purchasing power of the residents as they don't have to necessarily grow their food. Other alternatives would include diversification of agricultural activities and establishment of agro-processing factories to help in the provision of off- farm income generating activities.

In conclusion, on can note that the role of government, both national and county in improving rural agriculture is not significantly felt in Uvuu sub location. Equally, the public has not properly been sensitized on dangers of land subdivision and uncontrolled population growth. Adoption of mechanization and modern farming technologies has not been properly embraced in Uvuu. Also, agriculture related infrastructure is poorly developed within area of study.

6.4 Recommendations

If 63 percent decrease between previous and current average household land size as revealed in this study is allowed to persist in in Uvuu sub location in the coming years, food and livelihood security will be highly compromised. Both literature review and the research findings agree that land fragmentation is as a result of a myriad of factors which could be narrowed down to; population pressure and inheritance practices. Thus, addressing the land fragmentation problem requires formulation of strategies geared towards solving the underlying issues of land subdivision. These strategies would include; modification of the inheritance practices by encouraging collective land use, government recommending, enacting and enforcing minimum household land sizes for various ecological zones, sensitizing the public on dangers of land sub division and uncontrolled population growth etc.

Moreover, the key factors that have a direct impact on food security need to be addressed for the realization of a food secure sub-location. Some of these can be summarized as follows:

- Promotion of off-farm income generating activities both in the formal and informal sectors.
- Improvement of rural infrastructure
- Increased/improved access to markets.
- Investment in agro-processing and value addition,
- Development, enactment and enforcement of proper rural land use policies and strategies aimed at promoting rural agriculture
- Improving livestock farming as an additional measure in supplementing food and livelihood security efforts within Uvuu sub location.
- Promotion of more emphasis and investment in mixed farming and fruits growing to complement maize farming
- Eradication of non-progressive traditions and cultural believes in relation to land ownership and farming/agriculture in general
- Enhanced security of land tenure through land titling.
- More government support and funding in promoting rural agriculture e.g. in provision of agricultural extension services to farmers
- Improved mechanization and application of modern technology in agriculture.
- Development and adoption of climate change mitigation measures.

6.5 Areas of Further Research

Some of the possible areas for further research include; the required crop combination for sustainable food and livelihood security and, impact of irrigation and infrastructure development on sustainable food and livelihood security. From the review of literature, it was evident that crop diversification was critical in attaining food and livelihood security. Thus, examining the effect of crop diversification on food and livelihood security could form a good extension for this research.

Other areas of further research include; development of indicators that can be used in different farming systems and zones to determine minimum and maximum land holding sizes, delineation of ideal sites for irrigation agriculture in arid and semi-arid parts of Kenya, and government interventions required to improve food and livelihood security in different agro-ecological zones.

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Appendix 1: Household Questionnaire

DECLARATION: Information generated through this questionnaire will be held professionally and will be used solely for research purposes.

Sub-location………………………………………...………..…………………..

Questionnaire No……………………………………………………………….…

Name of Interviewer………………………………………….………………..….…

Date of Interview………………………………………………..…..…………….

Telephone No. of Interviewer……………………………………………………….

1.0 Respondent Profile
Tick (√) in the bracket provided, the appropriate answer.

1.1 Name of the respondent (Optional)………………………………………….
1.2 How old are you? (Years)...
1.3 Marital status
Married (   )   Single (   )   Widowed (   )   Divorced (   )   Separated (   )

1.4 Gender or respondent
 Male (   )   Female (   )

2.0 Household Data

2.1 What is the size of your household? ……………………….………………....
2.2 How many are Sons? ……………………………………………………………
2.3 How many are Daughters? …………………………………………………….
2.4 What is the number of other males living in your household? …………………...
2.5 What is the number of other females living in the household? …………………..
2.6 What is the highest education level attained by the household members?

Household members	Age	Education levels					Occupation
		None	Pre-primary	Primary	Secondary	Tertiary	
Father							
Mother							
Son / Daughter							
1.							
2.							
3.							
4.							
5.							

2.7 How many brothers did you have at the time of land inheritance?……………….

2.8 Did all of them inherit equal share of your parents' land?.....................................

2.9 How many sisters did you have at the time of inheriting land?.…………………..

2.10 Did any of them inherit land from your parents?...

2.11 If yes to 2.10 above, how many acres did each inherit?.................................

2.12 Are there any cultural practices around the use and inheritance of land?

....

....

3.0 Land holding arrangements

3.1 Do you own land?

　　　　Yes ( ) 　　　　　　　No ( )

3.2 If yes, how many pieces of land do you own?...

3.3 What is the total owned family land size in acres?...

3.4 Owned land characteristics

No.	Spatial Location and distance (Km)	Size (Acres)	Mode of acquisition	Main use	Tenure System	Ownership document
1						
2						
3						
4						
5						
	Total					

3.5 Do you rent any land?　　Yes ( )　　　　　　No ( )

3.6 If the answer to 3.5 is yes, then complete the table below.

No.	Spatial Location and distance (km)	Size in acres	Main use	Duration of renting	Cost of renting (annually)
1					
2					
3					
4					
5					
	Total				

3.9 Off-farm income generating activities

Other Source of Income	Frequency	Estimated amount per year (Ksh)

3.10 How big was your parents` land parcel before any sub-division?....................acres

3.11 Have they done any sub-division?

....

....

3.12   If there has been any sub-division then to how many heirs or beneficiaries?

…………………………………………………………………………………………

3.13   Do you think as a country we should continue sub-dividing land among heirs?

…...………………………………………………………………………………………

…………………………………………………………………………………………

………………………………………………………………………………………..

3.14   If yes to 3.13 why do you think so?

....

....

3.15   If no to 3.13 what do you think we should do as a country?

....

....

....

3.16   State one major problem of land subdivision to a farmer

…………………………………………………………………………………………

3.17   In your opinion how much land would be enough for your household in acres?

....

....

3.18   Explain your reason for the preferred number of acres in 3.17 above

…………………………………………………………………………………………

…………………………………………………………….…………………………

…………………………………………………………….…………………………

…………………………………………………………….…………………………

…………………………………………………………………………………………

4.0 Land Uses Food and Livelihood Security

4.1 What is the main economic activity that the household head engages in?

....

....

....

4.2 Do you practise any agriculture?

       Yes ( )   No ( )

4.3 If **Yes to 4.2**, what are the main crop and livestock land use activities on the farm?

Activity	Area (Acres or Sq. Metres)	Yield (kgs) (other) in Seasons		Use (Kgs) (Other)		Price per unit weight		Average income to the family (Kshs.)
CROPS		**Season 1**	**Season 2**	**Consumed**	**Sold**	**Min**	**Max**	
1								
2								
3								
4								
5								
LIVESTOCK TYPE	**No. Animals**	**Yield/Animal/Year**		**Use (Kgs) (Other)**		**Value (Ksh)**		**Average income to the Family**
				Consumed	**Sold**			
1								
2								
3								
4								
5								

Food and nutrition security

4.4   Compare the yield you get currently in your farm and the yields that used to come from your father's farm before sub-division.

Yields are the same   ( )   Currently yields are lower   ( )

Yields are more   ( )   I'm not sure   ( )

4.5   By how much has the yield change? A Quarter ( )   Half ( )
Three Quarters ( )

4.6   What do you think is the reason for the changes in yield?
……………………………………………………………………………………..
……………………………………………………………………………………
……………………………………………………………………………………

4.7   For how many months in a year do the current yields from your farm feed your family?

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

4.8   If not 12 months – how many months in a year do you have the following situations

	Intensity of scarcity	Duration of far yield availabilit (months)	Coping Strategies Employed
a	Sufficient food	At least 12 Mont	
b	Mild Scarcity	9 Months	
c	Moderate Scarcity	6 Months	
d	Severe Scarcity	3 Months	

4.9   In the last 3 months, has your family ever skipped a meal because of food shortage?

Yes ( )   No ( )

4.10 In a typical week, what are the main food types that your household feeds on?

	Monday	Tuesday	Wednesday	Thursday	Frida	Saturday	Sunday
Morning							
Lunch							
Supper							

4.11   How often do you take the following meals?

Type of Meal/Food	Frequency of intake (Daily, Weekly, Monthly, Annually, Other)
Milk	
Beans	
Chicken	
Fish	
Beef	
Pork	
Mutton	
Goat Meat	
Fruits	

Views on Land Subdivision

Give your opinion or comment on the effect of land sub-division or fragmentation on food security. State whether you agree or disagree with the comment.

4.12   Land fragmentations exists due to population pressure

Agree   ( )   Disagree   ( )   Not sure   ( )

4.13   Small sub-divided parcels lead to low crop yield

Not true ( )   Agree   ( )   Disagree ( )   Not sure   ( )

4.14   Modern farming techniques can easily be applied on small land sizes

Agree   ( )   Disagree   ( )   Not sure   ( )

4.15   With small land sizes, number of cattle kept has gone down

Agree   ( )   Disagree   ( )   Not sure   ( )

4.16   If you agree in 4.15 above, the change was from how many to how many?

....

....

4.17   Land fragmentation has made people adopt new farming techniques and skills

Agree   ( )   Disagree   ( )   Not sure   ( )

5.0 Human Settlement

5.1 Sketch the current arrangement of the homestead?

Home compound parameters	Remarks		
Total area of homestead compound (Sq. Metres)			
Main house total area (Square metres)			
Main house number of rooms			
Main house construction materials	Floor	Wall	Roof
Total **number** of houses Total **area** of other houses (Square meters)			
List other structures in the homestead (granary, firewood store, cowshed, chicken house, dog house etc.)			

5.2   Given the way land is being sub-divided among heirs - what is your proposal
on   how   farms   should   be   organized   in   the   future
………………………………………………………………………………………
………………………………………………………………………………………

5.3   Given the following possible patterns of human settlement – rank them in your order of preference.

a. Scattered
b. Linear
c. Clustered
d. Others - Specify

5.4   Do   you   have   any   additional   remarks?
....
....
....

Appendix 2: Interview Schedule for County Lands Officer

Name of respondent……………………………………..……………….......................

Position of respondent…………………………………………………………………..

Gender of respondent………………………………………………….........................

Name of Interviewer…………………………………………………………………….

Schedule Number……………………………………………………………………….

Interview Guide Questions

1. What are the most common land transactions in Uvuu Sub-location?
2. What is the average land holding size in the sub-location?
3. Are there significant changes to the average size of land holdings? Specify the changes?
4. What has brought about these changes?
5. How would you rate the level of land subdivision and fragmentation in the sub-location?
6. What are the common reasons for land subdivision in the sub-location?
7. What are the effects of land subdivision and fragmentation in the area?
8. What is the most form of land acquisition in the area?
9. On average, how many households have title deeds for their farms?
10. Are there any issues of land conflicts in the area? If yes, what kind of conflicts?
11. What do you think should be done to solve challenges associated with land subdivision and fragmentation?
12. What would you suggest to be the ideal land size for sustainable food and livelihood security in the sub-location?
13. How do we achieve and maintain the minimum land size?

Appendix 3: Interview Schedule for County Physical Planner

Name of respondent……………………………………..……………........................

Position of respondent…………………………………………………………………..

Gender of respondent……………………………………………………........................

Name of Interviewer…………………………………………………………………….

Schedule Number…………………………………………………………………….

Interview Guide Questions

1. How would you rate the level of land subdivision and fragmentation in the sub-location?

2. What are the stages followed when undertaking a land subdivision process? Are the outlined stages dully followed by the applicants in the sub-location?

3. What would you say are the effects of land subdivision and fragmentation in the area?

4. What do you think should be done to solve challenges associated with land subdivision and fragmentation?

5. Are there significant changes to the average size of land holdings? Specify the changes.

6. What has brought about these changes?

7. What is your opinion on the relationship between diminishing land sizes and food and livelihood security?

8. What are the most common forms of land use patterns in Uvuu Sub-location?

9. What is the most common form of human settlement in the sub-location?

10. Would you propose any kind of rearrangement to the existing human settlement patterns?

11. What do you think should be the ideal land size for Uvuu residents to realize sustainable food and livelihood security?

12. How do we achieve and maintain the minimum land size?

Appendix 4: Interview Schedule for County Agricultural Officer

Name of respondent……………………………….…………….........................

Position of respondent…………………………………………………………..

Gender of respondent……………………………………………........................

Name of Interviewer…………………………………………………………….

Schedule Number……………………………………………………………….

Interview Guide Questions

1. What are the main crops grown in Uvuu Sub-location and what are their total production per annum?

2. What proportions of the total land is occupied by the listed crops?

3. Where do the farmers sell their surplus produce?

4. What are the types of livestock reared in the sub-location and what are their average annual productions?

5. What is the average land holding in the sub-location?

6. Are the average land holdings adequate for sustainable food production?

7. What would you propose to be the ideal/minimum land size required to produce enough maize to feed a household till the next harvesting season?

8. How do we achieve and maintain the minimum land size?

Appendix 5: Focus Guide for Group Discussion

Focus Group: Demographic Details Questionnaire

Age…………………………………..

Gender   Male ☐   Female   ☐

Name (Optional)………………………………….

Occupation ………………………….................

How long have you resided in this locality?

Years……………….

Months……………..

Focus Group: Consent details

Thank you for accepting to participate. We are interested to hear your valuable ideas, facts and opinions on how population growth has affected your land sizes and land use decisions in relationship to food and livelihood security and so be able to provide policy recommendations and viable solutions to the county and national governments and national land management agencies.

a. *The purpose of the study is to examine the impacts of household land size and use on household food and livelihood security. We hope to learn things that can help come up with solutions to land management and enhance sustainable food and livelihood security once implemented.*

b. *The information you give us is completely confidential and your name shall not be associated with anything you say in the discussions. We understand how important it is to keep the information private. We will ask all participants to keep the information very confidential.*

c. *You may refuse to answer any question or withdraw from the discussions at any time*

d. *If you have any questions now or after the discussions, feel free to contact me or any other team member through the contacts provided below*

e. *We may have to tape the discussions so as to be able to capture the thoughts, ideas and opinions we hear from the group*

f. *Please check below box to confirm you agree to participate*

This is to confirm that I give my consent to voluntarily participate in the group discussions as long as the stated above consent details are strictly adhered to and that I was not coerced to participate in the discussions but voluntarily decided to partake in its deliberations.

Questions

1. When did you settle in the sub-location and where did you migrate from?

2. What are the reasons for settling in the sub-location?

3. How did you acquire the land you reside on?

4. What was the original size of the farm land?

5. What kind of crops did you grow and what types of livestock did you keep when you first settled in the area?

6. Have there been changes in the types of crops grown and types of livestock reared?

7. What kind of crops do you currently grow? What's the average acreage per crop?

8. What is the total production per harvest season? Is it adequate for your household? How long does it last?

9. What type and number of livestock do you currently keep?

10. What are the reasons for these changes?

11. Have the land/farm size you reside on changed overtime? What is the current land size? What brought about these changes?

12. Are there other land parcels owned by your household apart from the one you reside on? How many parcels? What is the average distance of location from the homestead? What kinds of farm activities are undertaken in these other farms?

13. Has farm productivity been changing over time? Why is it so?

14. Do you own the land parcels you occupy? Any ownership documents?

15. Is productivity dependent on ownership of land?

16. What is the settlement pattern in your homestead? Does it affect the available space for farming?

17. How much land would you say is adequate for you to produce enough food to last you till the next harvest season?

18. How do we achieve and maintain that adequate land both for the current and future generations?

Appendix 6: Checklist for Field Observation

The following will be observed during the field survey:

1. Land sizes
2. Settlement patterns
   a. Linear
   b. Clustered
   c. scattered
3. Housing structures
   a. Type of structure
   b. Number of structures
   c. Arrangement of the structures
4. Field crops
   a. Type of crops
   b. Area allocated for each crop
   c. Condition of the crops
5. Demarcations of farm sizes
   a. Physical or imaginary boundaries
6. Accessibility of the farms
   a. Road sizes
   b. Road conditions

Appendix 7: List of Plates

The photographs of the following items will be captured during the field survey:

1. House structures
2. Cultivated farms
3. Uncultivated farms
4. Demarcations of farms
5. Cases of malnourished individuals, if any

Appendix 8: Focus Group Discussion Attendance List - Youths

Focus Group Discussion Guide

Focus Group Consent Details

Thank you for accepting to participate. We're interested to hear your valuable ideas, facts and opinions on how population growth has affected your land sizes and land use decisions in relationship to food and livelihood security. In addition, offer policy recommendations and viable solutions to the county and national governments as well as national land management agencies.

o   *The purpose of the study is to examine the impacts of household land size and use on household food and livelihood security. We hope to learn things that can help come up with solutions to land management and enhance sustainable food and livelihood security once implemented.*

o   *The information you give us is completely confidential and your name shall not be associated with anything you say in the discussions. We understand how important it is to keep the information private. We will ask all participants to keep the information very confidential.*

o   *You may refuse to answer any question or withdraw from the discussion at any time*

o   *We may have to record (tape) the discussions so as to be able to capture the thoughts, ideas and opinions we hear from the group.*

Record of FGD participants

No.	Name	Age (years)	Gender	Marital status	Land owned (if any) (acres)
1.	Kamanthe Mutuku	28	F	Single	0 Acre
2.	Ruth Keli	26	F	Married	0.8 Acres
3.	Jeniffer Mulei	25	F	Married	0.5 Acres
4.	Dorine Kamanthe Kivuva	20	F	Single	0 Acres
5.	Eunice Syombua Kuti	30	F	Married	0.5 Acres
6.	David J. Kikuni	26	M	Married	0.8 Acres
7.	Philip M. Mwania	31	M	Single	0 Acres
8.	Mutuku S. Muli	24	M	Single	1.3 Acres
9.	Joseph Mnema Mutinda	32	M	Married	1 Acre
10.	Benjamin Musembi.	26	M	Single	0 Acres

F = Female
M = Male

Appendix 9: Focus Group Discussion Attendance List – Male

Focus Group Discussion Guide

Focus Group Consent Details

Thank you for accepting to participate. We're interested to hear your valuable ideas, facts and opinions on how population growth has affected your land sizes and land use decisions in relationship to food and livelihood security. In addition, offer policy recommendations and viable solutions to the county and national governments as well as national land management agencies.

- o The purpose of the study is to examine the impacts of household land size and use on household food and livelihood security. We hope to learn things that can help come up with solutions to land management and enhance sustainable food and livelihood security once implemented.
- o The information you give us is completely confidential and your name shall not be associated with anything you say in the discussions. We understand how important it is to keep the information private. We will ask all participants to keep the information very confidential.
- o You may refuse to answer any question or withdraw from the discussion at any time
- o We may have to record (tape) the discussions so as to be able to capture the thoughts, ideas and opinions we hear from the group.

Record of FGD participants

No.	Name	Age (years)	Gender	Marital status	Land owned (if any) (acres)
1.	Michael Isika	56	Male	Married	2 Acres
2.	Nyamai Mutithi	52	Male	Divorced	2.3 Acres
3.	Daniel Makau Fundi	54	Male	Married	1.5 Acres
4.	Simon Kaluli Kivindyo	71	Male	Married	0.7 Acres
5.	Kexisi Nyamai	63	Male	Widowed	0.5 Acres
6.	David Mwangangi	56	Male	Married	1.8 Acres
7.	Mutunga Muia	60	Male	Married	2.5 Acres
8.	Nelson Nganyi	57	Male	Widowed	1.8 Acres
9.	Kiviu Mutuku Mbithi	52	Male	Married	2.0 Acres
10.	Andrew Nzuko	55	Male	Widowed	1.2 Acres

Appendix 10: Focus Group Discussion Attendance List – Female

Focus Group Discussion Guide

Focus Group Consent Details

Thank you for accepting to participate. We're interested to hear your valuable ideas, facts and opinions on how population growth has affected your land sizes and land use decisions in relationship to food and livelihood security. In addition, offer policy recommendations and viable solutions to the county and national governments as well as national land management agencies.

- o *The purpose of the study is to examine the impacts of household land size and use on household food and livelihood security. We hope to learn things that can help come up with solutions to land management and enhance sustainable food and livelihood security once implemented.*
- o *The information you give us is completely confidential and your name shall not be associated with anything you say in the discussions. We understand how important it is to keep the information private. We will ask all participants to keep the information very confidential.*
- o *You may refuse to answer any question or withdraw from the discussion at any time*
- o *We may have to record (tape) the discussions so as to be able to capture the thoughts, ideas and opinions we hear from the group.*

Record of FGD participants

No.	Name	Age (years)	Gender	Marital status	Land owned (if any) (acres)
1.	Grace Munyao	55	Female	Married	0.3 Acres
2.	Feronicah Munini Maithya	56	Female	Married	0 Acres
3.	Kavata Nzamai	50	Female	Married	0.2 Acres
4.	Rhodah Kinyingi	58	Female	Married	1 Acre
5.	Musyawa Kitema	70	Female	Widowed	1.1 Acres
6.	Agnes Kivele Musyimi	53	Female	Married	0.4 Acres
7.	Mutunge Kyule Kikuni	60	Female	Married	0 Acres
8.	Mutheu Muia Muange	65	Female	Married	0.7 Acres
9.	Esther Mumbua Isika	54	Female	Divorced	0.6 Acres
10.	Wayua Muindi	63	Female	Married	1 Acre

1