

**IMPACT OF LAND SIZE AND LAND USE CHANGE ON RURAL LIVELIHOOD IN  
DAIRY FARMING ZONES IN KENYA: THE CASE OF KIGANJO SUBLOCATION IN  
KIAMBU - KENYA.**

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B63/6999/2017**

**A Thesis submitted in fulfilment of the requirements for award of Master's degree in  
Planning at the University of Nairobi.**

**May, 2021**

## DECLARATION

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



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## **DEDICATION**

I dedicate this work to my Dad, Mum and my kids.

## **ACKNOWLEDGEMENT**

I give my wholesome gratitude to God Almighty for the favor, strength, good health and resources necessary for the study.

My profound gratitude goes to my supervisors, Dr. Margaret Ngayu and Dr. Elizabeth Wamuchiru for their tireless efforts, guidance and support.

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## ABSTRACT

Land resource forms the main source of livelihood as it affords people the means of survival and is at the core of their economic and social lives. Small land sizes in rural areas occasioned by intensive land fragmentation is becoming a threat to viable agricultural activities and therefore food insecurity. Rural agricultural land use changes limit the potential of the peri-urban agriculture and increases the vulnerability of the poor in terms of food security and income (Gachunia, 2016) making their livelihoods unsustainable. This study was carried out to assess the relationship between land use changes and sustainable rural livelihoods in Kenya with focus on dairy farming in Kiganjo Sub-location of Gatundu South Sub County in Kiambu, Kenya. The study examined the following objectives; to analyse the land use changes that are evident in Kiganjo sub-location, examine the drivers of land use changes in the study area, assess the impacts of the land uses changes on rural livelihoods, determine coping mechanisms developed by households who depend on dairying as a livelihood and finally recommend a planning intervention that promotes sustainable rural livelihood. The study employed descriptive survey research to make intensive investigation of land use change and its implications on sustainable livelihoods in Kiganjo sub-location. Data was collected both primary and secondary through review of existing literature, household questionnaires, key informant interviews and a focus group discussion.

The study established that there has been reduction in land size by 93.54% and 89.99% from the initial family land to male and female children over three generations within a household and all attributed to prevailing inheritance system. Land conversion has as well been rampant from one agricultural activity to another occasioned by the economic status of the agricultural activity. The study as well found out that economic reasons at 80% are the leading factors that influence the change of land use. There was indication of reduced food crop while 29% mentioned that the change has resulted in reduced income. Land fragmentation also has a significant impact on dairy farming where 46% of the total number of respondents admitted that fodder crop has reduced considerably. For a rural household depending entirely on dairy farming in Kiganjo to live sustainably for a whole year it requires; 3 dairy animals producing an average of 6.20 litres of milk per day or two (2) Friesian cows giving them an optimal milk production of 26 litres per day. The minimum land size required for dairy farming at intensive zero grazing for 3 cows in the study area is 0.78Acres. The study established that there is a relationship between land use change and sustainable rural livelihood with emphasis on dairy farming. This study recommends that the county government of Kiambu ensures subdivision of land is regulated to control its impact on agriculture. The county government should support and encourage farmers to engage in mixed farming to help spread the risk and minimize shortage of food. New forms of bequeathing wealth to family heirs such as shares or other properties be considered rather than subdividing the land to prevent successive subdivision of agricultural land. The study area has an opportunity for high dairy production which can sustain the community, however, there is need to address the issue of land subdivision and conversion to allow for a sustainable dairy farming in the area.

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## CHAPTER ONE: INTRODUCTION

### 1.1 Background of the study

As a fundamental factor of production, land supports all living things and ensures survival including the existence of human beings (Bashir, (2013). Land acts as the major factor of agricultural production and nations depend on land to ensure food security for its people. The cumulative earth surface area is approximately 510 million square kilometers where land covers 29 percent while an estimated 71 percent is covered by water.

Land use changes are the number of activities undertaken on land depended upon by humans to accrue benefits from natural resources (FAO, 1995). Typical land uses examples comprise of urban use, infrastructure development, agriculture, livestock keeping and recreation use among others (Bashir, 2013). Global land uses include: agriculture, forests, barren land, glacier, shrubs and freshwater. A study on land use by Ritchie & Roser, (2013) confirmed that from the global agricultural land, livestock accounts for 77% while crops are left with 23%. The need for food security in the world has led to the expansion of agriculture which is gradually becoming humanity's largest impact on the environment.

Land use change is defined by Zonneveld, (1993) as the varying activities carried out by humans so as to exploit the natural landscape. Lambin & Geist (2008) noted that changes in land use are normally as a result of conversion and modification. Various heterogeneous activities have emerged on land which has seen it transform from one use to the other. Activities for human livelihood sustainability like agricultural food production activities, infrastructure development, shelter and extraction of minerals and other natural resources are hugely depended on this land. Change the use and cover of land can contribute to notable environmental consequences such as soil degradation, water pollution and loss of biodiversity (Turner et al, 1995). Additionally, changes in the use of land have significant impact on food security and increased vulnerability of human particularly in Africa (Bottomley, 2005).

Rural livelihoods obtain their basic capital from land, air and water as their natural capital, land use has been considered as one central aspect influencing livelihood of rural people. Ideally, 80% of world's total population in the world reside in the rural areas where they obtain their livelihoods directly from agriculture. The world population is projected by The United Nations to

increase by one third from 2013 to 2050, undoubtedly, this will raise the global food demand (FAO, 2017). As expected, agriculture should meet the growing demand for food and income, while simultaneously cater for increased animal welfare, additional ecosystem services and play a critical role in the production of renewable energy, including bioenergy (Wu & Li 2013).

A major impact of land use change is poor land management which has adversely degraded massive amounts of land, decreased the ability of land to produce sufficient food and is a leading threat to rural human existence especially in developing nations. While some areas are undergoing expansion of cultivation and grazing, others are intensifying (Maitima et al. 2010). Matson et al. 1997 & Tilman et al. 2002 notes possible negative regional externalities arising from intensification since chemical run off and water use can have far reaching effects beyond the actually cultivated areas.

This study was carried out in Kiambu County where land use changes are evident and influenced by the county's proximity to the capital city, Nairobi. Land is the major land resource where people derive their livelihoods, but with tremendous land uses there are negative impacts on farming. Rural livelihoods depend on agriculture and any change in agriculture leads to unsustainable livelihoods. With the emerging trends in land use change, the study will investigate how the changes have impacted on people's livelihoods with emphasis on those practicing dairy farming within Kiganjo sub location.

## **1.2 Problem statement**

Sustainable Development Goals (SDG) Goals No. 1 & 2 focuses on ending poverty in all its forms everywhere and ending hunger by achieving food security and improved nutrition and promote sustainable agriculture within nations by 2030. The United Nations (UN) acknowledges the challenges posed by population growth, climate change, economic downturns and the fact that land is inelastic. In the same breath, they are concerned that this goal may not be achieved. The analysis by United Nations in their progress report of 2020 indicate a decline in the world's population living under extreme poverty up from 15.7 percent in 2010 to 10 percent in 2015. Nowcast estimates put the rate of poverty at 8.2 percent in 2019 globally, a situation likely to be worsened by the Covid-19 pandemic, it is projected to hit 8.8 percent by end of 2020.



The United Nations avers that if a global hungry population of 690 million people is to be nourished, then profound changes in global food and agriculture systems are inevitable. It adds that this can be achieved by sustainable food production and increased agricultural productivity that are critical for supporting the alleviation of the perils of hunger and poverty.

Article 43 (1) (c) of the Constitution of Kenya, 2010, on the Social and Economic Rights states that “every person has a right to be free from hunger, and to have adequate food of acceptable quality” thus providing for a human rights-based approach to food security in Kenya. A study by Wanjiku & Wakibi (2015), shows that 7 percent of the population in Kiambu County are food insecure. Due to its proximity to Nairobi large market, Kiganjo Sub location and Kiambu County generally plays a major role in supplying a wide range of foodstuffs to the city.

Like in most rural setups, in Kiganjo sub location, land resource forms the main source of livelihood. Land affords people to the means of survival and is at the core of their economic and social lives. It is for this reason that the ever changing aspects of land size, land-use, tenure and sizes- needs to be understood. More importantly, researchers require to ably articulate the impacts that these changes have on rural households in order to offer alternatives that are for sustainable livelihoods.

Land size changes as a consequence of land subdivision results from socio-economic and cultural practices of inheritance and poverty. In Kiganjo sub location of Kiambu County, this phenomenon is evident in the reduction of the initially vast agricultural lands to smaller portions mainly used for residential purposes (Kiambu County, 2013). Due to the ever expanding limits of the City of Nairobi, landowners within Kiambu have resorted to subdividing land to smaller sizes for sale. The result is reduced farm sizes leading to a negative impact on the farm’s capacity to produce enough for the household food needs.

On the other hand, hitherto farm land, with high agricultural potential is rapidly transforming and giving way to residential developments. Rural agricultural land use changes limit the potential of the peri-urban agriculture and increases the vulnerability of the poor in terms of food security and income (Gachunia, 2016) making their livelihoods unsustainable. Land use changes in Kiambu has the double-edged outcome of spatial/landscape change and tenure change. Due to poverty

and poor agricultural production households have relinquished their land rights to new migrants to accommodate the rising demand of peri-urban housing.

Dairy production in rural areas has surpassed crop production especially in terms of profit in marginal, small and medium land holding sizes according to studies. A combination of dairying and crop production for small-scale farmers who possess smaller land parcels were significantly more profitable than crop farming alone (Kiambu County, 2013). Reduced land sizes and tremendous land conversion may lead to further negative impacts on dairy farming in Kiganjo Sub location thus compounding the danger of food insecurity, low incomes and poverty.

Considering the value of land on food production and the realization of the sustainable development goal on ending hunger, this study will endeavor to assess and examine the effects of the land size and land use changes on the dairy production in Kiganjo Sub location with the aim of developing proposals that promote the sector, ensuring sustained livelihoods particularly for security. It is expected that the proposals may be replicated and applied in other similar rural areas in Kenya.

This study entails to critically assess and establish the status of dairy farming in Kiganjo as affected by reduced land sizes and land uses. In this regard, the study has the overall objective of assessing the impacts of land size and land use changes on sustainable rural livelihoods.

### **1.3 Research questions**

1. How has land size changed in the study area?
2. Which types of land use changes are evident in the Kiganjo Sub location?
3. How do the land size and land use changes impact on the rural livelihoods in the study area?
4. What coping mechanisms have been developed by households who depend on dairying as a livelihood in Kiganjo Sub location?
5. What planning interventions are appropriate to promote sustainable rural livelihoods?

### **1.4 Research objectives**

1. To establish how land size has changed in the study area
2. To analyse the land use changes that are evident in Kiganjo sub-location
3. To assess the impacts of the land size and land use changes on rural livelihoods.

4. To determine coping mechanisms developed by households who depend on dairying as a livelihood
5. To propose or recommend a planning intervention that promotes sustainable rural livelihoods.

### **1.5 Justification of the Study**

Sustainable rural livelihood being the ability by people in rural areas to cope with stress and shock by using available opportunities in the rural areas like farming and hunting is the basic requirement for any poor man seeking to improve their lives. Cultivation of crops and rearing of livestock for food and for sale makes rural livelihoods manageable. Livestock production remains the most significant source of income for rural populations especially women, which is also a source of food for the household. Approximately 90 % of rural households are involved in farming activities (Davis et al. 2010a, b), dairying being one of it. Dairying is very important to rural livelihood as it has compound benefits to rural livelihoods in terms of supplies of households with manure, milk and meat. Dairying also takes up a small piece of land than any other form of agriculture. It has a value chain which ensures economic sustainability in the rural livelihoods. Dairying contributes to the county's and nation's economy ensuring food security in our country. It is therefore imperative to identify land use changes and how they impact on livelihoods depending on dairy production in order to improve food security. Kiganjo Sub-location has potential for dairy farming as there is a ready market as evident from dairy cooperatives in the County. The results of the study will benefit both the County Government of Kiambu and the dairy farmers. The ultimate goal of the study is to propose planning interventions which would ensure sustainable rural livelihoods in the study area. This will improve livelihoods and contribute substantially to the County's food security and Nation's GDP.

### **1.6 Significance of the Study**

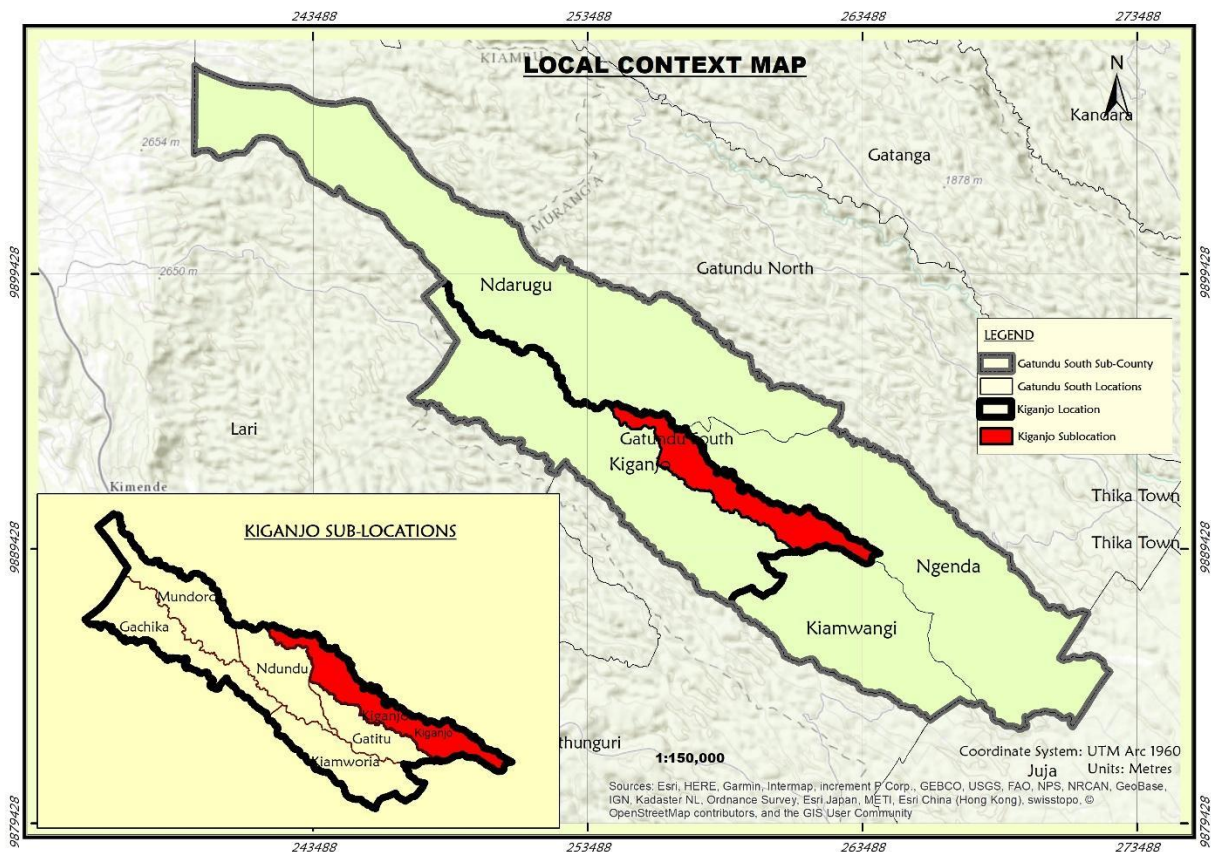
Agriculture plays a crucial role in the economy of Kenya as majority of households are heavily dependent on agriculture as their major source of livelihood. Land being finite is considered a shrinking resource due to both physical as well as human factors including climate change, increase in population and conversion into other land uses among others. An understanding of these factors is paramount in addressing the food insecurity. By undertaking this study, its

findings will facilitate the understanding of the land use changes in Kiganjo sub-location, the drivers of these land use change and the impacts of these changes on rural livelihoods. This information is useful to policy makers in coming up with sound strategies to address the situation.

### 1.7 Scope

Theoretically, this study attempts to examine land size and land use changes in regard to subdivision and conversion of use. This assessment is done within the framework of the rural household livelihoods in Kiganjo which depend entirely on dairy farming. The concept of sustainable livelihood in this study focuses on the ability of the user of the land, primarily the household to depend on the dairy produce for the household’s sustenance.

From a geographical perspective, the study was carried out in Kiganjo Sub-location within Gatundu South Sub-county, Kiambu County. Kiganjo was selected as it is the area where dairy farming is largely practiced in Gatundu South. The sub location measures 55.20Sq. Km with a population of 10,136 people according to the 2019 census (KNBS, 2019).



Map 1: Map showing Study Area (Kiganjo Sub-location)

## **1.8 Operational definitions.**

**Land use:** This refers to the modification and management of natural and wilderness environments into built up areas such as human settlements and semi-natural habitats like arable fields and pastures. In this context, land use focuses on how households have utilized their available piece of land.

**A Livelihood:** Ellis (1998) defines livelihood as those assets, activities and their access that jointly determine the living acquired by an individual or a household. It refers to the ability of an individual or household to acquire the basic life necessities that comprise of food, water, clothing and shelter. Thus, livelihood encompasses all actions that are involved in search for food, water, shelter, clothing and all necessities essential for survival of humans at individual and household levels. The way in which people use what they have to meet their needs and work towards their life objectives.

**Rural livelihood:** This is the ability of a household to acquire its basic needs from rural activities (Ellis, 1998). Examples of those actions falling under rural livelihood consists of agriculture (crop and livestock production), hunting and gathering, wage labor, trading, artisan work (weaving and carving), service provision especially transport services among other.

**Sustainability:** Is the ability to meet one's needs or a household's need without compromising the ability of future generations to meet their own needs. (Borowy, 2013).

**Sustainable rural livelihood:** A sustainable livelihood is one which can keep up with and recover from shocks and stress, enhance or maintain its capabilities and provide sustainable livelihood opportunities for future generations; and at the same time contribute to net benefits to the other livelihood means at local and global levels both in the short term and in the long term (Chambers & Conway 1991). In this case, it is the ability of the user of the land or a household to depend on the land for their survival, to remove vulnerability, eradicate poverty and keep the household moving.

**Off-farm:** Activities undertaken away from the person's own farm. They may include formal or casual employment in office or on other people's farms.

**Fragmentation:** Refers to the subdivision or breakdown of land into several smaller portions.

**Conversion:** refers to transfer of the intended use of land to another use for instance from agricultural to residential.

**Diversification:** the activities undertaken by household members in order to improve their social status and standard of living (Ellis 1996). It also refers to attempts undertaken by an individual or a household to find new ways of survival to raise income and endure shocks such as disasters and disease outbreaks (Khatun & Roy 2012). Rural livelihood diversification therefore entails undertaking different activities for income earning than focusing on only one source.

## **1.9 Thesis Organization**

Chapter 1 gives a brief introduction of the research, the background of study, research problem, the research questions and objective of the study. It also looks at the justification and significance of the study then definition of key terms used in the study.

Chapter 2 reviews the literature relevant to the study by reviewing both the theoretical and empirical literature on land use changes globally and locally, dairy farming globally, regionally, in Kenya and in Kiambu County. Looks at the existing policy and legal framework governing land use and dairy farming in Kenya.

Chapter 3 presents the overall methodology used by the study. Specifically, the chapter presents the study design, sampling techniques, sample size, data collection procedures and data analysis.

Chapter 4 presents the study area. This is the situational analysis of the area including the geographical location, population and demographics, topography, climate and physiographic features, land use patterns, socio-economic and cultural characteristics, social and physical infrastructure of the study area.

Chapter 5 presents the results of analysis and discussion of land use change, To analyse the trends in land size change and land use changes in the study area, analyse the land use changes evident in the study area, assesses the impacts of the land size and land use changes on rural livelihoods and determines coping mechanisms developed by households who depend on dairying as a livelihood. The chapter will as well recommend a planning intervention that promotes sustainable rural livelihood.

Chapter 6 presents the conclusions, discussion and recommendations of the study.

## **CHAPTER TWO: LITERATURE REVIEW**

### **2.1 Overview**

This chapter presents a systematic identification and analysis of literature related to land and the phenomena of its use, change in land uses and how it affects rural livelihoods, concept of dairy farming and its relation to sustainability of rural livelihoods; analysis of policies related to dairy farming, planning and use of land. The chapter provides an assessment of case studies derived from other rural contexts that offers good practices for the study area.

### **2.2 The concept of land**

Land refers to an area in the surface of the earth that comprises of the biosphere, the atmosphere and the lithosphere (Kenya land alliance, 2002). However, land can be defined differently by different people depending on how they deal with it for instance, land has been scribed by geographers as the space and location of a geographical boundary in terms of a country, homeland, rural area in contrast to urban areas and forestry. Land is also viewed in its economical context or focus more as a property, an estate or a commodity that is linked to an investment. According to the economic theory, land is considered as a factor of production which includes all the natural resources but it's so much different from capital. It is the most important factor of production, besides labor and capital and the foundation of economic development for the country as a larger population derives their livelihoods from land based activities.

Land has been at the center of merely every development, the most basic of all economies. Land is very significant as it constitutes the most important economic, cultural and political issues in Kenya, it was so before independence and still is today (Ambwere, 2003). Rights to this particular commodity then becomes key to individuals and groups. Africans in the pre-colonial era owned land communally, guided by the customary law. The customary system usually entails collective landholding and the allocation of farming rights over specific plots by the land management authority to smaller family units (Cotula, 2012). Under this system, land was not bought or sold but passed to next generations through inheritance, communities practiced agriculture on land for food security of their people. Land in Africa was not titled, the users obtained access to it through a combination of both customary and statutory laws. During colonization, the white settlers possessed most of the land from Africans by declaring all unoccupied land as crown land making land rights for Africans highly tenuous. The system

imposed statutory land laws which were not in support of the customary law and practice (International Institute for Environment and Development, 2006). After independence, most African states took control of their land through the established land laws and the constitution to promote agricultural development as well as seize control of land (Cotula, 2012). Even though most of the countries resorted to individual/private ownership, some of the African states vested land ownership with the state or both (Cotula, 2012). Where land is owned or held by the state, resource users may enjoy use rights so long as they put land to productive use. Privatization of land according to Lund, (2000) has caused increased tenure insecurity uncertainty and conflict when it comes to management. For the land under the state, Cotula, (2012) clarifies that land management institutions are mandated to monitor productive use, and to re-allocate land to third parties in case of none or poor use.

According to the Constitution of Kenya 2010, land belongs to the Kenyan people collectively as a nation, as communities and as individuals. The constitution further states that, “land in Kenya shall be held, used and managed in a manner that is equitable, efficient, productive and sustainable and in accordance to with the principles that shall be implemented through national land policy developed and reviewed regularly by the national government and through legislation”. As per Section 40 of the Kenya 2010 constitution, every person has the right to land, to acquire and own property of any choice and description in any part of the country, either as an individual or in association with others. The same constitution classifies land as public, private and communal with two tenure systems as freehold or leasehold. The country has a land titling program to register private property, converting customary land rights into freehold. Again, the constitution grants the rights to land holding on leasehold tenure only to non-citizens, however granted, such lease shall not exceed ninety-nine years. Any provisions of deed, agreement, conveyance or document of whichever nature purports to award any individual who is a non-citizen an interest in a land parcel more than the stipulated ninety-nine-year lease, such provisions shall be deemed as conferring on the person a ninety-nine-year leasehold interest and not more than that. Any parcels of land held in trust shall be considered as being held by a citizen only if and when all of its beneficial interest of the trust is held by individuals who are citizens, parliament can make legislation that can operationalize the provisions of this article. The power to regulate any use of land, or any interest in or right over any land is conferred to the state by the constitution particularly in the interest of public safety, defense, public order, public health,



public morality or land use planning with parliament mandated to enact any legislation that ensures investments in property benefits local communities and their economies.

Land is at the center of rural lives as it creates value. It forms the foundation of human living since it is the source of food and shelter, supplies space for urban and industrial development, it filters and stores water vital for human existence, and it supplies space for leisure, recreation and other social amenities (Verheye, 2008). A parcel of land can suffice individuals with nutritional, financial and physical security and a source of wages for its laborers. Land provides a base for status and identity within a family and community, a case much evident in Kenya where the rich, the educated, the elite and the poor all consider land as the sole most important kind of personal wealth, and it is deeply rooted with its distribution and use (Ambwere, 2003). Further, land can as well be the basis for amassing political power (Rural Development Institute, 2004). Additionally, land is a resource relied upon by the country for the generation of goods and services for the people.

Kenya's land size measures approximately 582,646 square kilometers. Regrettably, only a small proportion of it, 17 percent, is suitable for rain fed agriculture. The remaining 82 percent is an arid and semi-arid land (ASAL) that consists of mainly savannah grassland and savannah rangelands cover. These rangelands are nevertheless home to some 85 percent of Kenya's cumulative wildlife population, and an estimated 14 million Kenyans who practice dry land crop production and pastoralism (Mwichabe, 1996). Land in Kenya contributes 24 percent to the country's gross domestic product and in excess of 60% of the country's export earnings from the agricultural sector. As per the Kenya Constitution 2010, agricultural land plays a major role in reduction of poverty and more particularly to subsistence farmers and pastoralists who earn their livelihoods from agriculture based economic activities. Kenya's population is estimated to have been approximately 7 million at the census of 1962 (Mettrick, H. 1994), while according to the 2019 census the population stands at 47.6million.

Whereas land is inelastic, the increase in population has exerted so much pressure on it to sustain the population in terms of food and shelter. The longing for each adult Kenyan to have a land ownership title deed has contributed to subdivision of large tracts of family land to smaller parcels that are snapped up on promise of increase in its value. Conflicting interests on land arise due to the different competing and ever-expanding needs. Increasing agricultural productivity

and production is highly constrained by stiff competition for land resources between agriculture and human settlements.

### **2.2.1 Socio-cultural Issues of Land in Kenya**

In Kenya, land is a critical asset particularly for the rural and urban poor, just as it is in multiple other developing countries. Whether formal or customary, land rights act as a major form of economic access to key markets (Holden & Ghebru, 2016). Improvements in the independence of women's property rights grants women a greater control over agricultural income, more frequency of access to credit, and gain higher shares of labor market and business earnings. Most of the communities have rooted their land inheritance on patriarchal culture which grants men more power on land rights over women (Michuki, 2015). Women do not have adequate access to land, and do not even make major decisions pertaining to its allocation and use. Denying women rights of owning the land as a factor of production in one way or another hinder the contribution of women towards achieving sustainable livelihood as well as food security particularly in the developing world. Since land is a critical factor in agricultural production ensuring rights to ownership of land regardless of gender is imperative towards the achievement of food security as well as sustainable livelihoods. Due to the African culture of land inheritance, available land is subdivided among siblings making it too small for significant production (Ogato, 2013; Kameri – Mbote, 2005).

### **2.2.2 The Economic and Political issues**

It is important to note that land directly affects agricultural productivity. Currently, statistics show that at least 75 percent of Kenya's total agricultural output is generated from small-scale farming that also contributes up to 70 percent of marketed agricultural produce (Muyanga & Jayne, 2014). This means that the majority of the food products that ends on the tables of people across the country primarily comes smallholder farmers. Nevertheless, agricultural productivity is low in the country chiefly due to the fact that majority of the farms are nutrient-depleted, overworked, and very minute parcels of land that have been overly subdivided across multiple generations. The scenario is more complicated by the fact that majority of the smallholder farmers lack title deeds to their land. Despite the general consensus and acknowledgement that the land held and farmed is indeed theirs, the costs associated with registration and acquisition of title deeds to their held land are extremely high for most of smallholder farmers.

Owing to this, the smallholder farmers do not own the land legally and as such cannot use them as collateral for access to credit that can help them make necessary improvements to their agricultural production activities. Most importantly, smallholder farms cannot be amalgamated to one large parcel that can be farmed more efficiently with more advanced mechanization, productivity and profitability. The situation will even be more aggravated owing to shrinking of average land holding sizes resulting from cultural practices of subdividing family land to each son for inheritance. The Kenyan's land problem also affects other sectors such as manufacturing. This is attributed to a daunting process of procuring land for a company that desires to expand its operations to another part of the country. Such problems hinder developments and most importantly deny people the opportunities such as employment or ready market for farm produce and at the end compromising sustainable livelihood (Thuo, 2013).

Absence of legal title deed to a parcel dampens demand for land since potential buyers do not want to be entangled in complexities of proving land ownership. This situation also complicates land holder's possibility of coming together to merge smaller land pieces into a large land mass that can attract huge capital investments more effectively. Simply put, demand and supply are influenced by the land question. The construction of necessary facilities and infrastructure development in areas experiencing land issues is complicated, costly and prone to delays as disputes take a long time to resolve. Communities in some instances fail to agree with valuation of land provoking renegotiations, while in other situations absentee landlords complicate the land acquisition process making it long and arduous. However, the most complex of all situations involves cases where communities consider the land they reside on as ancestral while legally the land is owned by a separate entity or individual (Trebilcock & Rosenstock, 2015).

### **2.3 Land use**

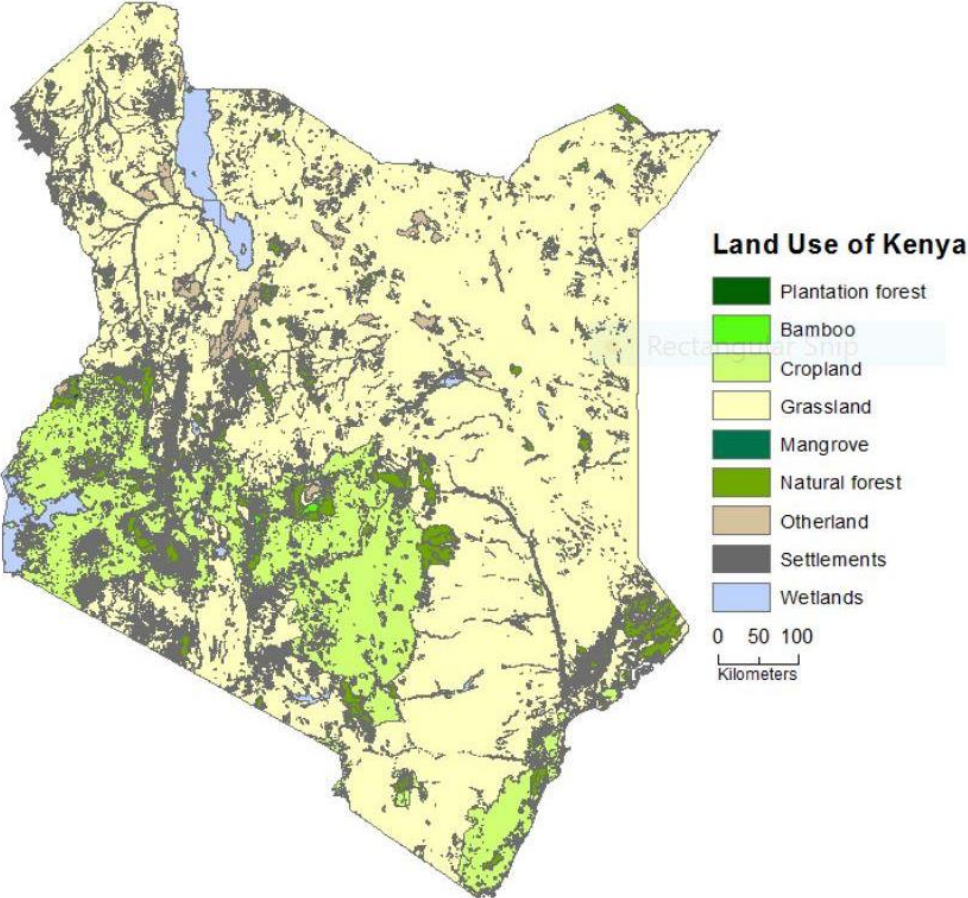
Land use refers to the management and adjustment of natural environment or wilderness into built environment such as settlements and semi-natural habitats such as pastures and arable fields (Musa & Odera, 2015). However, according to UNESCO, land use is defined as a land cover, where the focus of such cover of land is in form of its socio-economic purpose and the intentional use it has been subjected to. Use of land may differ in terms of nature and intensity in relation to its purpose and the biophysical aspects of the land itself. Some of the land uses include; recreational, transport, agricultural, open spaces, residential and lastly commercial land uses. Land use is related to the human movements and trends (UNESCO, 2009).

A study by Ritchie & Roser (2013) indicated that of the total land area of 13,003 million ha the global land uses include; agriculture taking 34% of the land area, forests cover up to 26%, barren land at 19%, glacier takes up 10%, shrubs 8%, while freshwater and built-up land take up 1% each. Arable land takes 28% of the global agricultural area, permanent crops take 3% while permanent meadows and pastures take up 69%, this accounts for the largest share of the world's agricultural area (Ritchie & Roser, 2013). In addition, there is disproportionate distribution of land use between crops that can be used for human consumption and livestock. Expanding agriculture hugely impacts the environment. It has contributed to complete transformation of habitats and exerts one the greatest pressures for biodiversity (Ritchie and Roser, 2013).

Out of the total land in Africa, just a fraction of it is suitable and used for arable purposes. According to FAO, estimating the potential area of land suitable rain fed agriculture excluding forests and built-up areas depends majorly uses soil, land cover and climatic characteristics. This has been important because as the population, incomes and urbanization levels increases across countries, the demand for food increases also. For example, it had been projected that the demand for meat and milk will keep increasing from 3.2% to 3.9% between 1997 -2020 as a result of the mentioned factors. It has also been documented that 60% of African population are dependent on livestock as a means of their livelihoods (FAO, 2007; Thornton et al., 2002; Rosegrant et al., 2001). Experts have pointed out that for the African countries to utilize the effective land tenure systems through provision of adequate incentives that promotes rapid agricultural growth, while at the same time reducing social tensions and conflicts (Cotulla et al., 2003; ECA, 2004; Feder and Noronha, 1987, Platteau, 1995).

According to the Kenya National Land Use Policy (GOK, 2017), in Kenya, Land use consists of pastoralism, agriculture, water catchments, urban and rural settlements, natural reserves, mining, industry, recreation, infrastructure, cultural sites, tourism, forestry, energy and fishing. A significant majority of the Kenyan population derive their livelihoods from land-based activities. Agriculture is the spine of Kenya's economy owing to its significant contribution to the country's economic growth. Kenyan farmers engage in both small- and large-scale farming of mainly crops, livestock and/or mixed farming. Land fragmentation is cited among the major hindrances to agricultural and industrial growth in Kenya by the National Land Use Policy. Further, the policy calls for the determination of minimum land sizes based on ecological and land use carrying capacities (GOK, 2017).

In Kiambu County for instance, farmers are converting their farms into residential plots to supplement the meagre income from the farms. Gatundu being one of the small lands holding areas in the county has the following land uses; Agriculture taking about 87%, residential and transportation taking 4.6% and 6.15% respectively. Industrial, educational, public purposes, commercial and public utility constitutes the remaining percentage of land (KISUP, 2020-2030).



Map 2: Land use map of Kenya (FPP, 2013).

### **2.3.1 Land use and planning**

Land use planning is becoming increasingly inevitable owing to growing scarcity of land resources attributed to growth in human populations and their aspirations. Land use planning is essential since it lessens the adverse effects of land use while enhancing efficiency in resource use with negligible impacts to future generations. Land use planning is considered as the methodical assessment of water and land potential, land use alternatives, and the socio-economic conditions necessary for identification, selection and adoption of the best land use options. The principal objective of land use planning is to designate land uses that meet the needs of people while simultaneously resources for future generations (Silberstein, & Maser, 2013).

The land use planning process is continuous and iterative. In most cases, three primary goals of equity, efficiency and sustainability are highly employed by planners in the development of land use plans. Equity in land use concentrates on dampening inequalities in food security, income and housing. On the other hand, efficiency in use of land is attained through matching the various land uses with areas that will harvest the maximum benefit at the least possible cost. Sustainable land use planning is focused on meeting the needs of the current generations while conserving resources for future ones. Therefore, a leading aim of land use planning is to strike a balance among these three goals. This is achieved majorly by use of information on appropriate technology, trade-offs, and consensus-based decision making. Most often, effective land use planning involves scientific information on land resources, integrated resource use evaluation, appropriate technologies and local communities (Chadwick, 2013).

Land use planning can be carried out at various levels mainly local, town, district, state, regional, national and international levels. For successful planning, a two-way link between these levels is critical. A “bottom-up” planning approach take off at the local level and connects to the immediate next higher tier with active local community involvement. The acceptability of the plan at the local level is vital for successful land use planning. Public education and awareness are core elements of land use planning that have often been neglected. However, current planning processes are increasingly recognizing these elements in addition to the primary methods of zoning and planning regulations that have been widely adopted by land use planners. Institutional reforms, economic incentives and investment through multi-agency cooperative projects are

other planning methods used by land use planners. Land use planners are currently facing multiple challenges that need addressing within a single planning framework hence land use planning is getting more complex and highly multidisciplinary. Some of these planning problems comprise of water allocation, nonpoint-source pollution, urbanization, global warming, ecosystem deterioration, deforestation, farmland deterioration, poverty and unemployment, low economic growth and desertification (Chadwick, 2013; Silberstein, & Maser, 2013).

### **2.3.2 Land Use Planning in Rural Areas**

Land in rural areas is regarded with so much importance as it represents space essential for agricultural sufficiency, timber and economic base. Rural land comprises a major spatial constituent for outdoor recreation which in turn is viewed as landscape quality (Clope, 2013). Rural land needs proper conservation to reduce the conflict of changes of land from rural to urban use which mostly arise with the need for housing development. Dent et.al. (2013) looks at rural planning as a way of dealing with poverty and livelihoods. They postulate that rural planning entails decision making on sustainable forms of land use in rural areas together with the commencement of suitable alternatives and implementation, monitoring and evaluation measures.

Rural land use planning is a public policy initiative that allocates and regulates land use so as to improve the physical, social, economic efficiency and well-being of a community (World Bank, 2010). On the other hand, FAO and UNEP (1999) considers rural land use planning as the systematic and iterative process undertaken for purposes of creating an enabling environment for development of land resources sustainable to meet the needs and demands of the people.

### **2.4 Land Use Change**

Land use change is considered as the process through which activities by humans transform natural landscapes, denoting how previously land has been used, typically accentuating on the functional role of land for economic activities (Paul & Rashid, 2017). According to Zonneveld (1993), land use refers to those various human activities carried out for exploiting natural landscapes including ploughing, hunting among others. In the Encyclopedia for Food Security, Ferranti et al. (2018) define land use change as the land cover changes associated with contraction or expansion of an area of land that has been used for diverse purposes. This in our case is the subdivisions, amalgamations and conversion of land uses (Zonneveld,1993).

It has been estimated that 83% of the human footprint has affected the global terrestrial land surface (Sanderson et al. 2002). In addition to that, 60% of the ecosystem's service has been degraded for the past 50 years alone. Wubie et al (2016) intimates that land use change is driven by various factors including population pressure, demand for fuel wood and construction material, agricultural expansion, policy and tenure insecurity. Changes in land use/cover is influenced by ambitious human forces such as technology, demographic factors, political structure, levels of affluence, attitudes and values and economic factors (Turner et al., 1995). The rates of land use which had already increased in the last century increased in the last decades at an alarming level. Globally there are various factors that would lead to land use change, some of these factors include: - urbanization, increasing income, food prices and price elasticity of demand, infrastructure development, policies at national and international level, property rights, land tenure, land degradation and bioenergy. However, these factors encourage for instance, most of the agricultural land to be used as residential or even commercial land uses (Lambin and Geist 2008).

Land use change attributes to both positive and negative outcomes. Besides the fact that change in land use is vital for food, feed and fiber production for human use, and also essential for provision of space for human habitation, it is arguable whether intensive, high yield production is preferable to lower yield production on a relatively small land area (Phalan et al., 2011). A common assumption is, when there is change from agricultural to either residential or commercial use, there would be inadequate land for cultivation of crops which would reduce the final produce from the land. According to studies, agricultural practices are considered the leading cause of landscape modifications and has interfered with the ecosystems for many animal and plant communities all over the world. Equally, land management practices like grazing, tillage and fire affect the composition, distribution of organic matter and cycling of nutrients within the ecosystem (Ewoi, 2014). According to Wu & Li (2013), some of the developing countries have shifted from largely agrarian to industrial economies to manage their demand for food, energy and natural resources which has increased with rising income. As much as other studies land use changes a cause to food insecurity, Kyle et al. (2019) reports that food production has increased dramatically since the 20th century through land use change. The supply of cereals globally outpaced the 1.3-fold population increase by a factor of 2.2 (FAO, 2017a). this increase in cereal production was attributed to agricultural intensification owing to enhanced crop yield and harvesting frequencies through addition of fertilizers, herbicides,



pesticides, irrigation, and mechanization (ibid). Africa has also suffered land use changes with main and direct drivers being: fuel wood collection and charcoal production, small scale agriculture, mining and informal logging. The underlying factors according to Malhi et al. (2013) are: population increase, governance, poverty and instability (Malhi et al., 2013).

Land in Kenya is used for water catchments, pastoralism, agriculture, rural and urban settlements, mining, industry, forestry, fishing, recreation, tourism, nature reserves, energy and as cultural sites (GOK, 2012). In 1953, the British colonial government through the Swynnerton plan proposed for consolidation of lands for purposes of improving the economy and food security in the Country (Swynnerton, 1955). With independence and African land ownership, the hitherto consolidated large agricultural farms have since been subdivided into small and uneconomical units of averagely 0.36Ha, which has led to low production (Kiambu CIDP, 2013-2017). Hydrology, climate and terrain factors determine agriculture in Kenya. These agro-ecological factors also influence the suitability of an area for a certain land use. In the country's high potential highlands there is prevalence of intensive cultivation owing to rich soils and high amounts of rainfall (Ministry of Lands & Physical Planning, 2012).

Land use change plays a pivotal role in the agricultural sector since rural livelihoods are dependent on agriculture. These land use changes can be differentiated through conversions from agricultural land to urbanization, changes to multifunctional use of land such as from agricultural use to business or pleasure combined with natural functions or recreation use, and changes in the type of agricultural production (Zondag & Borsboom, 2009). According to Musa & Odera (2015) agricultural land use changes can be viewed in the context of subdivisions/fragmentation, conversions, change in ownership and current uses.

#### **2.4.1 Land subdivision**

Land subdivision is the division of any land, held under single ownership, into two or more parts. According to the Oxford Dictionary, Subdivision derives from the word 'subdivide', which refers to splitting up or separating into smaller and smaller pieces. It is sometimes referred to as sectionalization, segmentation, partitioning or parcellation. Land subdivision is often the first step in the process of converting rural land to urban uses. It involves the division of land into plots or lots for sale and development (Agheyisi, 2018). King & Burton (1982) characterize land subdivision as a fundamental rural spatial problem. Concerns about subdivision of agricultural

land into small units in Kenya and world over have been about effects of such subdivisions on the agricultural productivity (Museleku, 2018). It is generally assumed that subdivisions of agricultural land into small sizes automatically leads to reduced agricultural productivity and thus may impact negatively on food security.

#### ***2.4.1.1 Land subdivision and rural livelihoods***

The high rate of urbanization in the rural urban fringes has resulted in a shift from agriculture to real estate development. Consequently, rural livelihoods depending on agriculture lose their main source of income rendering most farmers and casual laborers without a stable source of income (Feder & Noronha, 1987; Platteau, 1997).

Subdivision of land over several generations has resulted in very small holdings in many high-potential areas hence reducing private agricultural land sizes over the years. The initially large chunks of land have been subdivided and their use converted to accommodate the needs of the communities. Notwithstanding the enormous importance agricultural land together with the ASALs has on economic development, it is continually being subdivided into minute sizes (at time less than 1ha). The average farm size at the national level is about 2.5ha, where 98 percent of agricultural farm sizes measure approximately 1.2ha (Syagga & Kimuyu, 2016). Ambwere, (2003) claims that subdivisions of agricultural land have resulted to land units that are agriculturally un-viable with the production related over-intensification contributing to the degradation of the environment. He further notes that subdivision of land is spontaneous following subdivision of family land across successive generations and in-migration. According to Gatundu ISUP, 2020-2030, land fragmentation has been noted as a major threat to agricultural sustainability.

Land tenure systems (for instance customary rights to land), individualization of land titles, practices of land inheritance and acceptability to sell agricultural land are important socio-cultural drivers of subdivision (Mburu, 2009). Other main drivers of land subdivision in Kenya include population growth, market access and economic factors. Economic factors that predominantly influence land subdivision notably include per capita income/poverty, demand for urban housing and agricultural productivity (Chazan & Cotter, 2001; Ayonga, 2008; Nkedianye et al., 2009; GoK, 2016).

Furthermore, land laws that have granted people the power to subdivide and transfer agricultural land and granting of approvals for subdivisions by the county government have exacerbated agricultural land subdivisions. Consequently, this has contributed to land fragmentation, reduced farm size for animal feeds, grazing the animals and construction of animal sheds. Hence, dairy milk production has dropped significantly thereby not providing a stable income to the farmers (Thuo, 2010).

#### ***2.4.1.2 Driving forces to land subdivision***

Some of the global drivers of land fragmentation include; increase in human population, agriculture, housing, water, nature, employment, transport, demand for energy and recreation as they influence land-use predominantly indirectly. Zondag & Borsboom (2009) explores the drivers of land subdivision in the following clusters; Demographic, economy, technology, climate change and energy transmission. According to Scottish Government (2009), the leading drivers of land subdivision can be categorized as either technological, institutional, policy, environmental, social, demographic, cultural and economic factors. Chazan & Cotter (2001) on the other hand classify them as personal housing style preferences (demographic factors), population and household size, economic stimulus and government policies. Consequently, Lambin et al. (2003) generalized the land subdivision drivers and classified them broadly into demographic, cultural, institutional, social and technological factors, economic factors and natural/environmental changes. Most of the subdivisions of agricultural land in rural areas are attributed to scarcity of land, pressures from population growth and land inheritance practices (Blarel et al., 1992).

**Inheritance:** - refers to a way of bequeathing or excluding from wealth transfer across generations (from one generation to the next). According to the inheritance and family law in Kenya patterns of inheritance are linked to the organization of kinship ties in the society, ideas about wealth, freedom and equality and social structure. According to (King, R., and Burton, S., 1982), inheritance is linked with population growth as there is increase demand for land acquisition. This trend of increase in population leads to scarcity of land and will be likely to accept any available land. It is widely accepted that the primary cause of land subdivision is inheritance particularly when farmers desire to provide land for their heirs. Most inheritance laws require land holdings to be subdivided into equal portions amongst all heirs or in a few communities among the sons. Owing to this, the subdivision of land has become a continuous

process making land parcels get smaller and smaller due to the subdivisions across several generations (Olayiwola & Adeleye, 2006).

Land markets play a virtual role in the restructuring of land ownership when people acquire land for varied reasons such as investments, agricultural activities, enhancing personal prestige, secure current and lastly improving the future living conditions for the family. This is attributed to the multi-purpose nature of land resource. According to Grigg 1980, land markets contribute to further subdivision of the existing lands as the land owners try to respond to this demand by making land available. He further states that, purchase of land may reduce land subdivision where the farmers acquire neighborhood pieces of land to expand their holdings (Grigg, 1980).

**Population pressure:** - Kenya's population is growing at a very high rate, the 2019 population census reported a total population of 47,564,296 persons with a population density of 92%. Even though statistics indicate a drop of growth from 2.9 in 2009 to 2.2 in 2019 (KNBS, 2019), it is still clear that the numbers are going up each year. Kenya's land size is approximately 582,646 km<sup>2</sup> with just 17% of it appropriate for rain fed agriculture. Forest reserves cover approximately 2.2% of the arable land in Kenya. The remaining 82% is covered by the ASALs mainly consisting of savannah grasslands and rangelands. When the population increases, with land being static, the demand for land for settlement increases and thus pressure on existing land which will be partitioned. Kiambu County measures 2,539 Km<sup>2</sup>. The county has a total population of 2,417,735 people with a population density of 952 persons per Km<sup>2</sup>. Owing to high population, available agricultural land is put under enormous pressure resulting to uneconomical subdivision. Due to Kiambu county's proximity to Nairobi city, it is experiencing an influx of city people who prefer to reside in the county and its surroundings owing to its low levels of congestion and well-developed infrastructure facilities (Kiambu County, 2016). With the increasing demand of housing, real estate developers are buying land to put up real housing units and this has extended into the city's outskirts. Most of the City dwellers are preferring to buy land and develop their own houses to curb the high cost of rent that is increasing each year. For this sole reason most of the initial agricultural lands in Kiambu and specifically Gatundu have undergone subdivision. It is reported that in the next 60 years the world population is expected to double regardless of whether fertility rates will decline virtually in each developing country. These statistics evidence that land resources on earth must inevitably be more productive to accommodate the growing needs of food, clothing and shelter. It is feared that growth in global

population threatens the inherent ability of arable land to provide shelter, food, clothing and sustenance (World Bank, 1992).

**Urbanization:** - as a resultant factor of land use change is the physical growth of urban areas due rural – urban migration and the concentration of sub-urbans within major cities and around smaller ones in the village. Growth of urban areas has put immense pressure on prevailing land use with agricultural land being the most affected. Agricultural land is therefore fast diminishing at an accelerating rate within this context. This is highly attached to the fact that most of agricultural land is fast being converted into built-up/urban area and results to food insecurity. Rural lifestyles are mainly agriculture based with main agricultural activities being crop, livestock and forestry production. These activities may be a nuisance to the urban dwellers who buy land and develop housing in the rural areas seeking tranquility away from bustle and hustle of urban areas. Out of Kenya's total population of 47,564,296 persons, 32,732,596 are in rural areas while 14,831,700 are in urban areas, this figure has increased for the previous years

### **Scarcity of land**

The amount of land that is available for various land uses more specifically the agricultural growth has been shrinking with time. The total land area for the world is 148,940,000km<sup>2</sup> which is a limit on the land that the entire land available to humanity. Africa is the second most populous and large area land mass at 30.37 million km<sup>2</sup> second after Asia, which is 44.58 million km<sup>2</sup>. The total land area available in any location on the globe is fixed and hence the supply of usable land in such a place is immovable. This has created the need for competition between the various land uses and needs, though majority of land mass used for agriculture. The competition for land has been aggravated by the environmental factors and its impact on land availability. This has contributed to environmental resource scarcity concept. Arising from the increased climate change and associated weather patterns, the land available for agriculture for example shrinks further. This brings about disruptions in agricultural and other land uses patterns, which is more severe in less developed countries, which are prone to such patterns due to their overreliance on land resources (Magda, 2012).

#### ***2.4.1.3 Impacts of land subdivision on agriculture***

One of the impacts of land subdivision is that it may lead to increase in agricultural production costs which would have a negative change in agricultural productivity and this would lead to the tragedy of spatial anti-commons. According to the anti-commons theory, endowing with the exclusion rights of a scarce resource like land to too much profit minded individuals, the resource will most likely be wasted through underutilization since they tend to prevent one another from its access and hence result to the spatial tragedy of anti-commons (Heller, 1998).

The subdivision of land results to dis-utilization and underutilization of resources where it tends to be hard to adopt some new technologies for agricultural modernization when farms are small and subdivided. Lands divided in small portions may as well result to complexities for given crops forcing farmers to stick with certain crops and not change to high profit yielding others. Highly profitable crops such as fruits demand large farms. If farmers hold small subdivided farms, they will most likely be forced to growth less profitable crops (The world Bank, 2005).

The subdivision of land as per Blarel et al, (1992), has a tendency to hinder the efficient delivery of support services mainly because of the increased cost of extension services that occur with the raised number of farms. For instance, in cases of disease outbreaks that affect crops, the information availed by farmers, which may be incomplete, is highly relied upon by the extension officers. This will most likely not help prevent or reduce the damage especially if the given information is incomplete or distorted. With farm sizes declining steadily due to land subdivision, it becomes increasingly critical to deliberate on the influences are reduced parcel size has on agricultural productivity.

Land subdivision has some negative effects including higher costs like extra labor, evaporation of fertilizers, increase in negative externalities (such as access routes, soil conserving investments, reduced scope for irrigation), loss of land due to the borders and increase in disputes between neighboring farmers (Blarel et al. 1992).

#### **2.4.2 Land Conversion**

The process of changing the existing physical use of a parcel of (agricultural) land into some other form of use, or some other form of agricultural use besides cultivation of soil and planting of trees is land conversion (DAR, 2002). According to Li, J. (2014) just like subdivision, land conversion significantly reduces the agricultural land availability and threatens food supply. In a

study conducted by Kwame Nkuruma University in Ghana carried out in 2015, land conversion was prompted by population growth and urbanization which in turn place demands on agricultural land as it is required for development. The study revealed that rural livelihoods have been greatly affected as they shift from customary to commercial systems.

Kiambu County for instance has converted most of its initial agricultural land to residential to accommodate the population pressure from the neighbouring City of Nairobi.

## **2.5 The Concept of Rural livelihood**

Chambers & Conway (1991) define rural as the capabilities, assets and activities that rural people require for a means of living (Ellis, 1998). Rural livelihoods themselves comprise one or more activities which include small scale farming, fishing, herding, gathering, wage labor, trading, processing among others. These activities provide cash, food and other goods that satisfy a variety of human needs. Some of these outputs are consumed immediately while others are used in the long term or short term. (R. Chamber, R. Conway1992). Davis et al. 2010 notes that in Africa, 70% of rural households derive their incomes from farming activities compared to 50% Asians and Latin Americans who generate their income from farm-based activities. As much as rural livelihoods focus more on farming, they also involve themselves with non-farming activities to boost their economy. The major livelihood activities in Kiambu County are crop farming, small retail business, livestock keeping, and casual employment (KNBS, 2019).

### **2.5.1 Sustainable Rural Livelihood**

According to Chambers & Conway (1991), a sustainable livelihood is the kind of livelihood that is able to cope with and recover from shocks and stress, uphold or augment its assets and capabilities, and suffice sustainable opportunities for the livelihoods of next (future) generations. Sustainable rural livelihood is therefore, the ability by people in rural areas to cope with stress and shock using opportunities in the rural areas like farming and hunting appropriately considering the future generation. In a study conducted by Sajid A. et al. (2018) in Mansehra in Pakistan, it was noted that, sustainability of rural livelihoods is blocked by poor health issues, rural economy production faces obstacles of marketing challenges, a decline in income in rural areas is attached to prevalence of diseases in crops and livestock, shortage of land affects rural economy and illiteracy negatively affects the sustainability of rural livelihood. Pingali P. et al (2019) on the other hand, in their study on rural livelihood challenges argued that livelihood

diversification in India led to an overall economic boost and increase in productivity. The study adds that with the increasing urban sprawl, which has brought about more pressure on agricultural land as the reliance on cultivation as the main source of rural livelihood is declining.

The figure below shows some of the activities rural communities engage in for sustainability.

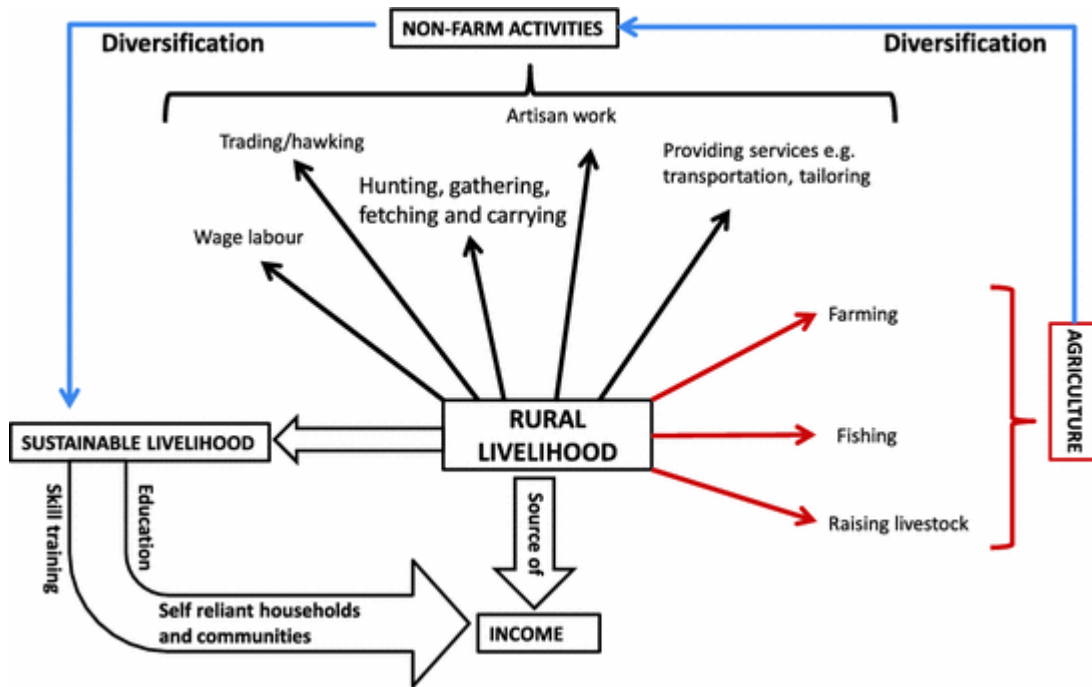


Figure 2. 1: Rural livelihood activities

Source: Infectious Diseases and Rural Livelihood in Developing Countries, 2016

### 2.5.2 Land Use and Rural Livelihoods

Agriculture is a source of livelihood for at least eighty percent (80%) of the people living in rural areas. Rural livelihoods depend on land uses like cultivation, livestock farming and the use of natural resources, they are therefore land-based (Andrew et al. 2003). A study by Ellis & Freeman reported that high reliance on food crop agriculture, low monetization of rural economy and less land and livestock holdings contribute to low incomes of household in rural areas of all countries. They further note that changes in land use such as subdivision of land, reduced access to right agronomic advice and inputs, decreasing civil security in rural areas and predatory taxation by local authorities worsen the already existing adverse factors threatening rural livelihoods (Ellis & Freeman, 2004).



Rapid land use changes in Africa include agricultural land subdivision and conversion which are a major threat to sustainable rural livelihoods. Reduced farm land, reduced animal feeds and grazing land, overstocking, milk production and human labor are some of the risk factors to sustainable rural livelihoods caused by land subdivision. Those rural dwellers with very limited or without access to agricultural land lead very vulnerable livelihoods since they experience difficulties in acquiring food and amassing other assets (FAO, 2007).

Agriculture employs over 28.7% of the population in Gatundu, the rural community is involved in crop production, dairy farming, poultry and pig rearing for their livelihoods (ISUP, 2020-2030). However, agriculture in the region is faced by challenges which include erratic weather leading to decline in production, reduced farm sizes as a result of subdivision, land use change due to urbanization and poor market prices for their commodities (ISUP, 2020-2030). In summary, land fragmentation has been noted as a major threat to agricultural sustainability in Gatundu.

### **2.5.3 Dairy farming as means of rural livelihood**

Dairying refers to the sector of agriculture that involves breeding, raising and utilization of dairy animals, mainly cows, for milk and other various milk processed dairy products production (Byron & Johnson, 1965). This is the kind of farming where cattle are kept primarily for milk production. The United States of America is ranked the world's largest producer of cow milk. According to USDA data, 2014, an average cow in the U.S produces 10,100kgs of milk annually. The study reports that in 2014, a cumulative 93.4 million metric tons of milk were produced by 9.3 million cows bred across 50,000 farms. This is majorly attributed to farm sizes and technology involved in dairy farming (Sumner, 2014).

In India, dairy farming has been known for its prominent role in strengthening India's rural economy, it has occupied a prominent position in the agriculture sector in general and livestock sector in particular. The contribution of livestock sector and fisheries sector to the total GDP during 2006-07 was 5.26 percent and around 26.63 percent of the total value of agricultural production is derived from this sector of which the contribution of the milk sub sector is highest (Kumar, 2009). The landless, small and marginal farmers and landless laborers constitute nearly 65% of the milk producers and contribute nearly 62% of the total milk production in India (Khanna, 2007).

India has embraced commercial dairy farming as an adjunct to food crop production as emphasized by the Government. However, small scale dairy farmers struggle with challenges like; fodder scarcity, traditional pattern of feeding, poor knowledge of concentrate preparation, traditional practices in disease control and unavailability of veterinary services among others. Improvement of these would automatically be a solution to food security and improved livelihoods (Kumar, 2009; Khanna, 2007).

Africa has been doing well in milk production up to 2008, however, there has been noted a decrease in production by 2018. This decrease in milk production could be stimulated by the negative impact of climate change on feed resources and animal performance. Since the dairying in Africa depends mostly on the weather. According to FAOSTATS, the low production of milk by Sub Saharan Africa has led to huge imports of milk and its products by many countries (Hidosa and Guyo, 2017). The nature of the yield gaps in the dairy sector in Africa provides opportunities to increase its produce despite the constraints being faced by the farmers in the dairy industry (Mayberry et al, 2017).

Dairy farming in Kenya dates back to the early twenties as introduced by European settlers but only picked up in the mid-1950s (FAO, 2011). This was referred to as the pre-independence period where dairy farming was majorly large scale as most of the agricultural land was converted to cattle breeding for export purposes (Muriuki, 2011 & Omore et al, 1999). The Swynnerton Plan prepared and released in 1954 was a post-war colonial development scheme, which aimed to increase and intensify the development of agricultural practice in Kenya as a remedy to the low production caused by the 2<sup>nd</sup> World War. The plan aimed at establishing household land holdings that were big enough to sustain the household/family's food self-sufficiency as well as allow them engage in alternative husbandry and as such generate cash income. It was envisioned that each of the 600,000 African families would hold approximately ten acres of farming units. This was deemed sufficient for each family to be in a position to raise its average productivity in annual cash sales of between £10 to £100 after meeting their own needs (FAO, 2007).

Dairying stands out as the single largest agricultural sub-sector in Kenya and the largest contributor to the livestock GDP. Kenya's dairy sector accounts for 14% of the agricultural GDP and contributes 3.5 % to the national GDP (USAID/GoK 2009). Dairy farming is a significant activity in Kenya's livestock sector. It is a core source of livelihood to an estimated 1 million

small scale Kenyan farmers (IFAD, 2006). The total population of dairy cattle in Kenya is approximated to 4.3 million with milk production of about 3.3 billion liters per year Republic of Kenya, 2015). The chief role of dairy to the Kenyan economy is its being a major source of livelihood to many Kenyans involved in its value chain together with nutritional value of milk and its products to multiple Kenyan communities in the rural areas. Kenyan dairy farming can be segregated into two main forms which are: Subsistence dairy farming and commercial dairy farming. Subsistence dairy farming is practiced abundantly in Kenya and it has remained an integral part of the lives of the dwellers of Kenya. It has been a common practice among families in Kenya to rear dairy cows and use these cows for their domestic dairy requirements (Rosegrant et al., 2001; Thorton, 2002).

Traditionally, the dairy animals reared in the households of Kenya were meant for serving the domestic dairy requirements. However, observing the opportunities in dairy business, lately, many households have entered into the dairy farming business by selling off the milk from their domestic dairy cows as a means of income generation (Karanja, 2003). The dairy practice therefore, provides the duo purpose of sentimental and business /income generating.

#### **2.5.4 Land and Dairying**

Land is required in the dairying subsector mainly for dairy sheds construction as well as for the production of animal feeds. For zero grazing, land requirement includes construction of structures for storing feeds, pens for maternity, milking parlours, room for milk, implements room, manure pit, roads and alleys between farm and office and chaff cutter shed among others. The land's carrying capacity determines together with the fodder required by livestock, which may be purchased from an outside source or grown on the farm, determine the size and nature of land required for fodder production. Boone et al. (2005) studied the impacts of subdivision of group ranches in Kajiado District on quantity of wild animals and livestock, from an ecological perspective. Their study found out that the quantity of livestock was declining due to subdivision of group ranches in the district. The subdivision of agricultural land, however, did not stop with subdivision of group ranches' land in Kajiado County. Individual private landowners have continued to subdivide their agricultural land, sometimes below 0.05ha subplots. Indeed, it is on the private land where most of the subdivisions are now taking place, yet extensive livestock production systems (mainly pastoralism) which require large contiguous agricultural land to

sustain is still practiced. There is need therefore to determine the implications of such subdivisions, which reduce agricultural land sizes, on productivity (Randall et al., 2005).

A well fertile acre of agricultural land that has guaranteed irrigation facilities can support on average 4 to 5 dairy cattle together with their followers. Nowadays the need for land for fodder cultivation is greatly minimized owing to availability of complete mixed rations in local markets. Nevertheless, there is a higher farm productivity and reduced costs of milk production if high quality farm produced green fodders are plentifully available. Farming is affected by land fragmentation arising out of its influence on production of foodstuffs. Further, land fragmentation can as well be a major impediment to the adoption of extensive agricultural production technology mainly because its impacts are projected to be larger on extensive farms than on the intensive ones (Dairy Farm Guide, 2019).

### **Small holder Dairying**

Small holder dairy production is categorised into three; traditional, cooperative and intensive (Devendra, 2001). The traditional type is which is usually accompanied with ad hoc marketing arrangements and most on the peri-urban farms. The cooperative is where farmers have formed aggregations and there is concentration of farms. The intensive type is where the herd sizes are larger on a small piece of land. Most developing countries have embraced small holder dairy farming due to the bulging population. The major constraints to dairy farming as reported by Moran, J. (2005) are; choice of species or breeds, availability of animals, feed resources and improved feeding systems, improved breeding, reproduction and animal health care, management of manure and organized marketing.

The main types of dairy breeds in Kenya are; Friesian, Aryshire, Guernsey and Jersey. Their optimal milk production is as follows;

<b>Breed of cow</b>	<b>Optimal milk production per lactation</b>
Friesian	7,800 kg
Jersey	6,800 kg
Guernsey	6,650 kg
Aryshire	5,400 kg

*Source: Livestockkenya.com*

Small holder dairy farming can be very beneficial with improved productivity by farmers, aside from higher levels of milk production, Falvey (1999) adds that it reduces the rural – urban population drift, entails year-round engagement of rural and peri-urban labour, enables landless people to make a reasonable rural living through dairying.

For intensive dairying to be sustainable, the following must be put under consideration;

- Adequate infrastructure and marketing opportunities,
- Government policies which promote dairy development
- Availability of funds for purchase of livestock and pasture
- Availability of productive and adaptable breeds
- Ready access to information on dairy production
- A farm management system to ensure adequate feed throughout the year
- Disease control measures
- Adequate hygiene for milk collection.

## **2.6 Theories**

From the foregoing, and in consideration of the study concepts discussed, a number of theories which have informed this study include the following;

### **Agricultural Land Use Theory**

This theory is based on the assumption of location theory that land use types vary in relation to distance from market. A general land use theory was modelled by Von Thunen. His theory comprises of a market surrounded by four concentric rings. The immediate first ring was a zone made up of perishable goods produced in belts in a closer proximity to the town. The further distant rings therefore specialized in production of crops that were less in volume and weight but drew highest prices in the market since they could afford to relatively tolerate high costs of transportation. Von Thunen therefore argued that land use to which a parcel of land is subjected to was a function of the land rent a farmer is able to pay and the cost of transporting produce to the market. This model is based the aspects of;

- Land values: this aspect is based on assumption that the values of land decreases as distance from the centre of the market increases. Higher land values depict the locational advantage of proximity to the market; land values decline as accessibility declines.
- Intensity of land use: it is premised on assumption that intensities on use of land declines as the distance from the centre increases in a direct response to the land value pattern. It argues that those producers on farmlands that have better access to the central market must intensively use the land to generate maximum revenues that justify their being located there. The sizes of farms usually increase with increasing distance from the centre of the market. The higher prices of land encourage farms to normally be of fewer acres.

Kiganjo sub-location is an agricultural town where farmers are involved in mixed, subsistence farming. The type of farming practiced as compared to Von Thunen's theory of land use is captured under three of his four zone where most of the farmers close to town practice dairying and intense farming while those far from town practice cash crop farming. Depending on the farm sizes, smaller farms are close to town as slightly larger farms are found as you move away from town where cash crop farming is practiced.

### **The Sustainable Livelihood Approach**

Chambers & Conway in 1991 and the Department for International Development (DFID) in 1999 developed the Sustainable Livelihood Approach theory. The theory was complimented by Norton & Foster in 2001. The livelihoods framework developed by DFID sought to identify the significant livelihood assets, their trends over space and time and the nature of stresses and shocks (social, economic and environmental) used by individuals and communities in the society so as to survive (Morse et. Al., 2013).

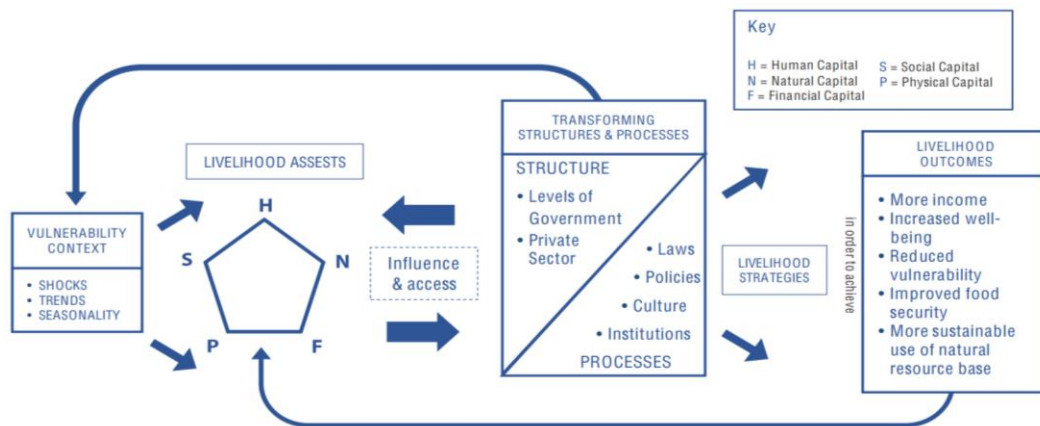


Figure 2. 2: Sustainable livelihood framework

Source: DFID (1999)

According to this approach, sustainability is viewed on basis of available livelihood assets (human, financial, physical, natural and social) and the scrutiny of the context of vulnerability (stresses, trends and shocks) in which these assets exist. Human assets include the human ability to work (provide labour), human knowledge and skills and good health; financial assets in this context comprise of incomes from employment, business and remittances and credit facilities; physical assets consist of the basic physical infrastructure facilities such as schools, road networks, water and sanitation (sewer) systems, health facilities among others; natural assets comprise of natural resources such as water bodies, land, soil, forests, fisheries and others; while social assets are made up of social resources that include membership to organized formal groups and relationships of trust that facilitate cooperation and economic opportunities together with membership to informal networks.

A livelihood is considered socially sustainable when one can cope with and recover from stress and shocks, and provide for future generations. In Kiganjo, where farming is their main source of livelihood, households are expected to manage their own family’s economical sustainability by planting crops which are of high value and can generate good income. They practice mixed farming as dairy farming cannot sustain their livelihoods.

## 2.7 Policy and legal framework

This section highlights the policies, guidelines and framework that support the development of the dairy sector and ensures the sustainability of the lives in rural areas. Some of these guidelines include;

## **2.7.1 Policy framework**

### ***i) Sustainable Development Goals (SDGs)***

The Sustainable Development Goals were established as action points for realizing the 2030 agenda for sustainable development. Goal No. 1: No poverty, aims at ending poverty in all its forms everywhere. Goal No. 2: Zero hunger, aims at ending hunger, achieving food security and improved nutrition and promoting sustainable agriculture. Lisa Dreier alludes that hunger can be eliminated within this lifetime, if we create better opportunities for farmers and focus on the needs of undernourished groups. With these goals as a benchmark, Kiganjo community will realise the no poverty goal.

### ***ii) Kenya Vision 2030***

Kenya Vision 2030 is the development blueprint for Kenya that covers the period between 2008 and 2030. The leading aim of the blueprint is to be able to transform Kenya into a highly industrialized upper middle-income economy by the year 2030 through the provision of high-quality life to all her citizens. Achieving national food security is considered a pivotal objective of the agricultural sector if the set vision is to be attained. A study by Wanjiku & Wakibi (2015) show that 7% of Kiambu County's population is food insecure. Under the Vision 2030, the government identified flagship projects among them; Agricultural policy reforms and establishment of livestock disease free zones and processing facilities in pursuit of achieving food security. Kiganjo's agriculture and specifically livestock production is supported by this vision.

### ***iii) National Land Policy (Sessional Paper No. 3 of 2009)***

The National Land Policy Sessional Paper Number 3 of 2009 provides the institutional, legal, technological, administrative and policy framework for the sustainable and desirable optimal use and productivity of land-based resources at the Community, County and National levels. Its main aim is to promote positive land reforms through the creation of accountable and transparent land related institutions, laws and systems for the improvement of the livelihoods of Kenyans.

### ***iv) National Land Use Policy of 2016***

This is a policy guiding Kenyans towards an environmentally and socially responsible use of land based resources for socio-economic transformation. It aims to promote best land use



practices for optimal utilization of the land resources in a sustainable manner. The policy specifically provides for coordination and integration of institutional linkages in planning at sectoral and cross-sectoral levels to foster collaboration and decision making among different land users, this should be able to control the land use in Kiganjo to avoid negative impacts on food security.

#### **v) National Dairy Development Policy**

The policy aims at developing and promoting a self-sustaining Kenya's dairy industry in line with the Millennium Development Goals and Vision 2030. This is intended to eventually translate into increased dairy sector productivity leading to national food security, increased incomes and economic growth. Dairy farming in Kiganjo is supported by this policy to contribute to national food security.

#### **vi) National Livestock Policy**

This policy addresses the challenges in the livestock sub-sector in the context of livestock breeding, nutrition and feeding, disease control, value addition and marketing, and research and extension. Among its objectives is to achieve appropriate livestock management systems for sustainable development of the livestock industry, focus research efforts in the livestock sub-sector on resolving current and emerging problems and address various cross-cutting issues that impact on the livestock sub-sector; among such issues are land, water, environment, infrastructure, insecurity, livestock-wildlife interactions, HIV/AIDS and other human diseases, gender and capacity building. With this policy in place and well enforced, dairy farming in Kiganjo can move to another level.

### **2.7.2 Legal framework**

#### **i) The Constitution of Kenya, 2010**

The Constitution of Kenya is the supreme law of the land dictating its ownership, use and management. Chapter five of the constitution of Kenya, 2010 dictates how land in Kenya shall be used and managed in a matter that is equitable, efficient, productive and sustainable. Article 40 of the constitution provides that Kenyans have the right whether individually or in association with others to own property in any part of the country. This is important because the article forms part of the bill of rights. The section also provides that no law can be enacted to deprive Kenyans

of their land or their rights arising from such land. The same land rights have been elaborated under the National Land Policy which has been developed through a political process. Therefore, land uses and access to land resources cannot be seen purely from a legalistic point of view. It should be tempered with constitutional, political, historical, cultural and economic dimensions. The same constitution under article 66 gives the state the mandate to regulate the use of any land or any interest/right over any land in the interest of public safety, defense, order, morality, health or land use planning. The use of land in Kiganjo is therefore controlled for the benefit of the community.

The land in Gatundu and other parts of central Kenya has been under intense debate on its access from the colonial times. Some of these dimensions have defined how such land has since been used. The government may undertake measures like land re-distribution, allocation, re-allocation, compensation for public land use and other appropriate measures which could be both legal and political (Kameri-Mbote, 2009). The constitution under section 15 of the sixth schedule gives the County government the responsibility of land use planning and development control, planning matters in Kiganjo are the responsibility of Kiambu County government. Article 43 (1) (c) of the Constitution of Kenya, 2010, on the Social and Economic Rights states that 'every person has a right to be free from hunger, and to have adequate food of acceptable quality' thus providing for a human rights based approach to food security in Kenya. Kiganjo being an agricultural town is mandated by the constitution to enhance food security for its people and the Nation at large.

### ***ii) Physical and Land use planning Act, 2019***

This is an ACT of Parliament that guides the use of land, planning and regulates development of land. The Act gives guidance on the objectives and the contents of Development Plans, advisory plans, zoning plans, subdivision plans etc. It also stipulates the processes of plan preparation and approval and it has been adopted in the project. Section 29 empowers Kiambu County government to prohibit or control the use and development of land and buildings within its area of jurisdiction.

### ***iii) Land Act, No. 6 of 2012***

The Land Act particularly provides for the sustainable administration and management of land and land-based resources and for connected purposes. This Act gives guidance on subdivisions and conversion of land from category to another in accordance with the provisions of this Act or

any other written law. With the massive land conversions in the study area, the Act is very ideal to ensure sustainability.

## **2.8 Case studies**

### **Small scale dairy farming in Lembang district, West-Java**

In a study by de Vries & Wouters (2017) on small scale dairy farms in Lembang district, West-Java, it was noted that scarcity and fragmentation of land were the cause to challenges of obtaining sufficient and good quality fodder and of recycling manure as fertilizer. Dairy farms in these states are small scale with farmers practicing zero-grazing with high stocking densities per unit of land with a milk production level and reproductive performance below potential. Sufficient land base is a key condition to sustainable development of dairy farming in Lembang district.

### **Canterbury dairy industry**

A study that investigated crop and dairy farming complementarities within the Canterbury farming system focused on analyzing drivers of changes. The findings by Peel, (2013) showed a combination of risk management by income diversifications, personal lifestyle needs and profitability were the leading drivers of land use change. Majority of dairy farmers in this region used their land as a platform for intensive milking while depending on the other sources for feed and grazing dry cows and young stock. The Canterbury cropping sector was as a result closely connected to the dairy sector. The coalescence of multiplicity of factors therefore explains the development of Canterbury dairy industry; including and not limited to dairying profitability, in both absolute terms and in relation to product prices for competing land uses, being a key driver of central importance. In addition, the continuing development of an irrigation system, that had begun much earlier, aided in the creation of a bio-physical environment that outrightly suited pastoral dairying. The seven farmers that participated in the case study considered mixed farming a success with six of them focused on continuing with both dairy farming and crop production. All case study farmers practiced intensive crop farming prior conversion and as such has a specialized skillset related to cropping that allowed them to maintain cropping within their operations (Peel, 2013).

## **Dairy production in Thailand**

When comparing the cost of production of dairy farming in Thailand across 4 farms, a study by Garcia et al. (2005) denoted that farms with higher number of cows on a smaller land had low profit as compared to the farm with less cows, this is attributed to the high amounts of purchased feed and other herd cash costs. As much as less land size favours dairy farming more than crop farming, growing of feeds is key to higher production. The study adds that the development in dairy has been driven by the increasing domestic demand for dairy products coupled with strong support to milk and beef producers through governmental policies, Supportive policies and partnerships with the private sector have quickly developed a formal dairy sector and protected milk price and subsidized domestic resources.



*Figure 2. 3: Dairy cow farming in Thailand*

## **Dairy industry in Kenya and Uganda**

Land use change has positively contributed to the growth of the dairy industry in East Africa. Ngigi, (2005) attributes the growth of dairy industry as the component of the region's smallholder agriculture to the increasing population pressure interacting with the need to sustain soil fertility and to intensify agricultural production. In as much as small scale dairying is doing great in East Africa and farmers can buy feeds for their cows to increase production, Ngigi, (2005) implies that under mixed farming, animals and crops reinforce each other in ways that can lead to substantial increase in per hectare productivity. She concludes that milk production in Kenya and Uganda is highly correlated to their respective rainfall patterns. The same study

attributes improved farm productivity to the efficiency of the marketing system which is enhanced by better breeding methods and sustainable feed management technology (FAO, 2007).

### **Performance of smallholder dairy farms in Murang'a**

In another case study by Van Schaik et al. (1996) on evaluating the performance of smallholder dairy farms in Murang'a, the authors noted that the smallholder dairy farms investigated differed in farm performance as production was strongly influenced by the performance of the dairy enterprise of the farm. Milk production and calving interval were the main indicators describing the performance of the dairy enterprise and, through that, overall farm performance. Results showed that both milk production and calving interval were influenced by the amount of concentrates fed, suggesting that feeding concentrates is an important indicator of high farm performance. Off-farm income also influenced overall farm performance as farms heavily dependent on off-farm income were often inefficient in their dairy enterprise (UNESCO, 2009; FAO, 2007).

### **2.9 Research Gap**

All the above studies have focused on smallholder dairy farming in other parts of the country and the world at large with a few on the relationship between land size and dairy farming. What has been missing has been holistic studies on the relationship between land size / land use change and dairy farming in Gatundu of Kiambu County in the recent times. This has therefore created research gaps on the impacts of land size and land use changes on sustainable dairy farming in Kiganjo sub-location of Gatundu South sub-County. This is important to form an integral part of policy formulation in the sub-County, the greater County and the Country. This study will seek to answer the underlying questions in Kiganjo sub-location in regards to sustainable livelihoods in small sector dairy farming.

### **2.10 Conceptual / Theoretical framework**

The study is guided by various theoretical persuasions including the Sustainable Livelihoods Approach (SLA) to the development interventions and the justifications for the choice of various development paradigms chosen. The five capitals of sustainable livelihood developed after Scoones, 1998 of: Natural capital, Human capital, Economic and financial capital, physical capital and social capital (Morse & McNamara, 2013).

A sustainable livelihood is one which can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels and in the short and long term (Chambers & Conway, 1992).

Sustainable rural livelihoods in Kenya are threatened by the continuous land use change which is occasioned by subdivisions and conversion of land. Population increase and urbanization has been a major contributor to land use change in Kiganjo and Kiambu County in general, the impact of these land uses on dairying is the cause of food insecurity and poverty. To ensure sustainable rural livelihoods through dairying, it can be assumed that there is need to identify the causes of land use change, enforce laws and policies supporting land use and encourage farmers to embrace agriculture through trainings and change in perceptions.

## Independent variables

## Dependent variables

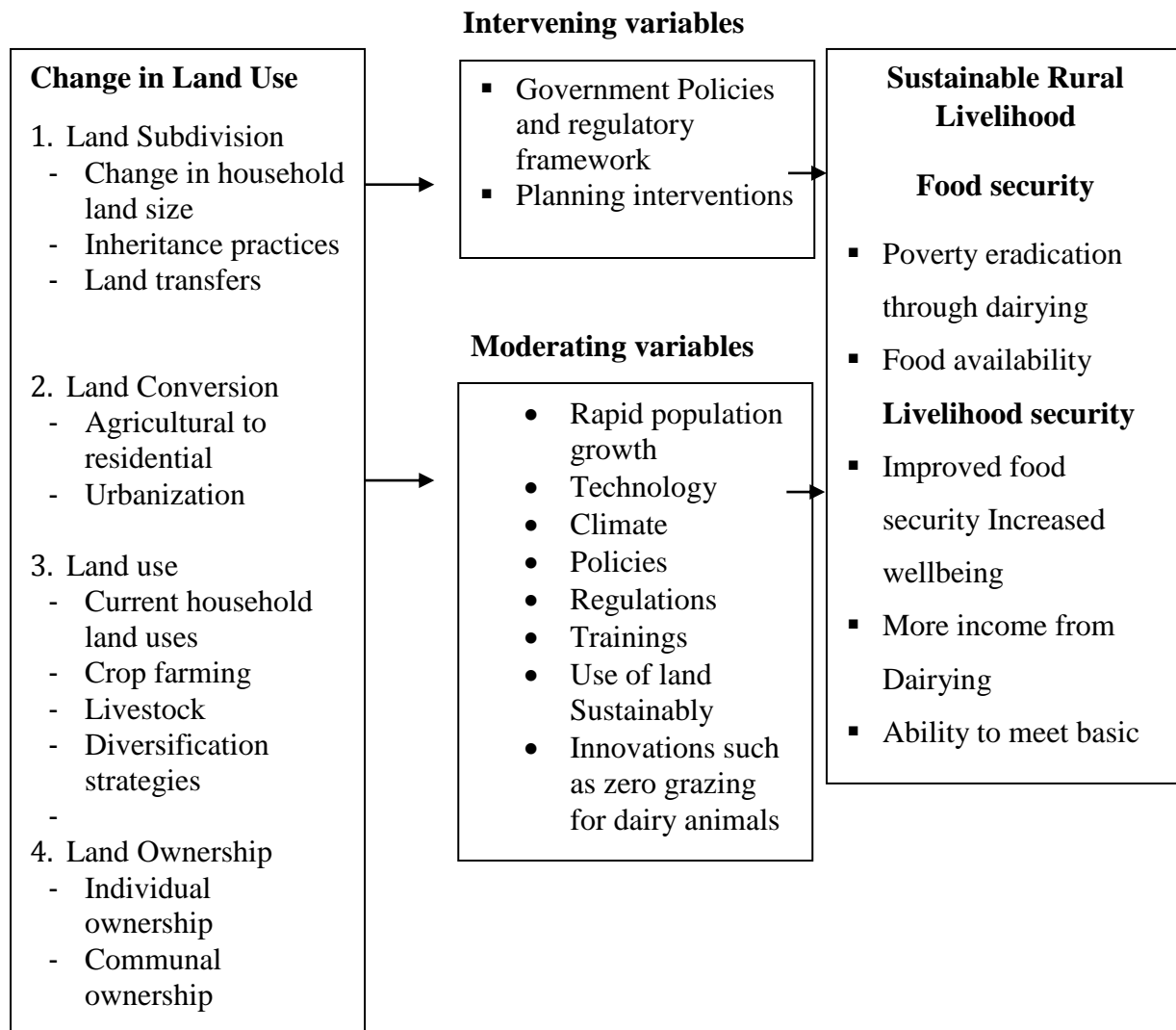


Figure 2. 4: Conceptual Framework

Source: Author, 2019

## **CHAPTER THREE: METHODOLOGY**

### **3.1 Overview**

This chapter entails a comprehensive explanation of the research methodology employed in this study. It outlines the research area, the target population, sampling techniques used, data collection methods, data organization, data analysis techniques and ethical issues during the study.

### **3.2 Research design**

Research design is the arrangement of conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure (Kothari, 2004).

The study employed descriptive survey research to make intensive investigation of land use change and its implications on sustainable livelihoods in Kiganjo sub-location. According to Jackson (2009), a descriptive research method is suitable when collecting data on a phenomenon is heavily dependent on instrumentation for measurement and observation. A descriptive survey research is characterized by obtaining information from a representative sample of the population and the findings are presented as being representative of the population as a whole (Bell 1993). Kothari (2004) says descriptive design assists the researcher in collecting data from a relatively larger number of cases at a particular time.

The purpose of this research was to gather detailed information in order to provide an insight on the impact of land use change on sustainable livelihoods among dairy farmers in Kiganjo sub-location in Gatundu south sub-County. The study was also supplemented by observations on dairy farmers' activities and discussions with the local administration officers i.e the area chief and the MCA on dairy farming.



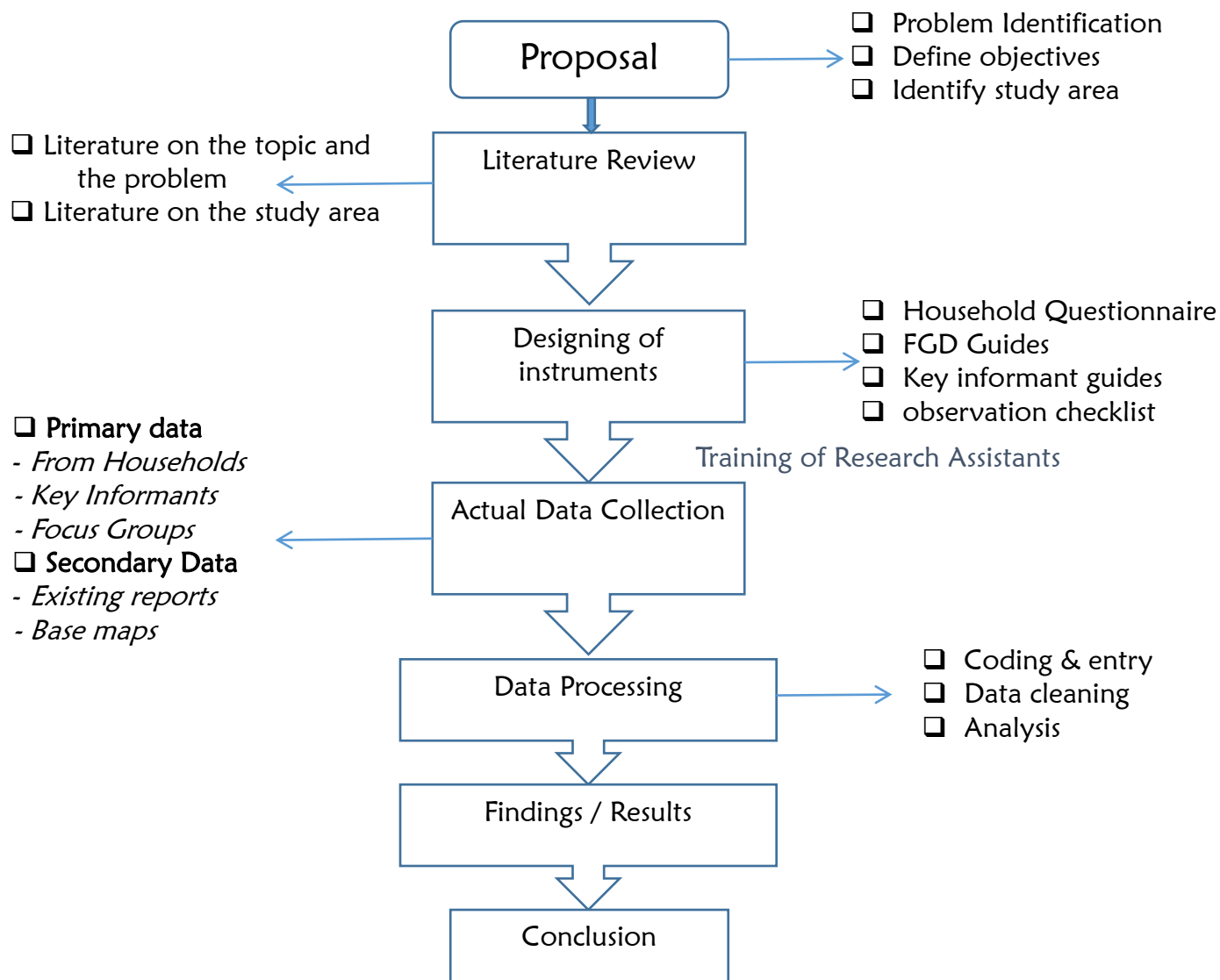


Figure 3. 1: Research methodology flow chart

### 3.3 Target Population

According to Mugenda & Mugenda (2003) a target population can be described as the entire group a researcher is interested in or the group about which the researcher desires to draw conclusions for the study. Creswell (2009) defines target population as the total collection of elements about which we wish to make inferences. The target population of the study consisted of all the households of Kiganjo sub-location. According to the population census of 2019, the sub-location had a total population of 10,136 people (KNBS, 2009).

According to the 2019 census, Gatundu South Sub-County had a total population of 114,180. The sub-county covers an area of approximately 192km<sup>2</sup> with a population density of 593 persons per

km<sup>2</sup>. Kiganjo Sub-location with a total population of 10,136 (KNBS, 2019) covers an area of approximately 19.2km<sup>2</sup>. The sub-location constitutes of 3 villages with their population as in the table below;

*Table 3. 1: Population of Kiganjo Sub-location*

<b>Village</b>	<b>Population</b>	<b>Area (Km<sup>2</sup>)</b>
Gatitu	2,620	5.4
Kiawandiga	2,553	6.0
Kiganjo	4,963	7.8
<b>Total</b>	<b>10,136</b>	<b>19.2</b>

Source: KNBS (2019)

This study therefore targets the entire population of Kiganjo sub-location which I 10,136.

Questionnaires were to be administered to either the household head (being the mother or father) or any adult person (18 years and above) related to the household head available at the time of interview. The study focused on households dealing with dairy farming either at small scale or large scale within the study area.

### **3.4 Sampling procedure**

This describes the method used by the researcher to determine the study sample size from which data was collected. Kothari (2004) points out that a sample size is a subset of the total population that is used to give the general views of the target population. The sample size is a representative of the population on which the researcher would draw conclusions of the research findings.

The study employed both the probability and the non- probability sampling techniques in selecting the study area and samples for the study where non- probability sampling entailed purposively selecting the study area while probability sampling entailed randomly selecting households to participate in the survey.

Purposive sampling was used in selecting the study area which is the Kiganjo sub-location in Gatundu South Sub-County. Kiganjo sub-location was chosen amongst other sub-locations within the four wards of Gatundu South Sub-county based on the availability of most dairying activities as compared to other region making it an ideal area to carry out this study.

Residents of the three villages within Kiganjo sub-location were then randomly selected so as to

give every household an equal and independent chance of being studied. Additionally, a convenient sampling technique was adopted to select only households involved in dairy farming within the 3 villages to participate in the survey. After achieving several households who engaged in dairy farming, they were then subjected to simple random sampling procedure that was achieved by randomly selecting participants from the subset of dairy farmers. The objective of the design was to give every head of a dairy household within the villages an equal and known chance of being chosen for inclusion in the sample.

The researcher picked 110 households based on Nassiuma (2002) formula as described below.

### 3.5 Sample Size

With a target population of 10,136 residents of Kiganjo sub-location, the study intended to determine a sample size which was manageable while being representative enough of the entire population under study. The study has adopted Nassiuma, 2002 in finding the sample size as follows;-

$$n = \frac{NCv^2}{[Cv^2 + (N-1)e^2]}$$

Where n = sample size, N = population size, Cv = coefficient of variation ( $\leq 50\%$ ), and e = error margin ( $\leq 5\%$ ). In this case is taken as 50%, e to be 5%, therefore, fitting this into the formula:

$$n = \frac{10,136 \times (0.5)^2}{[0.5^2 + (10,136-1)0.05^2]}$$

Sample size = 109.74 ~ 110

The households sample size is therefore 110 respondents.

### 3.6 Sampling Frame

The study then employed stratified simple random procedure where the target population was separated into strata to select the number of households per village which were to participate in the interviews as per table 3.1 below;

*Table 3. 2: Distribution of households to be sampled per village*

No.	Villages within Kiganjo Sub-location	Total Population	Determination of samples per village	Sample size (obtained via random sampling)
1.	Gatitu	2,620	(2,620/10,136)*110	28
2.	Kiawandiga	2,553	(2,553/10,136)*110	28

3.	Kiganjo	4,963	$(4,963/10,136)*110$	54
<b>Total samples</b>		<b>10,136</b>	$(10,136/10,136)*110$	<b>110</b>

Source: KNBS, 2019

This sample size is within the right margin for the researcher to manage comfortably. It is also adequate to give the researcher findings without significant bias.

### **3.7 Research instruments**

The researcher collected both primary and secondary data. Tools used in the collection of data on the phenomenon of the study included were as follows; household questionnaires, interview schedules for key informants, an observation checklist, a focus group discussion guide, and a camera.

#### **3.7.1 Data Collection**

The primary data focused on getting information on the household land sizes and land uses, financial returns from the land, the livelihood diversification strategies, factors influencing land uses, the impacts of land subdivision on dairy farming and possible planning interventions. Secondary data on the other hand involved existing data which was collected from; review of existing reports from libraries, internet, Registry Index Maps and public/government offices. Satellite imageries from google were used to show the settlement pattern and topography of the study area. Secondary data was reviewed from existing reports done in the county and the study area on land use/land cover, land fragmentations and agriculture specifically dairy farming.

#### **(i) Questionnaires**

##### ***Households***

Kothari (1985) states that questionnaires are simple to administer and relatively inexpensive to analyse. The household questionnaires were developed to capture baseline information on households practicing dairy farming in the selected households. They were developed and administered by the key researcher with the assistance of research assistants. The questionnaire contained both open-ended and closed-ended questions to capture detailed information from the dairy farmers. Open ended questions were used to seek the views of the respondents while closed ended questions captured the basic information on households with a view of meeting the

objectives set in the study. The questionnaire was divided into six sections covering the specific research question. The questionnaire in appendix (1) contained questions that were constructed to address the four research objectives. Administering of the questionnaires to households took place at the household level, households were randomly chosen (small and large scale) and within each selected household, the head of the household or a representative was chosen for an interview.

## **(ii) Interview Schedules**

Interview schedules are organized conversations with target groups where questions are asked and corresponding answers are given. Interview schedules in this case were organized questions for key informants and a focus group discussion. These questions sought to gather qualitative data which would respond to research questions like; drivers of land use changes, impacts of the land use changes on rural livelihoods and coping mechanisms developed by households who depend on dairying as a livelihood.

### ***Key Informants***

Interviews are more economical and provide a high response rate to the researcher. Furthermore, the researcher is able to clarify questions and gather a lot of information from the interviewee. Key informant interviews were administered to the area chief, livestock officer and the area member of County assembly (MCA). Interviews were done in order to get their insight on spatial land use change and its impact on community livelihoods and specifically dairy farmers in Kiganjo sub-location.

### ***Interview schedules for FGDs***

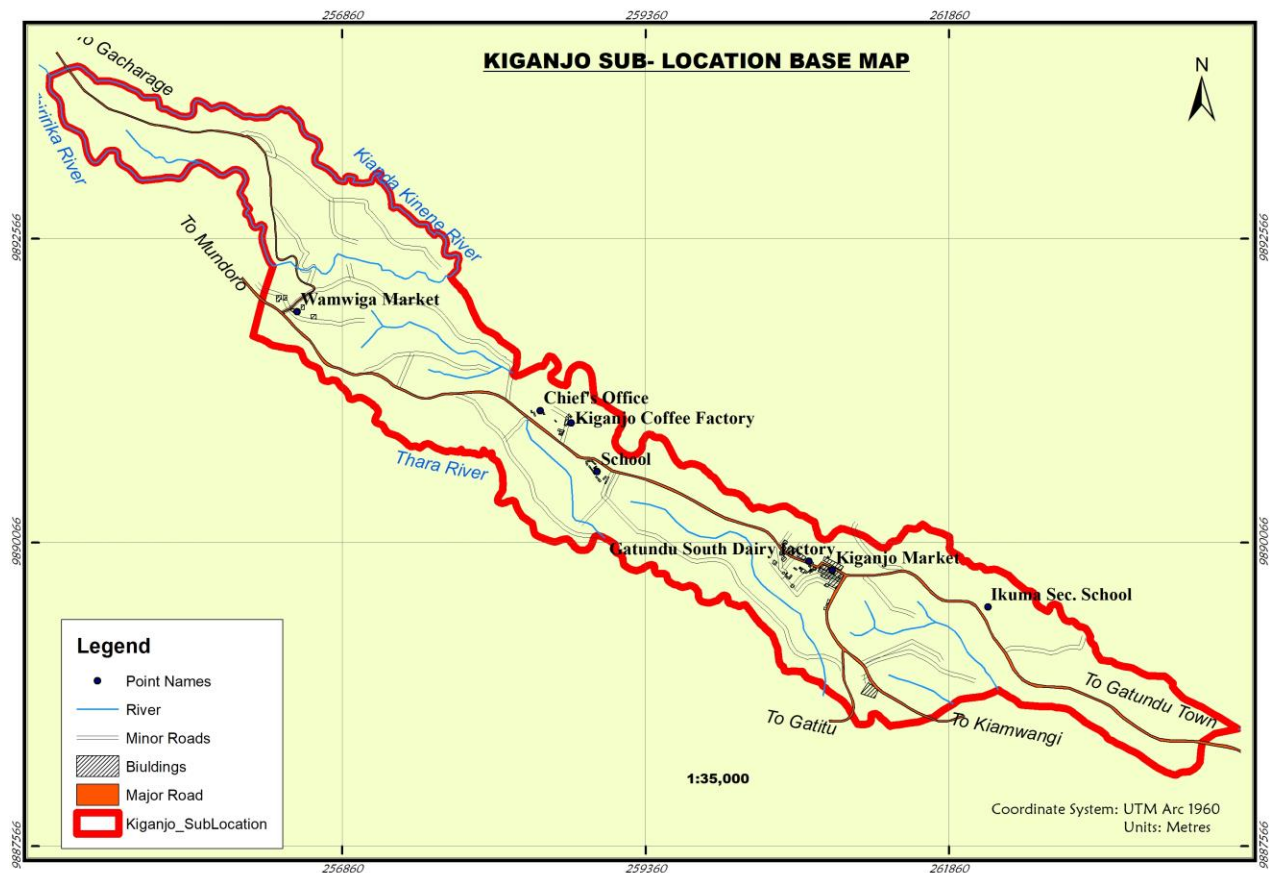
The focus group discussion involved a groups of farmers from the three villages as a representative of farmers in the study area. The researcher conducted a focus group discussion with 10 farmers to get responses on current land uses, drivers to land use changes, challenges associated with dairying, diversification strategies and possible coping mechanisms. Each topic was discussed separately and comprehensively as members gave their personal views on the issue.

### (iii) Observation matrix

The researcher with the aid of research assistants made independent observations on the type of farming done in the area, land uses, vegetation cover, public amenities, settlement pattern, animal feeds and breeds as well as community's lifestyle. This was accompanied with photography where possible.

### (iv) Base map

A base map for the study area was developed from Registry Index Maps (RIM) of Kiganjo registration block from the survey of Kenya at a scale of 1:2,500. The cadastral layer was digitized and overlaid to the sub location boundary shapefile as shown below;



Map 3: Base map for Kiganjo sub location

Source: Author (2019)

Table 3. 3: Analytical framework of data collection

<b>Research objective</b>	<b>Type of data required</b>	<b>Data collection Instrument</b>	<b>Source of data</b>	<b>Importance of data collected.</b>
<ul style="list-style-type: none"> <li>- Impact of land use change on rural livelihoods</li> <li>- Coping mechanisms to land use changes</li> <li>- Drivers of land use changes</li> </ul>	<ul style="list-style-type: none"> <li>- Land size</li> <li>- Land uses</li> <li>- Returns in dairy</li> <li>- Household expenses</li> <li>- Type of Feeds</li> <li>- Livelihood diversities</li> <li>- Trainings (Type and number)</li> <li>-Challenges</li> </ul>	Questionnaire	Farmers	-Responded to research questions on the drivers of land use changes, impacts of these changes to rural livelihoods and their coping mechanisms.
Planning interventions	<ul style="list-style-type: none"> <li>- Marketing</li> <li>- Trainings</li> <li>- Revenue</li> <li>- Optimum production</li> <li>- Challenges</li> <li>-Possible interventions</li> </ul>	Interview schedules	-Key informants	-To guide the researcher on proposing planning interventions for a sustainable livelihood in the study area.
<ul style="list-style-type: none"> <li>- Land use changes that are evident in the area.</li> <li>- Drivers of land use changes</li> <li>Impacts of the land uses changes on rural livelihoods.</li> <li>- Coping mechanisms developed by households</li> <li>Planning intervention</li> </ul>	<ul style="list-style-type: none"> <li>- Land use changes</li> <li>- Challenges</li> <li>- Possible interventions</li> </ul>	Focus group discussion	-Dairy farmers	-responded to research questions on the drivers of land use changes, impacts of these changes to rural livelihoods, challenges faced by farmers and their coping mechanisms.
<ul style="list-style-type: none"> <li>- Land use changes</li> <li>Drivers of land use changes</li> </ul>	<ul style="list-style-type: none"> <li>- Location and physical characteristics</li> <li>- Land type and size.</li> <li>- Land use</li> <li>- Community Livelihoods</li> <li>- Population/demographics</li> <li>Government interventions</li> </ul>	Document Examination	-Reports from existing documents.	-To get general information on rural livelihood, dairying and how dairy farming has been supported to sustain livelihood in rural areas.

### **3.8 Data analysis methods**

The methods of data collection combined both quantitative and qualitative forms of data at households, key informants and focus groups. However, for clarity, this subsection highlights the form of data analysis applied in this research.

#### *Qualitative analysis*

This is a process where you take descriptive information and offer an explanation or interpretation. The information analysed consisted of interview transcripts, documents accessed from respondents, pictures, videos from households, KII and focus group discussions. It typically revolves around the impressions and interpretations and therefore the role of the research was to systematize the responses in a structured and transparent form in an endeavor to address the study objectives.

#### *Quantitative data*

This is numerical data and can be collected in a number of forms. For this study there is a number of ways that the data was analysed.

- Units: Number of dairy farmers who take their milk to the dairy; litres of milk produced by farmers per day; amount of milk sold per day.

Prices: Amount of money spent on feeding dairy cattle or construction of cattle sheds, or the additional revenue of farmers following an extension programme. Amount of money received for selling milk in a cooperative.

- Proportions/percentages: Proportion of the community that has access to a artificial insemination service or extension services by the County livestock department.

- Rates of change: Prices of animal feeds/milk prices

### **3.9 Data presentation**

The Presentation of the final analyzed data was by use of various methods depending on the type of data. the essence of presenting data through the systematic methods is to bring out it's meaning, effect, or impact in the study where raw data cannot be well interpreted. The following were used;



- i. Tables, bar graphs, pie charts: These tools were used to present quantitative data obtained from the coding frequency in SPSS in form of numbers and figures. Pie charts were used to present data with three to four categories like gender of respondents, marital status, occupation, mode of land acquisition / ownership etc. on the other hand, bar graphs and tables were used to present data with more than four categories for instance age of respondent, household size, level of education, income levels, types of livestock. Agricultural activities etc.
- ii. Maps and images: These two are used when presenting qualitative data of a subject. Maps are normally used when one is presenting geographical data of the an area or phenomena. In this particular research, maps have been used to present the location of the study area in its local and national context. Images from google have been used to show facilities within the study area.
- iii. Photographs: Pictorial images are used when presenting visual qualitative data to enhance the quantitative one. Pain (2012) notes that visual methods enhance the richness of data and help with the relationship between the researcher and participant. Data enhancement is achieved as visuals facilitated communication and enabled the expression of emotions and tacit knowledge (the unspoken or unexpressed), and encouraged reflection. Photographs of the livestock reared, type of sheds, animal feeds have been used to show the type of dairying in the study area.

### **3.10 Ethical considerations**

The researcher observed the ethical guidelines as required by the University when engaging interviews to ensure that the procedures were fair and unbiased to all involved. Great care was taken to ensure that the respondents were comfortable in the research. The researcher explained the purpose of the research to all respondents in advance and how the data would be used. Research assistants were trained on ethical issues before interacting with the respondents. The researcher assured the respondents of the confidentiality of their information at all times during and after the research.

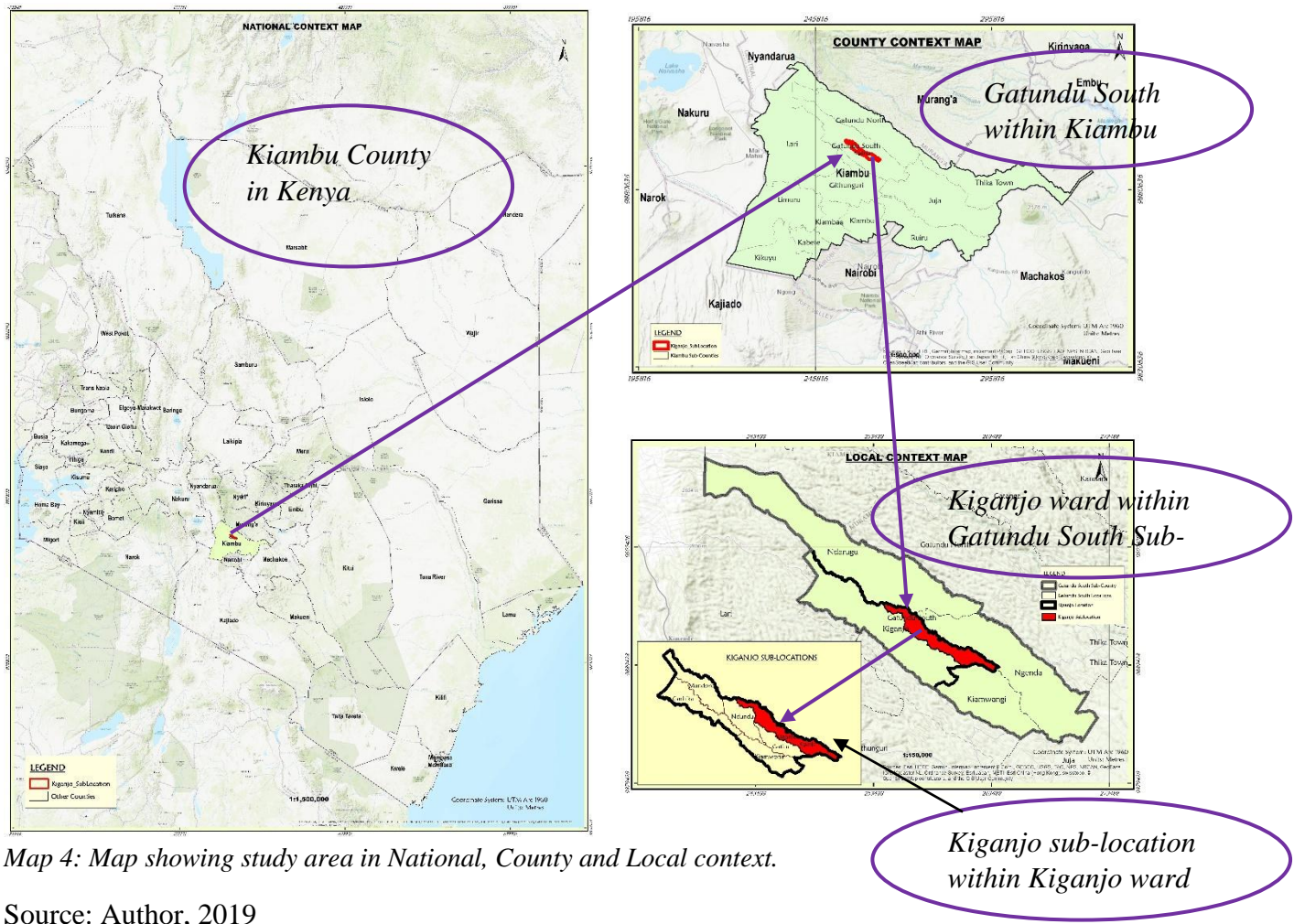
# CHAPTER FOUR: STUDY AREA

## 4.1 Overview

This chapter introduces the area of research study in terms of its geographical location, climatic condition, demographics, physical infrastructure and socio-economic characteristics.

## 4.2 Geographical location

Kiganjo sub location is located within Kiganjo ward of Gatundu South sub-county of the larger Kiambu County in Kenya. The sub-location is in the southern part of Gatundu town at 258660 Easting and 9890970 Northing. Kiganjo Sub-location measures approximately 19.2km<sup>2</sup> with an approximate 10,136 (KNBS,2019), the sub-location constitutes three villages; Kijanjo, Gatitu and Kiawandiga.



### 4.3 Population and Demographics

According to the 2019 census, Gatundu South Sub-County has a total population of 114,180 persons. The sub-county covers an area of approximately 192km<sup>2</sup> with a population density of 593 persons per km<sup>2</sup>. Kiganjo Sub-location has a total population of 10,136 (KNBS, 2019) and covers an area of approximately 19.2km<sup>2</sup>. This is constituted from 3 villages; Gatitu with a total population of 2,620 on an area of 5.4 km<sup>2</sup>, Kiawandiga village with a total population of 2,553 on an area of 6.0km<sup>2</sup> and Kiganjo village with a total population of 4,963 on an area of 7.8km<sup>2</sup>. The table below is a summary of the population distribution of Kiganjo sub location.

**Table 4. 1: Kiganjo Sub location population Distribution**

Village	Total Population	Male	Female	Households	Land size (Km <sup>2</sup> )	Pop. Density
GATITU	2,620	1,311	1,309	714	5.4	489
KIAWANDIGA	2,553	1,271	1,281	691	6.0	423
KIGANJO	4,963	2,460	2,503	1,457	7.8	640
<b>TOTAL</b>	<b>10,136</b>	<b>5,042</b>	<b>5,093</b>	<b>2,862</b>	<b>19Km<sup>2</sup></b>	

### 4.4 Population Composition in Kiganjo

Composition of a population is necessary to fully appreciate the characteristics of that population, it gives a population its personality. Data on population composition is useful in projecting the distribution of services by the government and as well monitor incidence of disease and death, and thus health care needs and demand. According to the Kenya National Bureau of Statistics (KNBS) population census of 2009, the following was the population distribution in Kiganjo ward.

**Table 4. 2: Population Composition in Kiganjo ward**

Constituency/Wards	Gender			Age group						Demographic Indicators			
	Total Pop	Male	Female	0-5 yrs.	0-14 yrs.	10-18 yrs.	15-34 Yrs.	15-64 Yrs.	65+ Yrs.	Sex Ratio	Total dependency Ratio	Child dependency Ratio	Aged dependency Ratio
Gatundu South Constituency	113,864	54,799	59,065	16,410	42,742	23,725	35,954	63,585	7,537	0.928	0.791	0.672	0.119
Kiganjo Ward	27,040	13,057	13,983	3,903	10,217	5,756	8,764	15,099	1,724	0.934	0.791	0.677	0.114

Source: KNBS, 2009

#### 4.5 Topography

Kiganjo area is characterized by steep slopes and ridges from the North West toward the South Eastern side of the town. The nature of the landscape depicts an ovale configuration with short spans of ridges and deep gorge valleys that run parallel to each other with close proximity and ultimately converging within river valleys; major river valleys in the area include Rwabura, Karimenu and Thiririka rivers. The altitude ranges between 2000 -2200 m a.s.l.



*Figure 4. 1: A section of Thiririka River within the study area*

Source: Field data 2020

#### 4.6 Climatic and physiographic features

Gatundu South Sub County climate is highly influenced by Aberdares Forest Ecosystem; climate is characterized by mist and rain that occur throughout the year, with precipitation varying from 1000mm yearly on the Northern Western slopes of Aberdare Escarpments to as much as 3000mm in the South Eastern, due the local differences in elevations, and the continentally, the climate is modified to “modified equatorial climate” (Sakwa, 2016). Kiganjo area experiences warm climate with temperatures ranging between 16°C to 20°C and an average annual rainfall of approximately 1000mm. The cool climate in the study area provides a pleasant environment for farming activities like dairy, maize and tea growing in the region. The coldest period in the Kiganjo area is experienced between June and July just like the entire County. The hottest period is experienced in the periods of January-March and September-October (KMD, 2015). The topography of the study area is gently sloppy and there are rivers, some seasonal flowing from Northwest to Southeast of Kiganjo town. The region has deep fertile volcanic red soil that supports various farming activities including growing of crops such as coffee, tea, and maize and animal feeds like nappier grass, among many others.

### 4.6.1 Agro-ecological zones

Gatundu area is generally in the lower and upper highland (UH1 & LH1) and midland 2 (UM2) zones. The area is characterized by hills, plateaus, and high-elevation plains. The area lies between 1,500-2,500 meters above sea level and is generally a tea and dairy zone with some agricultural activities like maize, horticultural crops and sheep farming being practiced.

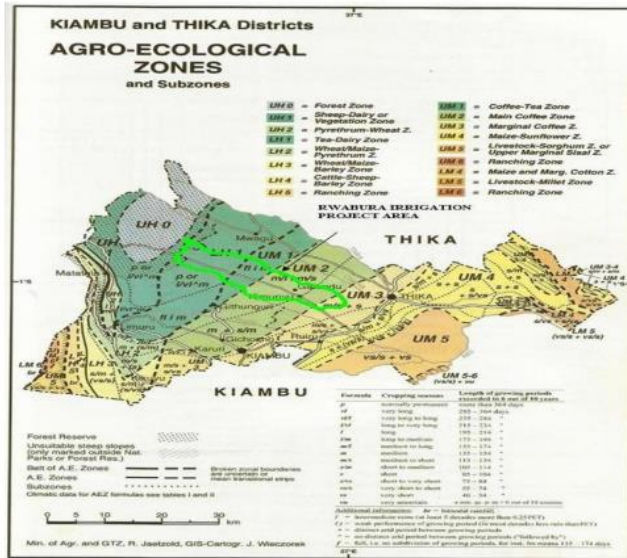


Figure 4. 2: Agro- ecological zones

### 4.7 Human settlement

This is the distribution of human activities across a landscape and the spatial relationship between these activities. The study area has both nucleated and linear type of settlements as defined by the topography and available infrastructure.

#### 4.7.1 Land Use Patterns

Gatundu South Sub County is divided into all major land use categories as follows: Agricultural, commercial, public purpose, recreation areas, residential, forestry, transportation, institutional, industrial area and water bodies. Industrial development in Kiganjo town is relatively minimal. Major industries within Gatundu South include the milk processing industry. The land prices vary depending on their location and proximity to the urban centers, all weather road network and tertiary educational institutions. With the fertile agricultural lands that characterize Gatundu in general, cost of land is comparatively high.





*Figure 4. 3: Evidence of a milk processing industry*



*Figure 4. 4: Land use pattern in the study area*

Source: Field data 2020

#### **4.7.2 Settlement patterns**

Kiganjo area being a rural village has both linear and scattered settlements. Linear settlements are seen along the major roads as seen in the image below.



*Figure 4. 5: Linear type of settlement in the study area*

Source: Field data 2020

This type of settlement pattern in the study area is characterized by the existing physical infrastructure as roads and valleys which defines the suitable terrain for cultivation of crops and homestead.



*Figure 4. 6: Nucleated settlements within the study area*

Source: Field data 2020

This pattern of settlement type in the study area is influenced by the availability of social amenities, land shortage, type of soils and security reasons define the nucleated type of settlement in the study area as families have settled around the market centre and the administration centre.

Sparse or scattered settlements within the study area can be seen as patches between parallel roads where the ground is not steep and has good fertile soils for agriculture. The land sizes in these sections are fairly large as compared to those along the road.

#### **4.8 Socio-economic/cultural profiles**

Majority of the people in Kiambu County as well as in the study area primarily rely on agriculture and industries as a means of sustaining their livelihoods. The majority of rural dwellers in the study area practice small-scale mixed farming, where they cultivate both cash crop and food crops (Wabwoba & Wakhungu, 2013) as well keep livestock. The most cultivated cash crops in the region include avocado, bananas, and coffee and some households cultivate arrowroots for sale as well. Several large-scale coffee farms provide raw materials to local industries in the area. Farmers also have cooperative unions that play significant roles in managing the growing and marketing the coffee and tea in the region. Food crops, on the other hand, include grains like maize, beans, peas, and different varieties of vegetables. Some of the



farmers in the study area do cultivate sweet potatoes, bananas, and cassava for household consumption.



*Figure 4. 7: Evidence of mixed farming in the study area*

Source: Field data 2020



*Figure 4. 8: Dairy animals in the study area*

Source: Field data 2020



In Kiganjo ward, people mostly depend on coffee, dairy farming, bananas, arrowroots, and macadamia among other crops for income and maize, beans, peas, for food. Kiambu County has several processing industries that specialize in processing agricultural produce and service provision that employ many people, including some in the study area (Ministry of Labour, Social Security & Services Kiambu County, 2015). Some of the leading industries within the county that influence lives of Kimunyu residents and other people in the county include Spinners & Spinners Ltd among others because it employs the majority of the residents. Del Monte and Brookside industries are also some of the industries in the region that provide off-farm activities through formal and informal employment to the majority of the people in the study area (Mbugua, 2016). It is also important to note that many people also engage in retail businesses where some are employed, and others manage their hotels and restaurants. Some of the population in the study area also sells foodstuffs and animal feeds, household goods, and others operate shops that sell both new and second-hand clothes. Hardware shops are also common in the area where some of the residents sell farm inputs as part of their off-farm activities for those who still engage in farming activities.



*Figure 4. 9: Macadamia trees in Kiganjo*

Source: Field data 2020

#### **4.9 Social infrastructure**

Social amenities include but not limited to primary schools, secondary schools, health centers, police station, and National and County Government administrative offices among others. There is also sufficient social infrastructure in the study area. There are plenty of religious

infrastructures in the study area, and the majority are churches because the people of the study area are mainly Christians, but there are a small number of people in the area who attend other denominations that include Islam and Hinduism.

Education facilities are also available under walking distance, for instance in Kiganjo area there are several nursery schools, primary and secondary schools. There are several institutions of higher learning within the area including Mt Kenya University Gatundu Campus, Kiambu Institute of Science and Technology and Kenya Medical Training Centre within the Sub County. Learners in search of tertiary education can as well move out of Kiganjo sub-location to institutions in Thika or other educational facilities like Kenyatta and Jomo Kenyatta universities, which are still in the County of Kiambu. The study area has various health facilities like Kiganjo dispensary, Hope medical clinic and Kiganjo health centre for health issues of its people. However, for inpatient services; Kiganjo residents travel to Gatundu level five hospital, which is approximately 11 kilometres from Kiganjo area.



*Figure 4. 10: Health facility in Kiganjo Sub-location*

Source: Google earth 2020 image



#### 4.10 Physical Infrastructure

The study area is well served with all-weather roads. The main road is Kenyatta road that links Kiganjo with Thika road and other centers within Gatundu including Gatundu town. Most of the feeder roads feed Kenyatta road that then links with other roads enabling people and especially farmers to transport their producers from sources to the market. In a report by the County government of Kiambu roads in Gatundu South in 2014, the County reported to have rehabilitated over 70km of roads in the sub-county and plans to construct a minimum of 3,500km by 2018. This has not been achieved so far but the project is underway.

Rural Roads Projects Done During Financial Year 2013/2014					
Sub County	Ward	Project	Length of road	Length graded	Length gravelled
<b>GATUNDU SOUTH SUB-COUNTY</b>					
	<b>KIGANJO</b>	P.C.E.A Ndarugurd	1	1	1
		Handege Kiganjo Access Road	1.5	1.5	1.5
		Kiganjo Polytechnic Access road	1.4	1.4	1.4
		P.C.E.A Kiganjo Rd.	2.5	2.5	2.5
		Kanyuira Rd.	1.8	1.3	1.3
		Kahatanjeng'ererd	1.0		
		St. Lawrence Gatahi Rd	1.0		



Figure 4. 11: Roads in Kiganjo area

Source: Google earth 2020 image

Most of the households are connected with clean-piped water, but the supply of water is only limited to human consumption. There is no water for farming in the study area meaning that all the farmers have to depend on increasingly unreliable rainfall for their farming. Every household manages their waste by burning the solid waste and use of pit latrines for liquid waste since the area is not connected with the sewer line. Most of the households are also connected to the main power grid system making electricity the primary source of energy for lighting.



*Figure 4. 12: Evidence of electricity in Gatundu town*

Source: Field data 2020

## **CHAPTER FIVE: DATA ANALYSIS AND DISCUSSIONS**

### **5.1 Introduction**

The purpose of this study was to assess the impacts of land size and land use changes on rural livelihoods in dairy farming zones in Kenya. This chapter presents the study findings based on the study questionnaire and other interviews as guided by the objectives; provide detailed interpretation and inferences of the findings; and based on this to present the study conclusions and recommendations and finally to indicate areas of further research which included aspects of the study that have been revealed by the study but go beyond its purview. As a forethought the study focused on the following objectives:

1. To establish land size changes in the study area,
2. To analyse the land use changes that are evident in Kiganjo sub-location,
3. To assess the impacts of the land uses changes on rural livelihoods,
4. determine the coping mechanisms developed by households who depend on dairying as a livelihood,
5. To propose or recommend a planning intervention that promotes sustainable rural livelihood in the study area.

### **Response Rate**

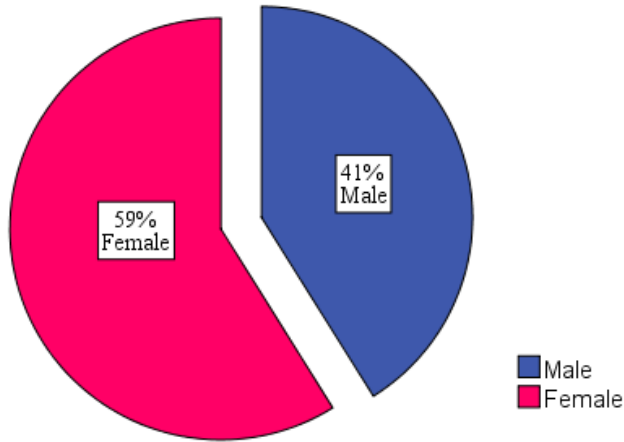
This is the proportion of the sample that participated in the study. The study targeted households dealing with dairy farming, a total of 110 household questionnaires were administered with the aid of research assistants. Out of 110 household questionnaires, 90 questionnaires were successfully completed and returned giving a response rate of 82%. The study findings presented in this chapter are derived from analysis of data from the household questionnaires, business, key informants and field observations.

### **5.2 Socio-Economic Characteristics**

#### **5.2.1 Gender**

Out of the ninety respondents, 59% were female and 41% were male as shown in Figure 5.1 below. From the study findings it is clear that there are more women than men who are left at home to take care of the farm and hence able to engage in the study.

**Gender of Respondent**



*Figure 5. 1: Gender of respondent*

Source: Field data, 2020

### **5.2.2 Age**

Most of the respondents were aged between 31 – 40 years constituting 22% of the total number of respondents. The respondent aged between 81-90 years were the least constituting a total of 3% of the total number of respondents as shown in Figure 5.2 below. The age of the respondent is a factor in production because as people becomes old or when they are young, they are less productive. In Kenya, the productive group ranges between 16-64 years while dependents are those below 15 years and those above 64 years old. The findings indicate that majority of the respondents have between 31-40 years, this age group is considered experienced and informed since they have witnessed the changes that have occurred in the study area over time in terms of land use and agricultural productivity.

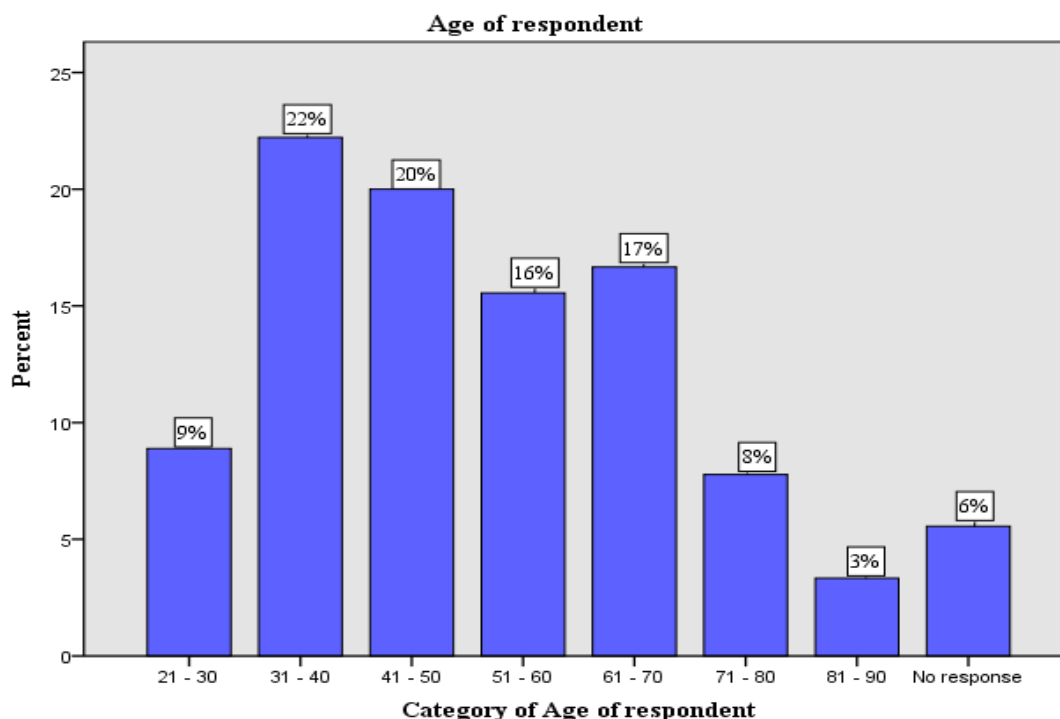


Figure 5. 2: Age of the respondents

Source: Field data, 2020

### 5.2.3 Education Levels

Secondary school is the highest education level attained by majority of the households constituting 37% with those who attained primary school constituting 24% of the residents while those with no school constituted 7% as shown in the Figure 5.3 below. The education level of the respondent is important because it determines the ability of the individual to read and write and also acquire information that is vital towards enhancing dairy farming and agriculture in general. Effective literacy skills open one's opportunities to employment/labour market. Due to the ever rapidly changing world and technologies, advanced levels of education would enable the dairy farmers to competitively keep pace with the ever changing trends of dairy in the world. Due to most of the farmers have not had the formal education, they tend to use the old technology hence providing less produce which in return provides little returns.

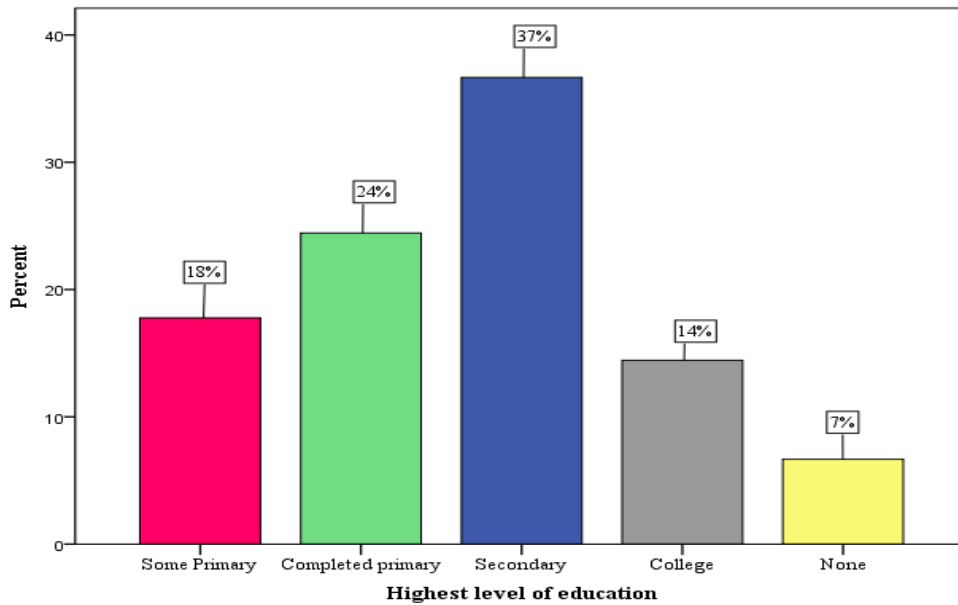


Figure 5. 3: Respondent's education level

Source: Field data, 2020

#### 5.2.4 Marital Status

Marital status is important in household sustainability for instance married couples are likely to support one another and increase the chances of household sustainability in terms of income and even food. Majority of the respondents at 80% are married while 12% of the total number of respondents are widowed. 7% are single while 1% of the total number of respondents have separated or divorced as shown in Figure 5.4 below.



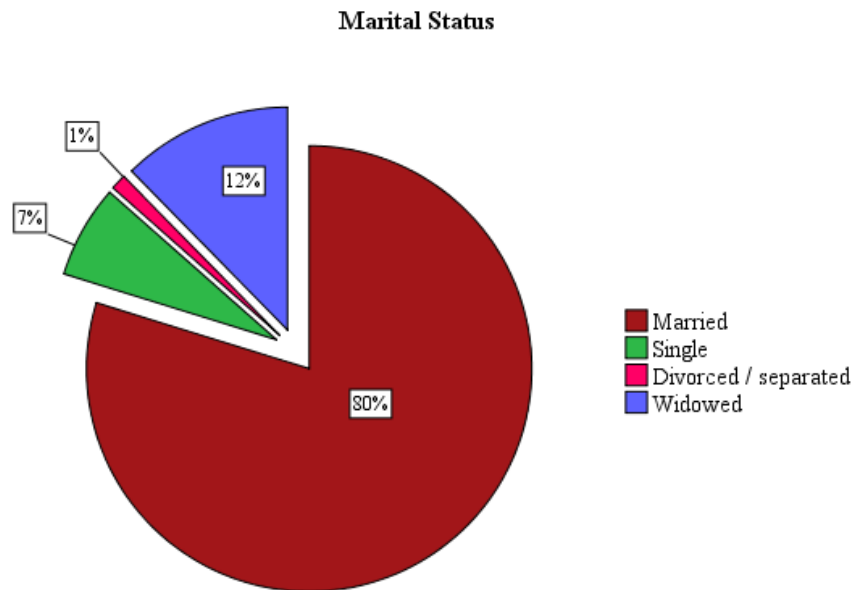


Figure 5. 4: Marital status

Source: Field data, 2020

### 5.2.5 Occupations

The analysis of data found that the main occupation of the respondents in the study area is farming providing employment to 95% of the total number of respondents. Business employ 3% while formal employment constitutes 1% of the total number of respondents as shown in the following Figure 5.5.

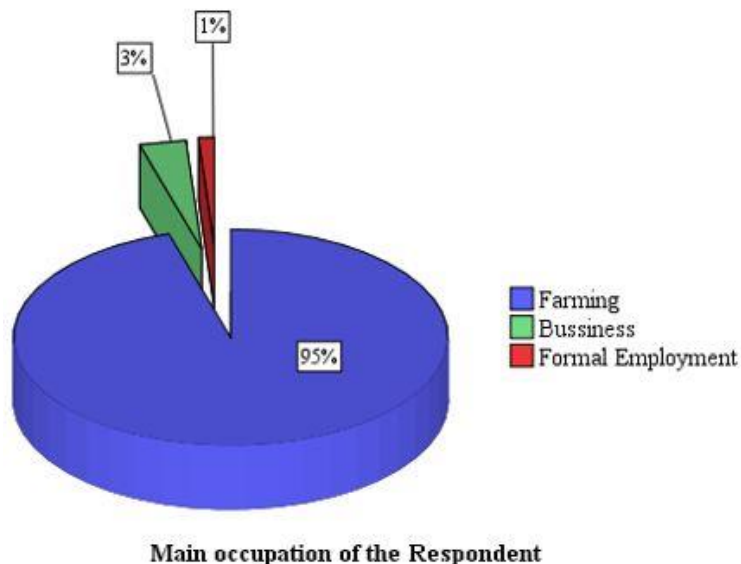


Figure 5. 5: Occupation of the Respondent

Source: Field data, 2020

### 5.2.6 Household Size

Household with many members require more resources to sustain them however when each member engage in income generating activity household with many members is likely to perform well compared to household with less members. The findings indicate that majority of the households at 24% in the study area have two members. Households with 4 members constitute 18% of the total number of households while those having 10, and 11 members are constituted by 1% of the households each as shown in the following figure 5.6.

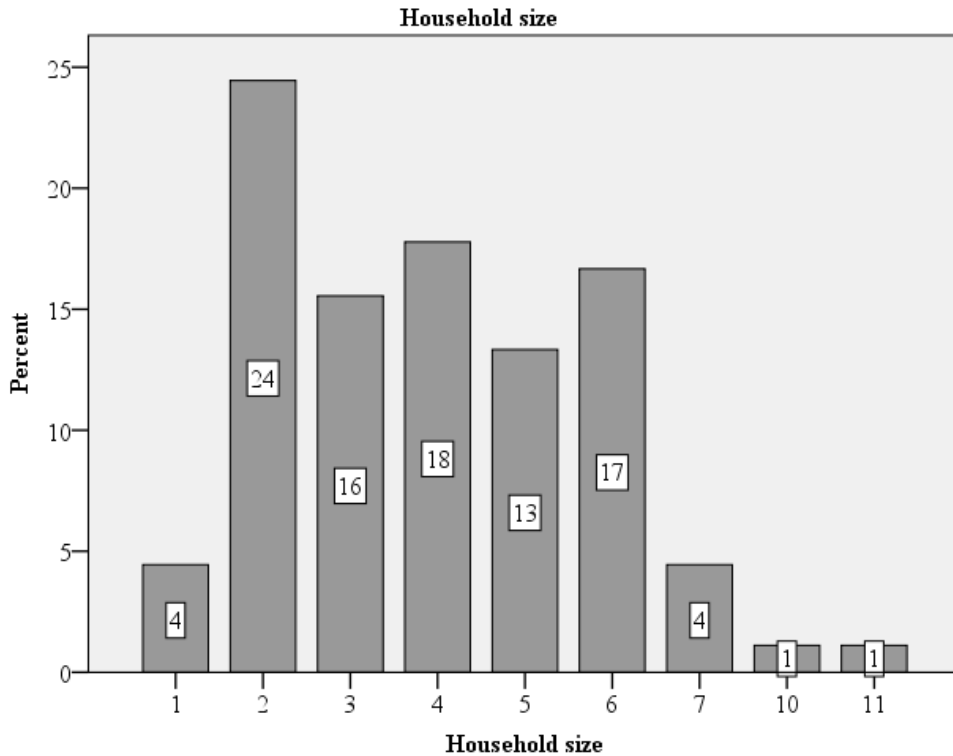


Figure 5. 6: Household Size

Source: Field data, 2020

The household size influences the overall agricultural output, the larger the household size, the larger the area set aside for the family homestead which means less land available for agricultural production. The household size also influences the future size of the land because of existent cultural practices like inheritance where offspring are allocated land belonging to parents upon their demise. Large households therefore tend to have lesser and lesser land size with each subsequent generation if the family is incapable of purchasing land. The average household size in the study area is 3.

### 5.2.7 Households living on or off farm

Majority of the respondents constituting 99% of the total number of respondents live on the farm while the remaining 1% live off the farm as indicated by Figure 5.7 below. On farm living means households deal in activities on their farm like farming and small scale businesses, off farm on the other hand indicates that households deal with activities undertaken away from the person's own farm. They may include formal or casual employment in office or on other people's farms. Results in this study indicate that Kiganjo is an agricultural town with its population relying on agriculture for a living. This therefore calls for proper management of the agricultural land in the area to sustain the livelihoods.

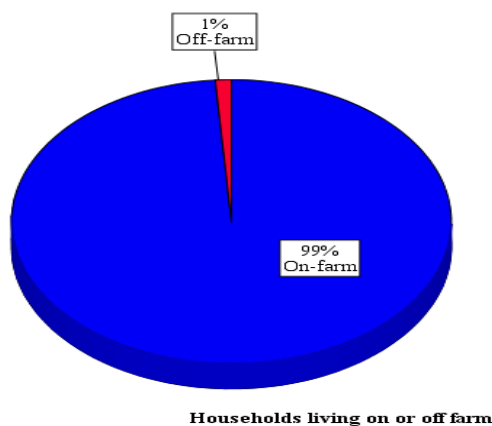


Figure 5. 7: Where Respondent live

Source: Field data, 2020

### 5.2.8 Land Size

The size of land is an important factor when it comes to food security and sustainable livelihood because if people with significant sizes of land utilize it properly, they will have a more sustainable livelihood than those with small portions of land. A key finding of the study is that the average land size is 2.0451 acres. Other findings in regard to land size indicate that majority at 48% own land less than 1 acre; 41% own the land between 1 & 3 acres; 3% own the land between 3 & 6 while 2% own the land between 6 & 9 acres. Those who own 9 acres and above are constituted by 6% of the total number of respondents as shown in Figure 5.11 below. Off those who own less than 1 acre, this land is distributed across various activities including crop farming area, dairy farming and area for the homestead.

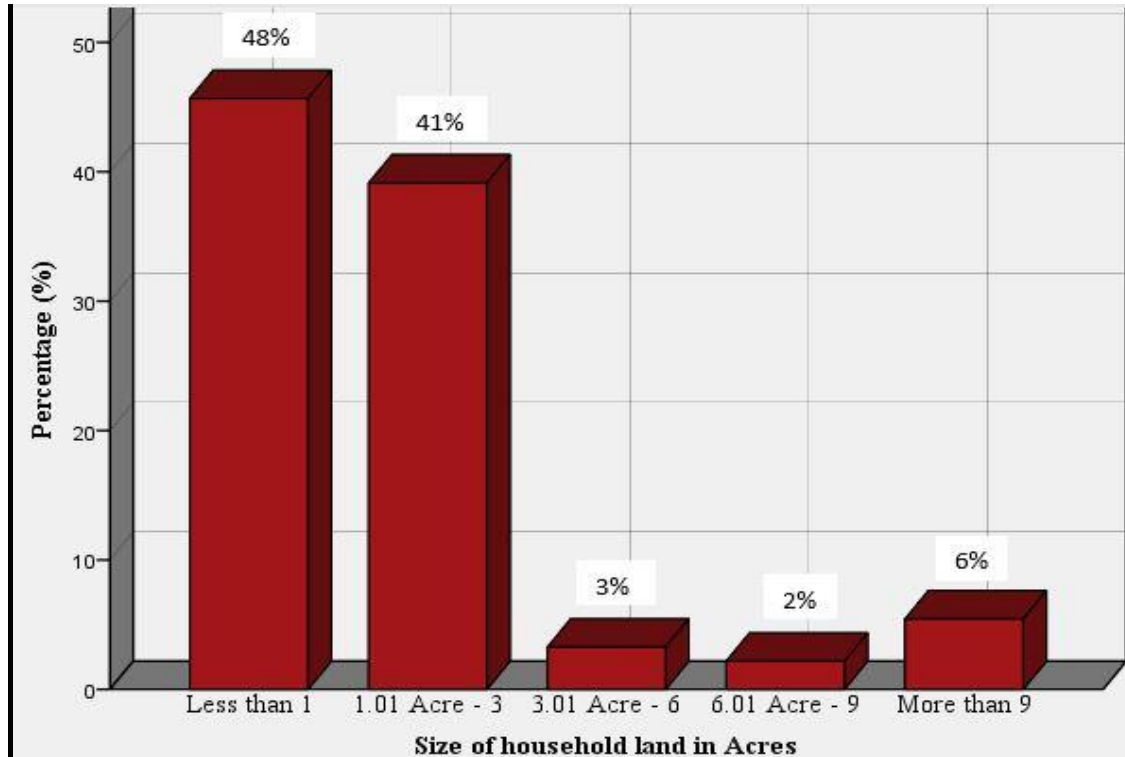


Figure 5. 8: Household Land Size

Source: Field data, 2020

### 5.2.9 Land Ownership

Land is a factor of production and owning a portion of enables an individual to engage in income generating activities thus enhancing sustainable livelihood and food security in the household. The Constitution of Kenya gives rights to all to acquire and own land in Kenya. In Kiganjo findings indicate that 91% of the respondents own the land they are living on by virtue of inheritance or buying while 9% do not own it. The 9% are only holding for their relatives who live away from home by utilizing on their behalf as shown on the Figure 5.8 below.

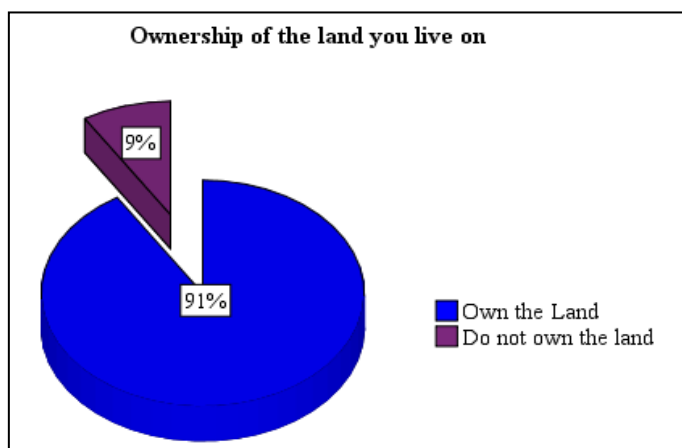


Figure 5. 9: Land Ownership

Source: Field data, 2020

### 5.2.10 Mode of Land Acquisition

Land can be acquired through different modes, namely, inheritance, purchase or lease. Given the socio-cultural practises of the people in the study area, inheritance is the dominant mode of land acquisition. However, land inheritance has led to diminishing land sizes because parents subdivide land into small portions depending on the number of children to bequeath the property. The findings indicates that majority of the households at 94% acquired the land through inheritance while 5% bought the land. , a few of the study respondents at 1% also were not willing to share their mode of acquisition of the land as shown in Figure 5.9 below.

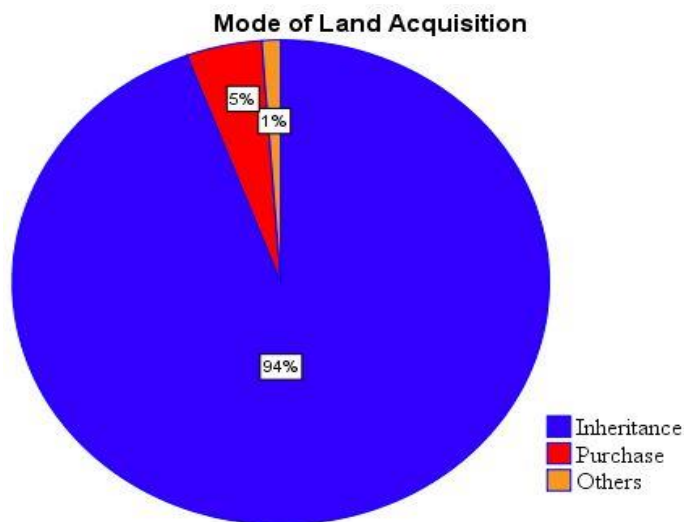


Figure 5. 10: Mode of Land Acquisition

Source: Field data, 2020

### 5.2.11 Formal Land Ownership

Owning a land title deed enables one to have security of the property and gives them freedom to engage in long term economic activities and even build permanent structures in the farm. Documents such as title deeds can also be used as collaterals to obtain loans enabling farmers to improve their agricultural activities or have diversification strategies for sustainable income.

The study findings indicate that majority of the respondents at 76% have title deeds while 7% have letters of allotment. One percent (1%) of the total number of households have share certificate while 16% do not have any land ownership documents as shown in Figure 5.10 below.

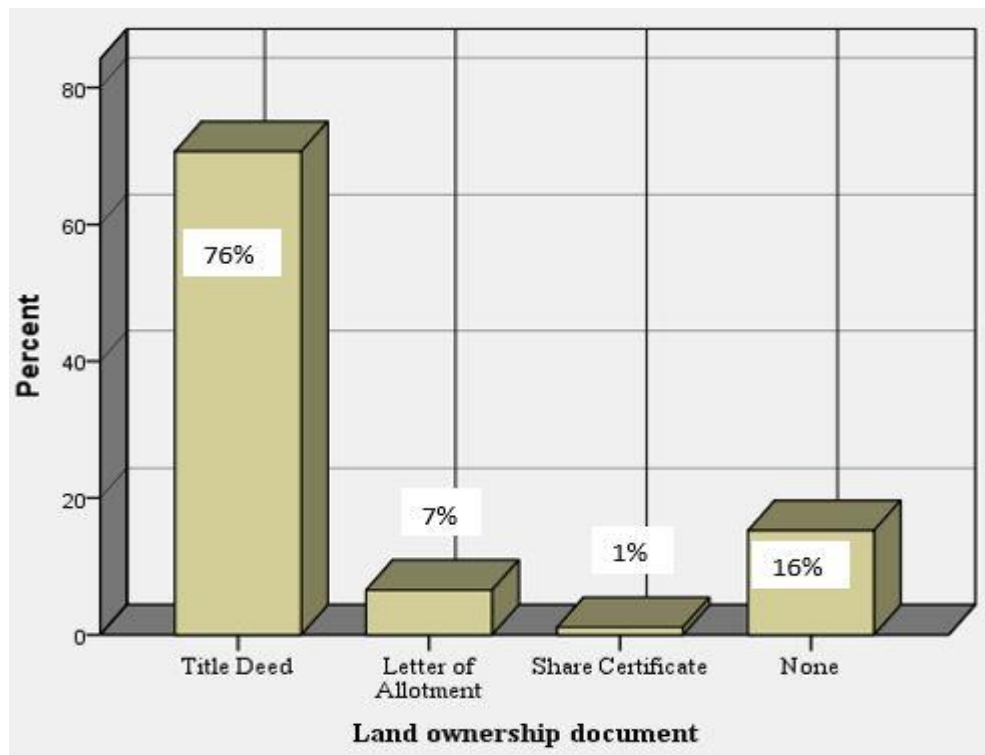


Figure 5. 11: Land Ownership Document

Source: Field data, 2020

### 5.3 Land Size Change in the study area

The size of land plays a significant role in determining the type of land use that an individual can engage in. When the size of land becomes smaller and smaller for instance the initial 1 acre which has undergone subdivision to about  $\frac{1}{4}$  acres, people tend to find alternative ways to ensure sustainability of households in terms of food and income like seeking formal employment or engaging in business. The study set out to determine the average household land size change in the study area. Information on land size was obtained and summarized as in the table below;

Table 5. 1: Average household land size change

Participants	Average land size for Grand Parents (Acres)	Average land size for current Male parents (Sons) in Acres	% change from Grandparent to son (Parent)	Average land size for male Grandchild	% change from Grandparent to Grandson

Male	5.20	0.83	84.04%	0.347	93.32%
Female	10.25	2.3	77.56%	0.65	93.66%
<b>Average</b>	<b>7.725</b>	<b>1.565</b>	<b>79.74%</b>	<b>0.499</b>	<b>93.54%</b>

The average initial land size of the households before subdividing or buying other parcels of land was 7.725 acres while the current land size during this study was 0.499 acres. The percentage land size change between the initial size and the current land size of the respondents is 94%. With continuous reduction in land size, and with the conventional ways of dairying embraced by farmers in Kiganjo, some of the dairy farmers will be forced to depend primarily on outsourced feeds to sustain their animals as they have space to grow feeds. This then calls for more advanced technological ways of dairy farming to promote intensive and lucrative farming.

### **5.3.1 Trends in Land size change**

During the pre-colonial era in Kenya, land was owned communally as guided by the customary law. Land was not bought or sold but passed to next generations through inheritance. During colonization the white settlers possessed most of the fertile highlands through consolidation leaving Kenyans landless in those areas. After independence, with most of the citizens taking up control of their land, the established systems allowed to own land privately. Land sizes have been on a gradual decline since independence as a result of population growth. With this system, families have subdivided their pieces of land in the name of inheritance or for the purposes of selling and at some point rendered them uneconomical.

#### ***Findings from the focus group discussions on land size change***

Data was collected from adult female of an average age of 64 years and adult male of an average age of 71 years on the amount of land transferred within two generation as follows;

1. Grandparents to Children
2. Children to grand children

#### ***(i) Land size change from Grandparents to Children***

Results were as follows; according to female participants, a household with an average number of children as 7.6 where 2.6 are sons and 5 are daughters. With an average family land size as

10.25 acres, 4.3 acres was given to sons and 0.56 was given to daughters. This resulted into a reduction of 77% from the initial father's land.

The second category of participant was of elder men, according to them, a household with an average number of children was 6.3 with 3.6 being sons and 2.8 being daughters. With an average family land size as 2.89 acres, 0.9 acres was given to sons and 0.35 was given to daughters. This resulted into a reduction of 68.6% from the initial father's land.

*Table 5. 2: land size change from Grandparent to Children*

Participant Label	Age of Participant (Years)	Number of Fathers' Children	Number of Fathers' Sons	Number of Fathers' Daughters	Size of Fathers household land (acres)	Land given to Father's sons (acres)	Land given to Fathers' daughters (acres)	% reduction from Parents to Sons
EF1	76	7	4	3	0	0	0.00	0.0
EF2	68	10	2	8	36	8.00	2.00	72.2
EF3	50	10	3	7	13	3.0	0.25	76.9
EF4	54	4	2	2	2	0.5	0.50	75.0
EF5	72	7	2	5	0.25	0.04	0.04	84.0
<b>Average Female</b>	<b>64.0</b>	<b>7.6</b>	<b>2.6</b>	<b>5.0</b>	<b>10.25</b>	<b>2.3</b>	<b>0.56</b>	<b>77.0</b>
EM1	73	7	4	3	1.5	0.30	0.30	80.0
EM2	72	8	2	6	1.0	0.50	0.00	50.0
EM3	70	5	4	1	2.0	0.50	0.00	75.0
EM4	69	8	5	3	24.0	0.75	1.30	96.9
EM5	70	6	5	1	3.0	0.75	0.00	75.0
EM6	73	5	1	4	3.0	0.75	0.75	75.0
EM7	75	7	5	2	0.0	0.00	0.00	0.0
EM8	73	9	4	5	6.0	1.50	0.00	75.0
EM9	62	2	2	0	6.3	3.15	0.00	50.0
<b>Average Male</b>	<b>70.8</b>	<b>6.3</b>	<b>3.6</b>	<b>2.8</b>	<b>5.20</b>	<b>0.83</b>	<b>0.26</b>	<b>68.6</b>

*(ii) Land size change from Children to Grandchildren*

Results were as follows; according to female participants, a household with an average number of children as 5.4 of which 2.4 are sons and 2.8 are daughters. With an average family land size as 2.8 acres, 0.81 acres was given to sons and 0.6 was given to daughters. This resulted into a reduction of 73.8% from the initial father's land.

The second category of participant was of elder men, according to them, a household with an average number of children was 5.7 with 2.2 being sons and 3.4 being daughters. With an



average family land size as 1.6 acres, 0.37 acres was given to grandsons and none was given to granddaughters. This resulted into a reduction of 76.9% from the initial father's land as shown in the table below.

Table 5. 3: land size change from Children to Grandchildren

Label	Age of participant	Number of Children	Number of Sons	Number of Daughters	Size of household land (acres)	Land given to sons (acres)	Land given to daughters (acres)	% change from parents to sons
EF1	76	7	4	2	3.5	0.75	0.50 (Parents)	<b>78.6</b>
EF2	68	6	4	2	4.5	0.75	0.75 (Parents)	<b>83.3</b>
EF3	50	1	0	1	0.75		0.75 (Parents)	-
EF4	54	5	2	3	0.75	0.25	0.75 (Parents)	<b>66.7</b>
EF5	72	8	2	6	4.5	1.50	0.25 (Parents)	<b>66.7</b>
<b>Ave</b>	<b>64</b>	<b>5.4</b>	<b>2.4</b>	<b>2.8</b>	<b>2.8</b>	<b>0.65</b>	<b>0.6</b>	<b>73.8</b>
EM1	73	7	4	3	0.50	0.125	0.25	<b>75.0</b>
EM2	72	5	2	3	0.25	0.125	0.00	<b>50.0</b>
EM3	70	6	1	5	0.50	0.50	0.00	<b>0.0</b>
EM4	69	3	1	2	4.00	1.00	1.0	<b>75.0</b>
EM5	70	4	2	2	0.75	0.20	0.35	<b>73.3</b>
EM6	73	6	1	5	0.75	0.125	0.625	83.3
EM7	75	5	2	3	0.75	0.15	0.6	80.0
EM8	73	7	2	5	3.50	0.50	3.0	85.7
EM9	62	8	5	3	3.10	0.40	2.7	87.1
<b>Ave</b>	<b>71</b>	<b>5.7</b>	<b>2.2</b>	<b>3.4</b>	<b>1.57</b>	<b>0.347</b>	<b>0.947</b>	<b>76.9</b>

The study shows that there has been a significant change in land sizes in majority of the households due to land inheritance from one generation to the other over time as a result of population growth. It is evident that the land which was previously held by grandparents was considerably larger compared to the one their children and grandchildren own in the study area. The average land size that the previous parents owned was 7.725 acres but as a result of massive land subdivision, the average land size for the current parents is 1.565 and 0.41 acres while that of the grand children is 0.499 and 0.773 Acres respectively as shown in Tables below.

Table 5. 4: Land Size Change Over two (2) Generations (Grandparent to Grandson)

Participants	Average land size for Grand Parents (Acres)	Average land size for current Male parents (Sons) in Acres	% change from Grandparent to son (Parent)	Average land size for male Grandchild	% change from Grandparent to Grandson

Male	5.20	0.83	84.04%	0.347	93.32%
Female	10.25	2.3	77.56%	0.65	93.66%
<b>Average</b>	<b>7.725</b>	<b>1.565</b>	<b>79.74%</b>	<b>0.499</b>	<b>93.54%</b>

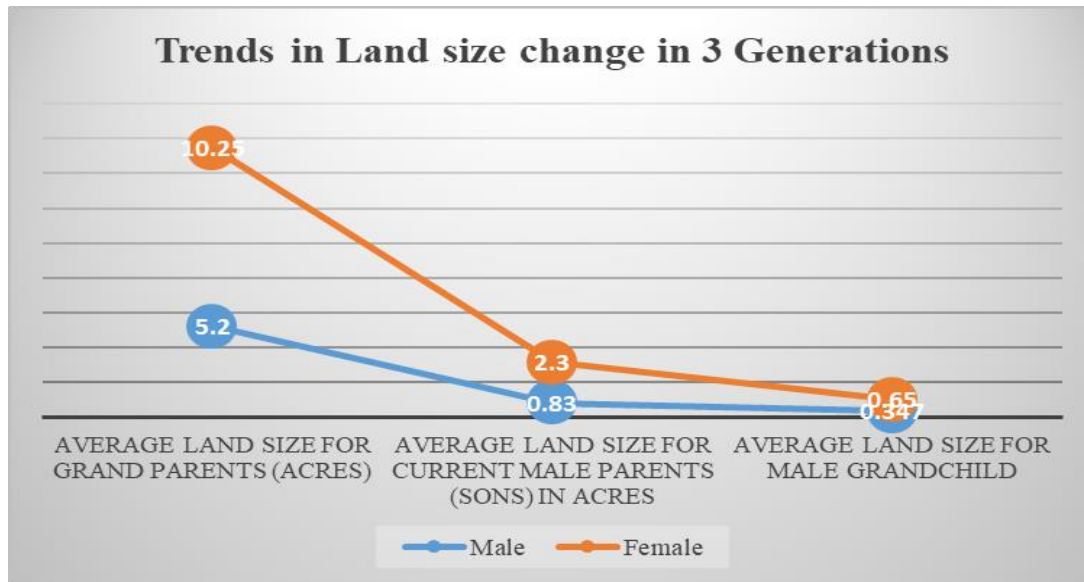


Figure 5. 12: Land Size Change Over three (3) Generations (Grandparent to Granddaughter)

Source: Field data, 2020

Table 5. 5: Land Size Change Over three (3) Generations (Grandparent to Granddaughter)

Participants	Average land size for Grand Parents (Acres)	Average land size for current Female parents (Daughters) in Acres	% change from Grandparent to Daughter (Parent)	Average land size for female Grandchild	% change from Grandparent to Granddaughter
Male	5.20	0.26	95.0%	0.947	81.79%
Female	10.25	0.56	94.54%	0.6	94.15%
<b>Average</b>	<b>7.725</b>	<b>0.41</b>	<b>94.69%</b>	<b>0.773</b>	<b>89.99%</b>

On average, there is a reduction of 93.54% in land size from the initial family land to male children over two generations while an 89.99% change to female children within a household.

### 5.3.2 Drivers of Land Subdivision

To understand the drivers of land use change through land subdivision, respondents were asked to state reasons why that land was subdivided. Eighty percent (80%) of the respondents reported that their land was subdivided in order to be given to children as an inheritance. Fifteen percent (15%) subdivided in order to sell to pay school fees for their children or to meet family issues. Five percent (5%) reported to have subdivided to pave way for development of rental units and shops for commercial activities.

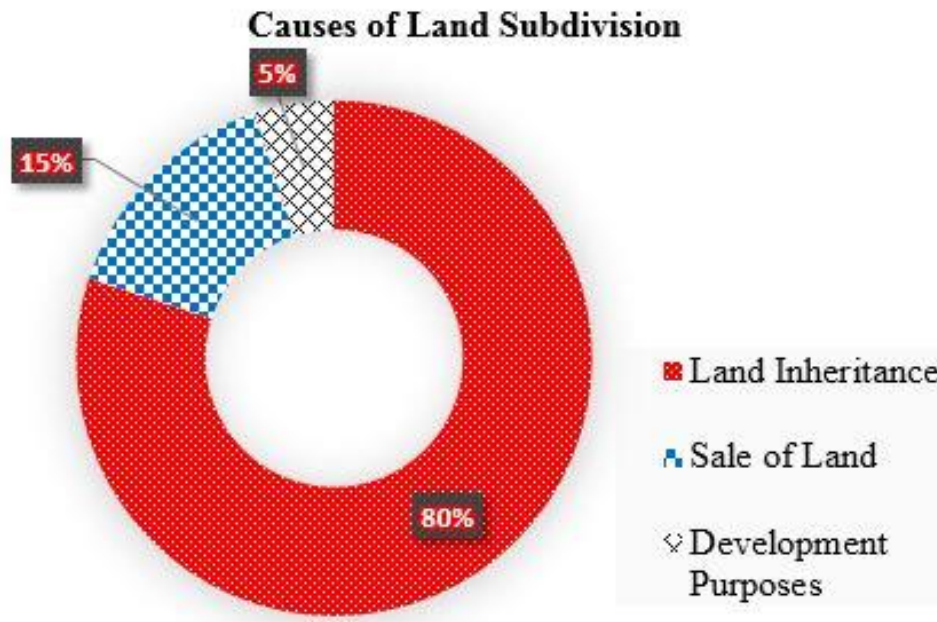


Figure 5. 13: Causes of land subdivision

Source: Field data, 2020

## 5.4 Land Use Change as a result of Conversion

### 5.4.1 Spatial distribution of land agricultural activities

Farmers in the study area use their land for different economic activities, on an average land size of 1 acre, cash crop occupies 42% of the total size of the land while food crop production is the second agricultural activity occupying 28% of the total size of the land. Livestock keeping that include dairy, pigs, poultry goats, sheep and fodder production occupies 21% of the total size of the land while homestead occupies 6%. The remaining 3% is occupied by fish ponds as shown on the Table 5.1 below.

Table 5. 5: Distribution of agricultural activities

<b>Type of agricultural activity</b>	<b>Percentage distribution under 1 acre</b>
Cash crop	42%
Food crop	28%
Livestock (including Fodder)	21%
Homestead	6%
Fish ponds	3%

Source: Field data, 2020

The study findings reveal that the main source of employment to majority of respondents as indicated by figure 5.5 is farming. The dominant land use in the study areas is agriculture where each household engage in it in one way or another. Household engage in agriculture in different forms ranging from cash crop, food crop cultivation and rearing of livestock.

#### **5.4.2 Productive Agricultural Activity**

It was important to find out the most productive agricultural activity in the study area. People tend to change from less profitable activities to those lucrative ones resulting to land use changes. The study findings indicate that banana farming is the most profitable venture in the study constituting a total of 28% while dairy farming and avocado follows closely as mentioned by 24% of the total number of households. Arrowroot cultivation comes after dairy farming followed by macadamia cultivation as mentioned by 14% and 7% of the total number of households respectively. A small percentage, constituting 3% of the total number of households mentioned coffee as a productive crop in their households as shown on Figure 5.15 below.

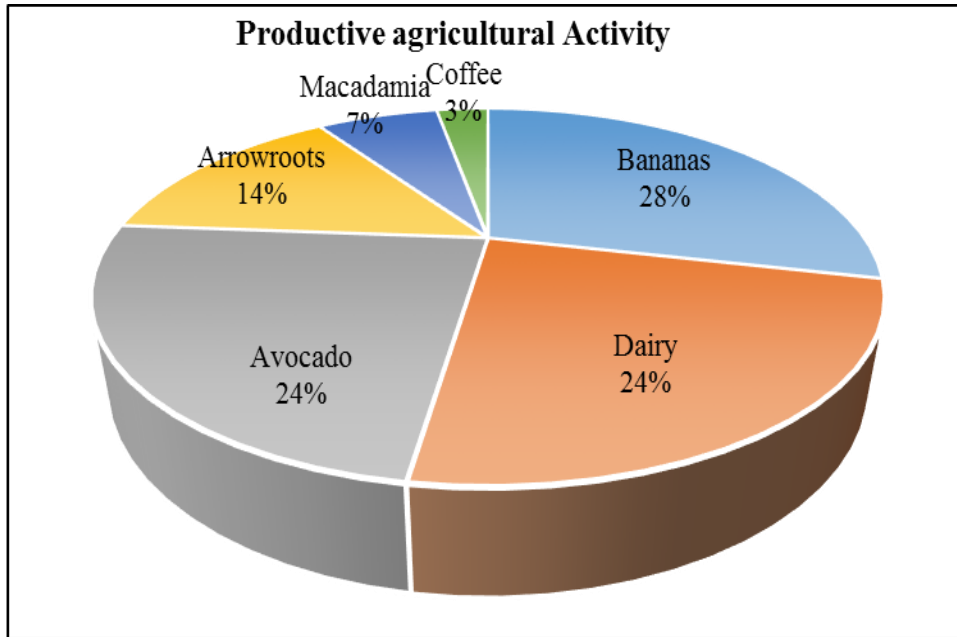


Figure 5. 14: Productive Agricultural Activity

Source: Field data, 2020

### 5.4.3. Cash Crop Cultivation

Apart from dairy farming, Kiganjo residents also engage in cash crop production. Banana crop is the leading cash crop in the study area where 40% of the total number of respondents engage in the production of the crop. A total of 31% of the respondents engage in cultivation of avocado fruits making it the second cash crop after bananas. Arrowroots is another significant cash crop in the study areas where 12% of the total number of respondents produce the crop. Residents of Kiganjo also cultivate coffee and macadamia constituting a total of 9% and 8% of the total number of respondents respectively has shown on the figure 5.12 below.

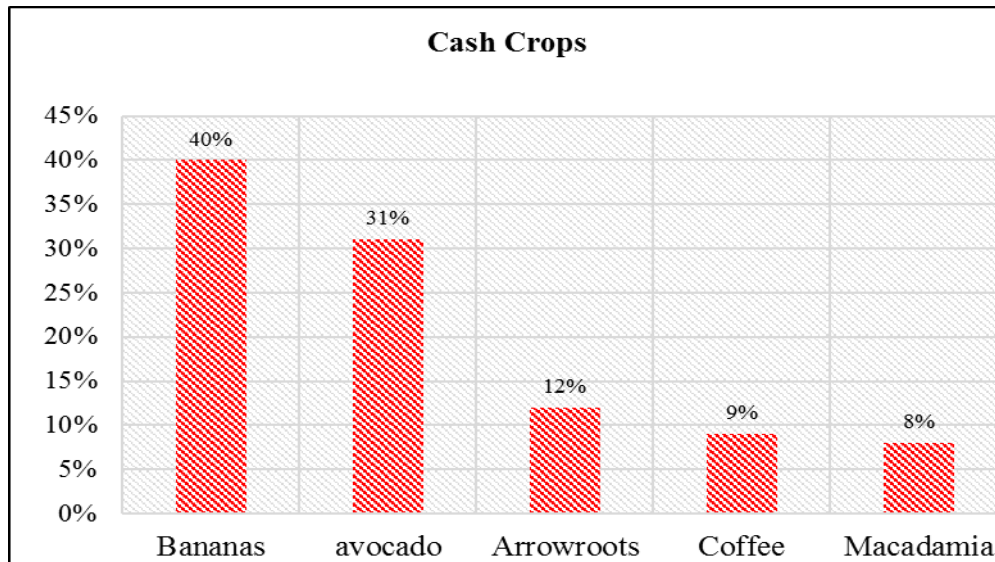


Figure 5. 15: Cash Crop Produced by Respondents

Source: Field data, 2020

#### 5.4.4 Livestock farming

Livestock rearing is another agricultural activity carried out by the respondents in the study area. Apart from dairy cows, 51% of the respondents engage in poultry farming as 16% keep dairy goats. The rearing of sheep and pigs is constituted by 14% and 9% of the total number of respondents respectively. Rearing of rabbits and keeping of pigs are carried out by 7% and 4% of the total number of respondents respectively as shown on figure 5.14 below. The size of land is critical determinant when it comes to livestock keeping and this is the reason why poultry farming is carried out by the majority of the respondents because it does not require more land in comparison to other animals.

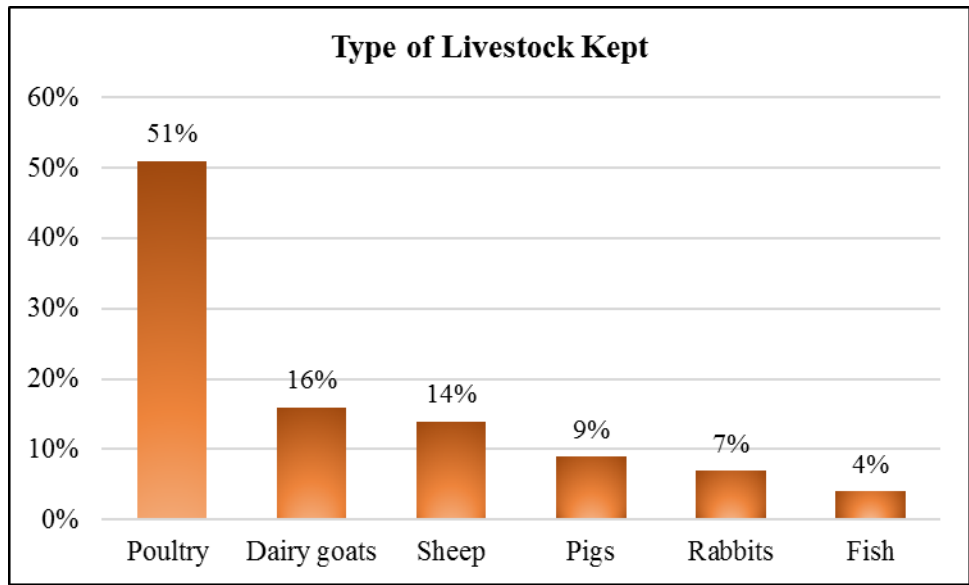


Figure 5. 16: Type of Livestock Kept by Respondents

Source: Field data, 2020

**5.4.4.1 Dairy Animals**

*Breeds of dairy animals kept*

According to the study, 94% of the farmers in the study area keep Friesian cows as five percent (5%) keep local breeds while just one percent (1%) keep jersey. The Friesian is most preferred because of its high level of milk production and are easily available in Kenya as they can easily adopt to the environment.

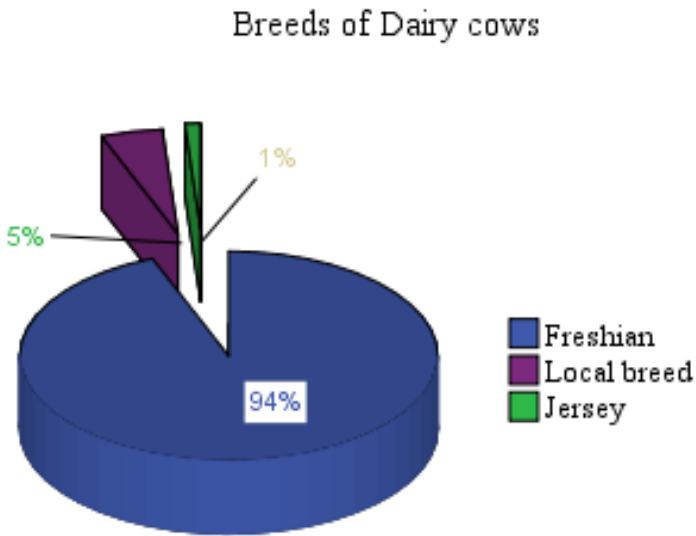


Figure 5. 17: Breeds of Dairy cows reared in Kiganjo

Source: Field data, 2020

#### 5.4.4.2 Amount of Dairy milk produced

With a total of 282 dairy cows in the participating households, a total of 1,747.70 litres of milk is produced per day. This translates into an average of 6.20 litres per cow per day.

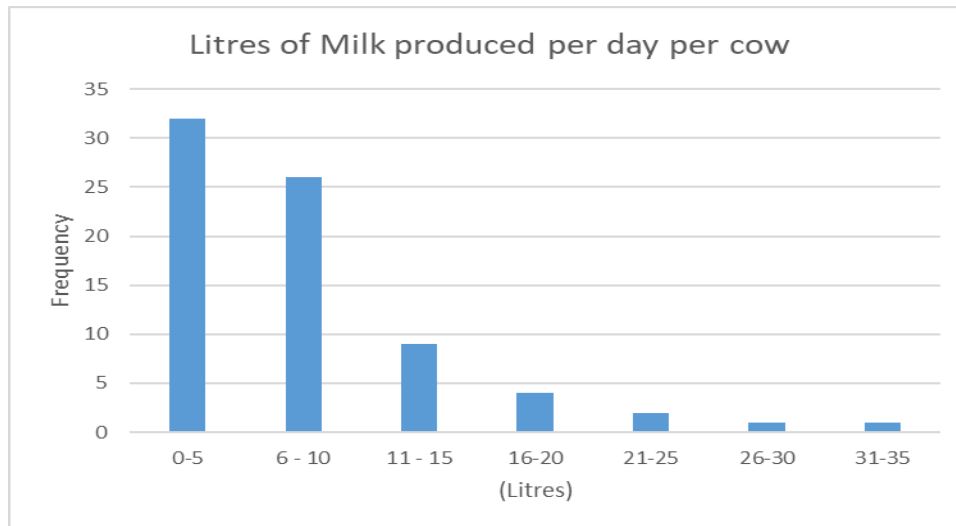


Figure 5. 18: Amount of milk produced per day

Source: Field data, 2020

#### 5.4.4.3 Income from Dairy milk

Farmers in Kiganjo sell their milk directly to consumers or to middlemen because of the poor pay by the cooperatives in the area. One litre of milk is sold at forty shillings (Ksh 40), if one cow produces an average of 6.20 litres and 1 litre is consumed by the household members, 5.20 litres is then sold to earn the household income for that particular day.

Income from 1 cow per day is  $(5.20\text{lt} \times \text{Ksh } 40) = \text{Ksh } 208/-$

In one month, 1 cow gives a household an income of eight thousand, three hundred and twenty shillings (Ksh 8,320/-).

#### 5.4.5 Drivers of Land Use Changes in Kiganjo Sub-location

Land use change plays a pivotal role in the agricultural sector since rural livelihoods are dependent on agriculture. Changes in the use of land are occasioned by various human activities and have a direct impact on agriculture. A study on the driving forces of land use change will contribute to a better understanding of the rural livelihood sustainability measures in the study



area. The study focused on changes occasioned by land subdivision and conversion of use in Kiganjo sub-location.

#### 5.4.5.1 Factors influencing the Changes in Land Use

From the discussions with farmers, eighty percent (80%) of the households who initially practiced maize and coffee farming reported to have discarded them for avocados, macadamias and fish farming due to their economic potential on the market. Single crop farming has as well been abandoned for mixed farming in an effort to increase returns as a way of sustaining their livelihoods. Twelve percent (12%) of the households attributed land use change to ownership change, for instance land has been converted from a father to a son; the son has the liberty to grow the crops they prefer and not necessarily those grown by his parents. Eight per cent (8%) of the farmers leave over farmed land which result to infertility and seek alternative portion, either for farming of similar crops or other types of crops. Figure 5.17 below show the reasons for change of land use in the study area.

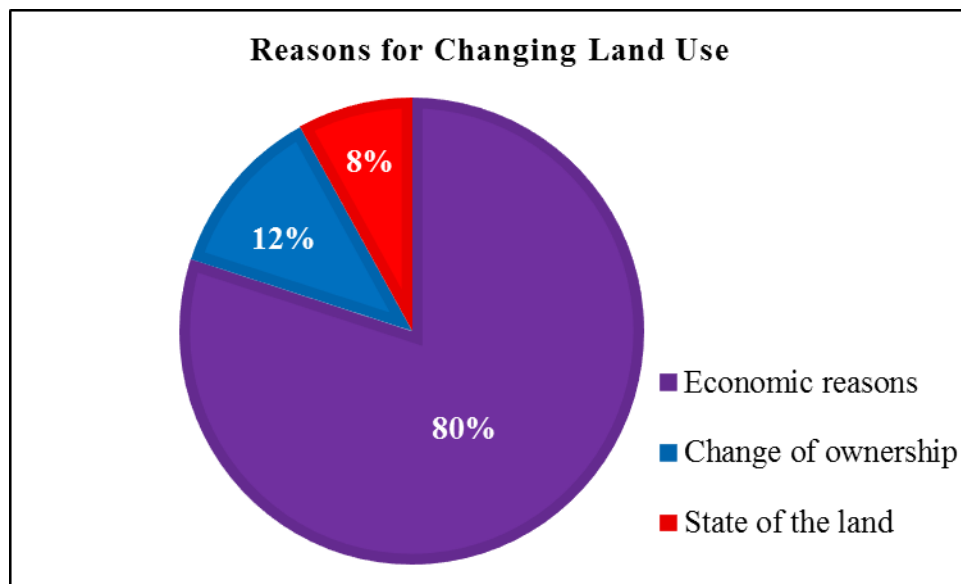


Figure 5. 19: Reasons for changing the use of land

Source: Field data, 2020

### 5.5 Impacts of the Land Uses Changes on Rural Livelihoods.

Land is the major natural resource that economic, social, infrastructure and other human activities are undertaken on. Hence, a change in land use has been considered the most important factor that influences the livelihood of rural communities. Since all human activities are

inimitably intertwined for rural communities it is therefore critical to understand and provide appropriate mechanism for survival where intensive land use changes have taken place. In Kiganjo, the study established the following impacts on rural livelihoods as a result of changes in land use.

### 5.5.1 Impact of subdivision on Household livelihoods

The findings of this study show that the main impact of land subdivision on the livelihoods of Kiganjo residents is food insecurity as reported by 65% of the respondents. When the land size reduces, most of the agricultural activities practiced initially are reduced or not done completely leading to less food production.

Close to a third of the households at 29%, indicated that they are farmers who fully depend on land for a livelihood as source of their income, therefore, low farm production meant less income as reported by farmers who practiced cash crop farming like coffee and tea.

Six percent (6%) of the households cited conflicts within families as another impact of land subdivision. The average land size in the study area is 2acres with some of families holding as low as ½ acre, with the notion of land inheritance, most of the young men expect their parents to give them a share of this piece of land, some have gone to an extent of forcing parents to subdivide for them and ended up selling out to foreigners. This issue has raised concern especially among aging parents who are no longer at peace with their notorious children.

The results are as shown in Figure 5:19 below.

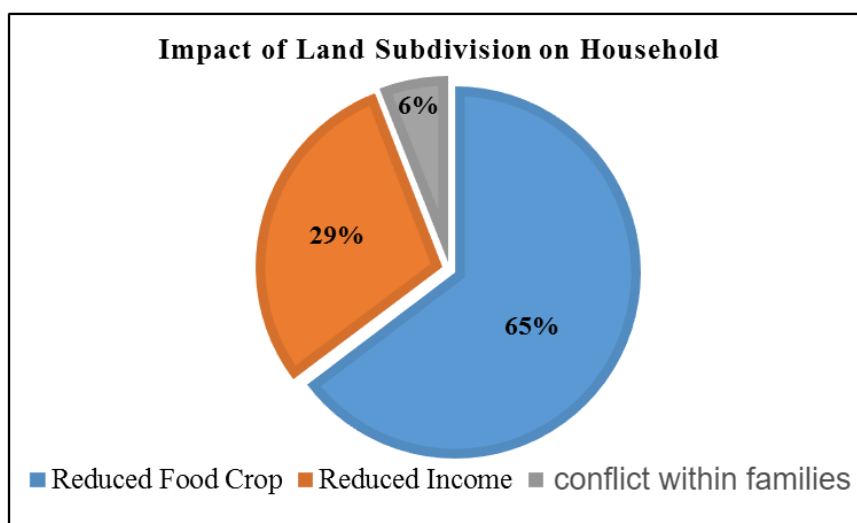


Figure 5. 20: Impacts of land subdivision on rural livelihoods.

### **5.5.2 Impact of Land Subdivision on Agriculture**

Land subdivision has both negative and positive impacts on agricultural practices. Land subdivision reduces agricultural productivity due to changing land uses and activities. Land subdivision is currently being objected by majority of the residents within the study area. This is not only because of the effect it has on agricultural output but also on the environment. According to this study, 60% of the respondents are not able to plant cash crops which require expansive land and thus limiting them to specific food crops. Crops like coffee, tea, macadamia and pineapples which would generate more income to farmers are no longer being planted as a result of the reducing land sizes. Farmers are only left with the option of food crops like maize, beans, bananas and vegetables.

25% of the respondents have resorted to zero grazing of their animals. Initially, farmers adopted the conventional way of grazing where animals would graze in the farm freely but due to diminishing land sizes animals are confined in sheds. This system has been embraced by farmers as they can easily manage their space of land coupling with cash crops.

10% of the respondents have ventured in poultry farming. Poultry farming makes a substantial contribution to food security in a household, ideally, poultry takes up little spaces of land as they are put in sheds. With the diminishing land sizes, most of the farmers are opting for poultry as the demand for eggs increases.

The remaining 5% have ventured into fish farming. Fish farming in the study area is an upcoming business opportunity as the demand is high with a ready market. Farmers venturing into fish farming are digging ponds within their farms where water is available and the business is good as it saves on space of land. It was reported that there is a high demand for fish in the area as compared to meat. The summary of results is as shown in Figure 5:20 below.

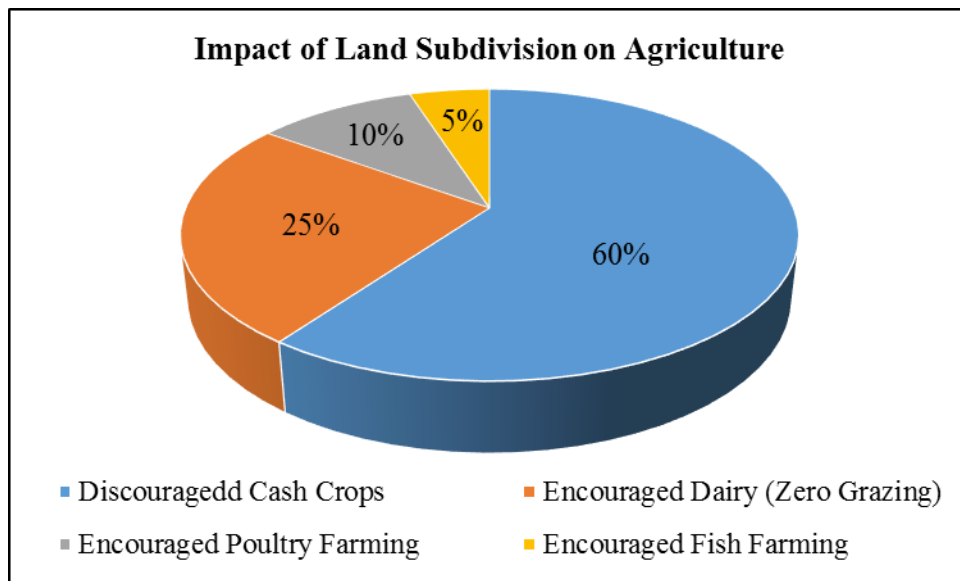
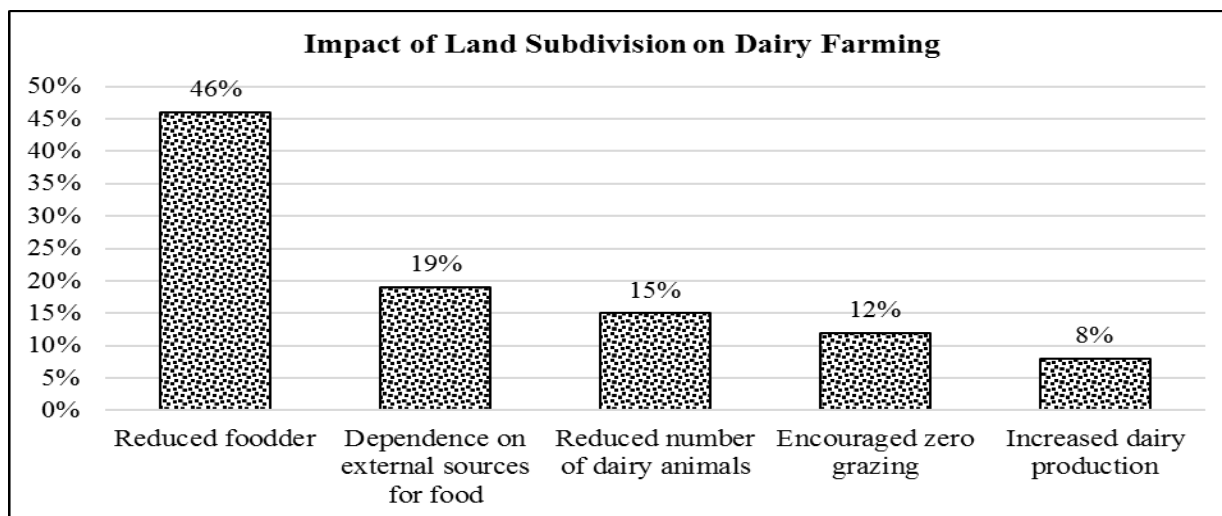


Figure 5. 21: Impact of Land Subdivision on Agriculture

Source: Field data, 2020

### 5.5.3 Impact of Land Subdivision on Dairy Farming

Land is a requirement in any agricultural activity practiced. As regards dairy farming, land is key for grazing and housing of animals. In the study area, where land subdivision has been recorded and farmers own on average ¼ acre, 46% reported reduction in fodder; 19% reported total dependence on external sources of feeds for animals; and 15% of the respondents attributed a reduction in number of animals kept on one’s farm to the small land size. 12% of the farmers who initially practiced the open grazing have now resorted to zero grazing which according to 8% has led to an increase in milk production. This is shown in figure 5:21 below.



*Figure 5. 22: Impacts of land subdivision on Dairy farming*

Source: Field data, 2020

Due to scarcity of land, some farmers have used the road reserves to plant feeds for the animals as seen in the image below



*Figure 5. 23: Napier grass along road reserves*

Source: Field data 2020



*Figure 5. 24: Evidence of zero grazing in the study area*

Source: Field data 2020

### 5.5.4 Solutions to small land sizes

From the focus group discussions held with farmers, several possible solutions were suggested to deal with the current land sizes as represented in the table below.

Table 5. 6: Solutions to small land sizes

<b>Response by Farmers</b>	
<ul style="list-style-type: none"> <li>• Zone agricultural land into different crop zones and ban sub-division.</li> <li>• Formulate a population policy of 2-children to contain the population growth.</li> <li>• Put up industries to process all the farm produce, create market and employ people so that they do not rely on the farm.</li> <li>• Invest in proper marketing of all agricultural produce for farmers to get good income.</li> </ul>	<ul style="list-style-type: none"> <li>• Adopt technology to intensify farming on the small farms.</li> <li>• Construct high rise buildings in the Rural Towns so that people can live in the farms as they farm the land.</li> <li>• Support farmers through training to increase milk production from 5litres per cow to 30litres in order to increase incomes.</li> </ul>

### 5.5.5 Challenges Faced by Dairy Farmers

Dairy farming though being the single largest sub-sector of agriculture in Kenya contributing to 14 % of the total Agricultural revenue collected nationally and contributing to 5-8% of the total GDP in the country is faced with challenges which may hinder its potential to improve livelihoods. Some of the typical challenges as cited by farmers in figure 5:24 below are as follows; 38% claim the feeds are expensive as they are not produced on the farms, due to smaller land sizes, most of the farmers source feeds from outside. 24% of the respondents claim the milk prices are poor, the cooperative within the study area is dormant and farmers have to sell milk to middle men at lower prices. 18% of the respondents attribute low dairy production to shortage of water in the area. 13% are faced with challenges of diseases which are expensive to manage as 7% attribute their low production to lack of extension services by the County government.

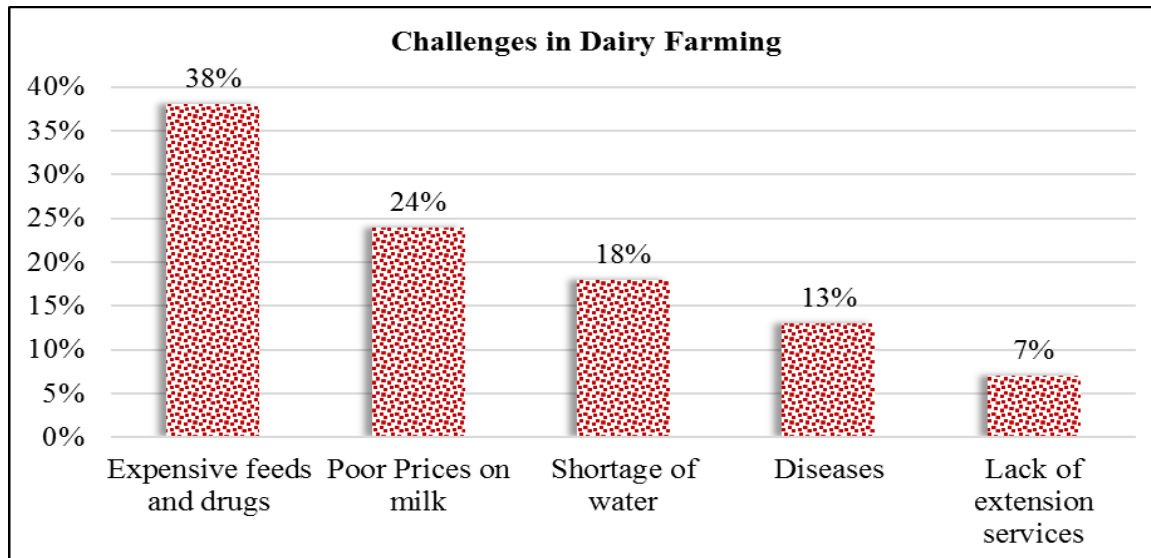


Figure 5. 25: Challenges Faced by Dairy Farmers  
Source: Field data, 2020

### 5.5.6 Solution to challenges in Dairy farming

To improve dairy production in the study area, farmers gave their views on how to deal with the challenges faced in 5.4.4 as follows; 41% feel that the government should subsidize the prices of feeds and drugs to the level that farmers are able to purchase. 30% wish for the government to establish good markets for the dairy produce through cooperatives, 18% feel that water should be availed for domestic use and irrigation of crops. 11% of the respondents wish that the government can provide extension services to farmers in the study area to enhance dairy production.



Figure 5. 26: Solution to Challenges in Dairy Farming  
Source: Field data, 2020



### 5.5.7 How to improve dairy farming in Kiganjo

Farmers in the study area agree that if dairy farming was enhanced in such a way that it can sustain the livelihoods of the community, they would treat it as their main source of income probably practice it as the leading agricultural activity in Kiganjo. Some of the suggestions given by farmers on the improvement of dairy farming include; good choice of dairy breeds that are productive and resilient to the climatic conditions in the study area, as cited by 32% of the respondents. 24% of them suggest enhancement of smart technology, according to the farmers, smart technology is cheaper with high returns but, applied where animals the number of dairy animals is high. Once smart technology is embraced, 18% of the farmers increase their herd for higher proceeds, to them this will be more economical with the new technology. 13% of the respondents claim if provided with extension services they will be able to improve in dairy production as 7% want it to be coupled with trainings and exhibitions on dairy management. 6% suggest that a reliable milk market be established in the study area. They blame the current cooperative for not supporting the farmers and seek for a re-assessment of the cooperative society. A summary of the same is shown in figure 5:26 below.

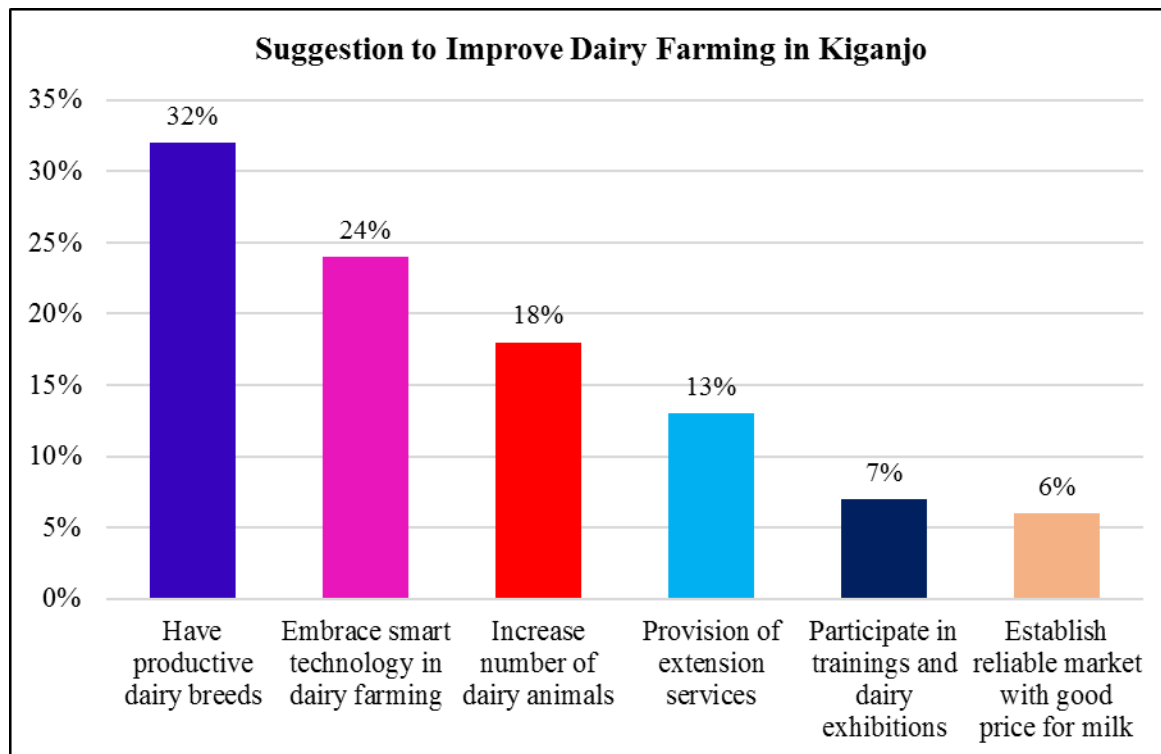


Figure 5. 27: Suggestions to improve dairy farming in Kiganjo

Source: Field data, 2020



## 5.6 Coping Mechanisms Developed by Households Depending on Dairying for Livelihood

This study's fourth objective sought to establish coping mechanisms developed by households depending on dairy farming for their livelihoods. Since most farmers operate on 1-3 acre piece of land which can only accommodate small scale dairy production, they have ventured in alternative food and cash crop farming to sustain their livelihoods. All the dairy farmers interviewed have engaged in mixed farming to provide a living for their families other than depending entirely on dairy. 35% of the respondents ranked mixed farming as the major coping mechanism. With the small land sizes that cannot allow them to grow enough animal feeds on their farms, most of the farmers are sourcing feeds from outside, 23% of the respondents ranked outsourcing of feeds as the second major coping mechanism. As a measure to ensure constant source of feeds for animals and deal with exorbitant prices in the market, 18% of farmers have resorted to preparing their own animal feeds locally. Farmers agree that cooperatives are good and should be able to support a farmer by getting them concentrates, vet treatment, artificial insemination for their cows on credit and pay them on time to eke a living. Kiganjo dairy cooperative in the area does not support farmers in any way, farmers have therefore resorted to selling their milk to middle men for instant cash which they claim is paying well than the cooperative. 16% of the respondents ranked it as the fourth major coping mechanism. Most of the dairy farmers keep 1-3 dairy cows under zero grazing as they cannot manage smart technology. 8% of the respondents therefore ranked it as the least coping mechanism adopted. The figure below shows a summary of the coping mechanisms by Kiganjo dairy farmers.

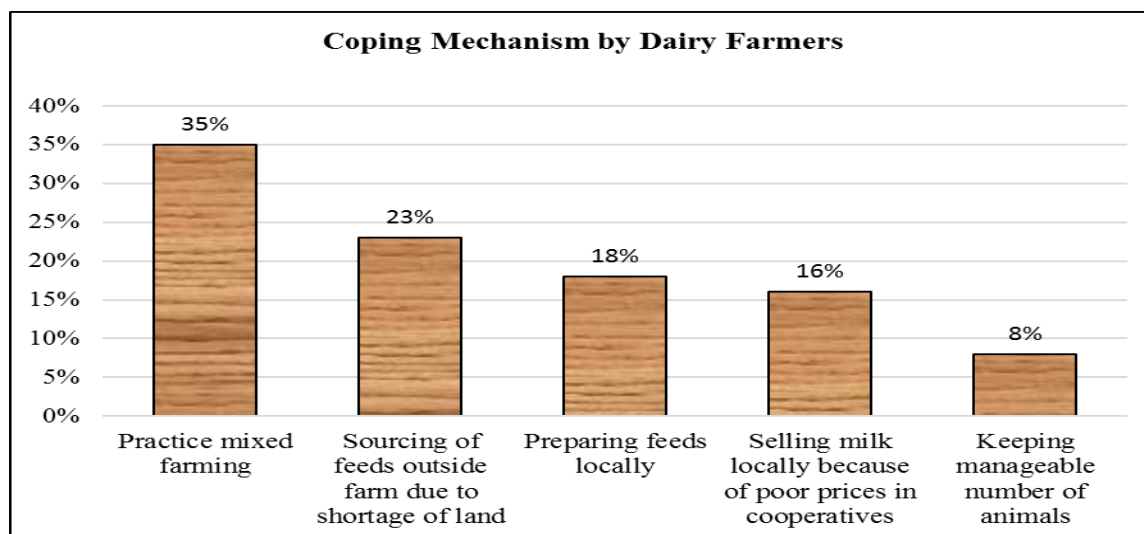


Figure 5. 28: Coping mechanisms by dairy farmers

Source: Field data, 2020



*Figure 5. 29: Dairy farmer selling milk locally*



*Figure 5. 30: mixed farming*

Source: Field data 2020



*Figure 5. 31: Farmers preparing animal feeds locally*

Source: Field data 2020

## **5.7 Planning Intervention to Promote Sustainable Rural Livelihood**

Chambers and Conway, 1991A defined sustainable livelihood as one which can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation. Rural communities depending on farming just like Kiganjo require to upscale the agriculture sector to achieve sustainability.

### **5.7.1 How to Promote Sustainable Rural Livelihood**

Farmers in the study area had the following in mind as approaches to a sustainable livelihood in Kiganjo; since one line of farming is not achievable with the small land sizes in the area, 41% of the farmers propose engaging in diverse activities either on farm or off farm to make living affordable. Smart technology is another way of improving small scale agriculture. 32% of the respondents were of the opinion that with smart farming technologies, returns will rise

eradicating poverty and therefore sustainable livelihoods. 15% of the respondents claim when a stop to land subdivision is put in place and probably land consolidation introduced, agriculture will stabilize and therefore sustainable livelihoods. 8% have the opinion that when good infrastructure is put in place and farmers have good road network and markets to sell their produce then live will be sustainable. The remaining 4% wish to embrace value addition on their produce as it paves way to good returns. A summary is shown in figure 5.30 below.

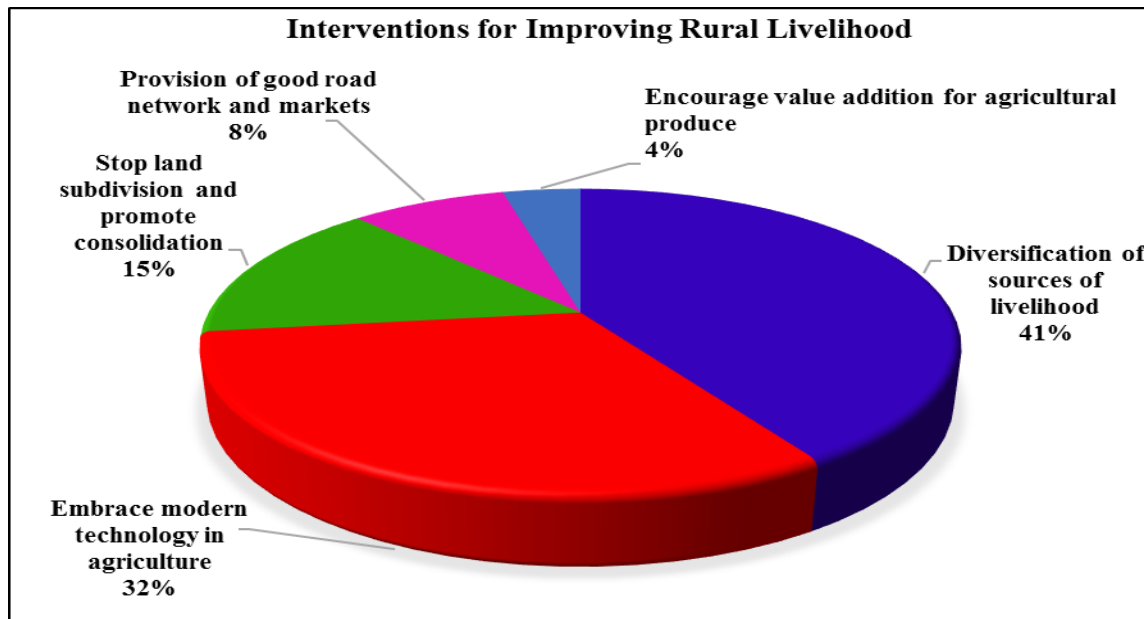


Figure 5. 32: Suggestions to improve rural livelihoods

Source: Field data, 2020

A proper land use plan for any rural village will consider proper use of the available land and will in turn accord the farmers an opportunity to practice proper farming which will ensure food security for the rural population.

### 5.7.2 Alternatives to sustainable livelihoods

In an effort to achieve a sustainable livelihood, farmers in the study area indicated to have introduced new agricultural activities which did not exist earlier. The move is attributed to low economic returns by the existing activities on the farm and the increasing demand of the new crops. It was important to establish if there has been change in the original use of land and the current. This revealed that bananas, though initially planted for home consumption has increased in demand and the prices in the market are promising. 30% of the respondents confirm to have increased the land area for bananas as well as introduce them on their farm. 25% have introduced

avocados which were never on their farms as 18% have introduced macadamia. Macadamia is an upcoming lucrative agricultural activity in the study area which every farmer would wish to have, the only limiting factor is the land size available. Dairy farming cannot be wished away as every family consumes milk from their own farms. 10% of the respondents have introduced dairy farming on their farms as 8% have ventured into pig rearing. Coffee farming has attracted 5% of the respondents with 4% practicing fish farming. Farmers claim fish farming as the incoming agricultural opportunity with a ready market and very soon those who have access to water will shift to fish farming. Figure 5:16 below shows the trend in upcoming or newly introduced agricultural activities in the study area.

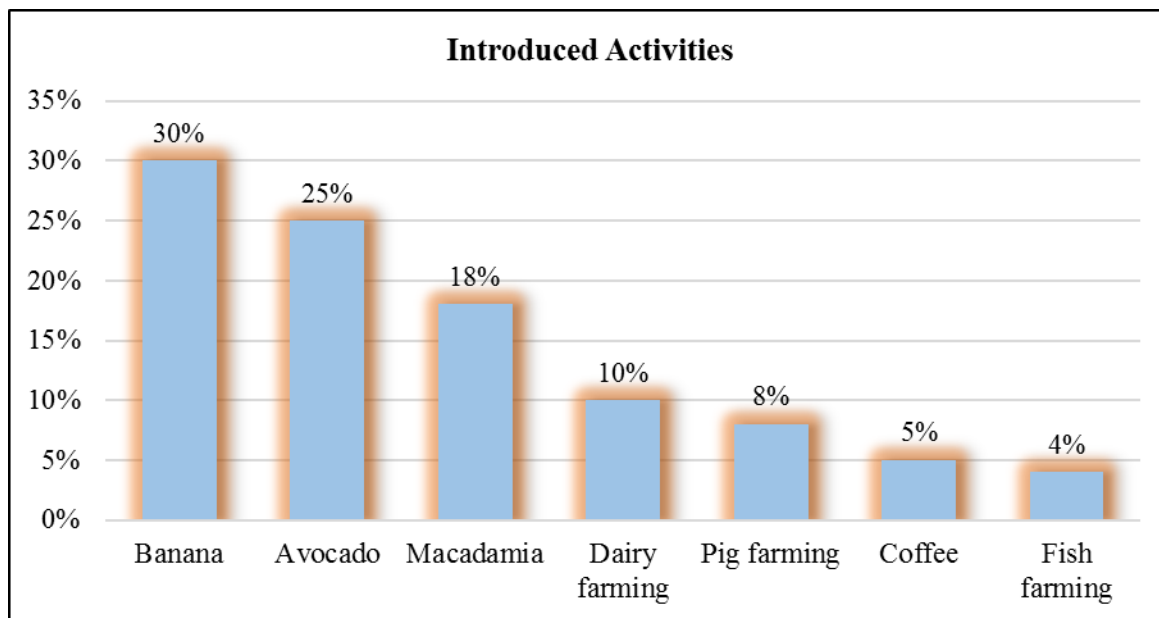


Figure 5. 33: Alternative agricultural activities

Source: Field data, 2020

### 5.7.3 Proposal for successful smallholder dairy farming in Kiganjo

#### Smart farming technology

Dairy farming unlike crop farming requires less land for a sustainable rural livelihood, due to the culture, most farmers prefer a mixed farming model as compared to relying on one line of farming.



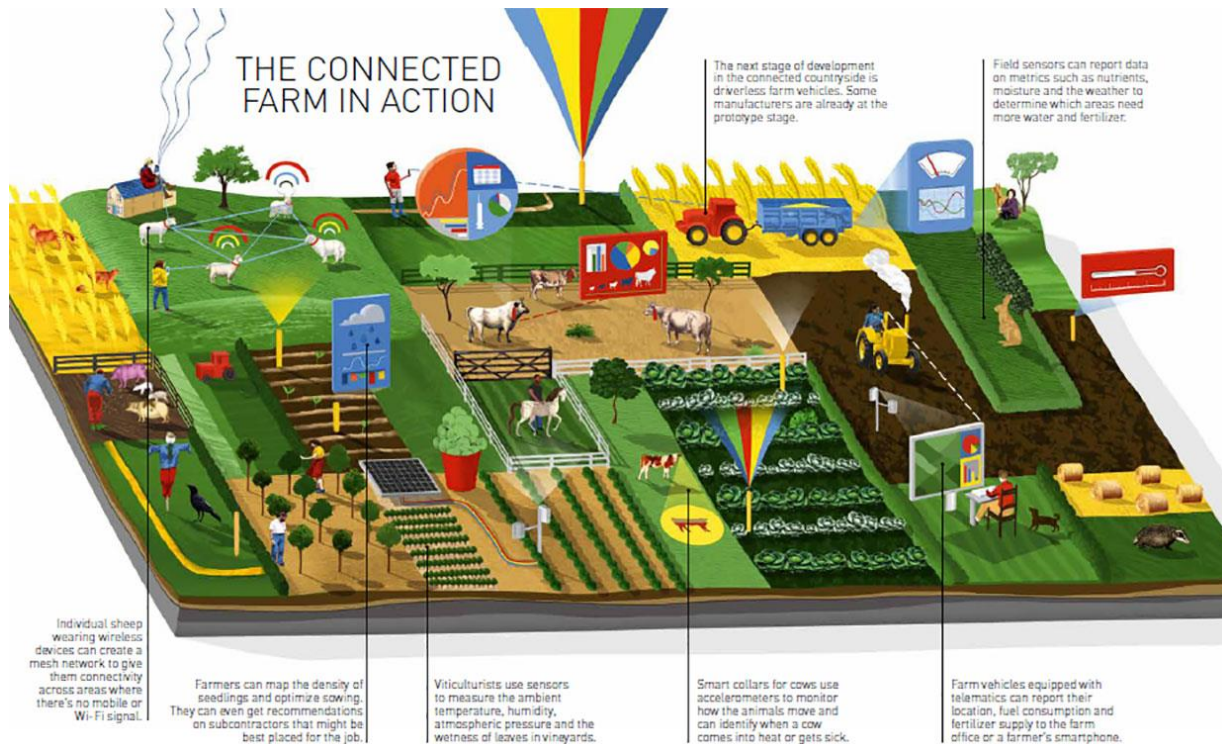


Figure 5. 34: Smart technology in farming

For an optimal income from farming, which is their main source of income, a clustered type of settlement will be ideal for the families in Kiganjo. Farmers have proposed that pieces of family land be consolidated to give room for farming.



Figure 5. 35: Clustered settlement pattern

Intensive dairy farming will be an option for dairy farming as farmers may export their milk to increase the income. This type of small scale dairying is preferred it takes up less land for enormous production.





*Figure 5. 36: Images of intensive zero grazing*

### **Benefits from dairy farming**

Aside from milk and meat products that promote food security, animal wastes can be used as manure for crops or be utilized for biogas for home cooking. These wastes from animal's urine and food cause environmental pollution and especially in relation to human and environmental health when not properly handled (S. Hidayati et. Al., 2019). Biogas technology is the biochemical conversion technology of bio-energy conversion where decomposition or degradation of organic matter occurred in the absence of oxygen by microorganisms. Reports indicate that one cow can produce 1 kg of manure which equates to 40 liters of biogas, while chicken dung with the same amount produced 70 liters. Bruun et. Al., (2014) indicates that biogas has a high energy content than the energy content of the fuel fossil. He adds that the calorific value of 1 m<sup>3</sup> biogas is equivalent to 0.6 - 0.8 liters of kerosene as 1 Kwh of electricity

takes 0.62-1 cubic meters of biogas which is equivalent to 0.52 liters diesel oil. In conclusion, biogas is very suitable to replace kerosene, LPG and ingredients other fossil fuels liters.

Three (3) dairy cows for this matter will produce 3kg of manure per day which will amount to 120 liters of biogas a day. This will be able to sustain a household of 5 members in cooking throughout the year.

## **CHAPTER SIX: SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS**

### **6.1 Overview**

This chapter presents the summary of the study findings, the conclusion concerning the findings from secondary and field data and finally the recommendations of the study.

With the global concern of food insecurity specifically in rural areas, the United Nations proposes that a profound change of the global food and agriculture system is needed to nourish the global population who are hungry today. It adds that this can be achieved by increasing agricultural productivity and sustainable food production which are crucial in helping alleviate the perils of hunger. In Kenya, rural agricultural land use changes limit the potential of the peri-urban agriculture and increases the vulnerability of the poor in terms of food security and income (Gachunia, 2016) making their livelihoods unsustainable. This study set out to assess the impacts of land size and land use changes on sustainable rural livelihoods in the study area. The study focused on land size changes and how land fragmentation has affected the livelihoods of people in these rural areas. The chapter will as well present the areas for further study based on the data analysis and findings.

### **6.2 Summary of Key Findings and Discussions**

The study was conducted in Kiganjo sub-location among farmers dealing with dairy farming. Most of the respondents to the research questions were female aged between 31 and 40 years. They had obtained at least a secondary school level of education. The age group and level of education are considered experienced enough to provide information on the research questions. The study established that the most of the households in the study area had 2 family members. 99% of the households depended fully on farms 91% of them owning the land they live on. Most of them have acquired their land through inheritance and 84% having an ownership document to the said land. The objectives of the study were; establishing the land size changes in the study area, analysing the land use changes that are evident in Kiganjo sub-location, assessing the impacts of the land uses changes on rural livelihoods, determining the coping mechanisms developed by households who depend on dairying as a livelihood and finally propose or recommend a planning intervention that promotes sustainable rural livelihood in the study area.



### 6.2.1. Land size change in the study area

Land size changes were viewed in terms of how family land has reduced in 10 years and the distribution between three generations as a result of inheritance. In addressing this objective, various questions on household land size and change were asked and responses analysed. The study established that land size has reduced and all attributed to inheritance. On checking the land size change between three generations, the study established that the average land size that the grandparents owned was 7.725 acres but as a result of land subdivision due to inheritance, the average land size for the current parents is 1.565 (male) and 0.41 acres (female) while that of the grand children is 0.499 (male) and 0.773 Acres (female) respectively. It also came out that more land is given to male children as compared to female children with an assumption that the female children will get married and own land with their husbands. A few who were given a share of the family land are those who never married or their marriages failed and came back home with children. On average, there is a reduction of 93.54% in land size from the initial family land to male children over two generations while an 89.99% change to female children within a household. It is evident that land size has continued to reduce in size to where it can no longer be subdivided further.

Just like other areas where land size change has been driven by population pressure, governance, poverty and instability (Malhi et al., 2013), Kiganjo sub-location is no different. The increase in population has led families to subdivide their land in order to give to their offspring in form of inheritance thus rendering them uneconomical. Most of the farmers in the study area are not happy with the trend of land subdivision within their area and have proposed solutions to deal with this issues as follows;

- Zone agricultural land into different crop zones and ban sub-division and instead consolidate family land.
- Put up industries to process all the farm produce within the area, create market and employ people so that they do not rely on the farm alone.
- Invest in proper marketing of all agricultural produce for farmers to get good income.
- Create high rise cluster human settlements for people to live as they farm the land.
- Adopt modern technology to intensify farming on the small farms.

- Formulate a population policy of two (2) children per family to contain the population growth.
- Construct high rise buildings in the Rural Towns so that people can live in the farms as they farm the land.

### **6.2.2. Household land use changes that are evident in Kiganjo sub-location.**

Land use change was noted in form of conversion of the use of land in the area. Land conversion has as well been rampant in the study area, however the conversion was noted to be from one agricultural activity to another occasioned by the economic status of the agricultural activity. This has impacted negatively on agriculture as some of the cash crops which were initially grown like coffee and tea can no longer be grown with the reduced land sizes. Dairy farmers have resorted to keeping only one or two cow on the farm as they have no land to grow feeds, this has led to reduced milk production in the area.

Questions on why farmers changed the use of land to the current use and causes of land subdivision were asked. The study found out that economic reasons at 80% are the leading factors that influence the change of land use. People tend to utilize the land with productive economic activities and if that activity becomes less productive they are likely to change and engage in more profitable activities. In the study area majority of the people have replaced activities such as coffee farming with profitable ventures such as banana, avocado and dairy farming. Change of ownership of the land also has a significant influence on the use of land because in the study area, new people tend to introduce new land use.

### **6.2.3. Impacts of the land size and land uses changes on rural livelihoods.**

In addressing this objective, questions on how land subdivision and conversion has affected agriculture in general and dairy farming were asked and responses analyzed. Majority of the respondents at 65% indicated reduced food crop while 29% mentioned that the change has resulted in reduced income. Land fragmentation also has a significant impact on dairy farming where 46% of the total number of respondents admitted that fodder crop has reduced considerably. With reduced cultivation of fodder crop, dairy farmers are forced to depend primarily on outsourced animal fodder. 15% of the total number of respondents have been forced to reduce the number of the animals to a number that the remaining land size can sustainably feed.

These land subdivision and land use changes emanating from conversion have impacted negatively on agriculture especially crop farming as they are a threat to agricultural sustainability. The impact on dairy farming as reported by other researchers like Khanna, (2007) who reports that in India, small and marginal farmers and landless laborers constitute nearly 65% of the milk producers and contribute nearly 62% of the total milk production in India. This is not the case with Kiganjo as most farmers still practice conventional dairying where a cow has to graze. Many rural smallholder households have managed to excel in dairy production with the modern technology like the case of Thailand, Kiganjo farmers have no objection to embracing technology with their land sizes. They propose for consolidation of farms and development of clustered settlements to apportion areas for crop and animal farming to sustain their livelihoods.

#### **6.2.4 Coping mechanisms developed by households who depend on dairying as a livelihood.**

To address this objective, the study analysed some of the challenges experienced by dairy farmers in the study area. The study established that from these challenges, most of the farmers have improvised ways to eke out a living. Through this they have proposed solutions which if well addressed, their dairy farming production will improve and sustain their livelihoods. Farmers have learned how to bridge the gap, for instance, farmers source fodder from different farms to feed their animals especially those who don't have sufficient land to cultivate fodder crops. Other farmers also prepare their feeds locally especially concentrates which are expensive to buy to ensure that they minimize the cost of production as much as possible. According to 38% of the respondents, the most appropriate way to improve dairy production in the study area is to encourage farmers to keep productive dairy breeds with high conversion rates. Embracing technology is another important way of ensuring that farmers access the necessary information that will enhance dairy farming in Kiganjo.

#### **6.2.5. Proposed planning interventions that promote sustainable rural livelihood in the study area.**

A sustainable livelihood as defined by Chambers and Conway (1991) is one which can cope with and recover from stress and shocks. It is the ability by people in rural areas to cope with stress and shock using opportunities in the rural areas like farming and hunting appropriately considering the future generation. Kiganjo sub-location being a rural village is expected to nourish from agricultural activities more than anything else. Like in most rural setups, in Kiganjo

sub location, land resource forms the main source of livelihood. This being the case, agriculture has been embraced as the main source of income, however, due to reduced land sizes, most of the farmers cannot grow the crops they initially did and so have developed alternative measures like dealing only in food crops and engaging in business to cope with their lives.

The study established that since one line of farming was not achievable with the small land sizes in the area, 41% of the farmers proposed engaging in diverse activities either on farm or off farm to make living affordable. Smart technology is another way of improving small scale agriculture, 32% of the respondents were of the opinion that with smart farming technologies, returns will rise eradicating poverty and therefore sustainable livelihoods. 15% of the respondents claim when a stop to land subdivision is put in place and probably land consolidation introduced, agriculture will stabilize and therefore sustainable livelihoods. 8% have the opinion that when good infrastructure is put in place and farmers have good road network and markets to sell their produce then live will be sustainable. The remaining 4% wish to embrace value addition on their produce as it paves way to good returns.

#### ***Engage in diverse sources of livelihood other than on-farm***

Since land size has drastically reduced and the population is still growing with each day, farmers have come to a realization that one source of income is not sufficient for a household. The study showed that most households have resorted to mixed farming, businesses and formal employment just to sustain their livelihoods. According to the sustainable livelihood framework a livelihood is considered sustainable when there is human, natural, financial, social and physical capabilities. When the land is sufficient to support the household financially and socially then a household will automatically look for ways to make a living.

#### ***Consolidation of land at family level and cluster settlements.***

The study indicates that a household land has reduced by 94% within three generations as a result of inheritance. This is very alarming since the next generation will not have any share of land for their survival. Discussions with farmers brought s to an understanding they are welcome to the consolidation idea, they proposed that the government amends policies on land subdivision to a reasonable minimum a family can own as families think of alternative mean to bequeath wealth to their off springs. Currently, since most of the lands have already been subdivided, the only

solution would be consolidation. Households can then regroup homesteads and release land on the periphery for farming, this would ensure high production not only for the family's sustenance but for the country's food security.

FAO.org reports that in most developing countries, consolidation of land was viewed as way of correcting property injustices. Land was usually restituted to the elderly, or in joint ownership to a group of heirs of an original owner. It reports that the European have a policy to reduce disparities between urban and rural areas by improving the rural situation. This is done through identifying the needs of rural communities for development such as Improving the agricultural sector by enabling farms to become more efficient and competitive, and better integrated in agricultural chains. In a study by Ghadermazi et, al., (2020) on land consolidation in Iran, the effects of consolidation indicated a higher level of crops production per unit area, yield per unit area, income from agriculture and its sustainability, job diversification, and a decrease in immigration in the studied villages.

For an optimal income from farming, which is the main source of income for Kiganjo residents, a clustered type of settlement will be ideal for the families. Farmers have proposed that pieces of family land be consolidated to give room for farming. This study advocates for consolidation of land either as family common homesteads or clusters of two to three families. It is more cost effective to provide basic services in clustered settlements than dispersed. The clustered settlement pattern makes it easy for the residents to have access to all the basic needs for instance electricity, clean-piped water, and good roads among many other physical and social amenities that will ensure that people are living in a good environment so that they can be able to free up the land for intensive agriculture.

### ***Smart farming and intensive Dairying***

Smart Farming is the application of digital information and data technologies for optimizing complex farming systems. Mellor, (2017) intimates that The modernization of farming systems is a key element of Inclusive Agricultural Transformation (IAT). Pivoto et al., (2018) notes that technological development like the usage of electronic devices and data transmission system has created essential changes in the agriculture process. Nations have therefore to rethink the agricultural methods which go in line with the reducing land sizes. Modernizing agriculture will

require more efficient and diversified agricultural production and a transition from predominantly subsistence farming to small-scale producer entrepreneurship to enable improvements in quality, quantity and diversity of food production. The study proposes embracing of technology in farming specifically intensive dairying which will increase farmer's income and create employment.

In as much as dairy farming requires less land than crop farming, land is still vital for growing of feeds and construction of sheds for the cows. Intensive dairy farming will be an option for dairy farming in the study area as farmers may export their milk to increase the income. This type of small scale dairying is preferred it takes up less land for enormous production.

#### **6.2.6. Minimum land size required for sustainable dairy farming in Kiganjo**

According to the Kenya National Bureau of Statistics (2018) basic report on Kenya Integrated Household Budget Survey 2015/2016, it is indicated that a member in a rural household requires a minimum of Kshs. 39,024 for survival throughout the year. Based on the average production of dairy milk in Kiganjo sub-location, the study aims to determine an ideal household land size that can sustain a household with an average of 3 members.

The total income generated per household from milk per day per cow is Ksh 208/-. In one month, 1 cow gives a household an income of eight thousand, three hundred and twenty shillings (Ksh 8,320/-), this translates to Ksh75,920 per cow per year.

Tegemeo research institute's method of calculating the income /returns from milk is; Enterprise profit = total revenues minus total costs (incl. depreciation and opportunity costs).

The Tegemeo institute study on cost of production from typical farms in twenty Kenyan counties reported costs ranging from 15.1 – 36.2 Kshs per litre of milk (Ndambi et. Al., 2017).

According to the dairy farmers in Kiganjo most of the revenues is spent on feeds and pesticides. On average, a farmer spends Ksh 4,822 per month per cow. The net income from milk production will therefore be Kshs. 3,498 after deducting the cost of production. This means that in Kiganjo, a household of 3 members will require a minimum of 3 dairy cows producing the same amount of milk per year for them to survive.

94% of the dairy farmers in Kiganjo keep Friesian breed of dairy cows, according to Livestockkenya.com, one Friesian cow produces an average of 7,800kg of milk per lactation, this

translates to an average of 26litres per day. According to the ministry of livestock manual, a friesian cow has a potential of 40-60 litres of milk per day when well fed. This then implies that a household producing optimally will require just 1 Friesian cow to sustain them for a whole year.

### ***Land requirement***

For intensive zero grazing where animals are not allowed to graze freely, land is required only for the sheds and growing of fodder. According to Dairyfarguide.com land is required for the construction of dairy sheds and ancillary structures including milking parlour, maternity pens, straw store, feed store, implements room, milk room, chaff cutter shed and manure pit, this makes it about 500 sq. ft. per animal. Fodder production for one adult dairy cow is 0.25 Acre of irrigated land, this gives a total of 0.261 acre per cow. One household requires 3 dairy cows to sustain their livelihoods annually, this translates to 0.78 acres for dairy farming.

### **6.3 Conclusions**

Small land sizes in rural areas occasioned by intensive land fragmentation have become a threat to viable agricultural activities and therefore food insecurity. Though some studies have shown that dairying in rural areas surpassed crop production in terms of profit in marginal, this study endeavored to establish the relationship between land use change and sustainable rural livelihood with emphasis on dairy farming in Kiganjo Sub-location. To achieve this, the study focused on specific research objectives and concludes as follows;

With regards to land size changes evident in area, the study established that land size has reduced by 93.54% and 89.99% from the initial family land to male and female children over three generations within a household. The reduction in family land size is attributed to inheritance. Reduced land sizes have led to low yields in crop production and encouraged zero grazing for dairy farmers. In as much as zero grazing is encouraged, farmers in the study area can only keep two to three animals citing high cost of feeds as they are outsourced. Land conversion has as well been rampant in the study area, however the conversion was noted to be from one agricultural activity to another occasioned by the economic status of the agricultural activity. Majority of the farmers who initially engaged in growing of coffee and tea have switched to crops like macadamia, dairy farming and fish farming which have good returns and a high demand. Land size change as a result of land subdivision and land use changes occasioned by conversion of agricultural activities have been found to affect agriculture and rural livelihoods in general. Since

80% of rural livelihoods depend on agriculture, changes in size and use of land will lead them to poverty and unsustainable livelihoods. According to the KNBS (2018), in the basic report on Kenya Integrated Household Budget Survey 2015/2016, one household member in a rural place requires a minimum of Ksh. 39,024/- to survive in a year. A household of 3 members (as per the survey) will require 2 dairy animals producing the same amount of milk at any point of the year to be well sustained. The coping mechanisms developed by households who depend on dairying as a livelihood are outsourcing of feeds for animals since they do not have land to grow as some have decided to prepare their feeds locally especially concentrates which are expensive to buy just to minimize on cost. These mechanisms however much they sound as a solution to the challenges faced by farmers, they have pushed farmers to keeping just a manageable number of cattle like 2-3, this cannot sustain their livelihood on the land. From the discussions with farmers, the study area has an opportunity for high dairy production which can sustain the community, however, there is need to address the issue of land use changes and challenges facing farmers to allow for a sustainable dairy farming in the area.

## **6.4 Recommendations**

In order to address the food insecurity issue and evident challenge facing the dairy sector with regards to land size and land use, various strategies need to be put in place and in scenarios where measures have been placed, they need to be enforced through a supervised implementation strategy to assess their success. Some of the strategies that can be employed include; -

### **6.4.1. Recommendation for household land size change**

Since land size is a major factor in agriculture, with the evidence of 93.54% reduction rate due to inheritance, the study recommends as follows;

*Regulation of land subdivisions;* - this research study recommends that the county government of Kiambu ensures subdivision of land is regulated to control its impact on agriculture. With the shrinking land sizes which are a treat to livelihoods in general, it is recommended that the county government encourages land consolidation through policies which encourages formation of common family homesteads thus freeing more land for agriculture.

*Land inheritance;* - being the main driver of reduction in land size in Kiganjo resulting to changes in land use. This study recommends that new forms of bequeathing wealth to the heirs such as shares or other properties rather than subdividing the land should be adopted to prevent



successive subdivision of agricultural land. This study encourages residents to refrain from subdividing their land for settlement and rather utilize vertical space to minimize wastage of land.

#### **6.4.2. Recommendation for land use change**

Land use change was noted to be conversion from one agricultural activity to another occasioned by the economic status of the agricultural activity. FAO (2007) notes that the livelihoods of rural people without access, or with very limited access to agricultural land are vulnerable because they have difficulty in obtaining food and accumulating other assets. With continuous land use change by Kiganjo people from cash crops to food crops will limit their income sources and therefore render their lives unsustainable. A proper land use plan needs to be developed to guide the use of the existing land and moreso the consolidated family land to achieve the financial and social capital required to make rural livelihoods sustainable. The study therefore recommends that the County government prepares a spatial land use plan for Kiganjo sub-location to guide the use of available land for sustainable production.

#### **6.4.3. Recommendation on the Impacts of land size and land use changes on rural livelihoods**

*Change in land size;* - The change in land size is significantly impacting on dairy farming and agriculture in general leading to food insecurity. This study recommends that dairy farmers should embrace technology that allows them to produce sustainably, for instance, selecting productive dairy breeds and learn to make nutrient rich animals feeds to minimize cost of production. The study also recommends that dairy farmers should embrace zero grazing with a number of animals synchronized to produce all year round. It was evident that farmers practising zero grazing produced more milk as compared to those practising free range.

To improve dairy production in the study area, it is recommendable for the farmers to choose the productive dairy animals and also embrace the new technology that include the use of artificial insemination and use of well-balanced feed to boost milk production. It is also important to advise farmers to keep manageable number of dairy animals that they can feed them well without straining. The constitution of the cooperatives to be revised to allow for farmers to voice their concerns.

#### **6.4.4. Recommendation to promote sustainable livelihood in Kiganjo**

The study recommends that farmers should diversify their sources of income and also practice mixed farming techniques to spread the risks in agriculture. Diversification strategies such as engaging in business or employment play significant role in supplementing the income from agricultural activities and ensure sustainable livelihoods of the rural people. It is also important to encourage the residents to engage in value addition of agricultural produce to fetch good market price and improve the livelihoods of the people. By embracing technology in agriculture, farmers will be in a better position to access crucial information concerning agriculture and in the process addressing sustainable rural income and food security. Improving dairy farming through introducing productive breeds and embracing technology could also significantly promote sustainable rural livelihoods. Practicing mixed farming is also crucial in ensuring sustainable rural livelihood because it helps to spread risks and make rural farmers more resilient to handle changes in agriculture.

The study further recommends that every household should install a biogas plant which will supply them with energy for cooking to save on fuel and gas. This will in turn ensure waste management from livestock and promote good health as it ensures sustainable livelihoods.

##### *Minimum household land size*

According to Dairyfarguide.com land is required for the construction of dairy sheds and ancillary structures including milking parlour, maternity pens, straw store, feed store, implements room, milk room, chaff cutter shed and manure pit, this makes it about 500 sq. ft. per animal. Fodder production for one adult dairy cow is 0.25 Acre of irrigated land, this gives a total of 0.261 acre per cow. The study recommends that one household in the study area will requires 3 dairy cows producing optimally to sustain their livelihoods annually, this translates to a minimum of 0.78 acres of land for intensive dairy farming.

#### **6.5 Suggestions for Further Research**

While other studies have focused on smallholder dairy farming in other parts of the country and the world at large with a view of maximizing milk production, this study focused on land uses particularly subdivision and conversion and their effects on dairy farming. In as much as there is a relationship between the two, dairy farming has not been well embraced by farmers as their main source of livelihood in the study area.

This study recommended that farmers embrace new farming technology that allows them to produce sustainably by selecting productive dairy breeds. Due to the contextual scope of the study, the study was unable to assess the type of animal breeds likely to survive well in the area with a maximum milk production. The study therefore recommends a study on effective breeding and feeding strategies to maximize milk production.

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## ANNEXES

### 1. Household Questionnaire

#### THE IMPACTS OF LAND USE CHANGE ON SUSTAINABLE RURAL LIVELIHOOD: THE CASE OF DAIRYING IN KIGANJO WARD – GATUNDU SOUTH

#### HOUSEHOLD QUESTIONNAIRE

**Declaration:** *The information collected is confidential and will only be used purely for academic purposes.*

**Questionnaire Serial No.** \_\_\_\_\_

County:	
Sub-County:	
Ward:	
Village:	
Name of Interviewer:	
Date of interview	
Start Time:	End Time:

#### Section 1: Respondent's Personal Information

Tick (✓) the appropriate answer.

1. <b>Name of Respondent</b>	
2. <b>Gender</b>	01 Male <input type="checkbox"/> 02 Female <input type="checkbox"/>
3. <b>Relationship with HH</b>	01 H/Head <input type="checkbox"/> 02 Wife <input type="checkbox"/> 03 Son <input type="checkbox"/> 04 Daughter <input type="checkbox"/>
4. <b>Age (Years)</b>	
5. <b>Highest Level of Education</b>	01 Some Primary <input type="checkbox"/> 02 Completed Primary <input type="checkbox"/> <input type="checkbox"/>

	03 Secondary	
	04 College	<input type="checkbox"/>
	<b>05</b> None	<input type="checkbox"/>
<b>6. Marital Status</b>	01 Married	<input type="checkbox"/>
	02 Single	<input type="checkbox"/>
	03 Divorced / Separated	<input type="checkbox"/>
	04 Widowed	<input type="checkbox"/>
<b>7. Religion</b>	01 Catholic	<input type="checkbox"/>
	02 Protestant	<input type="checkbox"/>
	03 Muslim	<input type="checkbox"/>
<b>8. Main Occupation</b>		

**Section 2: Demographic characteristics of other members of the Household**

**Household size** (*Includes all people living in the house*) indicate number.

<b>People</b>	Sons	Other males	Daughters	Other females	<b>Total</b>
<b>Number</b>					

**Demographics of other Members of the Household**

HH Members	R/ship to HH	Gender	Age (Yrs.)	Highest education Level	Main occupation	Location of main occupation	Other occupations	Location of other occupations	Lives on or Off Farm

01=Household head; 02=Wife; 03=Sons; 04=Daughter; 05= Daughter in-law; 06= Son in-law; 07= Grandchild; 08= Other relatives

Highest education level: 01=Some Primary 02=Completed Primary 03=Secondary 04=completed secondary 05=College 06=None

Lives on-farm = 01 : off-farm = 02

**Section 3: Migration Trends**

**Immigration**

9. Were you born in Kiganjo ward? 01. Yes                      02. No

10. If no, where were you living before you came to Kiganjo?

County ..... Sub-county .....

11. Why did you move here?

**Emigration**

12. Have any of your household members left to permanently settle elsewhere?

01. Yes                       02. No

13. If Yes, where to?

County	Sub-county	Male	Female	Reason

**Section 3: Land Tenure**



14. Do you own the land you live on? Yes  No

15. If Yes, how did you acquire the land?

- a. Inheritance
- b. Purchase
- c. Allocation by Government
- d. Others (Specify)

16. Do you have land ownership document?

17. If yes, What is the ownership document?

- a) Title Deed
- b) Letter of Allotment
- c) Share Certificate
- d) Temporary Occupation License
- e) Other (Specify)

18. What is the size of your land in Acres? .....

19. Has your land undergone subdivision from the original land?  Yes  No

If Yes, kindly give the Trends in land subdivision and change of use

Original size of your land (Acres)	Subdivision to sons (Acres)							Subdivision to daughters (Acres)							Sold (Acres)		Remainder	Land under Dairy	Under crops	
	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2				

Original size of your father's land (Acres)	Subdivision to sons (Acres)							Subdivision to daughters (Acres)							Sold (Acres)		Remainder	Land under Dairy	Under crops	
	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2				

20. Has any portion of your land been converted to another use? Yes      No

21. If Yes, which is the current use and size?

Initial Land use	Current uses	Size
	1. Homestead	

	2. Food crops	
	3. Cash crops	
	4. Livestock	
	5. Animal feeds	
	6. Any Other (Specify)	

22. In your opinion, how has the conversion of use affected dairy farming on your farm?

.....

.....

...

.....

.....

23. If your answer in 14 is No, what do you use your land for?

- a) Exclusive Dairy farming
- b) Mixed farming

24. How has it affected your dairy farming?

.....

...

.....

.....

.....

.....

.....

.....

**Section 4: Housing characteristics**

		<b>Main House</b>	<b>Kitchen</b>	<b>Granary</b>	<b>Livestock structure</b>	<b>Other structures</b>
No. of Rooms						
Material used	Floor					
	Wall					
	Roof					
Condition						

**Section 5: Livestock farming Information**

25. How many animals do you have on your piece of land?

Type of dairy animal	Breeds	Number
Cow		
Goat		
Bulls		
Others		

26. What type of feeds and amount do you feed your dairy animals per Month?

Type of feeds for the animal	Quantities of feeds	Amount of feeds per animal	Cost of feeds per month

27. Do you grow animal feeds?  Yes  No

28. If feeds are grown, how much land is under feeds?.....

29. Are the feeds enough for the animals?  Yes  No

30. If No. how much do you substitute per  
Month?.....

31. Is the land enough for the animals?  Yes  No

32. If not, what strategies have you put in place to ensure sustainable feeds for the  
animals?

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

***Milk Yields per Month***

<b>Dairy Animals</b>	<b>Breed</b>	<b>No.s</b>	<b>Yield per Month</b>	<b>Quantity consumed</b>	<b>Quantity sold</b>	<b>Income Earned</b>
<b><i>Cows</i></b>	Exotic					
	Local					
	Crossbreed					
<b><i>Goats</i></b>						
<b><i>Total Earnings</i></b>						

33. Are there other dairy products / byproducts that you sell?  Yes  No

34. On average, how much do you get per month from dairy  
products?.....

35. Does it satisfy your needs as a household?.....

36. In your opinion, how much is sufficient to sustain your household in a month?  
.....

37. Where do you sell your milk? .....

38. Do you receive training in Dairy farming? Yes  No

39. If yes, which training?

	Type of training	Institute offering training	Year Trained	Frequency of Training
1				
2				
3				
4				
5				

40. What challenges do you face in Dairy farming?  
.....  
.....  
.....

41. Do you receive livestock extension service Yes  No

42. If Yes, how often?  
.....

**Section 6: Income and Expenditure**

43. What is your total monthly income?

S/No.	Other Source of Income	Amount (Ksh) per	Amount (Ksh) per
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		Day	Month
1.	Crop sale		
2.	Milk		
3.	Other animal products/ by products.		
4.	Salary		
5.	Remittances		
6.	Other (Specify)		
<b>Total Income</b>			

44. What is your total Monthly Expenditure?

S/No.	Item	Cost (Ksh) per Month
1.	Food	
2.	Medical	
3.	Education	
4.	Rent	
5.	Energy	
6.	Transport	
7.	Animal Feeds	
8.	Other (Specify)	
<b>Total Expenditure</b>		

45. How much do you save per Month?

.....

46. Is the income adequate for your household needs?

### Section 7: Membership with financial institutions

47. Are you a member of any dairy cooperative?  Yes  No

48. If Yes, which one?



49. What benefits do you receive from the cooperatives?.....

50. What challenges do you experience as a dairy farmer?

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

**51.**What recommendations do you propose to ensure a sustainable livelihood with  
dairy farming?

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

## 2. KEY INFORMANT GUIDE

### INTERVIEW QUESTIONS FOR KEY INFORMANTS

#### Study Area: Kiganjo Ward - Gatundu North South Sub-County

**Declaration:** *All the information obtained will be treated with confidentiality and will be used only for the intended purpose of study.*

#### MCA

1. As a county government, do you have projects that support agriculture in the ward?
2. If Yes, Have you involved farmers when proposing and prioritising these projects?
3. Mention any particular project on dairy farming
4. Has it been successful?
5. If Yes, what are the indicators of success?
6. If No, what measures have you put in place to address the issues?
7. How would you compare dairy farming in Kiganjo and other parts of Kiambu County?
8. What are the challenges facing dairy farmers in your ward?
9. What initiatives has the County put in place to ensure sustainability of dairy farming?
10. Do you have cooperatives for dairy products within the County?
11. In your opinion, how have they been of benefit to dairy farmers?
12. How is the state of infrastructure? Are the roads in good condition to enable farmers get milk to the markets on time?
13. Generally, what are your views on the future of dairy farming in Kiganjo ward?
14. What strategies would you propose to boost dairy farming in your ward?

**Area Chief**

1. How has the average household land size changed overtime?
2. Have you recorded any land disputes in your area?
3. If Yes, what are the causes of the disputes?
4. Comparing crop farming and dairy farming in your village, which one does well?
5. Any reasons to your response above
6. Are the dairy returns able to sustain the livelihoods of the farmers?
7. What other activities are the farmers engaged in that sustain their livelihoods.
8. In your opinion, how has the land transactions affected dairy farming in Kiganjo area?
9. How do you think dairy farming can be enhanced in Kiganjo?

**Livestock Officer**

1. What are the average number of dairy cattle kept by farmers?
2. What is the average amount of milk produced by dairy cattle per day?
3. What are the types of dairy cattle kept by farmers?
4. What are the ideal yields per breeds?

<b>Breed</b>	<b>Average milk per day</b>

5. What is the average size of land used for hoarding 1 dairy cattle?
6. Which feeds do you recommend for higher milk production?

7. What is the contribution of livestock sector to the County's economy?
8. What are the factors affecting livestock farming in the County?
9. What are the common reported diseases affecting dairy animals in the County?
10. Do you offer agricultural extension services to livestock farmers? How often?
11. How has change in land sizes within Kiganjo affected dairy farming activities?
12. What strategies has the government put in place to promote livestock farming in the County?

### 3. Sample Photos during data collection



*Conducting a focus group discussion with dairy farmers in Kiganjo sub location*



*Conducting key informant interview with chief - Kiganjo sub location*