DYNAMICS OF LAND USE CHANGES ON THE LIVELIHOOD OF LOCAL COMMUNITIES IN BARINGO COUNTY

EDWARD LEKAICHU OLE KATEIYA

THESIS SUBMITTED TO THE DEPARTMENT OF ENVIRONMENTAL STUDIES, GEOGRAPHY AND AGRICULTURE IN THE SCHOOL OF NATURAL RESOURCES, TOURISM AND HOSPITALITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF DEGREE OF DOCTOR OF PHILOSOPHY IN LAND RESOURCE MANAGEMENT OF

MAASAI MARA UNIVERSITY.

2022

DECLARATION

This thesis is my original work and has not been presented for a degree or any other award in Maasai Mara University or any other Institution.

Signature…… Date ……..

Edward Lekaichu Ole Kateiya

Reg. No.TP01/MP/MN/3897/2017

This thesis has been submitted for examination with our knowledge and approval as University Supervisors.

Signature …… Date ……

Prof. Aggrey Daniel Maina Thuo, PhD

Department of Spatial and Environmental Planning,

Kenyatta University.

Signature ……. Date……

Dr. Maurice Ochieng Ombok, PhD

Department of Economics,

School of Business and Economics,

Maasai Mara University.

DEDICATION

My unbounded dedication goes to my wife Sylvia Silantoi Kateiya, who inspired me, provided constant encouragement, peace of mind, and took care of our children during the entire process of my Doctoral studies. I would not have been able to do this without you and your loving support.

ACKNOWLEDGEMENTS

First, I wish to express my heartfelt appreciation to my supervisors, Professor. Aggrey Thuo and Dr. Maurice Ochieng Ombok for their excellent supervision. I truly feel honored to have worked with you. My special thanks go out to Professor. Almadi Obere for wise advice and support, my colleagues Dr. Daniel Naikuni, Mr. George Odhiambo, Mr. Job Ogada, Dr. Charles Munene, and Dr. Patrick Gudda for their encouragement and inputs. I would not complete my Doctoral degree without your continuous moral support. I greatly thank my employer, Maasai Mara University, Narok, Kenya, for giving me the necessary enabling environment, including permission to collect data, use of university facilities and financial support to undertake this study. I must not forget to convey my special thanks to the School of Business and Economics staff and those in the School of Natural Resources, Tourism and Hospitality for their support. My other thanks go out to all those in one way or the other, contributing to completing this thesis. I appreciate all of you very much. Above all, I humbly thank God Almighty, whose sustaining grace has been sufficient for me to complete this endeavor.

ABSTRACT

Land is a principal factor of production, a source of life and livelihoods. It provides a means of living and a variety of uses such as agricultural, human settlement, environmental conservation, urban and industrial development purposes among others. These land uses have been changing, and compete for space in a fixed area, hence the rising land use conflicts and deterioration of local communities' livelihoods. The situation has threatened lives and livelihoods, making it difficult to plan for the livelihood activities in Baringo County. This is against the backdrop of land use policy changes including; sessional paper no 3 of 2009 on the National Land Policy, the Constitution of Kenya 2010, the Land Act, 2012, the Land Registration Act, 2012, the Community Land Act, 2016 and sessional paper no 1 of 2017 on National Land Use Policy that confers sanctity of land and its use. The study, therefore, sought to establish the drivers of land use changes, to determine the effects of land use changes and land use policy decisions, as well as to evaluate the responsiveness of government decisions on the land use changes. Using non-experimental survey design, the study obtained data used to answer the following research questions; what are the drivers, what the effects of land uses are and how do government decisions respond to the consequences of land use changes. a total of 323 households were randomly sampled from Baringo South, Tiaty, Baringo North and Eldama Ravine constituencies. The drivers of land use changes were qualitatively analyzed, while the Cobb-Douglas production model was used to estimate the effects of land use changes, and Multinomial logit model was used to determine the effects of land use policy and evaluate the responsiveness of government decisions. The study found out that land use policy change traced from colonial era was the key driver of land use changes in Baringo County. Land use policies changed from customary to European like statutory system during the colonial era, and its legacy continued to influence land use changes to date. The change created dual land use system; registered individual land use for arable which constitutes 20 % of the total land, and unregistered communal land use for dry areas which constitutes 73 % of the total land in Baringo County. This divergence due to dual application of policies spurred regional economic disparity associated with the wide productivity gap between ASALs and Highlands. The effects decreased human livelihood assets productivity by 56.1%, physical livelihood assets productivity by 53.4%, and financial livelihood assets productivity by 65.6% at different levels of significance. Though, it increased natural livelihood assets productivity by 54.3% and social livelihood assets productivity by 61.3 % at different levels of significance. The regional productivity difference showed that in Tiaty and Baringo South constituencies are ASALs under unregistered community land use, livelihood assets productivity decreased by 282.4 % and by 9% respectively. Whereas in Eldama Ravine and Baringo North which are highlands under registered private land use, livelihood assets productivity increased by 139.3% and by 5.1% respectively. The study found out that land use policy reinforces regional economic disparity and government decisions favored registered private land use relative to unregistered communal land use. The study concluded that dynamics of land use changes revolves around dual land use practices resulting to unstable and uncertain livelihoods for the local communities in Baringo County. The government, therefore, need to recognize, protect and register the local communities land use rights. Hence secure land tenure and sustainable livelihoods.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS AND ACRONYMS

ASAL	Arid and Semi-Arid Lands
APH	Agro-pastoral land Households
BN	Baringo North Constituency
BS	Baringo South Constituency
CD	Cobb-Douglas Production Function Model
CEC	County Executive Committee
CIDP	County Integrated Development Plan
CLH	Community Land Households
CoK	Constitution of Kenya
CRS	Constant Returns to Scale
DFID	Department for International Development (UK)
ER	Eldama Ravine Constituency
FAO	Food and Agriculture Organization of United Nations
GLA	Government Lands Act
ICT	Information and Communication Technologies
IDPs	Internally Displaced Persons
IEA	Institute of Economic Affairs
ILO	International Labour Organization
ISK	Institution of Surveyors of Kenya
KNBS	Kenya National Bureau of Statistics
KiPPRA	Kenya Institute for Public Policy Research and Analysis
LDGI	Land Development and Governance Institute
LIMS	Land Information Management System
LSK	Law Society of Kenya

LR	Likelihood Ratio
MCA	Members of County Assembly
MNL	Multinomial Logit model
MRS	Marginal Rate of Substitution
MRS	Marginal Rate Substitution
MRT	Marginal Rate of Transformation
MNP	Multinomial Probit Model
NACOSTI	National Council of Science, Technology and Innovation
NLC	National Land Commission
OLS	Ordinary Least Squares
PLH	Private Land Households
RoK	Republic of Kenya
RTS	Return to Scale
SLA	Sustainable Livelihoods Approach
SLF	Sustainable Livelihood Framework
SPRO	Survey Plans Records Office
SPSS	Statistical Package for Social Sciences
T	Tiaty Constituency
TCPAK	Town and County Planners Association of Kenya
UNDP	United Nations Development Programme
VIF	Variant Inflation Factor

CHAPTER ONE

INTRODUCTION

1.1 Introduction

The chapter comprises the background of the study, the statement of the problem, purpose, overall objectives, specific objectives, research questions, significance, scope, limitations, and operational definition of terms and organization of the study.

1.2 Background of the Study

Land is a source of life and livelihoods for the local communities in Kenya (Kateiya et al, 2021). It is a principal factor of production, and provides a means of living and a variety of uses such as agricultural, human settlement, environmental conservation, urban and industrial development purposes among others. These uses have been changing over time, and compete for space in a fixed area. Kenya has a total area of 582,646 sq km, of which 571,416 sq km land and 11,230 sq km water bodies (Sombroek et al., 1982). About 490,000 sq km of the total land area is arid and semi-arid lands (ASALs) which is characterized by low, erratic rainfall, high evaporation rates, poor soil fertility and scarce water resources. The remaining land area is high and medium agricultural potential with adequate and reliable rainfall (KNBS, 2016). The land area is distributed into seven agro-ecological zones namely; humid, sub-humid, semi-humid, semi-humid to semi-arid, semi-arid, arid and very arid. These zones were classified based on the ratio between annual rainfall, potential evaporation, and temperature (Sombroek et al., 1982). An agro-ecological zone is a land resource mapping unit, defined in climate, landform and soils, and/or land cover, and has a specific range of potentials and constraints (FAO,1996).

According to Soil survey (Sombroek et al., 1982), Kenya is divided into seven agro-climatic zones comprising of high to medium potential areas (agro-climatic zone II-IV) which constitutes 16 % of the total land area. This zone consists of mountains Mt Kenya and Elgon, source of rivers, forest, open grassland, and the highlands of Kenya, isolated parts of the rift valley. The ground elevations ranging from 900 meters above sea level to the peak of Mt Kenya receive an average rainfall ranging from 1000mm to 2500mm. The main livelihood activities undertaken in this zone include agriculture, intensive livestock keeping, forestry, and water catchment. The medium to marginal potential areas (agro-ecological zone IV-V) constitutes 20 % of the total land area. The ground elevation ranging 900 to 1800 meters above sea level, and rainfall ranging from 500mm to 1000mm per annum. The main livelihood activities include drought-tolerant crops, agriculture, forestry, extensive livestock keeping, and wildlife conservation. The marginal to Arid (agro-ecological zone VI-VII) constitutes 65 % of the total land area. The area receives rainfall ranging from 200mm to 400mm. The main livelihood activities are pastoralism and wildlife conservation. These agro-ecological influence the land use changes and determine livelihood activities of the local communities (see Appendix IV).

1.2.1 Dynamics of Land Use Changes in Kenya

Land use changes in Kenya is attributed to effects of natural and human induced factors (Aspinall & Hill, 2018). Natural factors mainly include drought and floods has been increasing in frequency and intensity and are largely associated with the effects of climate change. Climate change increases land degradation processes as well as enhancing risks to local communities' livelihoods, and influence greatly land use changes. Besides natural factors, human induced factors including land use practices, cultural beliefs and land use policy changes are key drivers of land use changes.

These changes are characterized by rising land use conflicts and land degradation, which threatens lives and livelihoods, making it difficult for local communities to plan for their present and future livelihood activities.

According to Resource Survey and Remote Sensing Report (RoK, 2016) covering 2000 to 2010, indicates that agricultural land use increased by 2.3 %, trees decrease by 1.3 %, forest plantations decreased by 8.8%, urban areas increase by 8.0% and water resource decrease by 1.6%. These land use patterns depict expansion of agricultural activities', increasing forest destruction, increasing industrial activities, and diminishing water resources. The trend portrays a threat to sustainable the livelihood for the local communities in Kenya. On a critical look, land use changes are mainly driven by government land use policy changes adopted by different political regimes (Thuo, 2013). These changes take a historical dimension that evolved from pre-colonial, colonial, independence and subsequent years after Independence to 2021.

In the pre-colonial era (before 1895), land use was managed through African local communities' customary laws (Thuo, 2013). Land use was based on local communities' experiential knowledge developed over the years (Catley et al., 2013). Land was owned by the entire community while individual community members had only user rights. Local communities enjoy territorial niches with boundaries defined by specific geographical and physical features such as rivers, mountains, trees, and valleys. The ethnic community chiefs, assisted by the Council of elders, had the power to make land use decisions.

Land use was assumed to operate in a dynamic equilibrium checked by raids and natural disasters such as war, disease outbreaks, earthquakes and famines. Soil fertility was maintained through shifting cultivation with adequate fallow periods of three (3) years or more required to restore soil structure and fertility. Much of the uncultivated land was used as pastoral communities grazing areas. Forested areas were used for hunting, trapping and honey gathering. The land use was communal, small-scale subsistence in nature, stable and sustainable in terms of provision for local communities' livelihood and environmental conservation needs. This land use system depicts a close economy without government intervention in terms of land use policy changes.

In 1895, Kenya became a British colony and changed land use policy. All land in Kenya was converted to crown land, local communities displaced, and customary land use arrangements became redundant. The colonial government dismantled the customary land use system based on collective ethnic community territorial niches, and replaced it with a nationalized government controlled land use system, accomplished through "dual land use system"; where the European settlers occupy the high rainfall and fertile areas, employing high productivity land use practices, whereas the local communities were restricted to crowded native reserves in the drier regions and allowed to continue with traditional methods of production, which were characterized by low productivity under modified customary land use system.

These changes created economic disparity resulting in a land use crisis in the 1930s (Thurston, 1897). The crisis compelled colonial government to rethink its position, and commissioned inquiries to defined the European highlands and local communities' areas (the Carter Land Commission of (1932-1933). The commission

recommended that local communities had adequate land, but required to embrace reasonable farming practices and integrate their fragmented landholding. The recommendations did not improve the situation.

In the same effort, colonial government conducted several studies, for instance a study led by Colin Maher in 1935 to investigate soil conditions in Kamasia (now referred to as Tugen hills covering Eldama Ravine, Baringo Central & Baringo North Constituencies), Njemps (now referred to as Ilchamus area surrounding lake Baringo in Baringo South Constituency) and East Suk (now referred as Tiaty Constituency). The study found out that an ecological crisis was approaching and recommended soil conservation practices. These practices included terracing, trenching, tree planting and destocking, as well as composting. The report compelled the colonial government to initiate an independently funded segment of the Department of Agriculture that offer guidance as well as implementing soil conservation strategies in European and local communities' areas. Therefore, managing soil erosion became the key driver of land use policies and practices, hence land use changes.

However, soil conservation practices were temporarily abandoned during Second World War (1939-1945). Through the war period (1939-1945), many of the agricultural field personnel joined the army, and land use was left to individual farmer's motivation to increase food production for internal needs to feed the local population, large army in the camps, and prisoners of war, and external food exports requirement by the Ministry food and supply. These resulted in over cropping, thereby exhausting the productive capacity of the land, which continued unabated.

After the Second World War, the colonial government embarked on reconstruction work to restore the declining productive capacity of the land. This entailed the territorial governments submitting comprehensive development plans for rural development in local communities' areas, including cash crop development but granting the most significant portion of funding for soil conservation and increased water supplies. Despite efforts by the colonial government, the land use crisis persisted. The situation was escalated by the 1943 famine leading to severe food shortages, particularly in Baringo County.

Further, in 1944, the colonial government appointed a multi-skills team of experts led by Norman Humphrey to research on the overall conditions affecting land use in Kenya. The study concluded that radical adjustments were significant if the land resource could be liberated from deteriorating irredeemably. The study advised the government to pursue the intensification of land use scheme by improving smallholdings and carefully initiating cash crops, the local communities above the carrying capacity of the land resource should be relocated to new settlement areas in less populated drier lands and attention given to new agricultural methods and drought-resistant crops and government should reinstate collective approaches including cooperative or group farming in the highlands to alleviate land fragmentation and attempt to intensify land use, introduce collaborative program of soil conservation, revived the old clan system in Kikuyu land where community elders were responsible for the ground under their jurisdiction, renewed attentiveness in the mixed smallholdings farmed on a rotational basis which had been central thinking in the 1930s, introduce the concept of farm planning which started with the livestock-carrying capacity of the land and adjusting other factors according to

accessible fertile grazing areas and introduced ecological zones in land use planning, ideally reinforcing the farm planning concept. Surprisingly, despite the huge effort, the local communities felt that their livelihood could be totally disrupted by resettlement and rejected the colonial government initiatives.

Nonetheless, the colonial government developed and adopted the Swynnerton plan of 1954, to intensify agricultural development in the reserves, by encouraging individualization of land use and providing land use security through an indefeasible title. The plan became the blue print land use policy in Kenya and had both positive and negative consequences. The plan positively promoted agricultural production system through provision of infrastructure and inputs in the areas considered to be high agricultural potential but negatively neglected and marginalized Arid and Semi-Arid Lands (ASALs) in terms of government budgetary allocation. This led to imbalance in land use between different regions, and created landlessness, loss of communal grazing areas and permanently distorted livelihood options for the local communities. It elevated a few individuals to become extremely rich (20%), while majority (80%) extremely poor (RoK, 2016). The plan brought out some individualism in land use but failed to change the local communities' perceptions on land use, hence continuing land use problems even further.

The majority of the local communities in native reserves endure suffering despite government efforts to alleviate land use crisis, the issues persisted increasingly, thereby, degrading livelihood of the local communities. The turn of events occasioned social disorder pitting local communities against the colonial government henceforth struggle for independence.

At independence in 1963, and subsequent years after independence to 2010, the

independent government of Kenya focused on redistribution of land resources, settling and resettling local communities in areas previously occupied by European settlers (Syagga, 2006). Land use policies retained the principles of the Swynnerton plan. The primary target was to transfer land use structures from former colonial rule to independent African governments. Many sectoral laws were formulated, each dealing with specific and scattered land use problems, including the Agriculture Act (Cap 318), the Forest Act (Cap 385), the Plant Protection Act (Cap 324), the Water Act (Cap372), and the Grass Fire Act (Cap 327) among others. All these Acts aim to address historical and social inequalities experienced with respect to the various aspects of land use changes during the colonial era.

Most of the anticipated land use changes after independence were not realized, primarily because of malpractices in government (Khamisi, 2018). He argued that since 1963, the land issues were placed under the executive mandate of the presidency. The presidency was tasked to initiate the resettlement program. The settlement schemes were massively affected by corruption from the presidency, local politicians, elites, and businessmen. The period was characterized by illegal allocation and land grabbing. Instead, elites and government officials took advantage of the situation and inherited European farms, and continued using land under the principles laid down in the Swynnerton plan.

These changes reinforced, the dual land use system previously used by the colonial government, now between the elites and poor local communities, which enhanced economic disparities, and bred a new paradigm shift of economic marginalization along ethnic lines and political domination among the local communities. These trends seemed to be chronic, and continue to encourage regional imbalance in land use practices, widening the productivity gap as well as skewed provision of livelihood

options for the local communities.

Cognizant to evolving trends, land use reforms efforts in Kenya, took a different twist due changes introduced and entrenched into the Constitution of Kenya 2010. Under the constitution of Kenya 2010, land use reforms focused on implementing the various recommendations, including those made by the Njonjo and the Ndungu commissions, several other studies, and taskforces reports.

Significant milestones have been realized including: enactments of Sessional paper No 9 of 2009 on the National Land Policy, the promulgation of the Constitution of Kenya in August 2010. The Constitution under Article 60 prescribes that land in Kenya be held and managed in an efficient, productive, and sustainable manner. The Constitution classifies land into three categories, that is, Public, Private, and Community Land. In this respect, Article 67 creates the National Land Commission to manage Public Land, among other functions and mandated the parliament to legislate land laws by revising, consolidating, and rationalizing existing land laws. This enactment includes: Land Act, 2012; the Act provides a framework for revising, consolidating, and rationalizing Kenya's previous land laws. The Act further provides the establishment of settlement schemes to provide access to land for shelter and livelihood. The National Land Commission Act, 2012; Act mandated NLC to manage public land on behalf of the National and County governments. The Land Registration Act, 2012 provides the framework for the registration of title to land in Kenya and gives effects to the principle and objects of devolved government in land use and management. The Community Land Act, 2016; Act provides for the recognition, protection, and registration of community land rights; management and administration of community land; specified the role of county governments concerning unregistered community land, and for connected purposes. The National Land use policy Sessional

paper no 1 of 2017; provide a legal, administrative, institutional, and technological framework for optimal utilization and productive use of land resources sustainably and desirably at national, county, and community levels.

However, despite the government interventions embodied with enormous legal support, land use changes continued to inflict suffering to the local communities at an alarming rate. This is evident by perpetual land use conflicts and worsening livelihoods of the local communities, from colonial era through subsequent years after independence (RoK, 2016). Underlying land use changes from colonial era to date (2021), the policy framework has maintained dual land use system. This system has over the years reinforced economic disparity between high rainfall and dry regions. The consequence of the economic disparity has caused devastating effects on the livelihood of the local communities in ASAL in Kenya, particularly in Baringo County.

1.2.2 Dynamics of Land Use Changes in Baringo County

Baringo County is one of the 47 counties created by the constitution of Kenya 2010. The county is located in the Rift Valley region between longitudes 35 30’ and 36 30’ East and between latitudes 0 10’ South and 1 40’. West Pokot to the North West, Turkana to the North, Samburu to the North East, Laikipia to the East, Nakuru to the South, Kericho and Uasin-Gishu Counties to the South West, and Elgeyo-Marakwet to the West are the bordering counties. The Equator cuts across the County at the Southern part. This geographical location has influenced the livelihood activities undertaken by the local communities. In addition, the county has been categorized as arid and semi-arid lands (ASAL), and land use changes have been greatly influenced by the national land use policy changes as well as other factors including the effects of climate change.

The county has a total land area of 11,035 km^2 of which 4,435 km^2 arable, 5,700 km^2 non-arable, 715 km^2 urban lands, and 165 Km^2 surface water among others purposes (CIDP, 2018). It is divided into three ecological zones; highlands, marginal areas and dry lands supporting various livelihood activities for the local communities. According to CIDP (2018- 2022), the total land area was further broken into high potential (2168 km^2), medium potential (2773 km^2), low potential (5299 km^2) and others (775 km^2).

The high potential land use covers higher elevations of the County, falling within the modified tropical zones with soils that are generally well-drained and fertile referred as highlands. This zone receives an average rainfall of 1000– 1500mm per annum and temperatures range from a minimum of 10°C to a maximum of 28°C. This area is considered to be a high potential for agricultural and improved livestock development. The area constitutes 20 % of the total land area mainly covering the Tugen Hills, and supports arable crop farming including food crops like cereals (maize & Beans), fruit trees and horticultural crops as the main livelihood activities. It also supports production of cash crops such as coffee, which is grown in small scale as additional livelihood activity. Most of the land use was under private land tenure.

The medium and low potential areas i.e Arid and Semi-Arid lands (ASALs) covers over 73% of the land area, and largely under communal land use. The area is considered to non-arable land receiving an average rainfall of 600mm per annum with temperatures ranging from a minimum of 28°C to a maximum of 40°C, has complex soils with various textures and drainage conditions which have developed from alluvial deposits. Some of these soils are saline. Shallow stony sandy soils characterize a large area with rock outcrops, volcanic ash, and lava boulders. This zone is a rangeland with isolated dryland subsistence agriculture pockets and small-

scale irrigation in Marigat -Baringo South, Barwessa - North Baringo, and Kolowa - Tiaty Constituencies. The area is characterized by recurring droughts (see appendix I) and floods associated with influence of climate change. The medium potential areas support both crops & livestock, while the low potential (arid zones) is suited to extensive livestock keeping under pastoralism as the main livelihood activities.

Past studies (Ochuka et al., 2019) show that, in the last three decades, from 1988 to 2018, agricultural land use increased by 21.11 %, 24.33 %, and 26.03%, pastoralism land use decrease by 15.14%, 19.27 %, and 23.01 %, human settlement land use increased by 2.22%, 1.43 %, and 2.47%, the vegetation cover decrease by 1.75%, 2.79 %, and 3.78%, water bodies decreased by 2.77%, 3.23% and 1.66%, in the 1988-1998, 1998-2008 and 2008-2018 periods respectively. It indicates that land use in the county has been changing; agricultural land use increases at an increasing rate, pastoralism decreases at an increasing rate, human settlement increase at an increasing rate. The vegetation cover decreases at a rising rate, and water bodies decrease haphazardly. These trends pose a worrying concern on the sustainability of land use changes with respect to the livelihood of the local communities in Baringo County.

1.2.3 Local Communities and their Livelihoods in Baringo County

In Baringo County, there are three main local communities; Tugen , Pokot and Ilchamus who have a great influence on land use. Though, there are others resident communities in the county including Nubians, Ogiek, Lembus, Turkana and Kikuyu among others, their influence on land use is minimal.

The three local communities with great influence on land use have diverse cultural background and beliefs on land. Land is the source life and livelihoods for these local communities. Each of these local communities holds land with unique cultural and

sentimental attachment as the source of prestige, social status, security and power. The physical and cultural survival of the specific local community depends on protecting their land resource. These local communities tend to be highly protective of their spatial justifications from potential migrants and intruders. These cultural attachments define the land use and promote inter-local communities' rivalries. This scenario accelerates land use changes in the area and perpetuates land use conflicts and worsening livelihoods.

Further, according to the National Population and Housing Census 2019 (KNBS, 2019), the Tugen local community belongs to the "Kalenjin ethnic group" and consists of crop farmers occupying mainly the county's hilly part (Tugen hills) with relatively high rainfall. They occupy four constituencies, mainly on the highlands, including Eldama Ravine, Baringo Central, Baringo North, and Mogotio Constituencies. The total land area covering the four study constituencies was 4822 km^2. The area consists of 1770.4 km^2 high potential, 2,069.6 km^2 medium potential, 709.6 km^2 low potential, and 267.2 km^2 other lands (CIDP, 2018). The area supports a human population of 422,312 people.

Land use changes in this area are largely on registered private land with title deeds. The local communities operate under individual decisions and employ modern land use practices and technologies. The livelihood activities comprise mainly crop farming. Land resources in this area are increasingly becoming scarce and characterized by subdivisions into uneconomical units, hence declining productivity and enhanced soil and water degradation. This scenario drives the local community to encroach into water catchment and forest areas causing massive forest destruction (see appendix 2) as well as migration to marginal areas seeking economic opportunities.

The Pokot local community was the second largest in Baringo County. They belong to the "Kalenjin ethnic group." They occupy Tiaty constituency in the lowlands of Baringo County. The area covers a total land area is 4516.8km^2 consisting of 225.8 km^2 high potential, 451.7 km^2 medium potential, 3834.8km^2 low potential, and 4.5km^2 other land (CIDP, 2018). Livestock keeping was the primary source of livelihood. They keep cattle, sheep, goats, camels and donkeys, and derived their products. The land resource supports a human population of 171, 027 people.

Approximately eighty per cent (85 %) of the land in this area fall under low potential, and it spans from West Pokot County expanding their territory into Baringo County. It borders Turkana, Samburu and encroaching into Laikipia Counties. Pokot local community moves from place to place with their livestock in search of water and pasture. The area is characterized by cycles of droughts that result in famine and acute shortages of food and water for both humans and livestock (CIDP, 2018). Land use in this area revolves around the flexible movement of animals in response to sparse, erratic rainfall, short vegetation and water (Mugabe et al., 2016). The land use in the area was essentially communal under the typical arrangement. The primary source of livelihood is livestock and livestock products under an extensive pastoral lifestyle.

The Ilchamus local community was the third largest local community in Baringo County. They belong to the "Maa speaking ethnic group" They are agro-pastoralists occupying the fertile flood plains surrounding Lake Baringo, and on the islands in the Lake. They keep livestock; grow crops under small-scale irrigation with subsistence fishing in the lake. They have permanent residence but occasionally move livestock from place to place, searching for pasture and water, especially during drought

periods. They occupy seventy-five (75 %) of Baringo South constituency in the lowlands of Baringo County. The total land area is 1678 km^2 broken down into 167.8 km^2 of high potential, 251.7 km^2 medium potential, 755.1km^2 low potential and 503.4 km^2 another land. Most of the land was not registered and held in trust for the community by the County government of Baringo. The area was facing steep competition arising from rapidly expanding crop farming against shrinking livestock rearing areas and influx of migrants from the highlands and from the dry areas. This situation was aggravated by the invasion of the poisonous tree (p*rosopis julflora*), which rustle both the grazing and crop space. These problems were amplified by often rising water level of Lake Baringo causing floods (Ondiege, 1996). The area was characterized by communal land use with no organized land use rights system in place, the land use was perceived to be free for all; a salient feature that makes the area more susceptible to land grabbing and encroachment associated with inter- local communities' land use rivalry.

1.3 Statement of the Problem

Land is a principal factor of production, a source of life and livelihoods for the local communities. It provides a means of living and a variety of uses such as agricultural, human settlement, environmental conservation, urban and industrial development purposes among others. Local communities strive to optimize output from land for their livelihood. It entails balancing the myriad of uses for collective or individual gains. In Kenya, past studies (Thurston, 1987; Thuo, 2013; Khamisi, 2018) show that land use policy changed from customary to European like land use system during the colonial era (1895 to 1963). It involves changing land use from collective use practiced by the local communities to individual land use system dedicated to the

European settlers. The changes aimed at encouraging European settlers to undertake agricultural activities, protect and provide them with exclusive land rights to own and control labour supply through poll tax and development of resident labour (squatter system). These changes allocate large chunks of productive land to European settlers by dislocating the local communities and their livestock forcing them into native reserves. The changes also gave European settlers mandate to control production of specific crops including coffee, sisal, wheat and dairy cattle among others, and supported through government research and advisory services. The changes were largely driven by technocrats and policy makers. The Local communities were restricted to occupying particular dry areas, and land use in those areas was controlled and administered by government in a piece meal basis limited to subsistence crops such as maize and beans. The changes rendered customary land use non-viable, and shifted land use control from local communities to government. The changes adopted dual land use system; different land use for arable and for dry areas. In arable areas, the European settlers practice high productivity farming using modern technologies under private land tenure. Whereas, in the dry areas, local communities practiced low productivity farming using traditional methods under community land tenure. These changes evolved from colonial era through subsequent years after independence to 2021, and seems to be chronic, and continued to promote land use problems, thereby perpetuating economic disparity between individuals and regions, accelerating land use conflicts and worsening the livelihood of the local communities. It is evident that the changes elevated a few individuals to become extremely rich (20%), while majority (80%), largely the local communities, became extremely poor (RoK, 2016). This is happening against the backdrop of land use policy changes including; sessional paper no 3 of 2009 on the National Land Policy, the Constitution of Kenya

2010, the Land Act, 2012, the Land Registration Act, 2012, the Community Land Act, 2016 and sessional paper no 1 of 2017 on National Land Use Policy that confers sanctity on land. Particularly, on the rise, is land use conflicts, displacement, destruction of property, inter community land use rivalry and increasing suffering as well destitution among the local communities. These changes have endangered lives and livelihoods, making it difficult for local communities to plan for their livelihood activities and future development, particularly in the dry and marginal areas of the Baringo County. These issues are now a major threat to the livelihood of the local communities in Baringo County. Therefore, this study seeks to establish the drivers of land use changes, estimate the effects of land use changes and evaluate responsiveness of government intervention.

1.4 The Purpose of the Study

The study aims to identify the drivers and determine the effects of land use changes on local communities' livelihood by measuring the productivity of livelihood assets, determine the effects of government land use policy by measuring household livelihood assets productivity, and evaluate the responsiveness of government decisions on land use changes.

1.5. The Study General Objective

The general objective of this study is to examine the dynamics of land use changes on the livelihood of the local communities in Baringo County.

1.5.1 Specific Objectives

The study-specific objectives are:

i. To establish the drivers of land use changes in Baringo County.

ii. To determine the effects of land use changes on the livelihood assets productivity in Baringo County.

iii. To determine the effects of government land use policy decisions on the household livelihood assets productivity.

iv. To evaluate government response decisions on the land use changes in Baringo County.

1.5.2 Research questions

To achieve the objectives of the study, the following research questions were answered:

i. What are the drivers of land use changes in Baringo County?

ii. What are the effects of land use changes on the household livelihood assets productivity in Baringo County?

iii. What are the effects of land use policy decisions on the household livelihood assets productivity?

iv. Why do land use problems persists despite government interventions in Baringo County?

1.6 Significance of the Study

This study is important to scholars/academicians, policy makers, policy review institutions, lobby and advocacy agencies in the national and County governments, international development agencies, and the local communities. To the scholars/ academicians, the study will go a long way in adding to the body of knowledge in the area of land use changes drivers, effects and responsiveness of government decisions. Empirical studies clearly indicates that the drivers of land uses changes, effects of

land use changes and responsiveness of government intervention with respect to livelihood of the local communities are poorly understood, particularly in Arid and Semi-Arid lands (ASALs) such as Baringo County.

Most empirical studies on land use changes focused on livelihood diversification. These studies devoted much efforts on developing coping strategies to counter the effects of land use changes, but silent on understanding the drivers, effects of land use changes and responsiveness of government intervention. Therefore, the conclusions of the previous studies may not be useful in explaining the perpetual land use problems prevalent in the study area. This study ventured to understand the drivers, effects and responsiveness of government intervention on land use changes with respect to the livelihood of the local communities. The findings will go a long way in enriching the existing literature and open new areas of research on dynamics of land use changes on the livelihood of the local communities covering all the ASALs counties in Kenya.

To the policy makers, the knowledge generated from the findings of this study will be useful in informing policy-making decisions to the Ministry of Lands, National Land Commission (NLC), Parliament (National Assembly and Senate) and County Governments. Empirical studies indicate that land use changes evolved from colonial era through subsequent years after independence to 2021, and seems to be chronic, and continued to promote land use problems, thereby perpetuating economic disparity between individuals and regions. Moreover, it is evident from previous studies that government use recycled policy formats focusing on arable areas with scanty attention to dry areas. This study will inform the policy process to revise policy format and orientation focusing on dry areas while constitutes approximately 68% of the total land in Kenya.

The findings will be useful for public policy reviewed institutions such as Kenya Institute for Public Policy Research and Analysis (KiPPRA) and Institute of Economic Affairs (IEA) to rethink and devise innovative appropriate policy measures to be more responsive to local communities' needs and aspirations. This study will go a long way in informing the public policy review institutions to review the government policy framework. The framework has maintained "dual land use system" which reinforce economic disparity between high rainfall and dry regions over the years. This has led to severe consequence on the livelihood of the local communities particularly in the drier areas.

To local communities and lobby and advocacy organizations, this study will be particularly useful in sensitization of local communities to lobby for recognition, protection and registration of their interest on community land. This study will go a long way as a lobby tool for local communities to seek their land ownership rights, use, management, planning and participation in County Integrated Development Plan (CIDP) prioritization, and also useful as a bargain tool popularizing environmental incentives for conservation, and in benefit sharing of land based natural resources such geothermal power generation, solar power, minerals and water resources among others.

Further, to International Development Agencies such a World Bank and Private development partners, the findings will spur new knowledge for mutual engagement and open up new areas for further research.

1.7 Scope of the Study

The scope of a study defines the boundaries of the research (Goes & Marylin, 2013). This study covers land use changes in the entire Baringo County. Secondary data on

existing literature was used to identify the drivers of land use changes tracing from colonial era through subsequent years after independence to 2021. Primary data was also gathered through non-experimental survey between September 2018 to February 2019, covering a representative sample of 323 households drawn randomly from Eldama Ravine, Baringo North, Baringo South and Tiaty constituencies. These four constituencies out of six adequately reflect the unique characteristics of land use changes in the County.

The data sources were considered adequate within the scope of this study for analysis to estimate the effects of land use changes, and the effects of government land use policy as well as evaluating the respond of government decisions on the land use changes under different tenure regimes prevalent in the study area. The models used to include Cobb Douglas production function and Multinomial logit were aligned to Sustainable Livelihood Framework (SLF). SLF focus on livelihood of the local communities, and links their production processes with policy organs, institutions and processes involved in land use changes. To operationalize the study objectives, livelihood assets productivity was used in proxy to estimate the effects of land use changes, while private land use households were use as reference group to estimate household livelihood assets productivity relative to community land use households and marginal land use households.

Livelihood assets productivity was measured in terms of coefficient for independent variables human, physical, natural, financial and social capital (inputs) to explain the changes in output (livelihood outcomes) as dependent variable. In the Multinomial logit model, the prediction was based on private land use households as a reference group, relative to community land use and marginal land use household's livelihood

assets productivity. The data was deemed adequate to ascertain the current status of land use changes in Baringo County.

1.8 Limitations of the Study

Although the research has achieved its objectives, there were some unavoidable limitations encountered and overcame. First, the study experienced challenges in primary data collection in terms of production statistics, household details and livelihood assets since about seventy-five percent (75 %) of the household heads hold cultural beliefs. They do not keep these records and some information is associated with taboos such as disclosing the number of children and number of livestock, hence makes data gathering difficult. This challenge was resolved by counter checking with authentic National Household Survey Report and Ministry of agriculture data.

Second, recall bias was common as a problem since most records are verbal. These challenges were foreseen and addressed by recruiting and training local students and engaging them to collect data deep in the villages. Using the National population census questionnaire and manuals (KNBS, 2019) to reconcile verbal information addressed recall bias.

Third, the study area was characterized by insecurity but this challenge was also foreseen and countered by recruiting, training and facilitating the local enumerators. Lastly, the results focus on Baringo County should therefore not be generalized to other ASAL counties whose geographical location, social relations and demography setting is different.

In general, the results provided significant and robust insights into the dynamics of land use changes applicable to the entire Baringo County.

1.9 Operational Definitions of Terms

Agro- pastoral land use households are households in the marginal land in the Baringo County whose main livelihood was based on both crop farming and livestock keeping, largely in community land (Author definition in the context of this study)

Community is defined as a consciously distinct and organized group of users of community land who are citizens of Kenya and share attributes such as common ancestry, similar culture, unique mode of livelihood, socio-economic or other similar common interest, geographical space, ecological space or ethnicity (Community land Act, 2016).

Community land is a category of land in Kenya vest and held by communities identified on the basis of ethnicity, culture or similar community of interest with unique mode of livelihood (Constitution of Kenya (article 63 (2) of 2010).

Community use of land means holding or using land in undivided shares by the community (Community land Act, 2016).

Dynamics of Land use changes means land use changes and their resultant consequences (Author definition in the context of this study)

Dummy variable is a qualitative variable used in regression analysis to represent subgroups of the sample (Maddalla, 1983). In this study, it was used to distinguish different regions characteristics in a single regression equation to depict the influence of regional variation in livelihood assets productivity (Author definition in the context of this study)

Elite class is few ruling groups, economically endowed with immense political power in government land use decisions (Khamisi, 2018).

Government intervention means changes in policies, laws, regulations, rules and guidelines intended to allocate, administer and regulate land use (Author definition in the context of the study).

Household livelihood assets productivity is used in proxy to determine the effects of land use policy decisions (Author definition in the context of this study).

Livelihood is a means of living including both social and material (DFID, 1999 definition)

Livelihood assets are inputs used in the production process by households in pursuit of their livelihood activities. They comprise of human, physical, natural, social, financial capital (adopted from Sustainable Livelihood Framework).

Livelihood assets productivity is the coefficient of the independent variables in the Cobb- Douglas model used in proxy to determine effects of land use changes

Livelihood assets attributes are characteristics of a specified livelihood assets used as change indicator to determine the effects of land use policy decisions (author conceptualization).

Local Communities are indigenous populations who reside and derive their livelihood from land use (Author Conceptualization).

Local community means an ethnic group of land users who are citizen of Kenya, share common ancestry, culture and unique mode of livelihood suited to the prevailing local conditions (Author definition in the context of the study).

Modern laws are rules and regulations that are put in place to guide the land use.

National Land policy refers to a set of regulations and guidelines used in the governance of land use

National Land use policy is a tool use to harmonize the various uses of land.

Pastoral land households are households in the dry part of the Baringo County whose main livelihood was based on extensive livestock keeping under pastoralism, and largely occupy community land (Author definition in the context of this study)

Private land refers to legally registered land held by any person under freehold tenure (Constitution of Kenya, 2010)

Private land use households are households in the highlands of the Baringo County whose main livelihood activity was crop farming largely in registered private land (Author definition in the context of this study)

Reference group is the highest frequency type of household land use in the data set. This is particularly useful in standard interpretation of multinomial logit models i.e. k-1 logits (Maddalla, 1983). In this study, the coefficient of the household livelihood asset productivity was interpreted relative to the reference group i.e. the coefficient of pastoral/community and agro-pastoral land use households livelihood assets productivity were interpreted relative to private land use households livelihood assets productivity.

Unregistered community land is land held in trust by county government on behalf of the local community for which it is held (Community Land Act, 2016)

Wildlife Conservancy refers to land managed by an individual landowner, body corporate, group of owners or a community for purposes of wildlife conservation and other compatible land use to better livelihoods (Wildlife Conservation and Management Act, 2013)

1.10 Organization of the Study

Chapter1 has described the background, the problem statement, purpose, overall objectives, specific objectives, research questions, significance, scope, limitations, and operational definition of terms and organization of the study. Chapter 2 reviewed the theories and empirical studies related to the study. It covered the theoretical literature review, empirical literature review and conceptual framework. Chapter 3 describes the methods employed, including the study area, the research design, the research instruments, data collection procedure and analytical framework. Chapter 4 presents the results per the objective of the study. i.e., establishing the drivers, quantifying the effects, evaluating the responsiveness and effectiveness of government intervention and decisions, and finally, Chapter five on the discussions and conclusions of the study.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter reviews literature related to the study objectives concerning land use changes, the livelihood of the local communities and government intervention to alleviate the situation. It covers the theoretical literature, empirical literature review and conceptual framework.

2.1 Theoretical Literature review of the study

The theoretical review gives the perspective through which the study is undertaken. The theoretical foundation of this is based on seven theories; the production theory, the tragedy of commons concept, the dualistic development thesis, the sustainable livelihood framework (SLF), the government intervention, decision and the probability Choice theories.

2.1.1 The Production Theory

The production theory is the theory underpinning the determination of land use changes on livelihood assets productivity. The production theory explains how the level of output changes as the quantity of factor input changes. It can be explained simply as the conversion of resources (inputs) to products (output). The theory assumes that the production process follows a linear path and certain specific conditions. These conditions include the state of technology assumed to be given, and one factor of production must always be kept constant at a given level.

According to theory, these conditions present quantitative relationships between inputs and outputs, and it is used as a tool of analysis in explaining the input-output relationship. Various scholars have developed and reviewed these input-output

relationships over time (Cobb-Douglas, 1927 & Leontief, 1936), giving various production functions. In this respect, there are three common variants of the production function; the linear production function (perfect substitutes), the Leontief production function (perfect complements) and Cobb-Douglas production function (imperfect complements). These functions have strengths and weaknesses with underlying assumptions, making them suitable for analyzing different production-related problems.

First, the linear production function is the most basic input-output relationship. In this case, the output of a production process is simply a function of inputs based on the perfect substitution assumption; capital can be substituted for labor perfectly. Under this relationship, an increase in the quantity of factor inputs will lead directly to increase in output. This type of production function assumes that the state of technology is given, one factor of production must always be kept constant at a given level and the theory is not applicable when two inputs are used in a fixed proportion. However, in a real-world situation, most input -output relationships are not linear. Therefore, the function may not be appropriate for this study.

Second, the Leontief production function was named after Wassily Leontief. Leontief analyzed Input-Output relations in the entire Economic System. The model provides a complete picture of the economy as a whole. It focused on industrial relationships within the domestic economy and assessment of the national output system. This kind of input-output relationship enables the calculation of sets of multipliers, which are tools to further evaluation of an economic system. Specifically, Leontief (1936) model visualizes an input-output relation as a combination of economic activities of

the entire economy. It incorporates all branches of industry, agriculture, transportation and all private person's economic activities. Leontief approach provided a reasoning and detailed explanation of the quantitative accounts of all sectors in the form of input-output tables.

Leontief's model is a demand-driven input-output relationship that generalizes interdependencies between industries within an economy. This model was widely accepted and largely used by governments as an economic planning tool. Despite governments' wide acceptance of the Leontief model as an analytical tool on the demand side of the production theory, Gosh (1958) criticized the Leontief approach and developed a similar model on the supply side. Gosh applied assumptions of the demand-driven Leontief model but focused on failures of the Leontief model, particularly in monopolistic or centrally planned economies with scarce resources. Gosh argued that the Leontief model only applies to demand-side changes under perfect market conditions.

Gosh, criticism notwithstanding, Leontief (1970) continued his focus on demand side input-output relation and incorporated the externalities into the conventional output picture of a national economy. He demonstrated that the conventional input-output calculation gives concrete answers to undesirable environmental effects of modern technology and uncontrolled economic growth. Leontief further reinforced the strengths of demand side input-output analysis that it allows for structural changes studies in the economy, and provides the tools necessary to evaluate sectors.

In this respect, Guo and Planting (2000), supporting the strengths of Leontief input-output analysis, analyzed structural changes in the USA economy and the role of international trade on those changes using a set of six input-output tables prepared over the 1972 to 1996 period. Guo and Planting found out that the multiplier product matrix measures the structural change. The multiplier product matrix provides a measure of linkages between industries, comparing industries or the industry itself at different points in time.

According to Miller et al. (1991), Leontief input- output analysis represents a closed economy concerning households' economic activities. They used comprehensive social account matrices to explain the United Nations system of national accounts to support Leontief's theoretical and empirical discussions on input-output analysis. In addition, many studies (Miernyk & Rose (1989); Ten Raa (2005); Miller et al. (1991); Miller (2009) and Park (2006)) argued that Leontief input-output models are attractive because they can be made operational and accessible at low cost.

In contrast, critics argue that Leontief input-output model was only applicable to developed economies. For instance, some studies, Tretyakova and Birman (1976), Feldman et al. (1976) and Tsoukalas (2011) used Leontief input-output model to evaluated developed economies. Tretyakova and Birman (1976) used the model to analyze the USSR economy, Feldman et al. (1976) used the model to analyze the US economy and Tsoukalas (2011) used the model to examine the UK economy. It could not explain different sectors of the domestic economy in developing economies.

Leontief input-output analysis assumed fixed input structure, fixed technological coefficients for all sectors and constant returns for primary factors of production.

These assumptions are unrealistic in a real-world situation. The function also assumed that all industry products are identical or are produced proportionally, in fixed proportions, to each other. The calculation of returns to scale in production are assumed to be constant in each industry. These assumptions may lead to overestimation in the interpretation of results.

Therefore, considering the strengths and weaknesses of the Leontief model, it is concluded that the model is not applicable for this study. In this study, the unit of analysis is the household at the micro-level in contrast with Leontief macro-level perspective. The approach assumed a competitive market system and non-scarce resources. This assumption may not apply to this study because livelihood activities are carried out in an imperfect markets' environment, and resources are always scarce. Leontief model may not be suitable for input-output analysis at the household level hence not appropriate for this study.

Third, Cobb- Douglas production function is another input-output relationship. It describes the technical relationship in the conversion of inputs to outputs. The function became famous in 1928 when American Economic Review Scientific magazine recognized it as a production theory (Cobb & Douglas, 1928). Cobb-Douglas production function in a simplified version is represented in a model written as:

$$Q = AL^{\alpha}K^{\beta} \quad (2.1)$$

Where Q= total production (the monetary value of all goods produced in a year),

L = labour input,

K = capital input,

A= total factor productivity and

α and β are the labour and capital share of output respectively.

These values are constant and determined by the available technology. The function assumes that the number of parameters equals one, i.e. $\alpha + \beta = 1$. Therefore, it is a linear homogenous production function which proofs as:

$$\text{If } \alpha + \beta = 1, \text{ then } \beta = 1 - \alpha \qquad (2.2)$$

The parameters of α and β are output elasticities for each input. If $\alpha + \beta > 1$, then the results mean increasing returns to scale and If $\alpha + \beta < 1$, the results are decreasing returns to scale. The returns to scale imply the changes in output subject to a proportional change in inputs. In reality, the function is not linear. Hence necessary to linearize to facilitate estimation by double log or natural logarithm and written as:

$$\text{Ln } Q = \text{LnA} + \alpha \text{ Ln } K - \alpha \text{ LnL} - \text{Ln } L \qquad (2.3)$$

$$\text{LnQ} - \text{LnL} = \text{LnA} + \alpha (\text{LnK} - \text{LnL}) \qquad (2.4)$$

$$\text{LnQ/L} = \text{LnA} + \text{LnK/L} \qquad (2.5)$$

Equation (2.5) connects labor productivity (Q/L) with the ratio of capital and labor (KL). According to Baily (1986), Cobb-Douglas can handle several inputs that enable us to measure technical progress in a production system. In this respect, the Cobb-

Douglas production function was applied in its extended form consisting of more than two variables written as:

$$Y=\alpha X_i\beta i\ldots\ldots X_n\beta ne\mu \quad (2.6)$$

Where Y stands for output,

Xi……. Xn stand for inputs

α……stand for a constant/ intercept,

βi……. βn stand for regression coefficients,

e ……. natural logarithms,

μ …. error term/ disturbance term

If the cobb- Douglas production function is expressed by the relationship Y and X, then equation (2.6) can be:

$$Y = f(X_1, X_2\ldots\ldots, X_i, \ldots\ldots\ldots, X_n). \quad (2.7)$$

To facilitate the estimation of the equation (2.6), the equation can be transformed in multiple linear forms by means of natural logarithm (Ln) as:

$$LnY = Ln\alpha + \beta_1 LnX_1 + \beta_2 Ln\, X_2 + \beta_3 LnX_3 +, \beta_4 LnX_4 + \beta_5 LnX_5 + \mu \quad (2.8)$$

Where Y = the dependent variable,

α = is constant term (intercept),

$X_1\ldots\ldots X_5$ = independent variable,

$\beta 1\ldots\ldots \beta_5$ = regression coefficients of independent variables,

$\delta 1\ldots\ldots \delta 4$ = regression coefficients of dummy variables,

μ = is the disturbance term

In this study, some independent variables are qualitative and require an additional technique to capture their influence. The study, therefore, adopted dummy variables to analyze the influence of these qualitative variables. According to Gujarati and Porter

(2009), dummy variables are used to capture the influence of qualitative variables in a regression model. A dummy variable is defined as a numerical variable used in regression analysis to represent subgroups of the sample (Maddalla, 1983). It is often used to distinguish different treatment groups and is helpful because they enable us to use a single regression equation to represent multiple groups. Maddalla points out that we don't need to write out separate equation models for each subgroup. Hence equation (2.8) can be written as:

$$LnY = Ln\alpha + \beta_1 LnX_1 + \beta_2 Ln\, X_2 + \beta_i LnX_i + \beta_n LnX_n + \delta_1 LnD_{1\text{-}4} + \mu \quad (2.9)$$

Where Y = the dependent variable,

α = is constant term (intercept),

$X_1 \ldots\ldots X_5$ = independent variable,

$\beta 1 \ldots\ldots \beta_5$ = regression coefficient of independent variables,

$\delta 1 \ldots\ldots \delta 4$ = regression of dummy variables,

$D_1 \ldots\ldots\ldots D_4$ = dummy variables and

μ = is the disturbance term

In this functional form (equation 2.9), the Cobb- Douglas production function has several strengths and weaknesses. The principal power of the Cobb- Douglas production function in its functional form can handle multiple inputs, and the estimated coefficient can be tested statistically for significance. The function can be applied in various situations. Since it is flexible and can be expressed as linear, quadratic, polynomials, square root polynomials, semi-log exponentials and transcendental function. The function has been applied successfully by many scholars to analyze various agricultural production processes. Over the years, different studies used the function to examine various aspects of agricultural production, including the

productivity of different inputs such as land, labor and capital in the production process.

Van Loon et al. (2005) used the Cobb- Douglas production function to measure the marginal contribution of each input to aggregate agricultural output. In van loon et al. study, various inputs were valued and measured in terms of quantifiable units. For example, crops and livestock productivity were measured in terms of yield per unit of land. Labor productivity was expressed by the hours of work needed to produce metric tonnes of produce (say cereals) and capital used in the production process in purchases of seeds, fertilizer, chemical, machinery, purchase of livestock feeds, among others to explain land productivity.

Dharmasiri (2009) used the function in measuring the spatial variation of agricultural productivity in different regions of Sri Lanka. Shafi (1984) used the function in measuring agricultural productivity and regional imbalances. Lewis et al. (1988) used the function to calculate productivity growth rates for agriculture and other sectors of the Australian economy. In the Lewis et al. study, it was concluded that the productivity growth rate in agriculture was higher than that of other sectors of the Australian economy.

However, despite the highlighted strengths of the production function in terms of its flexibility and wide application in agricultural production, critics argued that Cobb-Douglas production function was based on restrictive assumptions of perfect competition in factor and product markets, and it assumes constant returns to scale (CRS). The function is prone to serial correlation and heteroscedasticity since labor and capital are correlated, and the estimates are bound to be biased in the Neoclassical model. Further, critics argue that the unitary elasticity of substitution is unrealistic,

and the function is based on single-equation estimates, which are bound to be inconsistent and cannot measure technical efficiency levels and growth very effectively. The function was developed based on mathematical knowledge such as diminishing marginal returns to either factor of production or the property that the optimal expenditure shares on any given input of a firm.

Nevertheless, the Cobb-Douglas model has undergone several improvements to address most of the cited weaknesses in econometric diagnostics and remedial measures of heteroscedasticity and multicollinearity problems and the highlighted limitations of the function. Therefore, the model stands out to be the most appropriate for this study.

This study borrowed the Cobb-Douglas production function as a theory of production to analyse land use changes on livelihood assets productivity. In this study, inputs comprise human, physical, natural, social and financial capital, which constitute livelihood assets available for the households. These inputs are the independent variables used in the production process which yield outputs. The output represents the dependent variable which is the livelihood outcomes. Livelihood outcome is the sum of all production activities under different tenure regimes. In this study, the Cobb-Douglas production function was aligned to the sustainable livelihood framework, and applied to examine the relationship between the capital inputs (human, natural, physical, financial and social) on the resultant output.

2.1.2 The Government Intervention Theory

The theory grounding the effects of government policy decisions on land use changes is the theory of government intervention. Government intervention theory is based on

a British economist John Maynard Keynes (1883- 1946), in the 1940s revolutionary book, the general theory of employment, interest and money. Keynes emphasized the need for government intervention with the market system and management of the economy by the government to ensure efficient allocation of resources, achieve socially optimum production and distribution patterns of goods and services, and bring stability in growth, employment, and price level and foreign exchange rates.

Keynesian school of Economic thought emerged and dominated government decisions in the 1940s through 1960s. This period coincided with the colonization of the African region. The colonial government decisions were guided by the quest to gain control over land use as the source of economic and political power. In this study, land use changes in Kenya were assumed to emanate from colonial-era land use policies. The colonial-era land use policies set a precedent that influenced the formulation and implementation of policy in Kenya. During the colonial-era, land use policy changes were marshalled to change the traditional communal land use to the individual commercial production system.

The theory of government intervention is particularly useful in the determination of the effects of land use changes in objective two. The theory encompasses aspects taken into account in the Decision Theory, Tragedy of Commons, and Dualistic Development Thesis embodied with ideologies, mindset of technocrats and policy makers, and economic power relations estimated in objective two. In this study, the theory focus on the role of government in balancing or harmonizing competing claims on land use as well as provider of solutions to the ensuing land use problems through specific policies and laws such as Swynnerton plan, The National Land Policy, the Land Act, 2012, Land Registration Act, 2012, Community Land Act, 2016, and The National Land Use Policy, 2017 among others. This theory was embedded in the

methodology of the production theory, particularly to reinforce explanations given by the variable parameters used in the CD model. In this model, government intervention theory was captured in dummy variables representing study sites (constituencies) under different land use and ecological conditions.

2.1.3 The Decision Theory

The theory underpinning the responsiveness of government decisions on household livelihood assets productivity is the decision and probability choice theories. The decision theory is a principle associated with decisions. The theory provides a formal structure to make a rational decision in the situation of uncertainty. Given a set of alternatives, consequences, and correspondence between those sets, decision theory offers simple conceptual procedures for choice. According to David (1974), decision theory is a set of concepts, principles, tools and techniques that help decision-makers deal with complex decisions problems under uncertainty. The theory determines the optimal course of action when several alternatives are available and their consequences cannot be forecasted with certainty. The theory enables the decision-maker to analyze a set of complex situations with many alternatives and many different possible consequences and to identify a course of action consistent with the decision maker's basic economic and psychological desires. In this study, the responsiveness of government decisions during the colonial era and its legacy after independence was largely driven by the policy-makers and technocrats who believed that communal land use was an inefficient system associated with the tragedy of commons should be eliminated at all cost.

2.1.4 The Tragedy of Commons

The foundation of colonial land use policy change and its response to the consequences was based on ideologies and the perception of policymakers and technocrats about the pre-colonial communal land use system. Communal land use was perceived as free for all hence subject to individual abuse at the expense of the community. The tragedy of commons concept states that individuals use up resources shared by many to benefit themselves. It was first introduced by William Forster Lloyd, a British economic writer, in 1833. He offered the basic concept behind the tragedy of commons. This concept was largely underappreciated until American Ecologist and Philosopher Garrett Hardin wrote in a 1968 issue of Science magazine. Hardin refers to any naturally occurring resources that are used and consumed by the public at large. Hardin argues that tragedy of commons occurs when individuals neglect the well-being of society in the pursuit of personal gains. This leads to overconsumption or overuse and ultimately depletion of that common resource, to the detriment of all users.

According to Hardin (1968), the tragedy of the commons develops in this way. A communal land use during the pre-colonial era was perceived to be free to all. According to Hardin, each community member will use the land as much as possible in the commons. Therefore, following the concept of the tragedy of common, policymakers and technocrats believe that communal land use would provide diminished benefits to everyone if each individual pursues their self-interest. The value of communal land use can be reduced through overuse because the land is a scarce resource and continuous use may lead to overuse, hence the commons' tragedy (Hardin, 1968).

In this respect, colonial policymakers and technocrats believe that the solution to land use problems in Kenya was the imposition of private rights through government intervention. This mindset was inherited by independent Kenya policy makers and technocrats, thereby maintaining the same orientation using the same policy formulation templates. In this study, government decision and response strategies were viewed regarding policies, laws and regulations that guide land use. These decisions cause land use changes that influenced the livelihood of the local communities.

2.1.5 The Dualistic Development Thesis

Land use changes seem to be driven by the concepts articulated in the Dualistic Development Thesis. Dualism is a concept widely discussed in development economics. It describes the existence and persistence of increasing divergence between the rich nations and the rich and poor people on various levels (Michael et al., 2015). This concept embraces four key elements; the different set of conditions coexisting in a given space. In this study, the concept applies to the coexistence of modern and traditional methods of production. For instance, in the highlands, modern technologies such as the use of tractors in land preparation, planters in planting seeds, crop protection using chemicals, and harvesting using combine harvester hence high productivity, whereas, in the drier area, traditional equipment are used such as jembes, manual planting, weeding and harvesting hence low productivity. Hence wide productivity gap between highlands and dry areas.

According to the Dualistic Development Thesis concept, the coexistence is chronic and not merely transitional, the degree of this divergence fails to show any signs of diminishing, but they even have an inherent tendency to increase. The concept asserts

that government interventions do little or nothing to change the situation. Therefore, this concept could be used to explain the perpetual land use problems despite government interventions.

2.1.6 The Probability Choice Theory

The theory underpinning the responsiveness of government policy decisions is the probability choice theory. The theory of probability provides the means of rationally model, analyze and solve problems where future events cannot be foreseen with certitude. The theory assumes an interdisciplinary approach to determine decisions given unknown variables and an uncertain decision environment framework. The theory originates from a gamblers dispute in 1654 which led to a mathematical theory of probability by two famous French mathematicians Blaise Pascal and Pierre de Fermat. In 1657, Leibniz published the first book on probability. Jakob Bernoulli (1654-1705), Abraham de Moivre (1667-1754) and Pierre Laplace 1812) introduced a host of ideas and mathematical techniques for analyzing probabilistic ideas to many scientific and practical problems.

In this study, the government is the principal land use decision-maker, and decisions were considered a categorical dependent variable that takes more than two alternatives. Government decisions are dependent on some factors that interact in ways that would be difficult or impossible to predict with precision. This situation involves uncertainty and making choices between two or more alternatives. The choice models describe, explain and predict choices between two or more discrete alternatives. Government decisions take the form of a probability choice approach. This study, therefore, borrowed decision and probability choice theories to evaluate government decisions.

The probability choice theory was useful in the evaluation of government response decisions by forecasting and predicting the effects of policy changes on land use changes in objective four. The theory captured the relative effects of land use changes using private household land use as reference group compared with community land household land use and marginal land household land use. Basing on Multinomial logit Maximum likelihood estimates.

2.1.7 The Sustainable Livelihood Framework (SLF) Theory

In this study, the sustainable livelihood framework was adopted, and aligned to the production theory. The framework links production process at household level with policy institutions. The link provides a logical sequence that explain better the land use changes as a result of government and development partners' intervention. The foundation of livelihood theory is the Sustainable Livelihood Framework (SLF) concept. The concept is a development intervention adopted by some major international agencies such as DFID, CARE International, UNDP and ILO, among others, to facilitate the implementation of their development programs (Solebury, 2003). The concept focuses on livelihood assets required by local communities for a means of living, enabling environment (policies, institutions and processes) and sustainability (livelihood outcomes) (Scoones, 2008). The theory attempts to explain how livelihood outcomes change due to the influence of policies, institutions and processes in a logical sequence from production to output (Chambers & Conway, 1992).

The concept places communities at the center of the pentagon as an operating environment (Carney, 1998). The corners of the pentagon represent livelihood assets (H-Human, N-Natural, F- Financial, P- Physical & S-Social capitals) which are influenced by policies, institutions and processes (Carney, 1998). The concept became

prominent in the 1980s due to the basic needs development discontent of the 1970s and the top-down approaches (Chambers & Conway, 1992). It was first acknowledged as a development policy that meets the needs of the present generations without compromising the ability of future generations to meet their own needs; 'Our Common Future' (The World Commission on Environment report, 1987). The report argued that sustainable livelihood requires political, social and production systems that provide secure participation of local communities in decision-making and economic opportunities. This report recommends adopting an important livelihood concept was reinforced by a paper on the Greening of Aid: Sustainable Livelihoods in Practice (Conroy & Livinoff, 1988).

In this light, United Nations Development Programme (UNDP) in Human Development Report (1990) acknowledged and adopted the sustainable livelihood concept as a tool to analyze individuals and household's health, education and well-being (UNDP Human Development Report, 1990). The report recommended that local communities' participation, self-reliance, and sustainability be considered in all development interventions.

Subsequently, Chambers and Conway (1992) study on Sustainable Rural Livelihoods: practical concepts of sustainable livelihood for the 21st century upholds the Brundtland report on environment and development and supports the work of Robert Chambers at the institute of development studies (IIED) on the concept of sustainable livelihood framework theory. The study offered a working definition of livelihood as "*A livelihood comprises the capabilities, assets (stores, resources, claims and access) and activities required for a means of living; a livelihood is sustainable 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." The definition builds on earlier work done by Schumacher (1973), Sen (1981) and Jodha (1988).

Further, Carney (1998) simplified the definition and defined livelihood as *"A livelihood comprises the capabilities, assets (including both material and social resources) and activities required for a means of living."* To incorporate sustainability, the definition was further improved as *"A livelihood is sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base."* This definition was found appropriate in terms of development intervention under different perspectives, and from then onwards, several donor agencies and governments adopted the sustainable livelihood concept in various settings.

a) DFID adopted sustainable livelihood theory in administering foreign aid and focus its activities directly on improving the livelihoods of the local communities at the grassroots.
b) Oxfam, from 1993 used a sustainable livelihood approach as a component in formulating its overall aims, improving project strategies and staff training.
c) UNDP from 1995 used it to evaluate different types of capital (human, natural, physical, social, and financial) and examined how individuals leverage assets and cope with external sources of shocks and stress.
d) CARE International used the theory in emergency relief administration and the design of long-term development programs holistically.

e) Rennie and Singh (1996) used the sustainable livelihoods concept in participatory research and developed a guidebook for field projects.

As demonstrated by the wide acceptance and diverse application of the sustainable livelihood concept in various settings, the concept has several strengths and provides a logical sequence of activities. It guides the development and gives entry points to interventions. The concept provides a framework for analysis of what 'is' and what can be done. It offers the opportunity for evaluating the efficacy of government, non-governmental and private sector agencies interventions.

Critics of the Sustainable Livelihood Framework (SLF) argue that the SLF concept relies heavily on donor development agencies such as DFID, Oxfam, CARE International, and UNDP perspectives. In a sense, the local communities are considered recipients of the donation and visualize the rich helping the poor. It portrays a prescriptive and experimental attribute that tests whether new concepts work. The framework seems to be community/people-centred, but on a critical look, it still maintains top-down approach principles. Past studies on SLF as an analytical tool (Cahn 2000; Ellis 2000; Scoones 1998; DFID 1999) indicate that the approach has been carried out largely in Asia and Africa. This suggests doubt that the approach may not be applicable in developed economies such as Europe and USA among others with a different set of conditions.

Further, the approach is practitioner-dependent with institutional arrangement and processes, which may not fit the local communities' setup. However, despite the highlighted strengths and weaknesses, the concept assumes that planned outcomes would provide feedback to enhance livelihood assets productivity and make local communities more resilient. This assumption sounds good theoretically but not

realistic in the normal working conditions. Nevertheless, the concept of SLF seemed to be appropriate.

The SLF links land use by local communities, and policy organs, institutions, and processes. It is a participatory approach focusing on people's abilities and their assets. The theory has proven useful in various settings (Carney, 2008), and there are many variants of the theory depending on the purpose. Communities are placed at the centre, and the concept secures the participation of local communities in decision-making processes. This study borrowed the concept of sustainable livelihood frameworks to analyze individual's and household's production processes and the outcome of the production process. The concept was visualized as the overall study environment in analysis of local communities' production process, government policies & mindset of policymakers, and the resultant outcome. The concept provides a basis for analysis of livelihood outcomes changes due to changes in input levels where the livelihood production process and government decisions occur.

2.2. Empirical Literature review of the study

The empirical literature review focused on previous studies related to each study objectives; to establish the drivers of land use changes, to determine the effects of the land use changes on the productivity of households' livelihood assets', to determine the effects of the land use policy on households' livelihood assets productivity' and to evaluate the responsiveness of government decisions on the household livelihood assets productivity.

2.2.1 Establishing the Drivers of Land Use Changes

Empirical studies (Odhiambo et al., 2002; Thurston, 1987; Khamisi, 2018; Njonjo Commission report, 2002; Ndungu Commission report, 2006, Kateiya et al., 2021)

indicates that the drivers of land use changes take historical dimension associated with the policy changes in Kenya, tracing the origin from Colonial era and its ripple effects running through the various political regimes after independence. Odhiambo et al. (2002) investigated land laws and land use in Kenya and the implications for agricultural development. The study found out that the land use problems are chronic and associated with land use changes arising from the application of colonial statutory laws; the Indian Acquisition Act (1894), the Crown Land Ordinance (1902, 1915), the Crown Lands (Amendment) ordinance (1938). These laws facilitated the forceful acquisition of all productive land from local communities and alienated it from European settlers. The study also pointed out that these laws effectively gave European settlers legal mandates and enabling the environment to carry out agricultural land use activities in high rainfall areas referred to as White highlands.

Odhiambo pointed out that the European settlers were protected, provided with exclusive land rights, given control over labor supply through poll tax, supported in the development of resident labor (squatter system), supported to control the production of specific crops such as coffee, sisal, wheat, and dairy cattle as well as advisory services including research and agricultural extension by the colonial government particularly in the high rainfall and fertile areas referred as white highlands. Local communities were given little attention in terms of government services. Odhiambo further asserts a multiplicity of laws regulating land ownership and inherent inclination towards private ownership regime, but the communal regime remains in place in drier areas causing a major source of conflict in land use changes.

Thurston's (1987) study on smallholder agriculture in colonial Kenya: the official mind and the Swynnerton Plan of 1954 found out that in the mid-1950s, in response to sustained land use crisis and forms of agricultural production, the colonial government, developed a comprehensive plan to intensify land use in the local communities' areas. It stemmed from political decisions taken by the colonial government due to increasing pressures from local communities' demands for land use change. The plan aimed at addressing land use crisis and alleviating local communities' livelihood by moving the largest proportion of the local community (approximately five (5) million people) from subsistence to commercially-oriented farming, and form a framework for future land use in Kenya. The plan delineated land use into two basic development zones; the high-potential and the semi-arid. The plan's trust focused on the high-potential lands, where four-fifths of the population was concentrated, received priority, but the plan also provided minimal support to semiarid/pastoral areas.

The plan was designed according to the colonial government and expert philosophy: for smallholdings of economic size, at least seven (7) to ten (10) acres, for families of six (6) to eight (8) people, to raise their income from produce sales from between five (5) and twenty (20) sterling pounds to hundred (100) sterling pounds a year over and above the family's basic needs (Thurston, 1987). These smallholdings were to be consolidated in the fragmented areas, surveyed, registered, and developed over a period of fifteen (15) years as freehold farms with indefeasible titles. The study concluded that the Swynnerton plan became the key driver of the land use in Kenya and a blueprint land use policy during the colonial regime and its legacy spillover to independent Kenya. The primary failure of the plan was the neglect and

marginalization of drier areas in the country, which led to imbalances in development between different regions. The plan also created landless class and loss of communal grazing areas, among others. The plan reinforced the concept of dualism in land use changes in Kenya, pitting the European settlers and Rich African elites against the poor local communities.

Khamisi (2018) study entitled Kenya: Looters and Grabbers: 54 years of corruption and plunder by the elite, found out that at and after Kenya's independence from the colonial regime, the land was placed under the executive mandate of the presidency and tasked to initiate resettlement program to settle the displaced local communities during the colonial era. Khamisi pointed out that the resettlement program was massively affected by corruption from the presidency, local politicians, elites and businessmen.

Khamisi argued that the program was characterized by illegal allocation and land grabbing. Instead of addressing land use crisis facing the local communities, the elites and government officials took advantage of the situation and inherited European farms and continued managing them under the principles laid down in the Swynnerton plan. The poor local communities, especially those residing in the drier former natives' reserves, continued operating under customary land use arrangements.

Therefore, reinforced a dual land use system, which continued creating economic disparities between the elites and local communities. These scenarios maintained colonial systems and widened the productivity gap between the Elites and the poor local communities. The arrangement tilted toward ethnic lines creating a state of

animosity among the local communities' boiling into ethnic clashes witness during the election period (1992, 1997 & 2007/2008). This situation ignited numerous calls for land-use reforms.

Following the numerous calls for land use reforms, government of Kenya appointed Njonjo Commission (2002) to carry out an inquiry into the land law system in Kenya, and Ndungu Commision (2006) to undertake an inquiry into the illegal/irregular allocation of public land. These two commissions appointed by the government of Kenya recommended a review of the existing land use policies, laws and regulations. Both commissions recommended that there was a need to formulate a National Land Policy to replace the Swynnerton Plan, to entrench provisions of the National Land policy in the National Constitution of Kenya (2010) purposely to curb malpractices and manipulation by elites, devolve land governance to the devolved units, and develop a National Land use Policy. These efforts were perceived by many to be the new dawn to solving the land use problems and principal driver of land use changes in Kenya and, by extension Baringo County.

2.2.2 Determining the Effects of Land Use Changes

In this study, Household livelihood assets productivity was used as an indicator of land use changes. If the livelihood asset parameter is negative, then land use changes decrease household livelihood outcome, and if the livelihood assets parameter is positive, land use changes increase household livelihood outcome. Empirical studies (Suzane et al., 2009; Coast, 2002; Little et al., 2001; Fratkin and Roth, 2005) related to land use changes and livelihood of the local communities revealed mixed results, which gives insights to the current study. Suzane et al. (2009) investigated land use changes and livelihoods in pastoral areas; Kitengela peri-urban area in Kajiado

County, Mara area adjacent to Maasai Mara Game Reserve in Narok County, Amboseli area adjacent to Amboseli National Park in Kajiado County, Longido in Tanzania and Tarangire in Tanzania. The focus of this study was on the household economy within the social and cultural context. The study used household survey data on economic activities and returns remotely sensed data on agroecological, biophysical, social and economic/ demographic variables. The study employed non-parametric and parametric comparisons of households' data based on clusters and other categorizations. The study sites covered private land, peri-urban, group ranches under subdivision, communal land, and private gemstone mining.

Suzane et al. (2009) study found that pastoral land use changes exert pressure on land use and enhance diversification of livestock-based economies in the pastoral areas. These findings established that the areas experienced increased resource conflicts between different land uses, increased unmanaged dryland agriculture, decreased livestock holding per capita, and intensified land tenure conflicts. It was also established that the poorest households are more dependent on agriculture, while the wealthier households were mainly responsible for expansion in agricultural production.

The findings of the reviewed study are quite relevant and give insights into the current study. However, the current study differs from the reviewed empirical literature because it focuses on the productivity of specific household livelihood assets (human, natural, physical, financial and social capitals) instead of the household economy in the empirical study. The current study dug deeper into the core drivers of land use changes at the household level.

Similar studies (Coast, 2002; Little et al., 2001; Fratkin and Roth, 2005) used qualitative and statistical approaches to seek patterns and trajectories of land use change within an immensely diverse array of local communities, households and strategies. The studies focused on the diversification of livelihood strategies. These studies found out that livelihood diversification alters activities, the primary source of income, location, intensification of land use and changes the social identity of the local community.

Further, the studies found that intensification involves increasing inputs; land clearance, fencing, soil management, tree/planting, terracing, irrigation system construction and low mobility of livestock. This may lead to land degradation, which undermines livelihood assets productivity hence perpetuates the land use problem. This study findings, therefore, points at the policy change gap, which affirms the current position. No clear policies are taking into account the limitations of intensification in arid and semi-arid lands.

According to (little et al., 2001; O'Malley, 2003; Gallaty, 2005) studies on changing land use and livelihood of the local communities. Found out that land use changes arise due to increased competition for land resources, resulting to land use conflicts and violence in the arid and semi-arid lands. These findings revealed that land use changes enhance land use problems instead of offering land use problems solutions. Further, these studies pointed out a knowledge gap between land use policy changes provisions and prevailing environmental conditions on the ground. Accordingly, the gap led to a mismatch between the actual livelihood activities and land use policy

provisions. This scenario perpetuates land use problems and makes government policy decisions appear unresponsive.

Moreover, previous empirical studies indicate that governments have been intervening to alleviate land use problems through commissions of inquiries and several studies. Notable commission of inquiries during colonial era was the Carter Land Commission, 1932-1933 on land alienation claims by local communities during the colonial era; the Njonjo Commission of Inquiry into Land Law System of Kenya, 2002; Ndungu Commission of Inquiry into illegal/ allocation, 2006; and Several Taskforces. This confirms concerted and historical attempts by both colonial government and independent government of Kenya to respond to land use changes problems facing the local communities, but have consistently failed.

In line with government efforts, Maher, 1935 study on soil conditions of Kamasia, Njemps and East Suk; multiskilled team of experts (1944) tasked to carry out an inquiry into general conditions affecting land use in Kenya, and trying innovative approaches including cooperative or group farming to avert land fragmentation in the highlands, introduced communal programme on land conservation; reviving the old clan system in Kikuyu land; renewing interests in the mixed smallholding on a rotational basis; introducing the concept of farm planning; introducing the concept of ecological zones in land use planning; implementing the Swynnerton plan of 1954 to intensify land use and provide security during colonial era.

Further, the independent Kenya government introducing and implementing land use reforms including formulation and implementing National land policy, entrenching land use reforms in the Constitution of Kenya 2010, several laws and regulations, but

land use problems persist. In this regard, Huntington et al. (2011) study on integrating traditional and scientific knowledge through collaborative field research: identifying elements for success. The study found out that land use changes were associated with ideology and dominance in access to, use, control and management of land resources during the colonial era and more or less the same practice continued after independence. Huntington argues that these ideologies perpetuate land use problems and make government decisions unresponsive.

In other parts of the world, empirical studies revealed similar results, and seem to be universal in all developing economies. Pan Wang et al. (2019) study on determinants of livelihood choice and implications for targeted poverty reduction policies, Tibetan Plateau. The study used household data and a two-step clustering method to classify households into three types and adopted a multinomial logit model to identify determinants of households' livelihood choices.

The study found out that there is a certain contradiction between the poverty alleviation policies and the local farmers' needs, thus the effects of these policies will be weakened and the goal of poverty alleviation will be missed. From Pan Wang's study, the contradiction inherent in the policy might have led to misconception and development of wrong policies that do not address pertinent land use problems, hence depicting unresponsive government policy decisions.

Past studies (Ahmed, 2001; Almaey, 2008) revealed that ignoring or lack of proper knowledge about the importance of local communities' experiential knowledge has led planners and decision-makers to formulate land use policies that harm the local communities. Both studies; Ahmed (2001) study on livelihood competition, African Pastoralism: conflicts, institutions and government, and Almaey (2008) study on

Ideology, Land tenure Unbearable Stress: Rwanda caught in the Malthusian Trap, agreed that experiential knowledge held by the local communities in a specific location is critical in securing local communities' livelihoods and ensure sustainable land use.

Empirical studies (Kameri-Mbote, 2016; Kaguru, 2018) pointed out that the Constitution of Kenya 2010 has recognized the knowledge gap carried over the years, from colonial through the subsequent land use policy changes and implementation after independence. The studies assert that the constitution deliberately attempted to integrate experiential knowledge through public participation of the local communities in the planning, implementation and evaluation of all government policy decisions. It made it legally mandatory for all public policies and interventions to incorporate experiential knowledge.

However, in practice, local communities could not engage due to illiteracy and a lack of appropriate mechanisms for effective engagement and contribution. Therefore, according to these studies, land use changes have always continuously maintained the status quo driven by government land use policy decisions.

2.2.3 Determining the effects of Government Land Use Policy Decisions

In this study, it has been conceptualized that Household make their living under the prevailing land use policy environment. The policy environment can be favorable or unfavorable for household livelihood production activities. Favorable land use policies encourage household production activities and increase livelihood outcomes, while unfavorable land use policies reduce production activities and decrease livelihood outcomes.

Empirical study by Pan Wang et al. (2019) on the determinants of livelihood choice and implications for targeted poverty reduction policies in the Tibetan Plateau, used cross-sectional household data and a two-step clustering method to determine the effects of government land use policy decisions on local community's household livelihood choices. The study classified households into three types and adopted multinomial logit (MNL) model to identify determinants of households' livelihood choices. The study found out that there is a certain contradiction between the poverty alleviation policies and the local farmers' needs, thus the effects of these policies will be weakened, and the goal of poverty alleviation will be missed.

From Pan Wang's study, the contradiction inherent in the policy portrays the mindset of policymakers and technocrats' misconception and mismatch between policy orientation and local communities land use needs. This depicts inappropriate government policy decisions. Pan Wang et al. argued that the government has promulgated several policies but failed to consider the heterogeneity of different crop farmers and livestock keepers, causing contradiction that weakens the effect of policy implementation.

2.2.4. Evaluating Responsiveness of Government Decisions on Land Use Changes

The theory underpinning the evaluation of the responsiveness of government decisions is the probability choice theory. The theory provides an interdisciplinary approach deemed appropriate to determine how the government responds to problems under uncertain decision environment framework. In this study, household livelihood assets productivity was used as a proxy indicator of response. It is assumed that government response decision will focus on the resultant negative consequences of a policy action.

Therefore, it responds by instituting measures or interventions to rectify land use changes problems. These measures are intended to improve the livelihood of the local communities and create enabling environment for improvement. In this situation, the government response takes several alternatives, and the choice set is more than two. This response requires a multiple-choice model. This type of model is referred to as a multinomial choice, and different types of multinomial choice models exist and can be used in this study.

Among these models, Multinomial Probit and Multinomial logit are the most appropriate. In this respect, Dow and Endersby (2003) compared multinomial logit (MNL) and multinomial Probit (MNP) for voting research. They found out that the MNL model is preferred to the MNP model because MNL has a closed-form integral whilst the MNP model has an open form. This means MNP is more complex than MNL, and it could give some estimation problems. Therefore, based on the characteristics, strengths and weaknesses of the different multinomial choice models, this study adopted the MNL model since land use changes policy decisions are exogenous, and in most cases, the number of alternatives is more than two.

Some empirical, Wanyama et al., 2010, used MNL and Tobit models to determine income diversification strategies among rural households in Maize farming system of Kenya. The study found that the government's respond decision was important in alleviating poverty and food insecurity. The study concluded that, government response decisions take different alternatives choices, and decisions are implemented to respond to specific household livelihood assets problems. Cognizant to the above empirical study's findings, this study used household livelihood assets productivity as proxy indicator under different land use tenure regimes to evaluate government

response decisions. The interpretation of the results was based on the reference group households land use relative to others.

2.3 Summary of the Study Literature review

The summary of the study literature review gives a synthesis of theoretical and empirical literature review, linking theories, objectives and the study gaps. The theoretical literature review focused on the theory of production as the core theory driving this study. The theory provides a means of determining the effects of land use changes. It is particularly useful in the analysis of objective two. It explains how output changes with input changes as a result of land use changes. The foundation of theory of production is the production function which describes the technical relation of inputs and output, thereby providing appropriate method of analysis. This analysis was based on Cobb-Douglas (CD) model which describes the technical relationship in the conversion of inputs to outputs. In this study, the theory of production was aligned to Sustainable Livelihood Framework theory. The CD model used livelihood assets (inputs) as independent variables (human, physical, natural, financial and social livelihood assets) and livelihood outcomes (output) as the dependent variables. The model parameters were estimated using Ordinary least squares. The coefficients for each variable represent the specific livelihood asset productivities.

In this study, the sustainable livelihood framework theory link production processes of the local communities represented in the pentagon of livelihood assets (human, physical, natural, financial and social capital) through the influence of policies, institutions and process resulting to the outputs (livelihood outcomes). In the SLF framework concept, livelihood assets are referred as resources (inputs) used by local communities to obtain their livelihood (Ellis, 2000). Households combine these

resources (inputs) at their disposal to create livelihood production activities that enable them to achieve the best possible livelihood outcomes (Farrrington et al., 2002; Bezemer & Lerman, 2002). The combination of livelihood assets gives rise to a production process. The sustainable livelihood framework focuses on livelihoods. The theory was particularly useful, in generating objectives of the study, as it focuses on local communities' livelihoods and links production with policy institutions in a logical sequence from production to output. This helped in identification of the drivers of land use changes at each stage of the production process from production at household level in the pentagon through the influence of policies, institution and processes to livelihood outcomes. This linkage is facilitated by government intervention which involves actions intended to guide land use and address the resultant consequences of policy actions.

It is assumed that the resultant effects of land use changes arise from conflicting perceptions, ideologies and practices on land use between policymakers and local communities. This assertion, blend very well with other complementary theories including the decision theory, tragedy of commons and dualistic development thesis concept in explaining the effects of land use changes in objective two, three and four. Government intervention has been traced from colonial, independence and subsequent political regimes after independence to date (2021). Government provides land use policies and laws as general guidelines (rules of the game) that govern land use, and offer a link to governance institutions and processes. The institutions provide a means for local communities to access capital (human, natural, physical, financial and social) (DFID, 1999), and processes provide the procedures (management practices, land tenure rights and access) to undertake livelihood activities under different land use regimes.

The decision theory is important to the objective of this study, since it captures the philosophy of different government regimes with respect to national goals on economic growth. The theory concerns on responsibility of government decision in allocation of public resources among the various functions of the government. The decisions have been changing from colonial regime which largely favored individualization of land use specifically for European Settlers. At independence, government decision on land use changed and focused on land redistribution to local communities through settlement schemes, a process hijacked by well-educated and politically connected government official referred as elites capture. Presently (2021), land use decisions focus on registration and digitalization of all land in Kenya.

The tragedy of commons theory and the dualistic development thesis forms the foundation of colonial land use policy which was based on ideologies and the perception of policy makers and technocrats. The policy makers perceived communal land use as farming without returns comparing it with profit oriented individual system of Europe. These theories were used to captured economic power relations and explain the widening productivity gap between regions. The aspects were incorporate in the study as dummies variables in CD model analysis. This is particularly useful in capturing regional variation.

Therefore, the combination of theories of production and sustainable livelihood framework fits very well in the analysis of input- output relationships under Cobb-Douglas model as well as probability choice multinomial logit model for forecasting government decisions. The approach is useful in quantification of the effects of land use changes by estimating specific livelihood assets productivity (human, physical,

financial, natural and social capital) as critical inputs in the production process. The dummy variables are very useful in explaining regional variations. In addition, the probability choice theory was useful in the evaluation of government response decisions by forecasting and predicting the effects of policy changes on land use changes in objective four. The theory captured the relative effects of land use changes using private household land use as reference group relative to community land household land use and marginal land household land use basing on Multinomial logit Maximum likelihood estimates.

The empirical literature review focused on the past studies carried in the area of study. The studies revealed that previous studies have concentrated on livelihood and diversification strategies in the study area. Thuo, 2013 and Catley et al., 2013 studies on land use changes revealed that before 1895, land use was guided by African local communities' customary laws. The studies pointed out that land use was communal, small-scale subsistence in nature, stable and sustainable in terms of provision for local communities' livelihood and environmental conservation needs. Local communities enjoy territorial niches with boundaries defined by specific geographical, physical features such as rivers, mountains, trees and valleys, among others. Soil fertility was maintained through shift cultivation with adequate fallow periods of three (3) years or more required to restore soil structure and fertility. Much of the uncultivated land was used as pastoral communities grazing areas. Forested areas were used for hunting, trapping and honey gathering. Periodic droughts checked land use and inter communities' raids to maintain the dynamic equilibrium. This land use system was seen as sustainable and operate without government intervention.

The empirical literature review indicated that land use policy changed during the colonial era, the colonial government took over the control and management of the land resource, dismantled the ethnic community territorial niches and nationalized land use. All land became crown land, local communities were dispossessed, and customary land use laws became redundant. All existing land use rights by the local communities were at the mercy of the colonial power. These changes centralized land use basically to consolidate political and economic power. Land use changes were designed to suit government interests and individual commercial gains. This interest overrode the local community livelihood needs creating land use conflicts revolving around communal versus individual rights to land, trees and water. At independence and subsequent years after independence, the informal land claims emerged leading to malpractices of illegal land allocation and land grabbing. Moreover, in the study area, invade and claiming interests on land as well as rampant illegal manipulation of land ownership records. This scenario bred chronic inter local communities' rivalries resulting to land use conflicts, associated with unstable and uncertain livelihoods for the local communities.

Past studies (Little et al., 2001; O'Malley, 2003; Gallaty, 2005; Migot-Adhola, 1981) revealed that land use changes were founded on temperate climatic conditions agronomic principles and practices, which are implemented under the prevailing tropical climatic conditions. This poses ecological challenge in terms of variation in rainfall patterns, land cover, regional climatic conditions and soils. This led to ecological incompatibility gap which impacts negatively on the production system.

In the same light, studies (Coast, 2002; Little et al., 2001; Fratkin & Roth, 2005) revealed a technological gap between regions. In the dry areas local communities use

low productivity traditional method while high rainfall areas use high productivity modern technologies. This occasioned widening productivity gap between arable and ASALs areas. The review suggests that the situation was irreversible and continues perpetuating economic disparity and escalating land use conflicts in the study area.

Past studies (Ahmed, 2001, Warren, 2005, Berkes et al., 1995, Davies et al., 2010) indicates that colonial regime land use policies did not recognize local communities' experiential knowledge that evolved over centuries, and found to be locally appropriate to the prevailing local conditions. This omission led to misconception and wrong government policies that did not align with the local communities' traditional systems, hence unresponsive government decisions. Further, empirical study (Kameri-Mbote, 2016 & Kaguru, 2018) revealed that the current government land use reforms recognize the need to involve the local communities in development of public policy, but government failed to develop an appropriate mechanism for their effective engagement.

2.4 The Conceptual Framework of the Study

The conceptual framework of this study links the land use (production), sustainable livelihood framework (inputs in the pentagon- human, natural, financial, physical and social livelihood assets) and government decisions (enabling environment- policies, Institutions, processes) with outputs (livelihood strategies and outcomes).

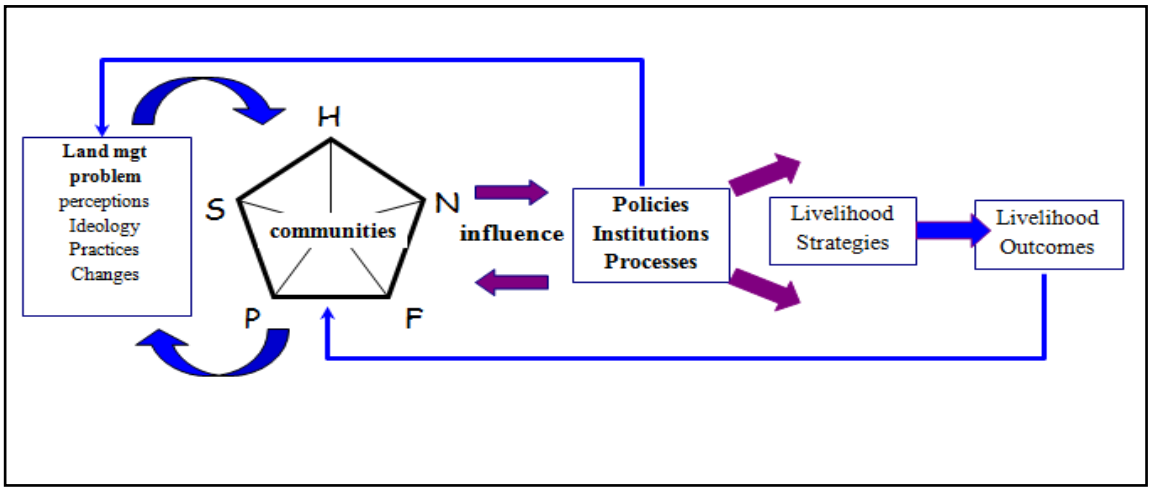


Figure 2.1: Modified DFID Sustainable Livelihood Framework

Accordingly, the local communities at the pentagon respond to land use changes as a result of the influence of policies, institutions and processes, by developing livelihood strategies. These livelihood strategies yield livelihood outcomes. Livelihood assets represents the independent variables and livelihood outcome represents the output. These livelihood outcomes can be explained in two streams; first, is the forward stream dynamics, which entail local communities adopting livelihood strategies to cope with land use changes, and second, the backward stream dynamics resulting from government interventions to counter the effects of the land use changes to sustain or improve local communities' livelihood outcomes. This is represented in a logical sequence.

2.4.1 The Forward Stream Dynamics

In the diagram (figure 2.1), the forward stream entails local communities developing and adopting livelihood strategies that cope with the policies, institutional and processes involved in land use changes. This stream is explained by the arrows originating from land resource use and management problems which affect local communities' livelihood assets (human, social, natural, financial and physical

capitals) conversion in the pentagon. The changes are influenced by policies, institutions and processes. This, in turn, triggers local communities to change their livelihood strategies to cope with the changes, thus changing their livelihood outcomes. In this study, livelihood strategies entail a combination of activities the local communities undertake to devise methods or approaches to achieving their livelihood goals (Carney, 1999). Accordingly, the resultant livelihood outcomes from the strategies undertaken in the circumstance determine the production level, wellbeing and the general living standards of the local communities in a circular flow fashion.

According to Armitage et al. (2007), Livelihood strategies are dynamic depending on policies, institutions and processes changes. The local communities have little control and therefore have to adjust their livelihood strategies to conform to the changes. As illustrated in figure 2.1, this conceptualization depicts the dynamics of land use under different political regimes and changing the external environment. For instance, during the colonial era, land use was based on English common law. This law was a doctrine of precedent, which is captured in the Latin Maxim: "*stare decisis et no quieta movere*," meaning: it is best to adhere to decisions and not to disturb questions put at rest. This doctrine greatly influenced Kenyan land use policies, institutions and processes. Under this law the changes are irreversible. The doctrine was adopted by the colonial government ideally to provide enabling environment for the European settlers and to lock out any distraction from dissenting ideas, especially from the local communities. This orientation was universally accepted as the mode of transactions that consequently influence policies, institutions and processes.

Given the policy position, local communities have no option other than to comply and adopt strategies that conform to the policies, institutions, and processes change the colonial government prescribed. They had to invent livelihood strategies that consider the prevailing institutions, organizations, policies and legislation. Hence shape up their livelihood outcomes. In light of this argument, (Cahn, 2003) pointed out that local communities' livelihood strategies change as the land use changes, though sometimes unverifiable and unfruitful livelihood techniques are passed down through culture, hobbies or other socio-psychological factors. On other occasions, these livelihood strategies are instigated as methods of survival during hard times. This perspective was captured under the vulnerability component of SLF as the external environment in which local communities exist.

Therefore, local communities' livelihoods are fundamentally affected by land use policy changes, disturbances and periodic changes where the individuals have little or no control. Furthermore, Cahn (2003) point out that in addition to coping with land use policy changes, local community's livelihood strategies encompass how local communities adjust to, and survive by, tensions and disturbances originating from various sources such as: first, trends in population resources, national/international economic, governance (including politics), and technological trends. Second, human health shocks include sickness and trauma, natural upsets, economic forces, conflict, and crop/livestock health shocks. Third, periodic prices, productivity, well-being and employment opportunities. All these stresses and shocks directly impact local communities' livelihood asset status and the options open to them in pursuit of beneficial livelihood outcomes (DFID, 2010).

Moreover, in support of Cahn's argument, Scones' (1998) has identified three types of local community's livelihood strategies: escalation of agricultural activities, heterogeneity of livelihood strategies for paid employment rural enterprises and migration (including income generation and remittances). (Carney, 1998) and (Cahn, 2003) categorized livelihood techniques into natural, non-natural resource-based and migration (but omitted remittances), whereas (Cahn, 2003) and (Ellis, 2000) characterized the livelihood strategies into both natural and non-natural resource-based activities (including remittances and other transfers) but excluded migration in their rural livelihood strategies. It is important to have genuine mediations to understand the diversity and dynamic of land resource management on the local communities' livelihood strategies (Cahn, 2003). Also, a fundamental matter in the evaluation of livelihood techniques is the balance at which an evaluation occurs, livelihood techniques, for example, are expressed can be described at a single household and village level and at regional or national levels (Scoones, 1998).

Furthermore, past studies (Cahn, 2003; DFID, 1999; Ellis, 2000; Scoones, 1998), argued that comprehending the formations and methods creates an association of the minor (individual, household and community) and the major (regional, government, powerful private enterprise) as they successfully dictate access of the locals and the utilization of the livelihood assets. (Cahn, 2003; DFID, 2010). Acknowledging institutional activities also permits the recognition of restrictions/barriers and chances to tenable livelihoods and sheds light on the land use procedures which underlie livelihoods sustainability (Cahn, 2003). In addition, the livelihood proposition seeks to promote choice, opportunity and diversity.

A livelihood strategy is a term used to denote the range and combination of activities undertaken and choices local communities make to achieve their livelihood goals (DFID, 2010). Depending on the assets the local communities have, the structures and processes that impact them (Cahn, 2003) would add tradition, and the land use system under which they operate, local communities theoretically choose livelihood strategies that are expected to provide the best livelihood outcomes.

2.4.2 The Backward Stream Dynamics

In this study, it has been conceptualized that the backward stream dynamics entails government interventions in terms of policies, laws and regulations intended to address land use problems. The interventions provide enabling environment for institutions and processes to work. Referring to SLF (figure 2.1), this stream is represented by the arrow originating from policies, institutions and processes back to land use and management problems. This entails interventions implemented to counter land resource management problems. It will trigger a spiral of effects on local communities' livelihood assets in the pentagon in a circular fashion. This flow is defined by the arrow that moves backwards from livelihood outcomes to the pentagon of local communities' livelihood assets. The dynamism inherent in the process influences livelihood strategies and joins the circular flow of land use inputs and outputs. The dynamic includes formulating new policies, establishing new institutions and processes, enacting new laws, regulations and intervention programs and projects under the land reforms agenda.

Generally, land use is closely related to policy changes that suit government objectives, and it is expected to take on board the aspirations of the local communities' livelihood aspects (Armitage et al., 2007). However, during the colonial

regime, the English common law based on modern technologies and suited to temperate conditions applied in tropical conditions. This contradicted local communities' land resource management practices and aspirations in light of customary beliefs under the prevailing tropical conditions. The contradiction negatively affected the local communities' livelihood resulting in widespread poverty. The phenomenon could be explained by the varying ideologies standpoints between modern and traditional aspects contradicting each other in practice leading to incompatibility, land use and knowledge gaps. The consequence of divergence affected the livelihood of the local communities giving rise to undesirable effects, including cultural, ecological and technological incompatibilities and land use conflicts. The effects are manifested by declining land productivity, environmental degradation, depletion of forest cover, destruction of water catchments, among others.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Introduction

This chapter presents the methodology used to conduct the study. It covers the study area, research design, population, sample and sample size determination, research instruments, testing research instruments, data collection and data analysis.

3.1 The Study Area

The study was carried out in Baringo County. The study area covers geographical location, political representation, ecological conditions, and land use and livelihood activities of the local communities. This is shown in figure 7.1, appendix I.

3.1.1 Geographical Location

Baringo County is one of the forty-seven (47) Counties in Kenya (CoK, 2010). It is geographically located between longitudes 35 30' and 36 30' East and between latitudes 0 10' South and 1 40'. The Equator cuts across the County at the Southern part. It covers 11,015.3 $km^{2,}$ of which 4, 435 Km^2 arable, 5,700 km^2 non-arable, 715.3 km^2 urban areas, and 165 km^2 are surface water. It borders with eight (8) counties namely, West Pokot to the North West, Turkana to the North, Samburu to the North East, Laikipia to the East, Nakuru to the South, Kericho and Uasin-Gishu Counties to the South West, and Elgeyo-Marakwet to the West.

3.1.2 Political Representation

Baringo County comprises six constituencies represented by Members of Parliament (MPs) in the National Assembly (CIDP, 2018). These constituencies include Mogotio, Eldama Ravine, Baringo South, Baringo Central, Baringo North and Tiaty. The size of these sub-counties varies as follows: Mogotio (1,314.6 km^2), Eldama Ravine (1002.5km^2), Marigat (Baringo South) (1, 678.km2), Baringo Central (799.9km^2),

Baringo North (1,703.5km^2) and Tiaty (4,516.8km^2). The county has 30 wards represented by members of the County Assembly (MCA) in the County Assembly. Political representation indicates participation in government decision-making processes.

3.1.3 Ecological Conditions

Baringo County is divided into two ecological zones, highlands and lowlands, with a transitional zone (marginal area) between the two zones. In the highlands, crop production was the main livelihood activity. The dominant crops grown on the highlands include cereals (maize, sorghum and finger millet), legumes (beans, green grams and cowpeas), roots and tubers (Irish potatoes, sweet potatoes and cassava) and nuts and oils (groundnuts, macadamia nuts, coffee and cotton). The Lowlands constitute both Arid and marginal areas. The marginal area constitutes 25 % of the total land area and is the convergence land use changes. The arid lands constitute 70% of the total land area. Baringo County is considered to be one of the ASAL counties in Kenya. The county is characterized by sparse, erratic rainfall and scarce water resources. It is prone to frequent droughts, floods and wide spread land use conflicts among others. The prevailing ecological conditions influence the type of livelihood undertaken by the local communities.

3.1.4 Land use and Livelihood Activities of the Local Communities

Land use in Baringo County is diverse, ranging from pastoralism, intensive agriculture, irrigation, forest, bushland, plantation, national reserves, urban use, transportation (airstrip & roads) and lakes (see appendix IX). Land use determines the livelihood activities undertaken by the local communities in the County. There are three main local communities are inhabiting Baringo County; the Tugen, Pokot and Ilchamus. Other communities that reside in the area include the Nubians, Ogiek,

Kikuyu and Turkana**.** These communities have diverse cultural beliefs and land use, therefore, undertake different livelihood activities. The Tugen occupy mainly the hilly part (Tugen hills), which relatively high rainfall area that engages in intensive agriculture as the main source of livelihood. The Ilchamus are agro-pastoralists occupying the marginal area covering the flood plains surrounding Lake Baringo. Land use is communal and the main economic activities are growing crops under small-scale irrigation and keeping livestock under a free-range system. The Pokot occupy the drier rocky area in the north-eastern part of the County. Land use is mainly pastoralism as the principal economic activity. Economic activities revolve around the flexible movement of livestock in pursuit of water and pasture. These culminate to diversify livelihood options for the local communities in the County (see Figure 3.1 and appendix).

3.2 The Research Design

The research design refers to the conceptual structure within which the research is conducted (Kothari, 2009). It involves consideration of the means of obtaining the information, the availability and the relevant skills, the methodology, the time and cost of the research. This study employed a non-experimental research design. It was preferred because of its merits in obtaining opinions, beliefs, attitudes, livelihood activities and outputs, among other relevant data from a large population. It is cost-effective, and the results can be generalized to inform policy decision-making in Kenya. The design was suitable because it enabled the researcher to gather data from a wide range of respondents at the household level. This design is particularly useful in developing tools, pretesting and collecting data deemed adequate for realizing the study objectives given the short time available and the budget constraints to accomplish the work.

3.3. The Population

According to the Kenya National Bureau of Statistics (KNBS, 2019) report, the human population of Baringo County was estimated at 666,763 made up 141,877 households distributed per constituency, as shown in table 3.1. The county is divided into Mogotio, Baringo South, Baringo North, Baringo Central, Tiaty (East Pokot and Tiaty East), and Eldama Ravine Constituencies.

Table 3:1: The population and number of households per Constituency

Constituency	Population	Area in Square KM	Density	Households
Baringo Central	96, 951	799.9	121.2	23,555
Baringo North	104,871	1,703.5	61.6	23,500
Tiaty	153,357	4,516.8	34.0	26,651
Eldama Ravine	129,535	1,002.5	129.2	30,774
Baringo South	90,955	1,678	54.2	19,854
Mogotio	91,104	1,314.6	69.3	18189
Total	**666,763**	**11,015.3**	**60.5**	**141,877**

Source: KNBS, 2019- National Population Census

3.4 Sample and Sample size determination

According to Kothari (2014), sampling takes any portion of the universe's population to represent that population. Out of the six (6) sub-counties/constituencies in the County, a representative sample of four (4) sub-counties was purposively selected. The selection criterion was based on ecological conditions, agro ecological zones and source of livelihood for the local communities in the area.

3.4.1 Sample Frame

The sample frame is defined as a source list containing all the households in the study area. From the list of 141, 877 households enumerated in the national population Census (see table 3.1), a sample frame comprising of 100,779 households was used as a source list. The source list of households in the sample was broken per sampling

unit; Baringo North (23,500), Tiaty (26,651), Eldama Ravine (30,774) and Baringo South (19,854) accordingly (see table 3.1). The study adopted Constituency as a sampling unit. Sampling unit is one of the units selected for the purpose of sampling. In this study, the sampling units include Baringo South, Baringo North, Eldama Ravine and Tiaty constituencies forming the sample frame of the study (see figure 3.1). The Sample frame was considered representative and appropriate as it constituted more than seventy percent (70 %) of the population and captured varied ecological conditions, cultural diversity, land use practices, and livelihood activities (see appendix III).

3.4.2 The Unit of Analysis

The study adopted households as a unit of analysis. Household is a major entity involved in land use and livelihood activities. The household head was assumed to be the key decision-maker in land use changes and could be a man, woman or intersex (see appendix V).

3.4.3 Sample Size determination

The sample size was determined using a formula for sample size determination for large populations (Cochran, 1963). The equation yields a representative sample for proportions. Thus,

$n = Z^2pq/d^2$:

Where n = the desired sample size,

Z = the normal standard deviation at the required confidence interval (95%) = 1.96, p = the proportion in the population estimated to have characteristics measured,

q = 1- p and d = the level of statistical significance set or the level of precision.

For this study p = 100,779 /141,877 = 0.7

Hence q =1-0.71 = 0.3

The sample size for the study was therefore;

$n = 1.96^{2} * 0.7 * 0.3 / 0.05^{2}$

= 323 households

The sample size of 323 was deemed adequate to represent the entire population, and the information gathered gave a relatively true reflection of the prevailing situation in the County (Appendix VII).

3.4.4 Sampling methods and techniques

According to Kothari (2009), sampling techniques are useful in selecting items in the sample. The study adopted different sampling methods to gather relevant information; purposive, random and cluster sampling. A purposive sampling method was used to select the sample frame. The random sampling method was used to gather information from households. Clustering sampling technique was use to select the reference group household land use relative to others in the study area. These methods ensured that all the relevant household heads were included in the study.

Purposive sampling technique was adopted because of the known characteristics of the sampling units (constituencies); Tiaty Constituency was chosen because of its ASAL climatic conditions, local communities adhere strongly to traditional beliefs, land was use communally, livestock keeping under pastoralism was the main source of livelihood, and the area has been experiencing widespread land use conflicts. In this area, several households are increasingly dropping out of pastoralism and settling down on permanent residence, then start engaging in crops production economic activities.

Second, Eldama Ravine Constituency was selected due to the high rainfall experiencing highland climatic conditions where crop farming was the main livelihood activity; intensive land use practiced which exert pressure on land leading to massive subdivision of land into uneconomic units. The area is characterized by widespread soil and water degradation. Local communities encroach into forest and move towards marginal areas seeking economic opportunities. In this area, the local communities use modern technologies (tractors, chemical and machinery), and land was privately owned with title deeds.

Third, Baringo South was selected because of its marginal climatic conditions, communal land use, receive a huge influx of economic immigrants seeking opportunities both from the highlands as well as those from the ASAL area. The marginal area seems to the meeting point of different land use practices and cultural beliefs. Therefore, experiencing the highest land use conflicts both technically and socially. Fourth, Baringo North combines highland and lowlands climatic conditions, a mixture of private and communal land use practices. Hence escalating land resource conflicts as well.

In summary, the sample frame is representative and gives a true picture of land use changes in Baringo County, covering high rainfall, marginal and low rainfall areas. However, purposive sampling method has some element of bias associated with the researcher judgment in the selection of the sample frame. Nevertheless, several measures including dividing the population into four test groups drawn from the selected sampling units, and each sampling unit data was tested separately instead of the entire sample size. Second, the study adopted personal interview which involved

face to face interaction. This enabled the researcher to observe attitude and behaviour of the household heads giving control over the environment eliciting the requisite data. Third, the data was also subjected to statistical tests for margin errors at desired confidence interval (90 %, 95 % and 99 %) as well as pre & post-diagnostic estimation tests were also carried out. These measures were employed to ensure good quality and accurate data was collected.

Random sampling technique was used to picked households from the source list of the study. The household in the source list were labeled with serial numbers, then selected randomly. Random sampling was adopted because it gives each household in the sampling unit an equal probability of being chosen. The respondents comprised household heads who were personally interviewed by the researcher and research assistants. A total of 323 household heads were personally interviewed, covering the entire study area; random sampling is referred to as chance sampling or probability selection. Under random selection, every component in the world has an equal opportunity of incorporation into the sample. Random selection guarantees the Law of Statistical Regularity, which states that if the sample is chosen is a random one on an average, the sample will have the same composition and characteristics as the universe. This is the reason why random sampling is considered the best technique for selecting a representative sample. This technique eliminates bias, and the sampling error can be estimated.

Clustering sampling technique was use in the selection of the reference group particularly for Multinomial logit model analysis. The standard explanation of the multinomial logit (k-1 models) is that for any unit change in the predictor variable, the logit of outcome variable relative to the reference group is expected to change by its

respective parameter estimate (which is in log-odds units) given the other variables in the model are held constant.

In this study, there are three dominant household land use; community land (pastoral) , marginal land (agro-pastoral) and private land households. In the community land households, livestock keeping (cattle, goats, sheep, and camel donkey among others) was the main livelihood activity. In the agro-pastoralism household land use, growing of crops such as maize, beans and at the same time keeping livestock were the main livelihood activities, while, in the private land households, intensive crop farming; both food crops such as maize, beans and commercial coffee, horticultural, wheat among other crops were the main land use. Based on the frequency of their occurrence, household land use in the study area were classified into three types; type I= community land households practicing extensive livestock keeping as the dominant livelihood activity, type II- private land households with crop farming as the dominant livelihood activity and type III-Agro-pastoralism households with a mixture of crop farming and extensive livestock keeping as their dominant livelihood activities. Using SPSS, the data set comprising of 323 households was automatically sorted. The frequencies obtained for community land households was 97 (30%), private land households were 135 (42%) and agro-pastoral land households was 91 (28%). The highest frequency was chosen as the reference group. Accordingly, the private land household type II had the highest frequencies, and therefore treated as the reference group. The types of households were summarized in Table 3.2 as follows:

Table 3:2 Clustering of Households in the Study Area (n= 323)

Study site	Sampled households	Community Household type I	Private Household type II	Agro- pastoral household type III
Baringo South	64	10	2	52
Baringo North	75	11	45	19
Tiaty	85	76	1	8
Eldama Raine	99	0	86	13
Total	323	97	135	91

Source: Survey data, 2019

3.5 The Research Instrument

The study adopted household questionnaires as the main research instrument. In this study, structured household questionnaires were used to obtain the requisite information from the household heads. A structured questionnaire is a data collection instrument with sets of question statements that the researcher is expected to find answers to (Kothari, 2009). The requisite information included household information, land use changes, livelihood assets, government decisions and land use conflicts (see appendix X).

3.6 Testing of Research Instruments

This entails testing the goodness of and pre-testing the research instruments.

3.6.1 Testing Goodness of the Research instruments

Testing the goodness of the research instruments is critical to ensure quality data is obtained and used. This includes testing the validity and reliability of the research instruments. In this study, testing the validity of research instruments was done by checking, and peer-reviewing the content, construct and face validity of the questionnaires. On content validity, expert assistance was sought from university supervisors and colleagues. On construct validity, the researcher ensured that the

items in the instruments measured the construct it purports to measure. For face validity, the researcher ensured that the appropriate font size, spacing and general outlook of the instrument were appropriate and appealing to the respondents**.**

Testing the reliability of research instruments; In this study, the instruments were subjected to test twice using the same sample, and the results were compared to check whether there was any correlation or not. The correlation value was 0.783, therefore, the instrument is reliable.

3.6.2 Pre-testing the Research Instruments

Before administering the questionnaires to the household heads, the instruments were pre-tested by administering the draft questionnaires to 16 households' heads drawn randomly selected from the four sampling units. The exercise was a rehearsal done to evaluate the feasibility, time, and cost required and improve the study's design. The process was useful in sentence construction and clarity questions. the task was necessary to test the applicability of the questions to all household heads. Further exercise helped to avoid overlapping responses and mismatches between the questions and answers. Corrections were made on the research instruments and included in the final data collection tools.

3.7 Data Collection

Data collection comprised of ethical consideration, actual data collection and verification of data collected.

3.7.1 Ethical Consideration

To carry out this study, the researcher sought an introduction letter from Maasai Mara University (see appendix XV) and a Research permit (see appendix XIV) from the National Council for Science, Technology and Innovation (NACOSTI) to collect data. After being granted permission by the authorities. The researcher identified three

Research assistants and one supervisor per sampling unit (constituency), and gave them three days of training on purpose and the data collection procedures. The research assistants were coached on collecting accurate data as much as possible, especially in the personal interviews, and the effective recording of the data to minimize discrepancies. Before data collection, the instruments were pre-tested. The research instruments were printed and distributed to the four research supervisors per constituency. The research assistants were instructed to make sure at the beginning of interviews, the household heads were assured confidentiality of the information volunteered and that the information would only be used for research purpose.

3.7.2 Data Collection

After pre-testing, the questionnaires were refined and administered to household heads at a household level between September 2018 and February 2019 by the researcher, the research supervisors and the research assistants. Structured questionnaires (see Appendix IX) were administered to household heads at the household level through personal interviews. The questionnaires were used to gather a case in point primary data from households' heads, capturing household profile, livelihood assets, livelihood activities and outputs. The data collection was carried out simultaneously in the four sampling units within six (6) months. The data collected was subjected to initial verification every evening debriefing after the fieldwork to identify missing data and outliers. A total of three hundred twenty-three (323) household heads at the household level were personally interviewed.

Personal interviews were preferred because it minimizes data discrepancies and ensures quality. It involves face to face interaction hence facilitates clarification of issues and is a good method collecting information in a structured way. The

interviewer follows the laid-down procedure prescribed in the questionnaire. In addition, before interviews, the research assistants were trained using instruction manuals that clearly explain the interviewers' jobs at each step According to Kothari (2009), the most significant merits of personal interviews are: obtaining unique and detailed information, the interviewer suing their persuasive skills can convince resistant respondents to participate or non-response from the respondents, the flexibility of personal interviews grant the researcher the opportunity to rephrase the questions, first-hand information is obtained by observing the respondent's body language, and the verbal conversations can be recorded, confidential and unique personal information is acquired, the researcher can effectively control the samples.

However, this method has some weaknesses. It is very costly to conduct personal interviews, especially when the sample is huge and widely spread geographically, there is a possibility that both the interviewer and the respondent can be biased when making judgments or responding to the questions, there are certain types of respondents such as important officials or executives, or people of high-income groups may not be easily approached, this data collection method consumes much time when the sample is large.

3.7.3 Verification of Data Collected from the Field

Data verification was done every evening after fieldwork to identify missing information and data outliers as quickly as possible. This was ideally to rectify errors gaps and minimize data discrepancies and ensure quality. Occasionally, the researcher conducts field checks throughout the survey period to ensure that the information collected conforms to the pre-defined standards of accuracy and ensure the research assistants were doing their assigned job diligently.

3.7.4 Recall Bias

The data collection entailed gathering information from household heads at the point in time (cross-sectional data). In the process of data collection, it was observed that reporting of past activities is potentially subject to a range of different recall errors. Some households' heads incorrectly shift forward or backwards, sometimes heaping past events into or out of the recall period. It was also noted in some cases that there was recall decay; that is, past events are forgotten and under-reported. This problem was corrected by counter checking with National Population Census questionnaires (KNBS, 2019)

3.8 Data Analysis

The data was analyzed qualitatively and quantitatively per objective. Objective 1 was analyzed qualitatively, and objectives 2, 3 & 4 were analyzed quantitatively. The data collected from the household heads was sorted, filtered and cleaned by checking for errors, duplication, miscalculation or any missing data. All the questionnaires were serialized, thoroughly screened to ensure there were no errors, no duplication, no miscalculation, no missing information, and then data coded accordingly. Data coding was done to convert the raw data collected from the field into a computer-readable form. The data was categorized, consolidated, and entered into the computer. A computer software, Statistical Package for Social Sciences (SPSS) version 20, was adopted. SPSS is a commonly used computer program in social science research. It is a comprehensive, integrated collection of computers programs for managing, analysis and displaying data. Diagnostics tests were carried out using the relevant techniques.

3.8.1 Establishing the Drivers of Land Use Changes.

In this study, objective 1; to establish the drivers of land uses changes in Baringo County was analyzed qualitatively. It entailed desk review of existing literature on land use changes in Kenya and Baringo County. The analysis was anchored on the

theory of production focusing on land as factor of production under different land tenure regimes (communal versus individual land use). Land use regimes were driven by perceptions and ideologies that revolves around the tragedy of commons and dualistic development thesis concepts. These perceptions and ideologies influence the formulation and implementation of land use policies in Kenya, because land use is a central function of the government. In this perspective, the resultant consequences and trends of land use changes were expected to explain land uses changes, as well as the effects of land use changes on the livelihood of the local communities. In the analysis, establishing the drivers of land use changes depend on policy orientation of given regime, clustered into three distinct political regimes, tracing the from the colonial era (1895 to 1963) through independence and subsequent years after independence (1963 to 2010) and land use reforms period (2010 to 2020).

3.8.2 Determining the Effects of Land Use Changes

Determining the effects of land use changes was analyzed quantitatively. The analysis of this objective 2 was guided by the theory of production. This theory was aligned to the sustainable livelihood framework (SLF). Many empirical studies (Smith et al.,2001, Soini, 2005, Hahn et al.,2009 and Sighn & Hiremark, 2010) have used the sustainable livelihood approach (SLA) on various aspects of household livelihood, including studies on livelihood diversity (Smith et al., 2001), livelihood vulnerability (Hahn et al., 2009), livelihood security (Sighn and Hiremath, 2010) and land use and livelihood of farmers (Soini, 2005) among others. In the SLF, livelihood comprises five major capitals; human, physical, financial, social, and natural capital. These capitals are referred to as livelihood assets consider inputs use by households in their production process.

In this study, SLF was used to capture household production process under different tenure regimes, represented in the pentagon of livelihood assets. Livelihood's assets were used as inputs in the household production process yielding outputs. Household production process involves conversion of inputs into output. The technical correlation between inputs and outputs is referred to as the production function. This function expresses the correlation between the number of inputs and the number of products made. This relationship is used as an important analytical tool underlying the theory of production.

The Cobb-Douglas production function model was preferred in this study because it has been used in many similar agricultural productivity studies. In the previous studies, Lewis et al. (1988) used the Cobb-Douglas model to calculate productivity growth rates for agriculture and other sectors of the Austrian economy. Van Loon et al. (2005) used the Cobb-Douglas model to measure each input's marginal contribution to agricultural output. Dharmasiri (2009) used the Cobb-Douglas model to measure spatial variation of agricultural productivity in different regions of Sri Lanka. In these studies (Lewis et al., 1988, Van Loon et al., 2005 and Dharmasiri, 2009), the productivity of the inputs is given by the specific input parameter concerning output in the regression model.

In this study, it is assumed that the gross output determines the livelihood of the local communities. The livelihood outcome is assumed to be equivalent to the gross output of all household production activities, including livestock and crop production. The gross output is a function of households' capital inputs, including human, physical,

natural, financial and social, referred to as livelihood assets. These livelihood assets are required for the livestock and crop production process.

This input-output relationship can be written mathematically as:

$$Q = f(X_1, X_2\ldots\ldots, \ldots\ldots, X_n). \quad (3.1)$$

Where Q = Gross output (all production activities- livestock and crops)

X1. Xn = inputs (human, natural social financial and Physical livelihood assets)

Therefore, modelling this case using the Cobb-Douglas production model framework follows a logical sequence.

Cobb-Douglas model evolved from a simple neoclassical model of the input-output relationship as presented in a model mathematically written as:

$$Q = AK^{\alpha}L^{\beta} \quad (3.2)$$

In this functional form, the model assumes the number of parameters equals one, i.e., $\alpha + \beta = 1$. Therefore, a linear homogenous production function. However, the Cobb-Douglas production function model has undergone several improvements and can be used to describe multiple input-output relationships. Empirical studies (Baily, 1986) demonstrated that Cobb-Douglas could handle several inputs. Hence, the model can be used to measure technical progress in a production system represented in a mathematical function or equation consisting of two or more variables written as:

$$Y=\alpha\, X_i\beta i\ldots\ldots\, X_n\beta ne\mu \quad (3.3)$$

Where Y stands for output,

Xi……. Xn stand for inputs

α……stand for a constant/ intercept,

βi……. βn stand for parameters,

e ……. natural logarithms,

μ …. error term/ disturbance term

Empirical studies have shown that the input-output relationship represented in equation (3.1) is not linear, and it cannot be directly estimated by the least square regression technique.

To facilitate estimation, it has to be transformed in multiple linear forms utilizing a natural logarithm (Ln). This entails applying natural logarithms on both sides of the model and equation (3.3) written as:

$$LnY = Ln\alpha + \beta_1 LnX_1 + \beta_2 Ln\ X_2 + \beta_3 LnX_3 +, \beta_4 LnX_4 + \beta_5 LnX_5 + \mu \quad (3.4)$$

Where Y = the dependent variable,

α = is constant term (intercept),

$X_1 \ldots\ldots X_5$ = independent variable,

$\beta 1 \ldots\ldots \beta_5$ = regression coefficients of independent variables,

μ = is the disturbance term

Transformation linearizes the relationship and compresses the bias hence enable easy and reliable interpretation. From the studies (Debertin, 1986 & Baily, 1986), the model can be applied to analyze the relationship between multiple inputs and the resultant output. In addition, Gujarati and Porter (2009) pointed out that qualitative independent variables can be incorporated into the model as dummy variables. Maddalla (1983) defined the dummy variable as a numerical variable used in regression analysis to represent subgroups of the sample. It is often used to differentiate various treatment groups and is useful because they allow the researcher to use an exclusive regression equation to represent multiple groups. In this study, dummy variables were used regional characteristics of the sampling units. The equation in transformed form can be written as:

$$LnY = Ln\alpha + \beta_1 LnX_1 + \beta_2 Ln\ X_2 + \beta_i LnX3 + \beta_2 Ln\ X4 + \beta_n LnX5 + \delta_1 LnD_{1\text{-}4} + \mu \quad (3.5)$$

Where Y = the dependent variable,

α = is constant term (intercept),

$X_1 \ldots\ldots X_5$ = independent variable,

$\beta 1 \ldots\ldots \beta_5$ = regression coefficient of independent variables,

$\delta 1 \ldots\ldots \delta 4$ = regression of dummy variables,

$D_1 \ldots\ldots\ldots D_4$ = dummy variables and

μ = is the disturbance term

3.8.2.1 Model Specification

The model was specified by inserting the dependent and independent variables into the model. Equation 3.5 was specified and written as:

$$Ln\ Q = Ln\alpha + \beta_1 LnH + \beta_2 LnN + \beta_3 LnP + \beta_4 LnF + \beta_5 LnS + \delta_1 LnBS + \delta_2 LnBN + \delta 3LnT + \delta 4LnER + \mu \quad (3.6)$$

Where Q = Gross output of all production activities (livestock and crop)

α = is constant term (intercept),

(H, N, P, F & S) ……Human, Natural, Physical, Financial & Social livelihood assets, respectively

($\beta 1, \beta 2, \beta 3, \beta 4$ & $\beta 5$) …. Regression Coefficient of Human, Natural, physical, Financial & social Livelihood assets

(BS, BN, ER and T) … Dummy for Baringo South, Baringo North, Eldama Ravine and Tiaty study site

($\delta 1, \delta 2, \delta 3$ & $\delta 4$) …… The regression coefficient of Baringo South, Baringo North, Eldama Ravine and Tiaty

$\mu \ldots\ldots$ …… Error term/disturbance term

The gross output includes all individual household livelihood activities in this study, namely livestock and crop production. These production activities vary from area to area within the County depending on ecological conditions, cultural beliefs of the

given local community and land use status. The study sites include Baringo South (BS), Baringo North (BN), Tiaty (T), and Eldama Ravine (ER), which reflect different ecological and land use changes in the County. These sites were used as dummy variables to capture the ecological and livelihood aspects in different parts of the county. The transformed equation (3.6) was estimated. In the model, the parameters of the independent variables give the productivity of inputs. It is assumed that the productivity of the inputs determines the overall household livelihood outcomes. The sign of the regression parameter for each household inputs is assumed to indicate the direction of change. If the sign is negative, it implies changes in the quantity of input decrease household output, while a positive sign implies changes in the quantity of input increase household output. If the sum of inputs regression coefficients is negative, then it means that changes in combined inputs decrease the general production output of the household and vice versa when the sum of coefficients is positive. The intercept indicates the efficiency parameter. The description, measurement of variables and the expected sign for dependent and independent variables (see table 3.3)

Table 3:3 Description of variables and expected signs use in Cobb-Douglas model

Dependent Variable	**Code**	**Description**	**Unit**	**Expected sign**
Gross output	Q	Output realized from all crops and livestock production activities	KES	Varied
Independent variables				
Human livelihood assets	Hedu	Household head level of education and skills	No of years	+
Natural livelihood assets	Ncl	Household natural capital in terms of household land size	Acres	-
Physical livelihood assets	Phyc	The monetary value of household physical capital	KES	+
Financial livelihood assets	Fsac	The Monetary value of household savings and cash	KES	+
Social Livelihood assets	Smem	Membership in household social groups and networks	No of groups	+
Baringo South Constituency	BS	BS = 1, 0 otherwise	Dummy	_
Baringo North Constituency	BN	BN = 1, 0 otherwise	Dummy	+
Tiaty Constituency	T	T = 1, 0 otherwise	Dummy	-
Eldama Ravine Constituency	ER	ER = 1, 0 otherwise	Dummy	+

Source: author's model specification

3.8.2.2 Explanations of the Expected Signs in the Model

The expected signs indicate positive or negative livelihood outcomes. After the data analysis, the findings may support the expected sign or go contrary. In this study, it is expected that land use changes improve household livelihood assets productivity. Increase in the human capital (e.g., level of education), the value of physical capital, increase financial resources, i.e., savings and cash and increase in membership social groups and networks are expected to increase livelihood assets productivity. This

means that land use changes were expected to increase household livelihood output and productivity of the respective livelihood assets. Whereas the expected sign for natural livelihood assets productivity is negative, which means land use changes were expected to decrease land size and productivity depending on the prevailing conditions and level of technology.

Further, land use changes will be expected to decrease household livelihood assets productivity in Baringo South and Tiaty constituencies due to escalating land resource conflicts. In Eldama Ravine and Baringo North, land use changes are expected to increase household assets livelihood productivity because of modernization of Agriculture and secure land tenure. This means that land use changes were expected to be influenced by regional variation in ecological, cultural diversity, land use and livelihood activities.

3.8.2.3 Diagnostic tests

In the analysis, several diagnostic tests were conducted to ensure the predictor variables could describe the dependent variables. The difference in land use and geographical position between different regions, in this study, different households suggest the possibility of autocorrelation. Clustering of households in the study area was used to solve the spatial autocorrelation. Pearson correlation coefficient (PCC), Tolerance and Variance Inflation Factor (VIF) were adopted to test the results. The variant inflation factor (VIF) tests the classical assumption of multicollinearity. It measures how much a variable is contributing to the error in the regression. It an index $1/1\text{-}R^2$ (1- 5= small, 5- 10= acceptable, > 10 = extreme). The Glejser test for heteroscedasticity. The test was carried out by regressing the residuals on the explanatory variables related to the heteroscedastic variance. If the value sig > 0.005,

then there is no heteroscedasticity and if the value sig < 0.005, then there is a problem of heteroscedasticity.

In addition, this study used dummy variables to capture regional variations in terms of ecology and livelihood activities of the sampling units. There is a likelihood of the independent variables becoming multicollinear, a situation known as a dummy trap. To avoid a dummy trap in the regression model, one dummy variable (n-1) was omitted. The omitted dummy variable becomes redundant. A quick dummy trap test was carried out by multiplying the altered independent variable (X') with the independent variable (X) and then calculate its determinant. If the determinant is zero (XX') =0, then there is a dummy trap, and if the determinant is not zero (XX') ≠ 0, then there is no dummy trap. All these diagnostic tests were done using SPSS version 20.

3.8.3 Determining the Effects of Land Use Policy Decisions

Determining the effects of land use policy decisions on the land use changes adopted indicator system of livelihood assets which is based on DFIDs Sustainable Livelihood Framework. The study borrowed methodological insights from empirical studies (Yan et al., 2010 and Fang et al., 2014). These studies used the indicator system to determine the impact of factors of livelihood strategies and the role of livelihood strategies in poverty alleviation. Multinomial logit regression model was used to identify the determinants of livelihood strategies on the basis of livelihood assets. In these studies, the selected livelihood strategies were subjected to discrete choice modeling using multinomial logistic regression.

Thus, the multinomial model specifies that

$$p_{ij} = \frac{\exp|(x_i'\beta_j)}{\sum_{i=1}^{m} \exp(x_i'\beta_i)}, \quad j = 1, \ldots, m,$$

Where; x_i are case specific regressors, representing a vector of observed livelihood assets that affect livelihood strategies, the model ensures that $0 < P_{ij} < 1$, βi was set to zero for one of the categories and the coefficients were interpreted with respect to the reference group (Cameron & Trivedi, 2009; Parrot et al., 2008; Train, 2003).

In this study, following the indicator system methodology, the effects of land use policy was estimated using household livelihood assets productivity as a proxy. The estimates were pegged on specific attributes for the chosen livelihood asset as change indicators. The coefficients of change indicators varied with the land use type adopted by different households; community land, private land and agro-pastoral land households. Drawing from Nielson et al., (2013), two-cluster method, households were classified according to the frequency of occurrence to select the reference group. In this study, 323 households undertaking various land use livelihood activities within community land, private land and agro-pastoral lands households were sampled to informed selection of the reference group. The frequency of occurrence is summarized in the table 3.4.

Table 3. 4: Frequency of household land use

Household Land use	Frequency	Percent	Valid percent	Cumulative percent
1. Community land	97	30.03	30.03	30.03
2. Private land	135	41.80	41.80	71.83
3. Agro-pastoral	91	28.17	28.17	100.00
Total	323	100.00	100.00	

Source: Survey Data. 2019

From this output, private land was the frequently occurring household land use. This output was obtained using SPSS software which automatically sorts the household land use groups and chooses the highest numbered group as the reference group. In order to measure and interpreted the effects of land use policy, the coefficient of the indicator variable was interpreted relative to the reference group (private land use households).

3.8.4 Evaluating Responsiveness of Government Decisions

The multinomial logit model was applied as follows:

$$\pi ij = Pr\{Yi = j\} \quad (3.7)$$

According to Maddala (1983), the household type under different land use was considered a random variable Yi that may take one of several discrete values, which we index 1, 2, . . ., J. where government response decision to household livelihood assets productivity is modelled in terms of the type of household. Discrete choice theory type of problems is better expressed as discrete bundles of attributes. Government decisions involve several alternatives that are probabilistic in nature. The options take the values “policy” or “law” or “regulation” or “projects,” which we index 1, 2, 3, and 4. Maddala points out the probability that the i-the response falls in

the jth household type (type = 1, type II = 2, and Type III = 3). In this case, πi1 is the probability that the i-th respondent is the household head. Assuming that the response of government decisions is mutually exclusive and exhaustive, we have PJ j=1 πij = 1 for each i, i.e., the probabilities add up to one for each individual household, and we have only J − 1 parameter.

3.8.4.1 Model specification

In this study, households were used as a unit of analysis and Dependent variable. The household livelihood assets (human, physical, natural, financial and social) were the independent variables. The variable used in the model were described and summarized in the table 3.5: Appendix

3.8.4.2 Model Estimation

According to Mc Fadden (1974), MNL has some special properties that can estimate its parameter under certain conditions. Let y_{in} be 1 if decision maker or observation n choose alternative I and o otherwise. The likelihood function is written as:

$$L = \prod_{n=1}^{N} \prod_{i \in C_n} P_n(i)^{y_{in}}, \tag{3.8}$$

According to Ben-Akiva & Lerman (1985), the equation is the linear- in- parameter logit (3.8). It can be rewritten as a log-likelihood function as follows:

$$\log L = \sum_{n=1}^{N} \sum_{i \in C_n} y_{in} (\beta' x_{in} - \ln \sum_{j \in C_n} e^{\beta' x_{jn}}). \tag{3.9}$$

The log-likelihood function equation (3.9) was set to zero to obtain first-order conditions as follows:

$$\sum_{n=1}^{N} \sum_{i \in C_n} [y_{in} - P_n(i)] x_{ink} = 0, \quad for\ k = 1, \ldots, K. \tag{3.10}$$

This function can be rewritten as follows:

$$\frac{1}{N}\sum_{n=1}^{N}\sum_{i\in C_n} y_{in}x_{ink} = \frac{1}{N}\sum_{n=1}^{N}\sum_{i\in C_n} P_n(i)x_{ink}, \quad k = 1, \ldots, K. \tag{3.11}$$

In this study, the parameter estimates of the model are relative to the reference group, the standard interpretation of the multinomial logit is that for a unit change in the predictor variable, the logit of outcome statistic relative to the reference group is expected to change by its respective parameter estimate given the variables in the model are held constant. The P-value is compared to a specified alpha level which in this study is set at 5% ($\alpha = 0.05$). The data set is processed using SPSS software version 20 as summarized in table 3.5

Table 3.5: Household Case Processing Summary

Household livelihood assets productivity	N = 323	Marginal percentage (%)
1.0 Community land	97	30.03
2.0 Private land	135	41.80
3.0 Agro-pastoral land	91	28.17
Valid	323	100.00
Missing	0	
Total	323	
Subpopulation	188	

N-provides the number of observations, Marginal Percentage- lists the proportion of valid observations found in each outcome variable's group, household livelihood assets productivity- the outcome variable in the regression, valid- the number of observations and all predictor variables, missing- the number of observations in the data set where data are missing from the outcome variables or any of the predictor variables data, Total- the sum of all observations in the data set, Subpopulation- consists of one combination of the predictor variables specified in the model.

Source: survey data, 2019

3.8.4.3 Interpretation of Model Results

According to Maddala (1983), it is important to note that multinomial logit model gives parameter estimates for K-1 models, where K is the number of levels of the outcome variables. In this study, SPSS is treating the private land use household's as the reference group, and therefore, estimated a model for community land

household's livelihood assets productivity relative to private land households, and similarly the model for Agro-pastoral land household livelihood assets productivity estimated relative to private land household livelihood assets productivity. Further the expected signs of the outcome variables indicate the increase or decrease in Household livelihood assets productivity as hypothesized in the model. After the data analysis the findings may support the expected sign or go contrary.

CHAPTER FOUR

FINDINGS, RESULTS AND DISCUSSIONS

4.0 Introduction

This chapter presents the findings, results and discussions. It covers descriptive findings and regression results.

4.1 Descriptive Findings

The descriptive findings encompass analysis of the basic information about the sampling units and description of variables (both categorical and continuous) used in the study. The descriptive statistics used comprise of percent, mean, standard deviation and frequency distribution. The findings gave insights of the drivers and effects of land use changes in Baringo County.

4.1.1 Basic Information about the Study area

The basic information about the study area is summarized in table 4.1

Table 4:1: Basic Information of the Study Area

Description	Eldama Ravine (n=99)	Baringo North (n = 75)	Baringo South (n=64)	Tiaty (n=85)
Area (sq. km)	1002.5	1703.50	1678.0	4516.8
Population (households)	129,535	104,871	90,955	153,347
Population density (km/h)	129	62	54	34
High potential-Ls (km)	601.5	681.4	167.8	225.8
Medium potential-L (km)	200.5	851.8	251.7	451.7
Low potential -Ls (km)	100.3	85.2	755.1	3834.8
Others -ls (km)	100.3	85.2	503.4	4.5
Land tenure (reg)	Private	Private/Community	Community	Community
Age of HH (av yrs.)	40-50	55- 60	57- 65	50-70
Family size (No)	4	5	5	6
Main livelihood activities (Human capital- yrs)	Crops/dairy University-25%	Crops/liv-intensive University -10%	Crops/live-extensive University -5%	Livestock University1%
(Physical capital-Kshs)	1,800	1,350	900	250
(Financial capital-Kshs)	5,000	3,500	2,500	< 1,000
(Social capital-groups)	10	6	2	0
(Natural capital_av acre)	2.5	5	Collective	Collective

Source: Survey data, 2019

The basic information gathered about the study area revealed salient issues and regional differences pertinent to land use changes in Baringo County. First, in Eldama Ravine Constituency, ninety-nine (99) household heads were randomly drawn from Ravine, Mumberes/Maji Mazuri, Lembus/perkerra and Koibatek wards. This area has a total land area of 1002.5 km^2 comprising of 601.5 km^2 high potential, 200.5 km^2 medium potential, 100.5 km^2 low potential and 100.3 km^2 others. Most of the land was registered private land with title deeds, and support a human population of 129,535 giving an average population density of 129 persons per square kilometer (sq.km). This profile indicates high population density suggesting increasing land use pressure. The profile shows that the local communities' livelihood activities consisted of 80 % crops and 20 % livestock (Dairy). This indicates that crop farming is the source of livelihood.

Further, majority (75%) of the livelihood activities were commercially oriented carried out on privately owned land. The profile indicate that the average age of the household head was 40 years, and the household heads' education level comprises 10 % never attended school, 20 % attained primary level, 45 % secondary and 25 % college and University level. This suggest that households in the area were headed by a youthful population and well-educated (25 % of the households headed by university graduates) with small family size consisting of 4 members. This implies rich human capital. However, most households had an average of 2.5 acres of land representing the natural capital. This capital embodied with conservation measures, including trees planted within the household farms. The physical capital represents output or yield realized in a year converted to (av of 1,800 kgs) per year. This translates to approximately Kshs 5,000 financial capital per household per month.

Moreover, the study shows that in Eldama Ravine constituency, fifty percent (50 %) of the households had iron sheet roofs and stone walls, 40 % had iron sheet and mud walls, and 10 % had grass-thatched roofs and mud walls. This reflects a moderate living standard. According to the findings, the average income for the households was Kshs. 5000 per month. Household income consists of employment, household enterprises, agricultural produce, rent, pension, financial investment and other transfer payments. The household heads were registered in at least ten groups. Therefore, the findings reveal that in Eldama Ravine constituency land use changes were mainly driven by individual commercial interest with profit motives guiding livelihood production activities under secure land tenure system.

Second, in North Baringo Constituency**,** seventy-five (75) households were randomly drawn from Kabartonjo, Saimo/Kapsarman, Saimo /Soi and Bartabwa. This area has a total land area of 1703.50 km^2 comprising of 681.4 km^2 high potential, 851.8 km^2 medium potential, 85.2 km^2 low potential and 85.2 km^2 others. Some of the land was registered as private land with title deeds specifically on the highlands, whereas in the lowlands, land was used communally. Baringo North Constituency supports a human population of 104,871 persons giving an average population density of 62 persons per square kilometer (sq.km).

The local communities' livelihood activities consisted of 50 % crops and 50 % livestock (20% Dairy and 30% Extensive). About 60% of livelihood activities were commercial-oriented, and 40% were subsistence. Land use was 30 % private and 70 % communal. The education level – 25% never attended school, 45 % attained primary level, 20 % secondary and 10% college and University level. 5 % households

had planted trees in their farms. The physical capital amounts to 1,350 kgs. In terms of housing, 30 % of the households had constructed iron sheet and stone walls, 30 % lived in iron sheet and mud walls, and 40 % were grass-thatched and mud walls. The average income of the households was estimated at Kshs 3500 per day. The household heads were registered in at least three groups.

It was observed that land use changes were largely driven by mixed drivers specific to the ecological zone; in the highland, the key driver is individual commercial interest for profit, and in the lowlands, it is driven by subsistence livelihood production activities. In the area, most households are sedentary farmers whose livelihood was mainly mixed farming consisting of cultivation of food crops with modest livestock rearing (sheep, goats and cattle herds).

Third, in Baringo South site, sixty-four (64) households were randomly drawn from Marigat, Ilchamus, Mochongoi and Mukutani wards. This area has a total land area of 1678 km^2 comprising of 167.8 km^2 high potential, 251.7 km^2 medium potential, 755.1 km^2 low potential and 503.4 km^2 others. Most of the land was registered private land with title deeds, and support a human population of 90,955 giving an average population density of 54 persons per square kilometer (sq.km). The local communities' livelihood activities consisted of 20 % crops and 80 % livestock (10 % dairy and 70 % extensive). It is noted that 20 % of livelihood activities were commercial oriented and 80% subsistence. Land use was 10 % private and 90% communal.

The study findings revealed that 40 % of the household heads never attended school, 40 % attained primary level & 15 % secondary and 5% college and University level. The results indicate that 95 % of its community land is not registered and held in trust by the County Government of Baringo. Land use was largely communal under customary arrangements. Land use conflicts were rampant. The physical yield per acre was approximately 900 kgs. Five per cent (5 %) of the households had iron-sheet and stone walls, 30 % iron sheet and iron walls and 65 % grass-thatched and mud walls. This implies that most households live in poor conditions, as shown by the nature of their housing. The average income is Kshs 2500 per month. The household heads were registered in at least two groups.

It was observed that land use changes in this area were largely driven by competition on land use. In the area, most households depend on Agro-pastoralism as the dominant livelihood's activity. The households combine extensive livestock rearing and rainfed cereal production as well as minor irrigation activities. In addition, the areas were characterized by land use conflicts occasioning Internally Displaced Persons (IDPs) livelihoods. IDPs are households which lost their livelihood assets and have been displaced from their ancestral lands. They are concentrated in camps, trading centers, and some live with relatives. They depend on humanitarian assistance and casual paid human labor in areas where they sought refuge for the safety of their lives and livelihoods.

Four, in Tiaty Constituency, eighty-five (85) households were randomly drawn from Silale, Loiyamorock, Tangulbei/korossi and Churo/Amaya wards. This area has a total land area of 4516.8 km^2 comprising of 225.8 km^2 high potential, 451.7 km^2

medium potential, 3834.8 km^2 low potential and 4.5 km^2 others. Most of the land was registered private land with title deeds, and support a human population of 153,347 giving an average population density of 34 persons per square kilometer (sq.km).

The local communities' livelihood activities consisted of 5 % crops and 95 % livestock (1% Dairy and 94 % extensive). 98 % of livelihood activities were traditional-oriented subsistence. Land use was largely (98 %) communal. This implies that most of the land was still held under community ownership, with only 2% under individual ownership. The majority (95%) of the residents had never attended school, 3 % attained primary level, 1 % secondary and 1% college and University level. This implies that most households were illiterate, a fact that affects the decision-making process of the residents in terms of land use policy changes. There were no planted trees on most farms, as seen by the bare land and dry environment. The average income of the households was less than Kshs 1000 per month. This implies that most of the households had very low-income levels. The household heads do not engage in groups activities. The area was dominated by livestock-based livelihoods activities, and entirely depend on livestock and livestock products. In addition, the areas was vulnerable to effects of climate evidence by recurring drought and floods. Consequently, most of the household heads have been changing their lifestyle to settle down in permanent homes and started engaging I n new livelihood strategies such as crop cultivation.

Comparing the profiles of different sampling units (Eldama Ravine, Baringo North, Baringo South and Tiaty constituencies) revealed that, land use changes were were driven by some factors such as the population density, ecological conditions, land use

practices, the age of household head and the level of capital (human, physical, financial, social and natural). These factors influence land use changes differently in different agro-climatic zones within the county. It is evident that, as the population density increases, land size decreases and land use pressure builds up. This, therefore, affects land use changes in twofold; first, on the highlands, covering Edama Ravine and higher part of Baringo North constituencies, land use changes exert pressure on the available land resource leading to subdivision of land into small parcels i.e in Baringo North, the land size average 5 acres, this area reduces further to an average of 2.5 acres in Eldama Ravine. Ideally aims to accommodate the rapidly increasing population. Second, on the lowlands covering Tiaty, Baringo South and the lower part of North Baringo constituencies, land use changes exert pressure on existing fragile marginal and arid land resulting to land degradation and rampant land use conflicts.

From the basic information analysis, the following generalizations were observed:
First, the population density decreases from highlands (Eldama Ravine (129) and Baringo North (62) to lowland (Baringo South (54) and Tiaty (34) head /Sq.km). This suggests land use pressure reduces from highlands as move to the dry areas. This implies that land use pressure is building up in highland. Resulting to land subdivision into uneconomical units. It was observed that land size has been progressively decreasing particularly in the highlands. For example, in Baringo North the average land size was 5 acres, whereas in Eldama Ravine the average was 2.5 acres. This scenario creates land pressure which force local communities to move from highlands to dry areas seeking livelihood opportunities.

Second, three distinct categories of land use in Baringo County were identified; Pastoral land use category in the dry parts of the county, and the main livelihood source of was extensive livestock production under communal land use system. The agro-pastoral land use category in the marginal lands and employs mixed production process of growing crops, and keeping livestock under largely communal land use system and Private land use category largely in the highlands and man source livelihood was crop farming with exclusive legally registered land use rights. This land use tenure variation influenced livelihood of the local communities.

4.1.2 Descriptive Statistics for Categorical Variables Used in the multinomial logit model

Descriptive statistics showed the distribution of categorical variables across pastoral land use households (type I), private land use households (Type II) and marginal land use households (type III) summarized in table 4.2.

Table 4:2: Descriptive Statistics for human livelihood attributes

Variables	Categories	Type I	Type II	Type II	t-test
Gender	Male	70 (72.00 %)	85 (64.45%)	63 (68.54%)	-2.35**
	Female	27 (28.00 %)	50 (35.55%)	28 (31.466%)	
Education	No education	52 (53.61%)	23 (17.04%)	25 (27.47%)	-3.90***
	Primary	21 (21.65%)	53 (39.26%)	37 (40.66%)	
	Secondary	14 (14.43%)	24 (17.78%)	16 (17.58%)	
	College	7 (7.22%)	19 (14.07%)	9 (9.89%)	
	University	3 (3.09 %)	11 (8.15%)	5 (5.49%)	
Occupation	Livestock	83(85.42%)	17(4.16%)	47 (51.65%)	-0.15
	Crops	14 (14.58%)	128(95.84%)	44 (48.35%)	
Labor	Family	85 (87.63%)	45 (33.33%)	33(36.26%)	-2.752***
	Hired	12 (12.37%)	90 (66.67%)	58 (63.74%)	
Health	Public	37(38.14%)	43 (31.85%)	28 (30.77%)	0.53
	Private	10 (10.31%)	60 (44.44%)	38 (41.76%)	
	Herbal	50 (51.55%)	32 (32.71%)	25 (27.47%)	

Source: Survey Data, 2019

The descriptive statistics focused on the characteristics of livelihood assets used in the models as land use change indicators in policy and government response decisions. On human livelihood assets, the study findings revealed on different results on different attributes. Thus; the findings revealed that there was gender disparity in land use production decisions in terms of household leadership. Majority of the households were headed by male. In the pastoral land use households type I (72 %), marginal land household type III (68.54%) and private land households type II (64.45%). This implies that males at the household level dominated land use decisions. The results also show that the education level among the household heads varied. The trends indicate the 53.61% of community land, 27.47% marginal land and 17.04% of private land households' heads had no formal education. This implies that household land use decisions were largely based on experiential knowledge suggesting they employ traditional production methods and rely on experience gained over the years.

The physical and natural livelihood resources the results are presented in table 4.3.

Table 4.3: Descriptive statistics for physical and natural livelihood attributes

Variables	Categories	Type I	Type II	Type II	t-test
Land use	Deed	0 (00.00%)	135(100.0%)	28 (20.88%)	0.63
	Collective	97 (100.00%)	0 (00.00%)	72(79.12%)	
Grazing area	Extensive	86 (88.40%)	45 (33.33%)	45 (49.45%)	-0.75
	Fodder	11 (11.60%)	90 (66.67%)	46 (50.55%)	
Shelter	Grass hut	63 (64.95%)	46 (34.07%)	23 (25.27%)	-0.73
	Mud, iron roof	17 (17.53%)	58 (42.96%)	46 (50.54%)	
	Iron, iron roof	5 (5.15%)	27 (20.00%)	17 (18.68%)	
	Bricks, tile roof	2 (2.06%)	4 (2.96%)	5(5.49 %)	
Lighting fuel	Firewood	45 (46.39 %)	18 (13.33%)	18 (19.78 %)	-0.08
	Paraffin	8 (8.23 %)	11 (8.15 %)	16 (17.58 %)	
	Solar	15 (15.46 %)	51 (37.78 %)	36 (39.56 %)	
	Electricity	2 (2.06 %)	41 (30.37 %)	8 (8.79 %)	
	Torch	27 (27.84 %)	14 (10.37 %)	13 (14.29 %)	
Cooking fuel	Firewood	72 (74.23 %)	43 (31.85 %)	36 (26.67 %)	0.44
	Charcoal	17 (17.53 %	62 (45.92 %)	47 (51.65 %)	
	Paraffin	4 (4.40 %)	5 (3.70 %)	3 (3.30 %)	
	Electricity	3 (3.30 %)	18 (13.33 %)	5 (5.56 %)	
	Gas	1 (1.10 %)	7 (5.19%)	4 (2.96 %)	
Water supply	River	84 (86.60 %)	37(38.14 %)	39 (42.86 %)	-1.45
	Piped	13 (13.40 %)	98(72.59 %)	52 (57.14 %)	
Information	Mobile	75 (77.32 %)	82(60.74 %)	46 (50.55 %)	-3.27***
	Internet	13 (13.40 %)	24 (17.78 %)	19 (20.88 %)	
	What Sapp	9 (9.29 %)	29 (21.48 %)	26 (28.57 %)	

Source: Survey Data, 2019

The results indicate that 100% of pastoral land use households employ collective land use practices, 72% of households in Agro-pastoral land use employ a mixture of collective and individual land use practices, while private land use households employ individual land use practices. The results further indicate that pastoral land use households (86%) relies on extensive grazing, Agro-pastoral land use households employ mixed land (extensive grazing 49.45 % & fodder 50.55%), and private land

use households (90%) rely on fodder. This implies that pastoral land use households had no incentive to improve grazing for their livestock, hence low productivity and prone to overgrazing and land degradation.

On physical livelihood assets, the results indicate that most households in the pastoral land use households (65%) had grass thatched huts and the main source of lighting and fuel for cooking was firewood, and rely on water drawn from the river for domestic and livestock purposes. This implies that land use decisions encouraged the destruction of the environment. It suggests that government response decisions are expected to focus on environmental conservation. Further, private land use households were dominated by a mud wall and iron sheet roof houses (43%), the main source of lighting was solar (38%), cooking fuel was charcoal (46%), and access piped water (72%). This result indicates improvement in livelihood but destruction of the environment still remains due to charcoal burning. Therefore, government land use policy decisions should focus on developing alternative sources of cooking fuel such as solar energy.

Moreover, In the agro-pastoral land use households, the results indicate that most households had mud walls and iron sheet roofs (51 %), the source of lighting energy was solar (40%), cooking fuel was charcoal (52%), and some households use piped water (42%). These results show improvement but environment destruction still remains an issue through charcoal burning. Hence, government land use policy should focus on environmental conservation and enhance livelihood options for the local community through promotion of small-scale irrigation. On access to information services**,** varied according to land use.

In regard to financial and social livelihood assets attributes, the descriptive statistics were presented in table 4.4.

Table 4.4: Descriptive statistics of financial and social livelihood assets attributes

Access credit	Banks	4 (4.12 %)	70 (51.85 %)	47 (34.81 %)	-10.05***
	Micro finance	6 (6.19 %)	32 (23.70 %)	32(23.70 %)	
	SACCO	2 (2.06 %)	15 (11.11 %)	8 (5.93 %)	
	M-Pesa	6 (6.19 %)	5 (3.70 %)	1 (0.07 %)	
	M-Shwari	6 (6.19 %)	6 (4.44 %)	2 (84.89%)	
	None	73 (75.26 %)	6 (4.44 %)	1 (0.07 %)	
Membership	Groups	5 (5.15 %)	113(83.70 %)	79 (86.81 %)	2.25**
	None	92 (94.85 %)	22 (16.30 %)	12 (13.19 %)	
Participation in decision	Meeting	2 (2.06 %)	35 (25.92%)	29 (31.87 %)	-0.60
	Seminar	4 (4.12 %)	45 (33.33 %)	32 (35.16 %)	
	Training	3 (3.09 %)	33 (24.44 %)	27 (29.67 %)	
	Planning	2 (2.06 %)	18 (13.33 %)	1 (1.09 %)	
	none	86(88.66 %)	14 (14.43 %)	2 (2.20 %)	
Land use Conflicts	Committee	4 (4.12 %)	5 (3.70 %)	6 (6.59 %)	-15.65***
	Campaign	12 (12.37 %)	15 (11.11 %)	24 (26.37%)	
	Lobby	6 (6.19 %)	10 (7.41 %)	6 (6.59 %)	
	None	67 (69.07 %)	105 (77.78%)	55 (60.44 %)	

Source: Survey Data, 2019

The results show that majority of the respondents (75.26 %) in the pastoral land use households had no access to credit, private land use households(51.85%) had varying degree of credit access from the banks and agro-pastoral land use households (23.70 % had access to credit from both banks and micro-finance for land use related activities. This result suggests that pastoral land use households lacked secure collateral for loans, therefore, had no access to credit from banks and microfinance. At the same time, private land use and agro-pastoral land use households had some level of access to credit. This implies that community land households have no security of tenure and lack title deeds to secure loans from financial institutions. The results suggest that the security of land use tenure is critical for households in access to services and has a great influence on the ability of households to repay the credit.

4.1.3. Descriptive Statistics for Continuous variables used in the multinomial logit model

Descriptive statistics on continuous variables used were summarized in table 4.5 as follows:

Table 4:5: Descriptive Statistics for Continuous Variables

Variables	Type I		Type II		Type III	t-test
	Mean	Std Dev.	Mean	Std Dev.	Mean	t-test
Human						
Age	65	5.75	45	5.25	57.5	-1.54
Household Size	10	3.0	5.34	2.05	6.24	1.23
Health expenditure	200	10.57	854.52	50.15	543.43	-0.30
Natural						
Land size (acres)	0.00	0.00	5.25	2.65	12.35	-5.13***
Tree (No)	2.05	0.51	10.57	3.75	5.95	-0.58
Invasive weeds	12.07	2.51	2.75	0.75	5.05	1.57
Grazing area	25.07	4.63	1.35	0.58	8.25	1.27***
Fodder (acres)	2.03	0.92	1.24	0.49	3.85	-5.01***
Physical						
Infrastructure						
Road	13.11	2.50	2.65	0.53	3.97	1.44**
Market	20.630	6.15	5.77	2.85	10.36	1.09**
Water Source	5.98	2.23	2.89	0.57	4.38	8.64***
Livestock (No)	53.98	5.33	5.25	1.39	7.46	-3.43***
Total output (KES)	5,385	1,357	10,250	2,515	9,765	1.74***
Financial						
Credit amount	9,509.75	3,234	55,735	23,652	39,674	-1.39***
Amount of savings	500.76	200.53	10,532	2,503	6,750	-1.18
Value of livestock	75,759.	5,050	42,954	10,375	36,986	-2.94
Value of crops	1,575	1,274	157,900	10,528	75,439	-3.50
Remittance (KES).	579.53	232.56	52,350	2350.34	5,789.73	0.96**

Source: Survey Data, 2019

The descriptive statistics on continuous variable used in the models, revealed varied results from one household to another depending on the dominant land use prevalent in the area. In the community/pastoral land use households (Type I), the mean age of household head was sixty-five (65) years, the family size was largely comprised of ten (10) members, and health expenditure was small, amounting to approximately two hundred shillings (200) per month. The Natural capital indicates that land use was collective and land size was not defined (0), households lack incentives to grow trees (a mean of two (2) trees planted per household per annum), heavily infested by invasive weeds (*prosopis juliflora*) taking 12 % space per acre. The area was

characterized by poor physical infrastructure and long distance to basic services including distance to main road (13 km), nearest market (20 km) and water source (6 km) and livestock owned by household (av 54 heads of cattle) with total output per month (Kshs 5,385) which translating to kshs 179.5 per day for a household size (10 members).

In the Private land use households (Type II), the mean age of household head was forty-five (45) years, the family size was largely comprised of five (5) members, and health expenditure was high amounting to approximately eight hundred and fifty-four shillings (854) per month. The natural capital indicates that land use was individual and land size (av. 5 acres), households had incentives to grow trees (a mean of eleven (11) trees planted per household per annum), sparsely infested by invasive weeds (*prosopis juliflora*) taking 3 % space per acre. The area was characterized by good physical infrastructure and long distance to basic services including distance to main road (3 km), nearest market (6 km) and water source (2 km) and livestock owned by household (av 5 heads of cattle) with total output per month (Kshs 10,250) which translating to kshs 342 per day for a household size (5 members).

In the Agro-pastoral land use households (Type III), the mean age of household head was fifty-eight (58) years, the family size was largely comprised of six (6) members, and health expenditure was moderate amounting to approximately five hundred and foty-three shillings (543) per month. The natural capital indicates that land use was individual and land size (av. 12 acres), households had incentives to grow trees (a mean of eleven (6) trees planted per household per annum), sparsely infested by invasive weeds (*prosopis juliflora*) taking 5 % space per acre. The area was

characterized by good physical infrastructure and long distance to basic services including distance to main road (4 km), nearest market (10 km) and water source (4 km) and livestock owned by household (av 8 heads of cattle) with total output per month (Kshs 9,765) which translating to kshs 326 per day for a household size (6 members).

In this light, it was observed that each household had a specific area alienated for individual livelihood activities, including grazing areas, and allowed to develop fodder enclosures. The results indicates that critical land use change indicators include land size, distance to basic services and the total output realized by the household.

4.2. Regression results

The regression results consist of Cobb-Douglas model estimates on livelihood assets productivity and Multinomial Logit model estimates on the effects of land use policy and responsiveness of government decisions on the household livelihood assets productivities in Baringo County. The regression results were as follows:

4.2.1 Cobb-Douglas model Estimates

Cobb-Douglas model was used to determine the effects of land use changes on the livelihood assets productivity.

4.2.1.1 Model Properties

Before interpretation and discussion of the model results, post-estimation tests were conducted to confirm that the predictor variables were able to describe the dependent variable. In this regard, the results revealed that the model predictor variables explain seventy-eight-point three (78.3%) percent of livelihood assets productivity, the variant inflation factor (VIF) for all variables was less than 10 indicating that there was no multicollinearity between model variable, and the Glejser test values were less than

0.05 indicating that there was no heteroscedasticity. These diagnostic measures confirm that the model was fit and can explain the livelihood assets productivity.

The model estimates measure the productivity of livelihood assets as an indicator of the effects of land use changes summarized in the table 4.6. Thus;

Table 4:6: Cobb-Douglas Model Estimates on Livelihood Assets Productivity

Independent variable	B	t-test	VIF	Glejser-test
Human	-0.561***	-3.792	1.490	0.035
Natural	0.543**	1.603	8.519	0.006
Physical	-0.534*	5.485	7.785	0.019
Financial	-0.676**	-0.986	3.029	0.005
Social	0.613***	1.593	7.028	0.000
Dummy BS	-0.090*	-0.092	6.053	0.000
Dummy BN	0.051***	0.155	7.353	0.001
Dummy T	-2.824**	-3.960	2.496	0.003
Dummy ER	1.393*	-5.833	2.103	0.000
Intercept				1.286
F-test				73.768
Adjusted R^2				0.783
N				323

***** = Significant at the level of 1%. ** = Significant at the level of 5 %. * = Significant at the level of 10 %., E.S. = Expected sign. If variant inflation factor (VIF) < 10, there was no Multicollinearity. If the value sig < 0.05 using the Glejser test, there was no Heteroscedasticity. Dummies (BS-Baringo South, BN- Baringo North, T- Tiaty and ER- Eldama Ravine)**

Source: survey results, 2019

The results show that the coefficient of human, physical and financial livelihood assets were negative and significant at 1%, 10% and 5% levels respectively. This means that land use changes decrease human, physical and financial livelihood assets productivity by 56.1 %, 53.4% and 67.6% respectively. This result suggests that land use changes decrease livelihood outcomes of the local communities in Baringo County. Thus:

The results show that the effects of land use changes decrease human livelihood assets productivity by 56.1% at 1% level of significance. Human livelihood assets comprise

of the chronological age of the household head, amount incurred on health expenditure, household size, number of years of formal education. This means that land use changes decrease health status, reduce life expectancy and low-level education hence limits knowledge and skills required capacity to adapt changes by individual households. This implies that land use changes promote poor health, lower education level thereby lack requisite skills and weak capacity to cope with the changes.

The results indicates that the effects of land use changes decreased physical livelihood assets productivity by 53.4% at 10% level of significance. It means land use changes affects household's physical livelihood assets reflected by changes in attributes such as distance to basic infrastructure such as road, water source, markets, number of livestock and total output in monetary terms. This implies that land use changes poor access to basic infrastructure, water supply and access to markets.

The results indicates that the effects of land use changes decreased financial livelihood assets productivity by 65.6% at 5% level of significance. Financial livelihood assets comprise amount of credit, amount of savings, value of livestock, value of crops and remittance. This means that land use changes decrease amount of credit, amount of savings, value of livestock, crops and remittance. This implies limited opportunities for investment.

On the other hand, the results show the coefficient of Natural and Social livelihood assets were positive and significant at 5 % and 1% respectively. This means that land use changes increased natural and social livelihood assets productivity by 54.3 % and

61.3% respectively. This result suggests land use changes improves environment and builds strong social capital for the local communities in Baringo County. Thus;

The results indicates that the effects of land use changes increased natural livelihood assets productivity by 54.3 % at 5 % level of significance. Natural livelihood assets comprise of land size including number of acres under grazing area and fodder as well as trees. This suggests land use changes improves natural environment.

The results indicates that the effects of land use changes increased social livelihood assets productivity by 61.3 % at 5 % level of significance. The social livelihood assets include number of groups the household head was registered as a member, number of trainings and seminars attended. This indicates improvement in social networks and participation in land use decision making processes.

Further, the model results indicate varied results for different regions within the county. The results show that in Baringo South (BS) constituency, which was largely marginal land dominated by Agro-pastoral land use households, the coefficient was negative and significant at 10 % level. This means that land use changes decrease livelihood assets productivity by 9 %. Similarly, in Tiaty (T) constituency, which was largely dry land dominated by pastoral land use households, the coefficient was negative and significant at 5% level. This means that land use changes decrease livelihood assets productivity by 282.4%. Whereas in the highlands parts of Baringo North (BN) and Eldama Ravine (ER) constituencies, which were dominated by private land use households, the coefficients were positive and significant at 1 % and

10 % levels respectively. This means that land use changes increase livelihood assets productivity by 5.1 % and 139.3 % respectively.

These results show that livelihood assets productivity varied depending on the regions within the Baringo County.

Comparing land use changes between regions, generally, in Baringo South (marginal lands) and Tiaty (dry lands), land use changes decrease livelihood assets productivity. This imply reducing livelihood outcomes for the local communities. The scenario could be explained by the rampant inter local communities land use conflicts characterized by persistent cattle rustling. Cattle rustling disrupts livelihood activities in Baringo South and Tiaty constituencies hindering local communities from engaging in livelihood activities. The situation leads to unstable livelihoods and uncertain future development, which is associated with unclear land use rights prevalent in communal land use. Whereas, the highlands covering Baringo North and Eldama Ravine constituencies, land use changes increase livelihood assets productivity. This implies increasing livelihood outcomes for the local communities. These results could be closely associated with secure land tenure on private land.

4.2.2 Multinomial Logit Model estimates

The results comprise of both the effects of land use policy, and evaluation of the responsiveness of government decisions on land use changes.

4.2.2.1 Effects of Land Use Policy decisions

Household livelihood assets productivity was used in proxy to determine the effects of land use policy decisions on land use changes. Coefficients of livelihood assets attributes were used as change indicators.

4.2.2.2 Model Properties

Before performing the interpretation and discussion of the results, the goodness of fit test was conducted on the Mlogit model using the Likelihood ratio (LR) Chi-Square test. In this study, the LR chi-square value is 405.56 and the significance level P value is 0.000. This indicates high goodness of fit. Therefore, the estimated results are stable and credible. In addition, the partial regression coefficients of independent variables have a remarkable ability to explain the dependent variable. The descriptions are based on coefficients and odds ratios values for each livelihood assets indicators which are attributes of each livelihood asset. The attributes were described in the model as explanatory variables. The coefficient of change indicator reflects the effects of land use policy on household livelihood assets productivity for community and agro-pastoral land relative to the reference group i.e. private land use households (Type II).

The multinomial logit estimates were summarized in the table 4.7 as follows:

Table 4.7: Multinomial Logit Estimates for Land Use Policy Decisions

Livelihood asset	Explanatory variables	Community/Pastoral land households (Type I)			Agro-pastoral households (Type III)		
		Coefficient	P > z	Exp β	Coefficient	P > z	Exp β
Human (HLA)	Gender	-0.049	0.010	0.005	0.546	0.000	2.065
	Education	2.389	0.045	57.225	1.375	0.005	1.003
	Household Size	-1.458	0.0161	0.907	2.879	0.000	10.005
	Age	1.236	0.000	0.003	0.498	0.000	2.005
Physical (PLA)	Road	-2.564	0.005	0.045	3.354	0.005	0.525
	Livestock	-0.584	0.085	0.025	5.675	0.001	0.657
	Buildings	-3.673	0.155	0.000	20.015	0.015	0.005
	Water supply	-0.232	0.021	0.307	5.698	0.001	0.055
	Source Energy	0.059	0.010	0.423	1.596	0.006	0.000
	Information	-10.457	0.015	1.017	5.782	0.115	0.000
Natural (NLA)	Forest cover	-4.362	0.001	270.532	-1.516	0.000	1.054
	Invasive species	30.175	0.000	2.065	10.438	0.001	0.475
	Grazing area	-7.603	0.000	1.003	-5.239	0.000	1.615
	fodder	0.041	0.000	0.005	4.167	0.000	0.385
Financial (FLA)	Savings	-5.105	0.003	0.005	10.765	0.005	0.653
	Livestock (va)	-15.632	0.000	0.525	5.897	0.001	0.995
	Crops in store	0.051	0.155	0.707	16.749	0.005	0.005
	Credit	-0.926	0.000	0.005	7.532	0.003	0.905
	Remittance	-0.125	0.010	0.055	0.864	0.213	0.000
Social (SLA)	Groups	0.302	0.142	0.075	-1.052	0.000	0.006
	Food for work	5.369	0.038	0.000	-0.032	0.000	2.958
	Donation	-2.783	0.045	1.001	3.060	0.075	1.054
	Voucher	-4.584	0.016	0.485	0.053	0.054	0.775
	Participation	0.534	0.035	1.516	2.035	0.065	2.515
Constant	-56.725						
Loglikelihood	-150.815						
LRch^2 (45)	405.56						
Prob>ch^2	0.000						
Pseudo R^2	0.683						

NB: Private land households were designated as the reference group.

Source: Survey Data, 2019

In the community/pastoral land use households (Type I), the results show that the coefficient for change indicators of human livelihood assets attributes; gender, education level, ability to labor and chronological age of household head for pastoral/community land use households type 1 were not significant. This imply that policy makers and experts ignore experiential knowledge of the local communities in policy formulation and implementation. These results agree with past studies by Ahmed (2001). Ahmed argued that land use policy does not take into consideration the local communities' knowledge and skills. The local community's experiential

knowledge comprises of experience accumulated over the years and handed down through generations by cultural transmission. The omission often leads to misconception and development of wrong policies as well as interventions strategies. Ahmed further pointed out that ignoring local communities' experiential knowledge may end up harming the local communities, distorting their livelihood, and in most cases render the modern policies redundant particularly in pastoral/ community land use households' changes compared with private land use households.

The results show that the coefficient for change indicators of physical livelihood assets increase infrastructure (roads), decrease total livestock owned, decrease the quality of shelter and buildings, decrease water supply, and decrease access to information under community land households. The results means that effects of land use policy decrease physical household livelihood assets productivity as reflected by negative coefficients of the change indicator variables including roads, total number of livestock owned, fixed assets such as buildings, water supply and access to information. This imply that the effects of land use policy lowers land productivity in the pastoral/community land households relative to private land households.

The results show that the coefficients for change indicators for natural household livelihood assets productivity decrease forest cover, increase invasive alien species and decrease extensive grazing in community land households relative to private land households. It implies that the effects of land use policy promote depletion of forest cover, accelerate the widespread invasion by invasive alien species, limits extensive livestock grazing. This means that the effects of land use policy enhance degradation of forests, accelerate invasion of invasive alien species and restrict extensive grazing. The effects are manifested by rampant land resource conflicts witnessed in the

community land households compared with private land households particularly in the dry lands.

The results show that the coefficients for change indicators of financial livelihood assets decrease savings, decrease livestock value, and decrease credit. This implies deterioration of saving, diminishing value of livestock and limited credit sources for individual households in community land households relative to private households. This could be explained low likelihood for opportunities for saving and investment due to lack of land tenure security in the community land relative to private land households. On social household livelihood assets productivity; the coefficients of change indicators for social livelihood assets including membership in groups, food for work, donation, and voucher and participation were not significant. This imply that the effects of land use policy discourage social capital development.

In the agro-pastoral land use households (Type III), the results show that the effects of land use policy increase human, physical, natural and financial, and decrease social household livelihood assets productivity. The coefficient of change indicators for human livelihood assets shows that gender, household size and the age of household head were positive and significant. This means that the effects of land use policy on land use changes enhances human livelihood assets productivity.

The results show that the coefficients for change indicators of physical livelihood assets show that roads, total livestock owned, machinery and buildings, water supply and access to information were positive and significant at different levels. This implies the effects of land use policy increase infrastructure (roads), increase livestock owned, increase quality of shelter and buildings and increase water supply in agro-pastoral land use households relative to private land use households. This means that

land use policy influence livelihood activities in the agro-pastoral unlike community land use households.

The results show that the coefficients for change indicators for natural livelihood assets productivity decrease forest cover, increase invasive alien species, decrease extensive grazing and increase growing of fodder in agro-pastoral land households relative to private land households. This means that the effects of land use policy enhance degradation of forest cover, accelerate invasion of invasive alien species, restrict extensive livestock grazing and enhance the growing of fodder in agro-pastoral land use households relative to private land use households land use changes.

The results show that the coefficients for change indicators of financial livelihood assets increase savings, increase livestock value, and increase crops in store and increase credit in agro-pastoral land households relative to private land use households. This implies improvement in saving, enhance livestock, promote storage and enhance credit sources. The results show that there is high likelihood for opportunities for saving, increase investment in livestock, improvement in storage and increase credit sources for agro-pastoral land households.

The results show that the coefficients of change indicators for social livelihood assets decrease membership in groups and also decrease food for work. This means that the effects of land use policy in the agro-pastoral land use households discourages social capital development and limits joint efforts.

4.2.2.2 Government Response Decisions

The results of Multinomial logit model used to evaluate the responsiveness of government decisions on land use changes

Model Properties

The model's parameter estimates were based on multinomial logit k-1, where k is the number of levels of the outcome variables, β- regression coefficient for the model. Std error- these are the standard errors of the individual regression coefficient for the respective model estimates. Wald -This is the Wald Chi-square tests the null hypothesis that the estimates equal zero. df- this column lists the degree of freedom for each of the variables included in the model. Sig- these are the P-values of the coefficient or the probability that within a given model, Exp (B) – These are the odds ratios for the predictors. The odds ratio of a coefficient indicates how the risk of the outcome falling in the comparison group compared to the risk of the outcome falling in the reference group changes with the variable in question. An odds ratio > 1 indicates that the risk of the outcome falling in the comparison group relative to the risk of the outcome falling in the reference group increases as the variable increases. 95% Confidence Interval for Exp(B) – This is the Confidence Interval (CI) for an individual multinomial odds ratio given the other predictors are in the model for outcome relative to the reference group. It provides a range where the “true” odds ratio may lie. The estimates were summarized in table 4.8.

Table 4:8. Multinomial Logit estimates for Government Response Decisions

Household livelihood assets		B	Std Error	Wald	Df	Sig	Exp β	95% Confidence interval for Exp (β)	
								Lower bound	Upper bound
Human	Intercept	1.576	1.125	2.865	1	0.002			
	CLH	-0.025	0.023	1.256	1	0.005	0.974	0.974	1.012
	APH	-0.046	0.020	3.879	1	0.044	0.963	0.928	0.999
	Grd	0.785	0.375	4.623	1	0.032	2.263	1.064	4.986
Physical	Intercept	-4.075	1.263	10.172	1	0.001			
	CLH	0.033	0.024	1.208	1	0.00	1.036	0.987	1.056
	APH	0.054	0.037	5.467	1	0.035	1.045	1.003	1.078
	Grd	0.043	0.351	0.008	1	0.045	0.986	0.501	1.928
Natural	Intercept	1.125	1.265	1.987	1	0.052			
	CLH	-0.052	0.032	0.956	1	0.005	0.955	0.962	1.162
	APH	-0.065	0.034	4.987	1	0.051	0.973	0.928	0.989
	Grd	0.985	0.486	3.945	1	0.006	2.473	1.064	5.094
Financial	Intercept	-3.575	1.457	10.172	1	0.005			
	CLH	-0.055	0.047	0.508	1	0.046	0.957	0.949	1.056
	APH	-0.034	0.037	2.478	1	0.000	1.088	1.057	1.271
	Grd	0.063	0.351	0.006	1	0.016	0.994	0.501	1.052
Social	Intercept	1.925	1.315	3.872	1	0.006			
	CLH	-0.074	0.023	0.987	1	0.043	0.994	0.9824	1.023
	APH	0.059	0.052	3.879	1	0.024	0.967	0.925	0.987
	Grd	0.896	0.397	3.523	1	0.045	4.221	1.064	4.415

*NB **Reference group** is private land households, **CLH**-Community Land Households, **APH**- Agro-pastoral Households, **Grd-** Government response decisions.*

Source: survey results, 2019

The results revealed that government response decisions are more likely to increased human, physical, natural, financial and social household livelihood assets productivity by 0.785, 0.043, 0.985, 0.063 and 0.896 times in both Community land (CLH) and agro-pastoral land (APH) households respectively relative to private land household livelihood assets productivity. The results indicates that government response decisions are more likely to affect negatively human, natural, financial and social household livelihood assets productivity by 0.025, 0.052, 0.055 and 0.074 times

respectively in the community land relative to the private land. Whereas in the agro-pastoral land, it is more likely to affect negatively human, natural and financial household livelihood assets productivity by 0.046, 0.065 and 0.034 times respectively relative to private land.

On the other hand, the results indicate that government response decisions are more likely to affect positively physical household livelihood assets productivity by 0.033 times in community land, while in the agro-pastoral land, it is more likely to affect positively physical and social household livelihood assets productivity by 0.054 and 0.059 times respectively relative to private land. These results means that government response decisions favor private land household livelihood assets productivity compared with community land and agro-pastoral households livelihood assets productivities.

The results agree with empirical study by Thurston (1987) that government response decisions and intervention strategies focus on arable under registered private land use and give little attention to marginal and dry parts of the country under unregistered communal land use. This scenario promotes regional imbalance in land use favoring agronomic development in private land use households. These response decisions promote dual land use system which perpetuates wide productivity gap between arable and non-arable lands in Baringo County.

Furthermore, government response decisions on land use changes affect household livelihood assets productivity negatively or positively. The negative coefficient on natural household livelihood assets productivity suggest government response

decisions enhances the degradation of forest and promote unsustainable production systems.

Similarly, negative coefficient on financial household livelihood assets productivity suggest that government response decisions suggest a weak financial support system for community/pastoral and agro-pastoral land use households to access financial resources. it implies that government response decision lacked of appropriate framework for local communities in the ASAL areas to access financial services. This could be explained by lack of collateral to access financial capital.

Further, the negative coefficient for social suggest that government response decisions do not support networks and connections, relations of trust and mutual support, formal and informal groups, common rules and sanctions, collective representation. It implies that government response decisions do not have mechanisms for participation in decision making and leadership process in community/pastoral and agro-pastoral land use households.

4.3 Discussion of the study results as per objectives

4.3.1 The Drivers of Land Use Changes

The study findings indicates that the key driver of land use changes in Baringo County is land use policy. This finding supports the theory that land use policy changes directly influence land use changes and the livelihood of the local communities in Baringo County. The study findings also agree with literature reviewed (Odhiambo et al.,2002, Suzane et al., 2009 & Thuo, 2013) that land use changes are driven by land use policy changes originally introduced by colonial

government, and later replicated by the subsequent political regimes after independence to date (2020) in Kenya.

The study findings demonstrates that land use changes in Baringo county takes historical dimension associated with land use policy changes, which influenced directly the livelihood of the local communities initiated during colonial era. The core objective of colonial land use policy was to control of land use in Kenya by weakening local communities communal land use system. It dismantled customary communal land use system and replaced it with a nationalized government controlled dual land use system, where the European settlers occupy the high rainfall and fertile areas, employing high productivity land use practices under private land tenure, whereas the local communities were restricted crowded in native reserves in the drier regions, and allowed to continue with traditional methods of production, which were characterized by low productivity under modified customary land use system.

In this respect, in Baringo County, historically, the local communities were group into three native reserves; Kamasia (now Tugen), East Suk (now Pokot) and Njemps (now Ilchamus). The local communities in these three grouping according to cultural background were moved toward the dry areas covering Baringo South and Tiaty constituencies to create room for European settlement on the highlands covering Eldama Ravine and Tugen hills (now Baringo Central and Parts of Baringo North). The study findings support the argument that the root cause of land use changes in Baringo county is driven by colonial land use policy which led to land use crisis in 1930s (Collin Maher report, 1935). The Consequences impacted negatively on the

livelihood of the local communities leading to unstable livelihoods and persistent land use conflicts to date.

However, the study results indicates that land use policy changes at independence in 1963, and subsequent years up to 2020, maintained the status quo that reinforced the dual land use system previously used by the colonial government, but now taking a different dimension pitting politically connected elites against the local communities. Land use changes during this period continued advancing economic disparities, and further bred a new paradigm shift of economic marginalization along ethnic lines and political domination among the local communities. The changes intended to remedy historical and social inequalities ended up reviewing in piecemeal the sector's laws dealing with specific and scattered land use changes. The analysis supports the theory that land use changes promoted wide productivity gap between arable land use under privately owned land, and non-arable land use under unregistered community land use.

In Baringo County, the study demonstrates that land use policy changes influence land use changes and livelihood of the local communities differently in the highlands, the marginal lands and the dry lands. In the highland region (Arable area), covering Edama Ravine and Baringo North constituencies where population density was high (129 persons/sq Km and 62 persons /sq km) for Eldama Ravine and Baringo North respectively, land use changes exerted pressure on the available land resource leading to subdivision of land into uneconomical small parcels. Similarly, in the marginal lands covering Baringo South (54 persons/sq km) and dry lands covering Tiaty (34 persons/sq km) constituencies, land use changes exerted pressure on existing fragile

marginal and arid land resulting to land degradation and rampant land use conflicts (see table 4.1). These land use changes cause continuous movement of people from one region to another seeking economic opportunities.

The study results indicates that land use changes pose a steep competition among the various land uses particularly in the marginal lands. This competition is mainly driven by the rapidly expanding crop farming into livestock rearing areas as well as the massive influx of migrants from both the highlands and from the dry areas into the marginal land (Baringo South) seeking economic opportunities. This situation has been aggravated by the invasion of the poisonous tree (p*rosopis julflora*), which rustle both the grazing and crop space. The competition is also amplified by often rising water level of lake Baringo causing floods (Ondiege,1996). The analysis supports the theory that the marginal lands particularly Baringo South was the focal point of land use conflicts in Baringo County.

Moreover, the results demonstrate that non arable was experiencing unclear land use rights, a salient feature that makes the area more susceptible to land grabbing and encroachment.

In this regard, the study results support the theory that poorly defined land use rights in the unregistered community land promotes invade and claim interest on land use as well as illegal manipulation of land ownership records. In Baringo County, this scenario is manifested through inter local communities land use conflicts which seems to be politically motivated setting the neighboring local communities as opponents. In

this light, two perspectives emerged; Pokot- Ilchamus and Tugen-Ilchamus land use conflicts.

The study findings indicates that Pokot- Ilchamus land use conflicts set Pokot and Ilchamus as rivals. The Pokot community invades and claims interest on Ilchamus community land through armed raids disguised as cattle rustling. They kill, maim victims, take away livestock and sustained terror by frequent armed attacks. This forces the Ilchamus community to run away from their land to safer areas in camps as internally displaced persons (IDPs) or seek refuge elsewhere within and without the county.

Immediately after the raid, the Pokot community quickly settled in the deserted land resource strangely through government support. Specifically, through the help of Tiaty Constituency Development Funds (CDF), the government builds schools, hospitals, and establishes administrative units deliberately overlapping the existing boundaries and changing the names of the places. These actions seem to be tactful politically motivated dispossession attempt setting Pokot and Ilchamus as rivals, thereby perpetuating inter-local communities over land use conflicts.

The study demonstrates a correlation between land use changes and political power dynamics in the county. Hence, the Ilchamus community being weak politically, they are overwhelmed, displaced and forced to migrate from their ancestral land elsewhere for safety. This situation not only complicates land use, but stifles livelihood options available to Ilchamus local community. In fact, it is almost impossible for the

Ilchamus community to engage on basic livelihood activities as well as planning for their future development.

On the other hand, the study results indicates that Tugen – Ilchamus land use conflicts set Tugen and Ilchamus as rivals. This land use conflict is a cold war actualized through illegal manipulation of land ownership records. The Tugens move in and settle in the Ilchamus community land as economic immigrants, and cunningly legalize their occupation through manipulation of existing land laws in their custody, taking advantage of their political correctness dating back to Moi's presidency and its legacy. The manipulation included securing grazing rights areas (Ol arabal), curving special administrative units (Endao, Arabal and Marigat locations), registered group ranches (Marigat, Bartum, Barkibi A and B) using the defunct group representative Act cap 287, and they also set up special projects and Wildlife conservancies (Chunei and Kibokush) within Ilchamus Community land.

Further, the Tugen , as economic immigrants from high rainfall areas, carry with them undesirable land use practices suited to arable areas such as cultivation of crops, and apply the same practices on dry the lowlands. These practices seem to be incompatible with the marginal and dry land conditions, hence accelerates environmental degradation on the fragile soils. In addition, land use changes in the have been aggravated by natural factors associated with climate change which are characterized by cycles of droughts (see appendix 1), massive environmental degradation (see appendix II), sporadic rising water level of Lake Baringo and invasion by noxious weed p*rosopis juliflora*, pose a great challenge to the livelihood of Ilchamus local community. These factors occasion among others, constrained

livelihood options for the local communities leading to unstable livelihood under uncertain conditions for which local community cannot plan their future development.

The analysis supports the theory that land use policy changes drives land use changes that fuel inter-communities' rivalry, and encourage unstable livelihood under uncertain conditions for which local community cannot plan for their future development particularly in the ASALs of the county.

4.3.2 The effects of Land Use Changes on Livelihood Assets Productivity

The results indicates that land use changes decrease human, physical, & financial livelihood assets productivity, and at the same increase natural and social livelihood assets productivity. This study demonstrates a direct relationship between land use changes and livelihood assets. Decrease in livelihood assets productivity means land use changes decrease livelihood outcomes for the local communities. Therefore, decrease in human, physical and financial livelihood assets productivity suggest deterioration in livelihood outcomes, depicting worrying concern on the sustainability of land use changes. The results agree with previous study findings by (Ochuka et al., 2019) on land use changes in Baringo county. On the other hand, study results indicate that land use changes increase natural and social livelihood assets productivity. This result suggests that land use changes improve natural environment and builds a strong social capital.

Further, the study findings demonstrate a wide productivity gap between the highland and ASAL areas within the county. The results conform to dual land use practice in the county. In this study, the highland covers Eldama Ravine and Baringo North constituencies comprise of arable land with the high rainfall and fertile areas,

employing high productivity land use practices under private land tenure, whereas the non-arable land covers Baringo South and Tiaty constituencies characterised by low rainfall, using traditional methods of production hence low productivity under communal land use system. The findings suggest that the gap is widening and seems to be chronic causing persistent land use conflicts in the county.

4.3.3 Effects of Land Use Policy decisions

The study results indicate that land use policy decision in Baringo county work in tandem with the national government policy framework. Furthermore, the results could be associated with political power relations among the local communities within the county, and it seems to be chronic and persistent. The study results support the previous studies (Huntington et al., 2011) that land use changes are associated with ideologies and dominance in access to, use, control and management. This perpetuates land use conflicts and make government response decision ineffective.

In line with Huntington argument, the county government response decisions were driven by self-gains and political decisions. The policy makers and technocrats in the county deliberately manipulate policies and legal instruments in favour of specific local community's sentiments and identities to secure economic and political advantage. The response decisions were characterized by uneven life chances, inequitable distribution of the resource, and unequal political decision-making power among the local communities. This created a sense of micro colonization, hatred, fear, and suspicion among the local communities leading to continuous land use conflicts (Kateiya et al., 2021).

This result explains the wave of land use conflicts being experienced in the county, which include crude attempts of historical assimilation and displacement processes through violent eviction of the minority local communities in out-of-date disguised practices such as cattle rustling. The perpetrators kill, maim, and traumatize the victims and subject them to persistent terror. They forcefully take away the victims' economic assets (livestock) and vandalize existing productive assets purposely to weaken the victim's economic and social base. The aggressing local community enjoys political power to move in and occupy the deserted land. Surprisingly, the government facilitates the aggressing community using administrative structures to create overlapping administrative units, changing the names of the places they invaded, support to establish their residence, schools, and other social amenities on the victims' ancestral land resource. The local communities are dispossessed of their ancestral land rights, and the heinous acts proliferating destitution and misery in the county (Kateiya et al. 2021).

Further, the consequences of land use changes have led to a situation where community professionals and elites migrate from land use conflicts for safety, and seek better economic options elsewhere leaving behind the poor and vulnerable in the land use conflict zone. This situation which could be referred as "brain drain" among other things, threatens the livelihood and the existence of the minority local indigenous Community in Baringo County. These results agree with past studies in the area (Anderson, 2008).

4.3.4 The responsiveness of government decisions on household livelihood assets productivity

The study results demonstrate a direct relationship between government intervention decisions and land use changes. The results indicates that government response

decisions is more likely to increased human, physical, natural, financial and social household livelihood assets productivity by 0.785, 0.043, 0.985, 0.063 and 0.896 times respectively, in both Community land (CLH) and agro-pastoral land (APH) households relative to private land household livelihood assets productivity. The analysis supports the theory that government's response decisions are still follow and reinforce the historical bias in land use inherited from colonial era.

In this respect, the study results support the theory that government response decision focus on the private land use with scant attention to agro-pastoral areas (marginal areas) and wholly ignored Arid lands households. This result suggests that government decisions were oriented toward increasing household livelihood assets productivity in the highlands with minimal intervention support to the ASALs (dry and marginal areas).

The results confirms that government response decisions were skewed to marshal economic gains for individual household livelihood assets productivity in the highlands covering Eldama Ravine and Parts of Baringo North which were largely privately. In contrast, community land and agro-pastoral households, continued operate under customary arrangements left at the whims of collective communal land use characterized by low productivity and rampant land use conflicts. This situation is seen to promote high productivity in the highlands and low productivity in the ASALs particularly in Baringo South and Tiaty areas. Therefore, government response decision continues to impoverish the local communities in the ASAL parts of the county under the current (2021) dispensation.

CHAPTER FIVE

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

5.0 Introduction

The chapter describes the study's summary, conclusion, and recommendations per objective suggestions for further research.

5.1 Summary of Findings

This section gives a summary of the findings and results per objective of the study;

5.1.1 The Drivers of Land use Changes

The key driver of land use changes in Baringo County is land use policy traced from colonial era through the subsequent governments after independence to 2020. The colonial government changed land use from communal territorial niches by local communities to a nationalized system control by government and administered through its governance structure that trickle down from national to the local level, covering the entire country. The colonial government adopted a dual land use system bias for development of arable (high rainfall area) designated for European settlers and non-arable (low rainfall areas) ear marked for local community's reserves. These areas (arable and non-arable) operated under different technologies and land tenure regimes. In arable areas, the European settlers use modern technology suited to developed economies with secure land tenure promoting high land productivity for individual gains, whereas in non-arable areas, local communities use traditional production methods for collective community gains. This scenario led a wide productivity gap between the arable and non-arable areas breeding perpetual land use conflicts pitting against local communities and European settlers during colonial era, and fueling inter-local communities' rivalry in subsequent years after independence to date (2020).

As a result of these changes, coupled with increasing population density, changing ecological conditions due to climate change, changing land use practice and rampant land conflicts, land use changes disorganize local communities land use and social system, broke down the traditional grazing and cropping patterns particularly in dry areas of the county including Baringo South and Tiaty. These changes cultivated unsustainable livelihoods for the local communities in Baringo County. Further, the study findings revealed that land use changes are historical and have originated from colonial era dual land use system that stems from national to the local level (Baringo County). This scenario has negatively affected the livelihood of the local communities countrywide, since then, land use changes have continued to promote regional economic imbalance between the arable and non-arable lands throughout Kenya particularly in Baringo County.

5.1.2 The Effects of Land Use Changes

The regression results indicated that livelihood assets productivities varied from one household to another depending on the ecological zone and the type of land use. Thus, land use changes decreased by 56.1% at 1% level of significance human livelihood assets productivity. This result reflects deterioration in livelihood assets productivity and decline in individual household's production. in different zones within the County. In the dry and marginal lands, which is largely communal, covering Baringo South and Tiaty. This means the productivity of human livelihood assets for individual households decreases education, the skills, experiential knowledge, and ability to labor, and health to pursue livelihood strategies necessary to achieve livelihood objectives. The resultant consequence is perpetual poverty, escalating resource conflicts, degradation of the environment, and chronic food shortages amongst the local communities. Whereas in the highlands, which is largely private,

covering Baringo North and Eldama Ravine. This means the productivity of human livelihood assets for individual households increases the skills, knowledge, and ability to labor, and health to pursue livelihood strategies necessary to achieve livelihood objectives. The resultant consequence is sustainable livelihoods. These results imply that the dynamics of land use changes support private land in the current dispensation. This result agrees with the hypothesis expected negative sign.

Natural livelihood assets productivity by increased by 54.3 % at 5 % level of significance, and it reflects an overall increase in individual household's livelihood assets productivity in different zones within the County. In the dry and marginal lands, which are largely communal, covering Baringo South and Tiaty, the productivity of natural livelihood assets for individual households increases the capital flow and services used to derive livelihood. Most of the land had been left idle due to land use conflicts. This means regeneration of bushes and trees in the abandon land. The resultant consequence enhanced generation of bushes implying improved recycling of nutrients. Whereas, in the highlands, which is largely private land, covering Baringo North and Eldama Ravine, the productivity of natural livelihood assets for individual households increased depletion of forest cover implying environmental degradation.

Physical livelihood assets productivity decreased by 53.4% at 10% level of significance, and it reflects an overall decrease in individual household's livelihood assets productivity in different zones within the County. In the lowlands, which is largely communal covering Baringo South and Tiaty, the productivity of physical livelihood assets for individual households decrease infrastructure, producer goods, tools and equipment, means of transport, shelter and buildings, water supply, and sanitation, energy, access to information needed to support livelihood. The resultant

consequence implies deterioration of local communities' livelihood. Whereas, in the highlands, which is largely private covering Baringo North and Eldama Ravine, the productivity of natural livelihood assets for individual households increase infrastructure, producer goods, tools and equipment, means of transport, shelter and buildings, water supply and sanitation, energy, access to information needed to support livelihood. The resultant consequence is improved of local communities' livelihood.

Financial livelihood assets productivity decreased by 65.6% at 5% level of significance, and it reflects an overall decrease in individual household's livelihood assets productivity in different zones within the County. In the lowlands, which is largely communal covering Baringo South and Tiaty, the productivity of physical livelihood assets for individual households decreases financial resources such as savings (cash, bank deposits), liquid assets such as livestock, credit providing institutions, and inflows (pensions, transfer payments, remittance) that local communities use to achieve their livelihood objectives. The resultant consequence implies diminishing financial resources to support the livelihood of the local communities. Whereas, in the highlands, which is largely private covering Baringo North and Eldama Ravine, the productivity of natural livelihood assets for individual households increases financial resources such as savings (cash, bank deposits), liquid assets such as livestock, credit providing institutions, and inflows (pensions, transfer payments, remittance) that local communities use to achieve their livelihood objectives. The resultant consequence improves financial resources to support livelihood objectives. This could be associated with the security of tenure.

Social livelihood assets productivity by 61.3% at 1% level of significance, and it reflects an overall increase in individual household's livelihood assets in different zones within the County. In the lowlands, which is largely communal, covering Baringo South and Tiaty, the productivity of social livelihood assets for individual households decreases social resources which local communities draw in pursuit of their livelihood, social networks and connectedness, membership in groups, the relationship of trust, reciprocity and exchanges. This means that social livelihood assets don't facilitate cooperation, have no influence on transaction costs, and may not provide the basis for informal safety nets and strategies chosen to achieve livelihoods outcomes. The resultant consequence implies disorganized social relations, and weak informal safety nets hence propagate unsustainable livelihood. Whereas, in the highlands, which is largely private covering Baringo North and Eldama Ravine, the productivity of social livelihood assets for individual households increases social resources which local communities draw in pursuit of their livelihood, social networks and connectedness, membership in groups, the relationship of trust, reciprocity and exchanges. This means the social livelihood assets productivity facilitates cooperation, reduces transaction costs and provides the basis for informal safety nets and strategies chosen to achieve livelihoods outcomes. Therefore, the resultant consequence implies sustainable livelihoods.

Regional variation; the study covered Baringo South (BS), Tiaty (T), Baringo North (BN), and Eldama Ravine (ER) regions within Baringo County. These regions were captured as dummies in the Cobb-Douglas model. The coefficients for all regions were significant at different levels. The coefficients signs were different for different regions. In this study, the sign of relevant coefficient, either positive or negative,

indicates the direction of land use change. In the lowlands covering Baringo South and Tiaty, the coefficients were negative at 10% and 5% significance levels, respectively, and both sites had negative signs. This suggests that the productivity of livelihood assets for individual households in the lowland decrease which implies that land use changes reduce the livelihood of the local communities. Whereas, the highlands covering Baringo North and Eldama Ravine, the coefficients were positive at 1% and 10 % level of significance, respectively, and both sites had positive signs. This suggests that the productivity of livelihood assets for individual households in the highlands increase

5.1.3 The Effects of Land Use Policy Decisions

The study results indicated that the effects of land use policy decisions decreased human, natural, financial and social and increase physical in community land household. This means that policy do not take into consideration the local community's knowledge and skills. It enhances degradation of forests, accelerate invasion of invasive alien species and restrict extensive grazing. Further, deterioration of saving, diminishing value of livestock and limited credit sources and discourages social capital development. The results affirms that policy makers and experts ignore experiential knowledge of the local communities hence develop wrong policies as well as interventions strategies based on their mindset.

Whereas, in the agro-pastoral areas, land use policy decreases human, natural & financial and increase physical and social household livelihood assets productivity. This means policy ignores local communities' experiential knowledge and skills. The policy promotes degradation of forest cover, accelerate invasion of invasive alien species, restrict extensive livestock grazing and enhance the growing of fodder. The policy has low likelihood for opportunities for saving, investment in livestock,

improvement in storage and limits credit sources. On the other hand, land use policy increases physical and encourage social capital development.

In general, the results showed that effects of land use policy are more or less the same for community and marginal area. The policy have maintained the same policy orientation that promotes conflicts increased, and the livelihood of the local communities deteriorating at an alarming rate in Baringo County.

5.1.4 The Government Response Decisions

The study results indicated that government response decision favoured private land household's livelihood assets productivity relative to community land and agro-pastoral household's livelihood assets productivities. It showed that government response decisions is more likely to increased human, physical, natural, financial and social household livelihood assets productivity by 0.785, 0.043, 0.985, 0.063 and 0.896 times in both Community land (CLH) and agro-pastoral land (APH) households respectively relative to private land household livelihood assets productivity. These results support (Migot-Adhola's, 1981; Thurston, 1987; Thuo, 2013; Odote, 2013; Khameri-Mbote, 2016) argument that ASAL areas, largely under communal land use, have continuously witnessed neglect in government decisions during the colonial era spilling over to the post-independence governments. However, the gap has been widening despite colonial and successive governments attempt to resolve the land use changes problems but failed to get a lasting solution.

Indeed, historically, literature reviewed show that colonial government have attempted several farming approaches intended to resolve land use changes problems between arable and non-arable productivity gap; by restoring communal land use practices, introducing cooperative or group farming, applying lessons learnt from other areas, re-introducing the old clan system of land use, reviving mixed

smallholdings farming, introducing the concept of farm planning, to develop the concept of ecological zones and eventually comprehensive plan intended to intensify land use in the local community areas. At independence in 1963 and subsequent years up to 2010, the independent government to inherit the European farms, redistribute land, settle landless, and re-settling the displaced local communities. The decision retained and reinforced colonial land use policies, and the objectives were never realized.

At household level, the results indicated that government response decisions were more likely to affect negatively human, natural, financial and social household livelihood assets productivity by 0.025, 0.052, 0.055 and 0.074 times respectively in the community land. In the agro-pastoral land, results indicated that government response decision were more likely to affect negatively human, natural and financial household livelihood assets productivity by 0.046, 0.065 and 0.034 times. These results indicate that land use changes continue to deteriorate the livelihood of the local communities at household level in Baringo County despite post-independent Kenyan government land reform agenda gear to address land use changes problems. To undertake several studies and appoints commissions of inquiry, including the Ndungu and Njojo commissions. The studies and appointed commissions of inquiries recommended a review of outdated policies, institutions, and processes. This process was denoted as the "National Land Reform Agenda".

Nevertheless, critics on national land reform agenda, argued that national land reforms agenda followed colonial philosophy and driven by board room decisions only on paper but not applicable on the ground. This argument asserts that government response decisions lacked the local communities' knowledge inputs. Therefore, government response decision organs, policy makers and experts find

themselves in an ethical quagmire, torn between the perceived needs of the local communities to honestly respond to land use changes problems or wishful thinking to raise the chance of political and donor support but essentially unrealistic.

However, the constitution of Kenya 2010 made public participation constitutionally mandatory for all public policy processes. These were ideally to ensure local communities' livelihood concerns were taken into account. She argued that the local communities could not engage, but the platform offered paved the way for rubber stamping that local communities have participated in. In this study, the results support Kameri- Mbote argument that the task of experts, decision-makers, and decision-making bodies was routine work. Given these findings, the colonial government decisions in response to land productivity problems became the prime driver of the dynamics of land use changes. Luedeling et al. (2015) point out that many government decisions in response to household livelihood assets the productivity of household livelihood assets and resource management policies are implemented in risk environment due to extreme weather events, resource conflicts, local communities' preferences, and political interference. However, all these efforts did not improve household livelihood assets productivity for the local communities.

5.2 Conclusion

The study aimed to understand the dynamics of land use changes on the livelihood of the local communities in Baringo County. From the study findings and econometric models results, the study came up with a number of conclusions per objective.

5.2.1 The drivers of land use changes

The study concluded that the key driver of land use changes in Baringo County is land use policy. Land use policy influenced land use and affect the livelihood of the local communities negatively or positively. The effects of land use changes trails back

from colonial era through the subsequent governments after independence to date (2020). The changes disorganize local communities' social system, broke down traditional grazing and cropping patterns, depleted soils fertility & degraded the environment.

The policy changes have occasioned irreversible changes that affected local communities differently in different agro-climatic zones within the county. The changes are directly related to the population density, ecological conditions, land use practices, the age of household head and the level of capital (human, physical, financial, social and natural). As the population density increases, land size decreases and land use pressure builds up culminating to land use changes. In the highlands, covering Edama Ravine and higher part of Baringo North constituencies, land use changes exert pressure on the available land resource leading to subdivision of land into small parcels and intensify land use. whereas, in the lowlands covering Tiaty, Baringo South and the lower part of North Baringo constituencies, land use changes exert pressure on existing fragile marginal and arid land resulting to land degradation and rampant land use conflicts.

5.2.2 The effects of land use changes

The study concluded that the effects of land use changes in Baringo County have both positive and negative effects on the livelihood of the local communities. The effects are different for different regions in the county. In the dry areas (Tiaty) where the main livelihood activity was extensive livestock keeping under pastoralism, and in the marginal areas (Baringo South) the main livelihood activities were both growing crops and livestock keeping, land use changes affect negatively livelihood assets productivity and promote fatal land use conflicts. In the highlands covering Eldama Ravine and high-altitude elevation in Baringo North constituencies, the main

livelihood activity was intensive crop farming, land use changes affected positively the livelihood of the local communities. This result confirms disparity in economic development between regions within the county. This disparity was largely attributed to the effects of the dual land use policy framework for arable and non-arable areas inherited from colonial era.

Further, the study concluded that the effects of land use changes varied depending on land tenure regimes, in the highlands covering Baringo North and Eldama Ravine constituencies, land was registered under private land tenure with title deeds. Land use changes increased livelihood assets productivity by 5.1 % at 1% level of significance in Baringo North constituency and increased by 139.3 % at 10 % level of significance in Eldama Ravine constituency. Therefore, land use changes increased livelihood assets productivity promoting high productivity and sustainable livelihood of the local communities in arable area of the county. Whereas, in the lowlands mainly the non-arable arid and semi-arid lands (ASALs), the land use in that ASALs was largely under unregistered community land use with unclear land use rights. Land use changes in these ASALs covering Baringo South mainly practicing agro-pastoral livelihood activities decrease livelihood assets productivity by 9 % at 10% level of significance, and in the Tiaty constituency largely practicing pastoralism livelihood activities decrease livelihood assets productivity by 282.4 % at 5% level of significance. Therefore, land use changes decrease in livelihood asset productivity in agro pastoral and community land use.

This conclusion could be explained by the rampant land use conflicts linked to unclear land use rights. Unclear land use rights in these areas promoted invade and claim interest as well as unscrupulous manipulation of legal system (ownership of land, securing grazing rights, changing names of places, shifting administrative

boundaries and establishing conservancies among other malpractices). Currently the county has been witnessing land use conflicts which was manifested in form of cattle rustling. These conflicts disrupted livelihood activities and suppress individual interest thereby lowering livelihood assets productivity, and in the worst-case scenario, land use changes as a result of land use conflicts have hindered local communities from engaging in livelihood activities. This situation led to a wide productivity gap between lowlands (dry and marginal areas) largely under communal land use, and highlands (high rainfall areas) mainly under private land use. Therefore, the study concluded that land use changes decreased livelihood assets productivity in communal land, and increased in private land use.

Further, land use changes widen the productivity gap between private and communal land use, and situation seems to be chronic and not merely transitional. Moreover, in the dry and marginal areas, the local communities were stack on traditional production methods, and land remains the primary source of livelihood and prestige. It was noted that local communities still hold on customary land use arrangement based on ethnic territorial niches, and each local community protects its jurisdiction. This aspect promoted inter-community rivalry culminating in land use conflicts which stifled the livelihood options for the local communities.

The study concluded that in the arid and semi-arid areas covering Tiaty and Baringo South constituencies, land use changes triggered unique inter-community rivalry that entails invade and claiming interest on communal territorial niches. This is seen as politically motivated seizure of land resources from one ethnic community by others, occasioning frequent and fatal inter-ethnic land resource conflicts. The situation was chronic with consequences that have led to forced eviction, continued deterioration of livelihood assets productivity, increasing environmental degradation, and the

emergence of different land use patterns culminating to widespread poverty prevalent in the area.

The study concluded that effects of land use changes have led to "brain drain" particularly in Baringo South. The well-educated professionals and elites migrated to other areas within and without the county leaving behind the poor and vulnerable population.

5.2.3 The Effects of Land Use Policy Decisions

The study concluded that government land use policy decision and interventions followed the colonial policy templates. The effects of land use policy decrease human, natural, financial and social household livelihood assets productivity in the dry and marginal areas under communal land use compared with private land use. This confirms that policy framework was ineffective in addressing household livelihood assets productivity of the local communities. The policies orientation still based on colonial mindset with the implicit notion that traditional customs and beliefs in land use is not the most efficient land use in the Baringo County. However, this conclusion needs a critical look in view of devising innovative approaches on communal land use taking into account development in technology and emerging global trends. Communal land use may no longer be tenable practices.

5.2.4 The Government Response Decisions

The study concluded that government response decisions favor private land use changes compared with ASALs covering community land (arid lands) and marginal land (semi-arid lands). This means that land use changes maintained the same policy orientation from colonial era to date (2020).

5.3 Specific Contribution of the Study Results

The Novelty of this study is the method used to analyze the findings and results. Firstly, the study combined qualitative and quantitative methods to analyze land use changes on the livelihood of the local communities. This approach is different from previous studies which focus largely on livelihood diversification strategies without understanding the drivers, effects and government response decision on the resultant land use changes. This study appropriately used qualitative secondary data to establish the drivers of land use changes, and at the same time, used primary data, and quantitatively applied econometric models to determine the effects of land use changes and government response decision on livelihood of the local communities. The approach yielded robust findings and results that reflect the actual dynamics of land use changes and its effects on the livelihood of the local communities in Baringo County.

Secondly, the current study results are useful and had provided vital information that informs the development of the County Integrated Development Plan (CIDP). The study findings revealed need for recognition, protection and registering all community land under the provision of community land Act 2016 as priority to be incorporated in the CIDP. This will secure land use rights and promote sustainable livelihood for the local communities.

Thirdly, beside the merits of the methodology employed, the study results are unique in the sense that most studies focused on arable areas and give little attention to ASAL area which constitute approximately 70 % of the total land area in Baringo County. Most of those studies recommendations focus on livelihood strategies

diversification in arable areas in the county, but may not be applicable to ASALs. The current study contributes to the body of knowledge, and reflects on the livelihood of the local communities in Baringo County. Comparing land use changes in dry and marginal areas (ASAL); a case of Baringo South and Tiaty constituencies which consider to be non-arable with arable areas covering Eldama Ravine and part of Baringo North. The study clearly identified land use policy as key driver, and root cause of land use changes. The study comprehensively quantified the effects of land use changes on livelihood assets productivity, determined the effects of land use policy and evaluated the responsiveness of government decisions on household livelihood assets productivity.

Fourth, the current study results are complete, and will go a long way in informing the development of Baringo County Integrated Development Plan (CIDP). Adoption of this study recommendations in the CIDP will ensure recognition, protection and registration of community land use rights for local communities hence ensure sustainable livelihoods and end perpetual land use conflicts.

Fifth, Baringo County being one of the ASAL County in Kenya, this study approach can be replicated to cover the entire ASAL counties in Kenya presently facing similar turbulent land use conflicts including Marsabit, Wajir, Mandera, Garissa, Turkana, Samburu, West Pokot, Elgeyo-Marakwet, Isiolo and Laikipia among others.

Six, this study results will open new areas of research for both academic and policy making processes. It is imperative to find the root cause of persistent land use conflicts and at the same time scrutinize land user rights in ASAL in Baringo County.

Lastly, the study findings and results will contribute to the body of knowledge through publications of articles in refereed journals, sharing in both local and International Conferences, and a copy of the complete thesis will be available in Maasai Mara University Library and repository.

5.4 Recommendation and Policy Implications

From the study findings and conclusions, the study proposed several recommendations focusing on theoretical, practical and policy implications as well as suggesting areas of further research.

5.4.1 Theoretical Recommendations

The study findings and results have contributed more knowledge on the dynamics of land use changes on the livelihood of the local communities and other variables that influence the land use in the Baringo County. The study results support the application of production theory aligned to the sustainable livelihood framework (SLF) theory with related concepts and other theories such as the tragedy of commons, the dualistic development thesis, the government intervention theory, the decision theory and the probability choice theory in explaining land use changes.

First, the study recommends the approach to be emulated by other academic researchers, since it provides a logical sequence of processes from production at household level to the output (livelihood outcomes) capturing the influence of institutions, processes and policies. The approach provides a clear entry points and inherent flexibility allowing the use of quantitative and qualitative analysis as well as robust interpretation of results.

Second, the approach needs to be expanded to cover all the arid and semi-arid lands in (ASALs) in Kenya which constitutes 68% of the total land mass, and facing similar land use conflicts.

5.4.2 Practice Recommendations

The study recommends government to sensitize and mobilize local communities residing on unregistered Community Land to register their land claims within the provisions of Community Land Act, 2016. The study noted that unclear land use rights in the unregistered community particularly in Baringo South, specifically in Ilchamus community land encourage malpractices deliberately proliferated by the populace local communities against minority within the county; The Pokot from Tiaty constituency invade and claim interest through disguised cattle rustling, while the Tugen local community encroach through illegal manipulation of land ownership records in their custody. The legal manipulations include seizure of grazing rights, registering group ranches, establishing wildlife conservancies, overlapping/curving administrative units, altering boundaries and setting up special projects.

These salient issues promote inter-community rivalry, unstable and uncertain livelihoods in the county as well as threatening dispossession of minority local communities from their ancestral land. It is crucial to prioritize registration of all unregistered community land in the County Integrate Development Plan. This recommendation will go a long way toward recognition, protection and securing land use rights in the county. This, therefore, eliminate/reduce land use conflicts and guarantee sustainable livelihood for the communities.

5.4.3 Policy Recommendations and implications

The study recommends change of dual policy orientation in Kenya, and put in place a uniform land use policy that recognize, protect and register all unregistered

community land in Baringo County as enshrined in the constitution of Kenya 2010. There is need for the Baringo County to prioritize land use changes, and put in place appropriate measures in the County Integrated Development Plan (CIDP) in order to harmonize and minimize land use conflicts particularly in the dry and marginal areas (ASALs).

5.5 Further Research

The study recommends in-depth research on the persistent land use conflicts and examine land use rights in the Baringo County**.**

REFERENCES

Ahmed, A. G. M. (2001). *Livelihood and resource competition, Sudan. Mohamed Salih, Dietz and Mohamed Ahmed (eds.) African Pastoralism: Conflicts, Institutions and Government. Pluto Press, London*, 172-193.

Ahmed, I. and Lipton, M., (1997), *Impact of structural adjustment on sustainable rural livelihoods: a review of the literature*, IDS Working Paper 62, Brighton: IDS.

Alimaev, I. I., & Behnke Jr, R. H. (2008). Ideology, land tenure and livestock mobility in Kazakhstan. In *Fragmentation in Semi-Arid and Arid Landscapes* (pp. 151-178). Springer, Dordrecht.

Anand P. (1993). Foundations of rational choice under risk. *Journal of Environmental Economics and Management*

Anderson, D., and E .Lochery. (2008). "Violence and Exodus in Kenya's Rift Valley, 2008: Predictable and Preventable? *Journal of Eastern African studies*.

Andre, C., and J.P. Platteau. (1998). Land relations under unbearable stress: Rwanda caught in the Malthusian trap, *Journal of Economic Behavior and Organization*, vol. 34 (1): 1-47.

Armitage, D., Berkes, F., & Doubleday, N. (Eds.). (2007). *Adaptive Co-Management: Collaboration, Learning, and Multi-level Governance*. Vancouver: University of British Columbia Press

Atwood, D.A. (1991).Land registration in Africa: The impact on agricultural production, *World Development*, 18 (5): 659-71.

Aspinall. J. and Hill, M. J. (2008). *Land use change: Science Policy and Management*, New York; CRC Press

Baulch, R., (1996), *Neglected trade-offs in poverty measurement*, IDS Bulletin, 27: 36-43

Behnassi, M., & Yaya, S. (2011). Land resource governance from a sustainability and rural development perspective. In *Sustainable agricultural development* (pp. 3-23). Springer, Dordrecht.

Ben-Akiva M.E. & Lerman S.R. (1985). *Discrete choice analysis: theory and application to travel Demand*- MIT press.

Bennet, C.N. (1973). *Research Methods in Universities*. Route/edge. London.

Berkes, F., George, P. J., & Preston, R. J. (1991). The evolution of theory and practice of the joint administration of living resources. *Alternatives*, 2(18), 12–18

Bezemer D J., Lerman, Z (2002). *Rural Livelihoods in Armenia*. The Centre for Agricultural Economic Research, the Department of Agricultural Economics and Management Discussion Paper No. 4.03.

Bloom, L.H. (1985). *Psychological testing and assessmen*t. Boston: Mc Graw Hill

Bloomberg, M., Morgenroth, J., Rosser, B. J., Page, M. J., Harrison, D., & Jones, H. (2012). 5 Erosion, land use, erosion control, & land tenure in the Waiapu catchment. *Waiapu River Catchment Study*, 173.

Boli, R. (2005). *Livelihood assets of rural Kenyans. Senior Seminar in International Development Studies* (IDS) Final Paper. Retrieved 13/10/2012 from http://schant.socialdev.net/data/FAO/IDS_2006_boli.pdf

Borg, W.R. & Gall, M.D (1989). Ed *Research. An introduction* (4th Ed). New York.

Boserup, E. (1965). *The Conditions of Agricultural Growth: The Economics of Agrarian Change under Population Pressure,* London: Earthscan Publications.

Bruce, J. W. (1986). *Land tenure issues in project design and strategies for agricultural development in sub-Saharan Africa* (No. 1804-2019-3070).

Cahn, M. (2003). *Sustainable livelihoods approach: Concept and practice. In D. Story, J. Overton & B. Nowak (Eds.), Contesting development: Pathways to better practice. Proceedings of the third biennial conference* (pp. 284-288). Aotearoa/New Zealand Development Studies Network (Dev-Net)

Cahn, M. (2006). *Sustainable rural livelihoods, micro-enterprises and culture in the Pacific Islands: Case studies from Samoa.* (Unpublished doctoral thesis), Massey University, Palmerston North, New Zealand

Cahn, M. L., Conner, M. M., Schmitz, O. J., Stephenson, T. R., Wehausen, J. D., & Johnson, H. E. (2011). Disease, population viability, and recovery of endangered Sierra Nevada bighorn sheep. *The Journal of Wildlife Management*, *75*(8), 1753-1766.

Cameron and Trivedi, (2009). *Microeconometrics Using Stata*. Stata Press. *Texas USA*.

Carney, D, Drinkwater, M, Rusinow, T, Neefjes, K, Wanmali, S & Singh, N. 1999. *Livelihoods approach compared: A brief comparison of the livelihoods approaches of the UK Department for International Development (DFID), CARE, Oxfam and the United Nations Development Programme (UNDP), November 1999.* London: Department for International Development.

Carney, D. (1998). *Implementing the sustainable rural livelihoods approach. Paper presented to the DfID Natural Resource Advisers' Conference*. London: Department for International Development.

Carney, D. (1999). *Livelihood approaches compared.* London: DFID.

Carney, D. (1999). *Sustainable Livelihoods: What Contributions Can We Make*? London: Department of International Development.

Carswell, G., (1997), *Agricultural intensification and sustainable rural livelihoods: a think piece*', IDS Working Paper 64, Brighton: IDS.

Chakrabartty, S. N. (2018). Better composite environmental performance index. *Interdisciplinary Environmental Review*, *19*(2), 139-152.

Chambers, R & Conway G. 1992. *Sustainable rural livelihoods: Practical concepts for the 21st century. Brighton:* Institute of Development Studies, University of Sussex. (IDS discussion paper; no. 296.).

Chambers, R. (1983). *Rural Development: Putting the Last First.* Harlow: Longman Scientific and Technical, Essex.

Chambers, R. (1999). *Relaxed and participatory appraisal: Notes on practical approaches and methods*. Brighton: Institute of Development Studies, University of Sussex.

Cheche, K. (1982). *Independent Kenya.* Nairobi: Zed Press.

Cherni, J.A., Hill, Y. (2001). Hill energy and policy providing for sustainable Rural livelihoods in remote locations: the case of Cuba *J. Geoforum,* 40 (4).

Constitution of Kenya (2010) the Constitution of Kenya (2010). *Retrieved from*.

Cotula, L., C. Toulmin, and C. Hesse. (2004). *Land Tenure and Administration in Africa: Lessons of Experience and Emerging Issues,* London: International Institute for Environment and Development

Cox, M., Arnold, G., & Villamayor Tomás , S. (2010). A review of the design principles for community-based natural resources management, *Ecology and Society*, *15(4)*, *38.*

Crosbie, W. (2005). *The Essential Research Skills.* Suva, Fiji: Amokura Publications.

Daudeline, J. 2002. *Land as a source of conflict and in the post-conflict settlement, World Bank Regional Workshop on Land Issues in Africa and the Middle East*, April 29-May 2, 2002, Kampala, Uganda.

Davis, C.K. (1997). *How to design and evaluate research.* New York: Mc Graw Hill

Davis, B., winters, P., Carletto, G., Covarrubias, K., Quiñones, E. J., Zezza, A., & DiGiuseppe, S. (2010). A cross-country comparison of rural income-generating activities. *World Development*, *38*(1), 48-63.

Debertin D.L. (1986). *Agricultural Production Economics*, Canada: Collier Mac Millan

Deininger, K. (2003). Land Policies for Growth and Poverty Reduction: A World Bank Policy Research Report, Oxford: *World Bank*

Desai, K. (2002). Land Reforms through People's Movements. *Land Reforms in India: Issues of Equity in Rural Madhya Pradesh*.

Dharmasiri, L.M. (2009). *Applicability of Cobb-Douglas production function in measuring the spatial variation of agricultural productivity in Sri Lanka*, University of Peradeniya Press.

DFID (1999) *Department for International Development). Sustainable livelihoods guidance sheets.* Available from the livelihoods learning platform. www.livelihoods.org.

DFID (2000). (Department for International Development) Sustainable Rural Livelihoods Guidance Sheet, *London,* UK.

DFID (2001). Sustainable Livelihoods Guidance Sheets: Retrieved May 12, 2006, from http:/www.livelihoods.org/info/info_guidancesheets.html

Dorward, A. (2009). Integrating contested aspirations processes and policy: development as hanging in, stepping up as stepping out. *Journal development policy revision* 27 (2), 131-146

Donward, A., Anderson, S., Bernal Y.N et al. (2009). Hanging in, stepping up and stepping out: Livelihood aspirations and strategies of the poor. *Journal of Development Practice*, 19 (2) 240-247

Drimane, S. (2002). *HIV/AIDS and Land: Case Studies from Kenya, Lesotho, and South Africa, report, Human Science Research Council*, Pretoria, South Africa.

Ellis, F. (2000). *Rural Livelihoods and Diversity in Developing Countries*. New York: Oxford University Press.

Ellis, F., Bahiigwa, G. (2003). Livelihood and Rural Poverty Reduction in Uganda, *J. World Deve*. 31 (6), 997-1013.

Fang, Y., Fan, J., Shen, M., Song, M., (2014). Sensitivity of Livelihood Strategy to Livelihood Capital in Mountain Area: Empirical Analysis based on Different Settlement in the Upper Reaches of the Minjiang River, China. *Ecol Indic* 38, 225-235.

Farrington J, Ramasut T, Walker J (2002). *Sustainable Livelihoods Approaches in Urban Areas: General Lessons, with Illustrations from Indian Cases*, ODI, London, UK.

Feldman, S.D., McClain and Palmer, K. (1976). Sources of Structural Change in the USA, 1963-1978. An Input- Output Approach. *The Review of Economics and Statistics,* 69(3) 503-510.

Fred-Mensah, B.K. (1999). Capturing ambiguities: communal conflict management alternative in Ghana, *World Development*, 27 (6), 951-965.

Hardin, G. (2016). The tragedy of the commons. *Food Ethics*, 54.

Goes, J.,& Marylin, K.S. (2013). Dissertation and Scholarly Research; Recipes for Success. Seattle, WA: Dessertation Success LLC.

GoK, (1965) African *socialism and its application to planning in Kenya* (No. 10). Government Printer.

GOK, (2016). *National Spatial Plan 2015-2045, pp 3 historical background pre-independence planning Swynnerton plan of 1954 failures.* Government printer

GOK, (2013). Baringo County CIDP, 2018-2022. *County integrated development plan*. County Government of Kenya

GoK. (1954), *A Plan to intensify agriculture in Kenya*. Government Printer, Nairobi, 1954.

Gosh, A. (1958). Input-output Approach in an Allocation System. *Economical* 25(97) 58-67.

Gujarati, (1992), Gujarati, J. (2013). An "inverse" relationship between mathematics identities and classroom practices among early-career elementary teachers: The impact of accountability. *The Journal of Mathematical Behavior*, *32*(3), 633-648.

Gujarati, D., and Porter, D.C. (2009). *Basic Econometric.* 5th Edition, Mc Graw- Hill.

Gujarati, (1992), Gujarati, J. (2013). An "inverse" relationship between mathematics identities and classroom practices among early-career elementary teachers: The impact of accountability. *The Journal of Mathematical Behavior*, *32*(3), 633-648.

Guo, J. and Planting, M.A. (2000). *Using Input-output Analysis to Measure US Economic Structural Changes over 24 years.* Bureau of Economic Analysis working paper 1.

Hahn, M.B., Riederer, A.M., Foster, S.O. (2009). The Livelihood Vulnerability Index: Pragmatic Approach to assessing risks from climate variability and change. A case of study in Mozambique. *J Global Environ. Change,* 19 (1) 74-88

Heyer, J. (1981). *Rural Development in Tropical Afric*a. London: Macmillan.

Huntington, H. P., Gearheard, S., Mahoney, A. R., & Salomon, A. K. (2011). Integrating traditional and scientific knowledge through collaborative natural science field research: Identifying elements for success. The *Arctic*, 437-445.

Issac & Michael (1981). *Education Research. An Introduction* (4th Ed). New York. Longman Publishers.

Jayne, T.S., T. Yamano, M.T. Weber, D. Tschirley, R. Benfica, A. Chapoto, and B. Zulu. (2003). Smallholder income and land distribution in Africa: implications for poverty reduction strategies, *Food Policy,* 28, 253-275.

Kaguru, J. M. (2018). *Towards Effective Commissions of Inquiry in Kenya: a Review of the Commissions of Inquiry Act in Light of the Constitution of Kenya 2010 University of Nairobi* (Doctoral dissertation, University of Nairobi).

Kameri-Mbote, P. (2016). *Kenya Land Governance Assessment Report:* World Bank Group

Kanji N, MacGregor, J. Tacoli, C., (2005). *Understanding market-based livelihoods in a globalizing world: combining approaches and methods*. International Institute for Environment and Development (IIED).

Khamisi, J. (2018). *Kenya: Looters and Grabbers: 54 years of corruption and plunder by the elite, 1963-2017*. Plano, Texas, USA: Jodey Book Publishers

Kimberlin, C. L., & Winterstein, A. G. (2008). Validity and reliability of measurement instruments used in research. *American journal of health-system pharmacy*, *65*(23), 2276-2284.

Kothari, C.K. (2014). *Research methods and Techniques*. New Delhi: New age International (P) Ltd.

Leo, C. (1981). Who Benefited from the Million-Acre Scheme? Towards a Class Analysis of Kenya's Transition to Independence. *Canadian Journal of African Studies,* 15(2).

Leo, C. (1984). *Land and Class in Kenya*. Toronto: University of Toronto Press.

Leontief, W. (1936). *Quantitative Input-Output Analysis and National Accounts*. The Review of Economic Statistics 49(3) 412-419.

Leontief, W. (1970). Environmental Repercussions and the Economic Structure: An Input-Output Approach. *The Review of Economic Statistics,* 53(3) 262-271.

Lewis, P. E. T., Martin, W.J. and Savage, C.R. (1988). *Capital Investment in Agricultural Economy*. Quarterly Review Rural Economy.

Little, P. D., & McPeak, J. G., (2018). Mobile peoples, contested borders: land use conflicts and resolution mechanisms among Borana and Guji Communities, Southern Ethiopia. *World Development, 103*, 119-132.

Luedeling, E. Lanzanova, D., Muchiri, C., Shepherd, K. D., Rosenstock, T. S., Krawinkel, M., & Whitney, C. W., (2018). Probabilistic decision tools for determining impacts of agricultural development policy on household nutrition. *Earth's Future, 6*(3), 359-372.

Mc Fadden D. & Train K. (2000). Mixed MNL Models for Discrete Response. *Journal of Applied Econometrics*.

Maddala, G. S. (1983). Methods of estimation for models of markets with bounded price variation. *International Economic Review,* 361-378.

Miernyk, W. & Rose, A. (1989). Input-Output Analysis. First fifty years Economic System. Research, 1 (2) 229-272.

Meinzen-Dick & Adato, 2001 Adato, M., & Meinzen-Dick, R. (Eds.). (2007). *Agricultural research, livelihoods, and poverty: Studies of economic and social impacts in six countries*. Intl Food Policy Res Inst.

Michael P., *Todaro & Stephen Smith.* (2015). Economic Development Washington DC, Washington University Press

Migot-Adhola, S. E., and Little, P. D. (1981, August 4-8). *Evolution of Policy towards the Development of Pastoral Areas in Kenya*. Paper presented at the Conference held in Nairobi, Kenya.

Migot-Adholla, S., and F. Place. (1998). The economic effects of land registration on smallholder farms in Kenya: evidence from Nyeri and Kakamega districts, *Land Economics,* 74 (1), 360-373.

Miller, R.E (2009). *Input-Output Analysis. Foundations and Extensions.* Volume 2, Cambridge University Press.

Mingate. F.L.M (2012). *Potential for Co-management Approaches to Strengthen Livelihoods of Forest-Dependent Communities: A Case Study of the Arabuko-Sokoke Forest Reserve, Kenya. (*Doctoral dissertation, Lincoln University)

Moyo, S. (1995). *The land question in Zimbabwe* (p. 3). Harare: Sapes Books.

Mugabe, J & B D Ogolla. (1996). Land Tenure Systems and Natural Resources Management. In J K Coetzee, J Graaff, F Hendricks & G Wood (eds). *Development, Theory, Policy and Practice.* Cape Town: Oxford University Press.

Mwangi, (2014) Mwangi, M., & Kariuki, S. (2015). Factors determining adoption of new agricultural technology by smallholder farmers in developing countries. *Journal of Economics and sustainable development*, *6*(5).

Ndungu Report. (2006). *Report of the Commission of Inquiry into the Illegal/Irregular Allocation of Public Land*: Republic of Kenya.

Njonjo Report. (2002). *Report of the Commission of Inquiry into the Land Law System of Kenya:* Republic of Kenya.

Nyandimo, J. A. (2011). ICT and Public Procurement in Kenya. (*Unpublished MBA Thesis),* University of Nairobi.

Obeng-Odoom, F. (2012). Land reforms in Africa: Theory, practice, and outcome. *Habitat international*, *36*(1), 161-170.

Ochieng, W. (1995). *Themes in Kenyan Histor*y. Nairobi: Heinemann.

Ochuka, M., Kiprop, C. Minagawa, and Ogando, G. (2019). Land use/Land cover Dynamics and anthropogenic driving factors in Lake Baringo Catchment, Rift Valey Kenya. *Natural resource Journal,* 10, 367-389

Odhiambo, W., and H. Nyangito, (2002) *Land laws and land use in Kenya: Implications for agricultural development*: Kenya Institute for Public Policy Research and Analysis,

Odote, C. (2013). The dawn of Uhuru? Implications of constitutional recognition of communal land rights in pastoral areas of Kenya. *Nomadic Peoples*, *17*(1), 87-105.

Okoth-Ogendo, H. W. O. (1995), *Tenants of the Crown: The evolution of the agrarian law and Institutions in Kenya*, Nairobi

Okoth-Ogendo, H. and W. Oluoch-Kosura (1995), Final report on land tenure and agricultural development in Kenya. Nairobi: The Ministry of Agriculture, Livestock Development and Marketing, Republic of Kenya and the Royal Netherlands Embassy.

Okoth-Ogendo, H.W.O. (1998). The Perils of Land Tenure: The Case of Kenya. Tokyo: United Nations University Press.

Ondiege, P. (1996). *Land Tenure and Soil Conservation. In J K Coetzee, J Graaff, F Hendricks & G Wood (eds). Development, Theory, Policy and Practice*. Cape Town: Oxford University Press.

Orodho, A. J. (2003). *Essentials of Educational and Social Science Research Methods*, Masola Publishers.

Otsuka, K., and F. Place. (2001). *Land Tenure and Natural Resource Management: A Comparative Study of Agrarian Communities in Asia and Africa*, Baltimore: 17 Johns Hopkins University Press.

Pan, W., Jianzhong, Y., Xiaobo, H. (2019). Determinants of Livelihood Choice and Implications for Targeted Poverty Reduction Policies: A Case Study in the YNL River Region, Tibetan Plateau. Journal of Ecological Indicators.

Pallant, J. (2011). SPSS Survival Manual 4th edition: A step by step guide to data analysis using SPSS version 18. *Maidenhead, Berkshire: Open University Press. Retrieved from http://www. allenandunwin. com/spss*.

Park, J. Y. (2006). *The supply Driven input-output Model: re-interpretation and Extension.* Open University Press.

Parrot, L., Dongmo, C., Ndoumbe, M., Poubom, C (2008). Horticulture, Livelihood, and Urban transition in Africa: Evidence from South-West Cameroon. *Agric Econ* 39(2) 245-256.

Pimentel, D., Berger, B., Filiberto, D., Newton, M., Wolfe, B., Karabinakis, E. & Nandagopal, S. (2004). Water resources: agricultural and environmental issues. *Bioscience, 54*(10), 909-918.

Pinckney, T., and P. Kimuyu. (1994). Land tenure reform in East Africa: good, bad, or unimportant? *Journal of African Economies*, 3 (1), 1-28.

Pindyck, S., & Rubinfeld, L. (1998). Econometric models and economic forecasts. *United States of America: McGraw-Hill, Inc*.

The Republic of Kenya, (2016). *National Spatial Plan 2015-2045, Optimal Productivity, Sustainability, Efficiency and Equity in the use of our Land and Territorial Space*, Government printers.

The Republic of Kenya, (2013). *Baringo County CIDP, 2018-2022. County integrated development plan*. County Government of Kenya

The Republic of Kenya, (1954), The Swynnerton Plan of 1954: A Plan to intensify agriculture in Kenya. Government Printer, Nairobi.

Train, K., (2003). *Discrete Choice Method with Simulation*. Cambridge University Press.

Robson, C., & McCartan, K. (2011). *The analysis and interpretation of qualitative data. Real-World Research. 3rd ed.* Padstow: Wiley.

Rola-Rubzen, M. F., Hardaker, J. B., & Dillon, J. L. (2001). Agricultural economists and world poverty: progress and prospects. *Australian Journal of Agricultural and Resource Economics, 45*(1), 39-66.

Rutten, M. (2010) Land reform in Africa: Lessons from Kenya. In Naerssen, T., Rutten, M. and Zoomers, A, editor, *In: The diversity of development,* Assen: Van Gorcum.

Scoones, I. (1998). *Sustainable rural livelihoods: A framework for analysis.* , *London,* UK.

Scoones, I., Marongwe, N., Mavedzenge, B. et al., (2012). Livelihood after land reforms in Zimbabwe: The understanding process of rural differentiation. *Journal of Agrarian Change*, 12 (4) 503-527.

Shafi, M. (1984). *Agricultural productivity and regional Imbalance*s, Concept Publishing Company, New Delhi

Shipton. (1998). *The Kenya land tenure reform: misunderstandings in the public creation of private property, in R.E. Downs and S.P. Reyna (eds.) Land and Society in Contemporary Africa,* Hanover, University Press of New England.

Shivji, I. G. (1998). *Not yet democracy: reforming land tenure in Tanzania*. IIED.

Singh, A. S., & Masuku, M. B. (2013). Fundamentals of applied research and sampling techniques. *International journal of medical and applied sciences*, *2*(4), 124-132.

Singh, P. K., Hiremath, B. N. (2010). Sustainable livelihood security index in a developing country: a tool for development planning. Journal of Ecology. *Indic* 10 (2), 442-451.

Soini, E. (2005). Land use patterns and livelihood dynamics on the slopes of Mt Kilimanjaro, *Tanzania J. Agric. Syste,*.85(3), 306-323.

Sombroek, W.C., Braun, H.M.H and van der Pouw, B.J. A. (1982). *Explanatory Soil Map and Agro-climatic Zone Map of Kenya*. Government Printer, Nairobi, Kenya.

Smith, D.R., Gordon, A., Meadows, K.et al. (2001). Livelihood diversification in Uganda: patterns and determinants of change across two rural districts. *J. Food Policy,* 26 (4), 421- 435.

Syagga, P. (2006) Land ownership and use in Kenya: Policy prescriptions from an inequality perspective. *Readings on Inequality in Kenya: Sectoral Dynamics and Perspectives,* 289.

Ten Raa, T. (2005). *The Economics of Input-Output Analysis.* Cambridge University Press.

Thuo, A. D. M. (2013). Genealogy of Land Ownership, Use and Management Problems in Kenya during the Pre-August, 2010 Constitution Period. A Review. *International Journal of Engineering Research & Technology, 2(8)*

Thurston, A. (1987) *Smallholder agriculture in colonial Kenya. The official mind and the Swynnerton Plan. Cambridge, Reino Unido,* Cambridge African Monographs.

Townsend, R. F., Ceccacci, I., Cooke, S., Constantine, M., & Moses, G. (2013). *Implementing agriculture for development: World Bank Group agriculture action plan (2013-2015)* (No. 77911, pp. 1-132). The World Bank.

Tsoukalas, J. (2011). Input-Output Inventories in the UK. *Journal of the Royal Statistical Society,* 78(3), 460-479.

Van Donge, J.K. (1999). Law and order as a development issue: land conflicts and the creation of social order in Southern Malawi, *Journal of Development Studies*, 36 (2): 373-399.

Van Loon, G.W., Patil, S.G., and Hugar, L.B. (2005). *Agricultural Sustainability; Strategies for Assessment.* SAGE Publication, New Delhi

Wakoko, V. (2012). The evolution of Land Law in Kenya. *URL: https://www. Academia. Edu/8972722/The_Evolution_of_Land_Law_In_Kenya (05.09. 2017)*.

Wayumba, G. (2017). A Review of Recent Land Policy Developments in Kenya. *International journal of scientific research and engineering studies, 2(7), 41*-46.

Wanyeki, L.M. (eds.) (2003). *Women and Land in Africa: Culture, Religion and Realizing Women's Rights,* London: Zed Books.

Wanyonyi, A., Nyadimo, E., & Kariuki, J. (2015). Land Tenure Security in Kenya (M. Kirk Ed. Report 3, 2015 ed.). UN Nairobi: UON, Publishing Services Section, *Nairobi, ISO 14001:2004 certified.*

Warren, C. (2005). Community mapping, local planning and alternative land use strategies in Bali. *Geografisk Tidsskrift-Danish Journal of Geography*, *105*(1), 29-41.

Wooldridge, J. W. (2002). *Econometric Analysis of Cross Section and Panel Data*. Cambridge, Massachusetts: The MIT Press.

Yamano, T., and T.S. Jayne. (2004). Measuring the impact of working-age adult mortality on small-scale farm households in Kenya, *World Development*, 32 (1): 91-119.

Yamano, T., K. Otsuka, F. Place, Y. Kijima, and J. Nyoro. (2005). *The 2004 REPEAT Survey in Kenya (First Wave): Results, GRIPS Development Database* No.1, National Graduate Institute of Policy Studies, Tokyo.

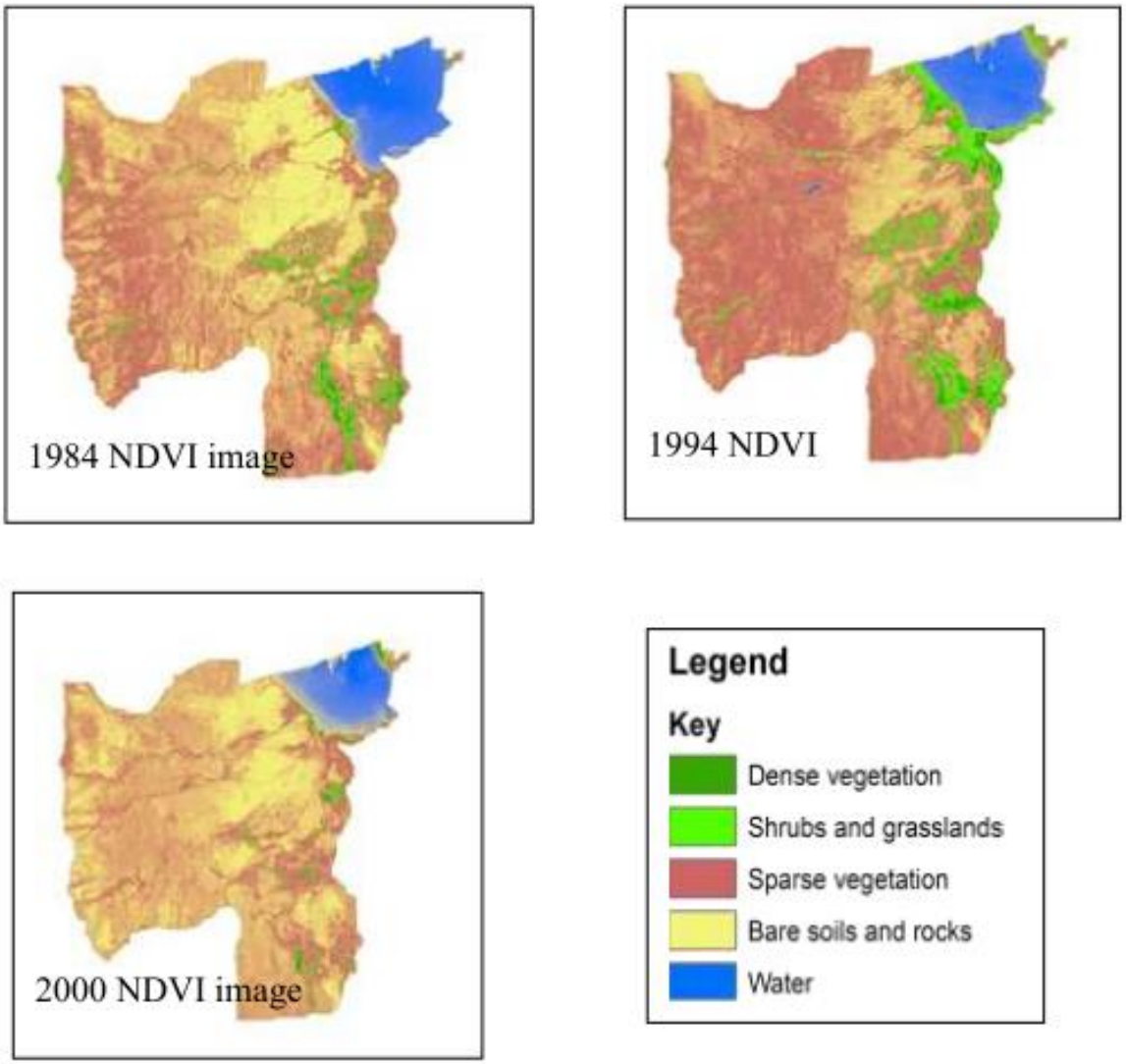
Yan, J., Wu, Y., Zhang, Y., Zhou, S., (2010). Livelihoods Diversification of Farmers and Nomads of Eastern Transact on Tibetan Plateau. *J.Geogr.Sci.*,20, 757-770.

Zohrabi, M. (2013). Mixed-Method Research: Instruments, Validity, Reliability and Reporting Findings. *Theory & practice in language studies*, *3*(2).

APPENDIXES

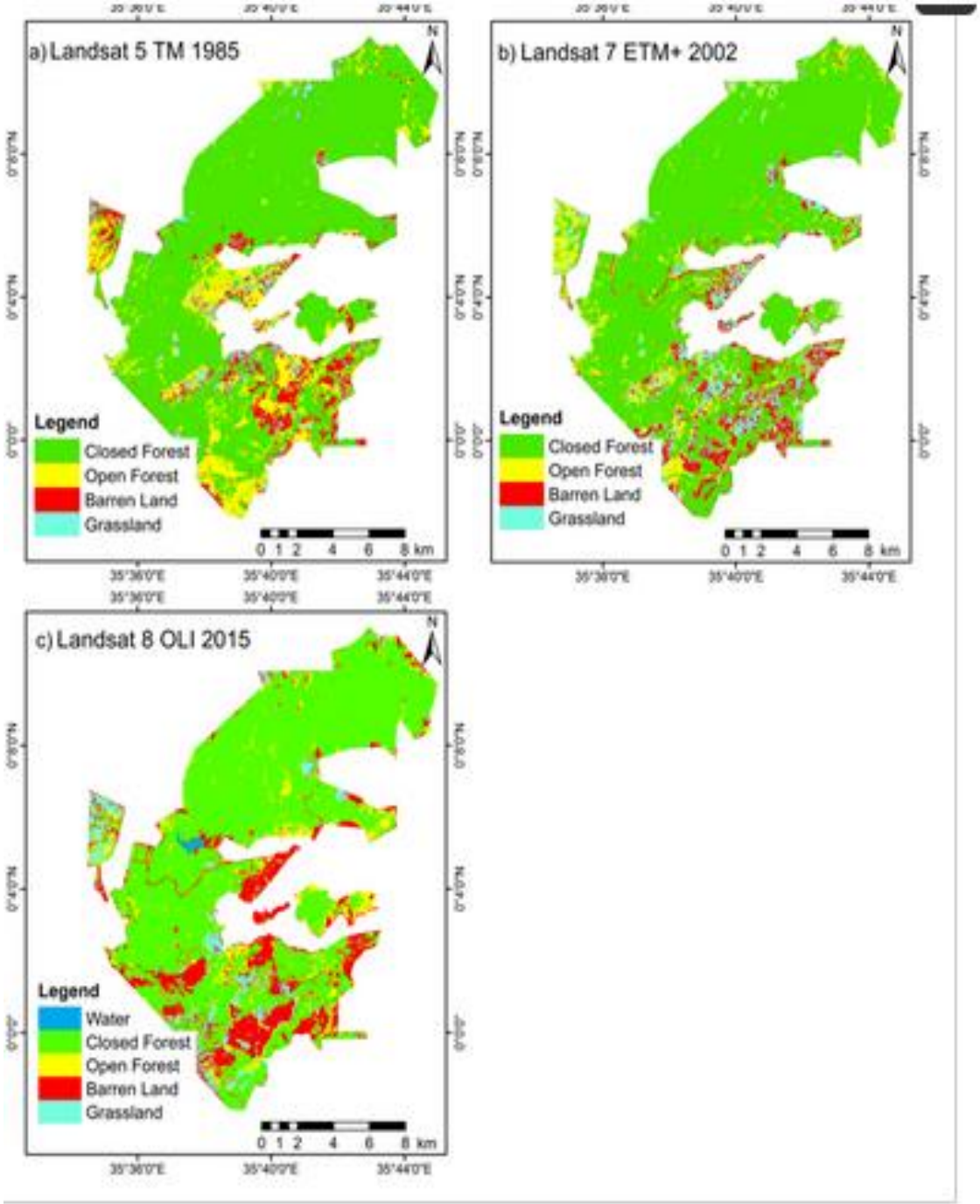
Appendix I:

Figure 7:1: Satellite images of Baringo South showing trends of Drought and depletion of vegetation cover (1984 NDVI image, 1994 NDVI image and 2000 NDVI image).



Appendix II:

Figure 7:2: Map of Lembus Forest in Eldama Ravine Showing Forest Destruction Trends



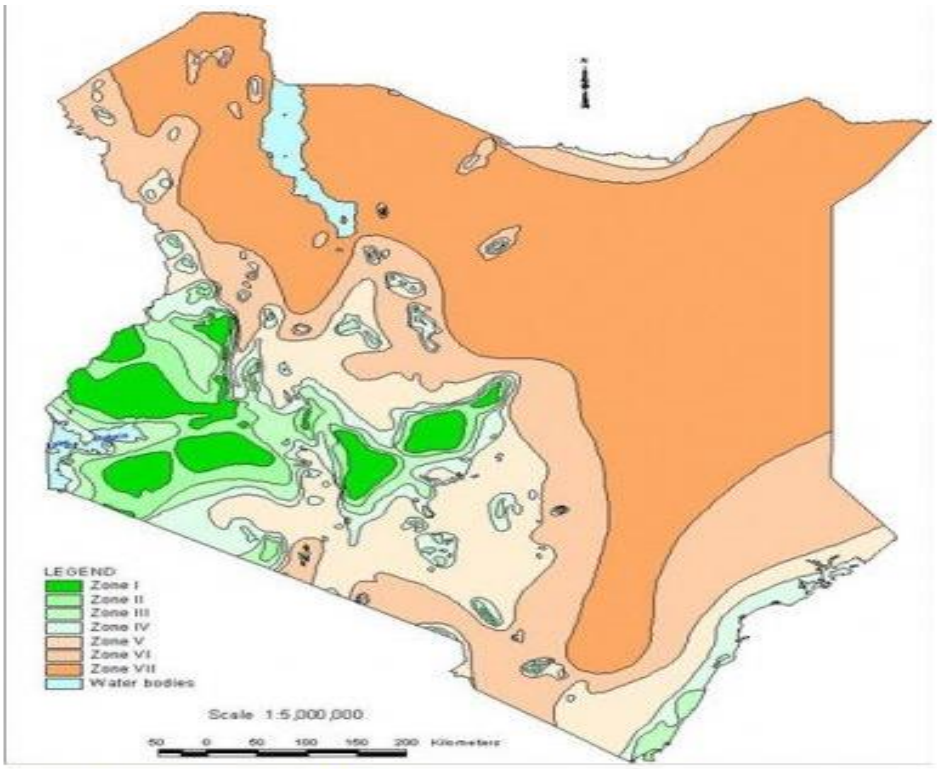
2. Land-cover maps of the Lembus Forest in (a) 1985; (b) 2002; and (c) 2015.

Appendix III:

Figure 7:3 Map of Baringo County Showing Livelihood Zones

Appendix IV:

Figure 7:4 Map of Kenya Showing Agro-Climatic Zones



Agro-climatic zones of Kenya
(c) Kenya Soil Survey

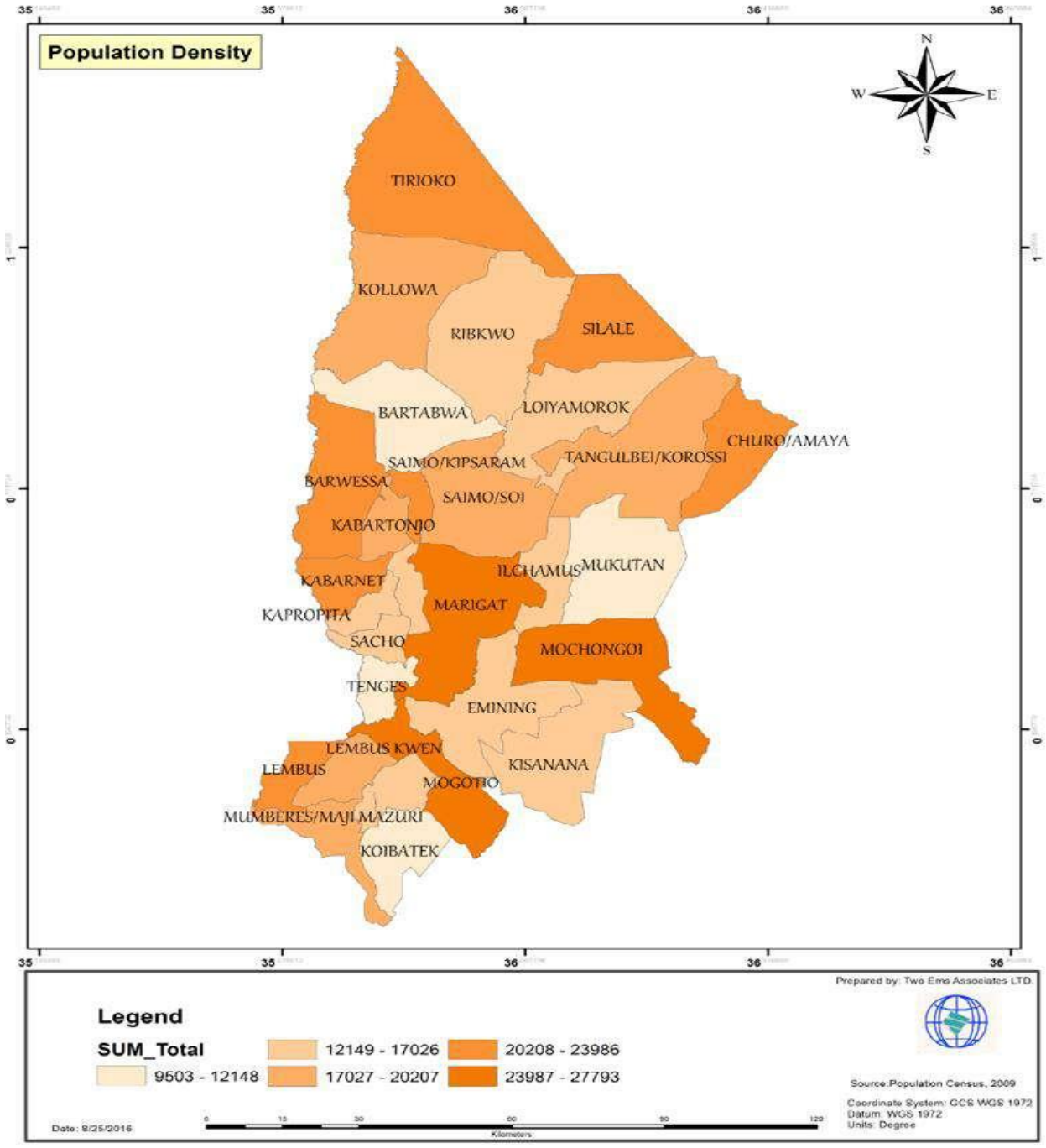
Agro- Climatic Zones of Kenya

Zone	Classification	Moisture index R/Eo ratio (%)	Annual Rainfall (mm)	Land area (km2)	Land area (%)
I	Afro-Alpine	>80	700	25,400	4.4
II	Humid	65-80	1000-2000	23,800	4.1
III	Sub-humid	50 – 65	950- 1500	25,700	4.4
IV	Semi-humid to semi-arid	40 – 50	500 -1000	28,700	4.9
V	Semi- arid	25 – 40	300- 600	87,300	15.0
VI	Arid	15 – 25	200-400	126,400	21.7
VII	Very arid	< 15	150-- 300	265,300	45.5

Source: Sombroek et al., (1982)

Appendix V:

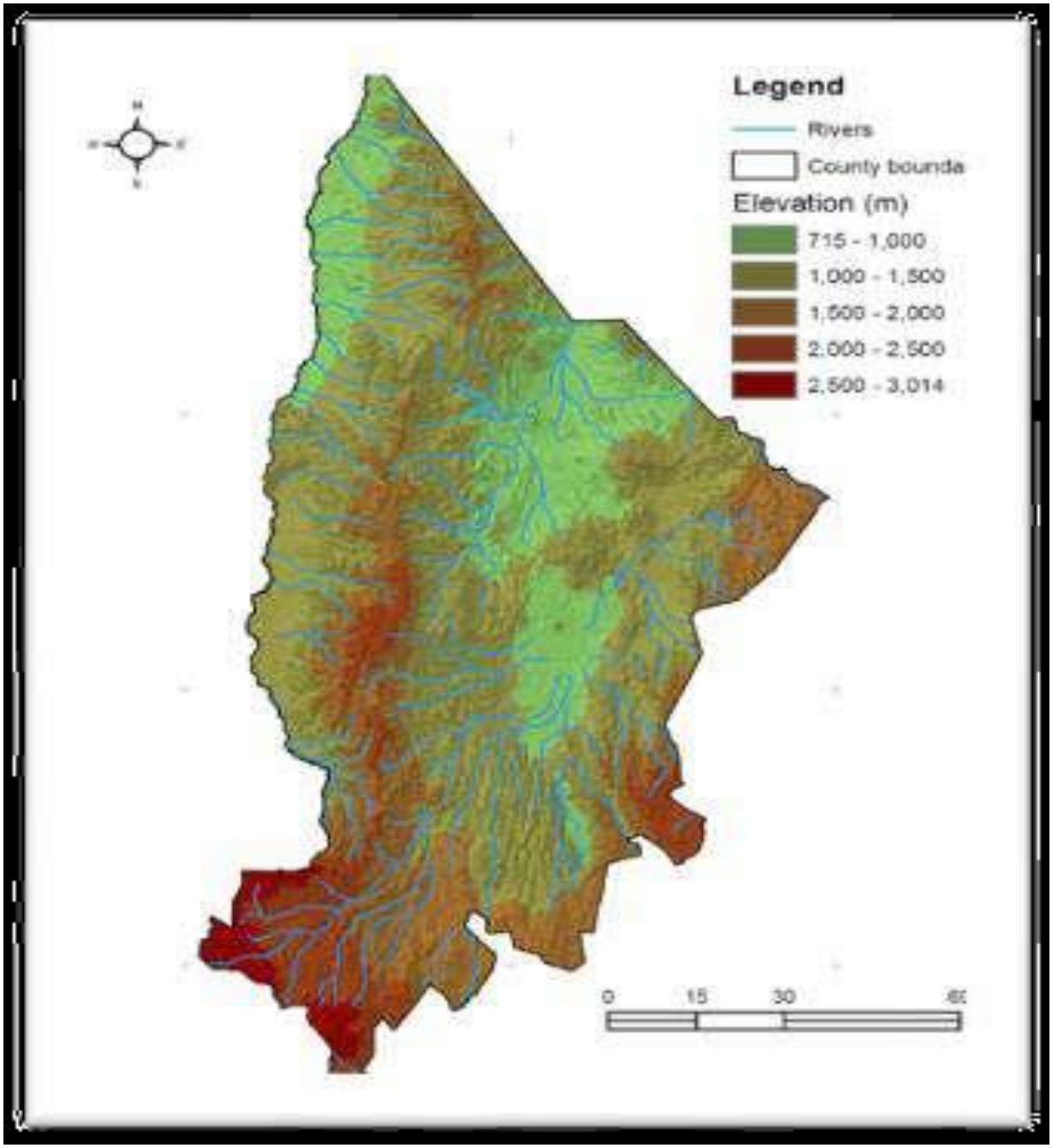
Figure 7:5: Map of Baringo County showing wards and population densities



Source: Population Census, 2019

Appendix VI:

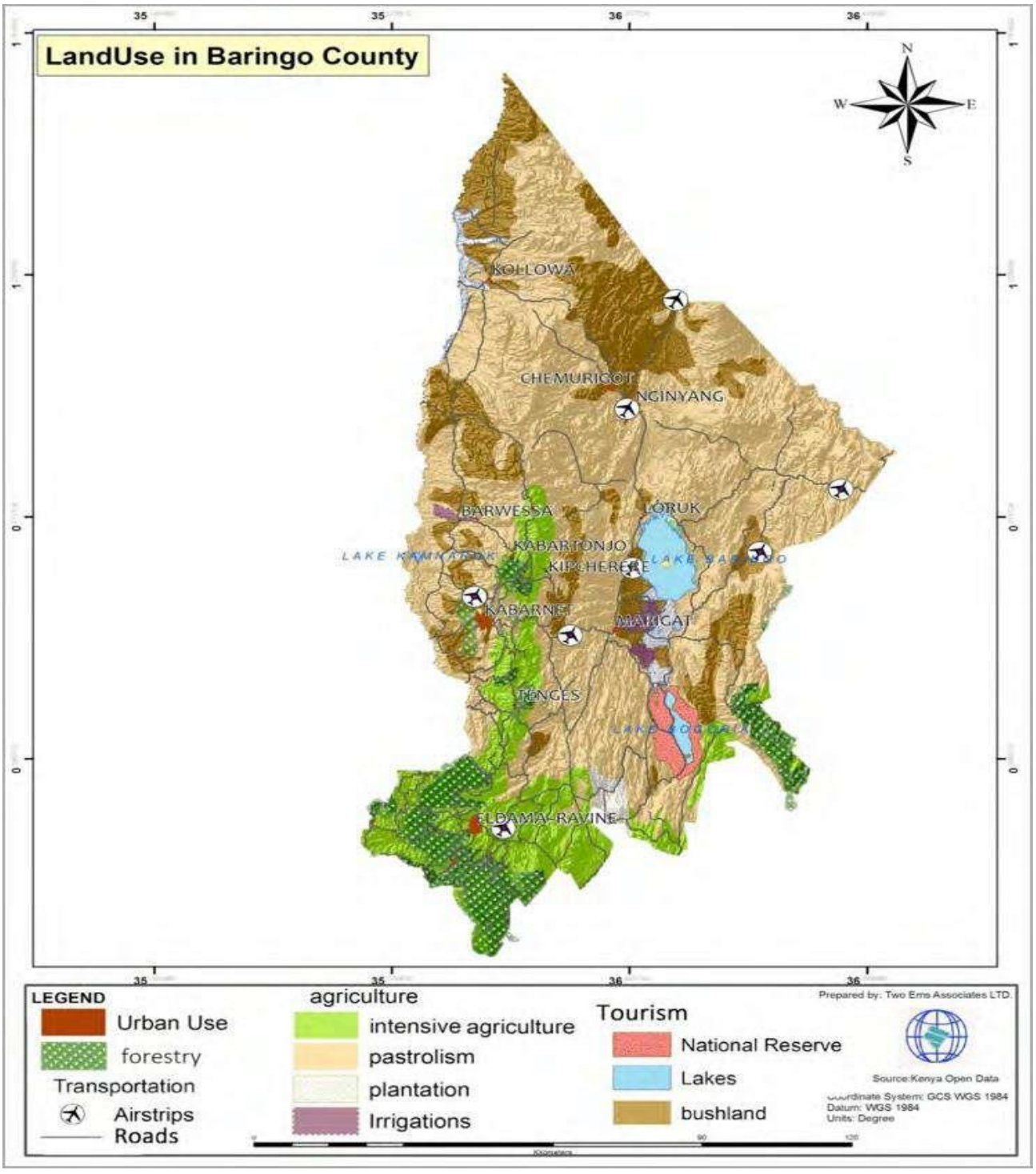
Figure 7:6 Map of Baringo County showing Topography



Source: Baringo County CIDP, 2018-2022

Appendix VII:

Figure 7:7 Spatial Map of Baringo County Showing Land use



Source: Kenya open data

Appendix VIII: Description of variables

Table 7.0 The Description of variables and expected signs used in Multinomial Logit Model

Dependent Variable	Code	Description	Unit	Expected sign
Household land use	Type I	Households located in Community Land	Dummy Type I =1, 0 otherwise,	
	Type II	Households located in Private Land	Dummy Type II =1, 0 otherwise,	Reference
	Type III	Households located in Marginal land	Dummy Type III = 1, 0 otherwise	
Government response decision		Government response alternative choices	Policy =1, 0 otherwise,	
		Law	law =1, 0 otherwise	
		Regulation	Regulation = 1, 0 otherwise	
Independent variables-household livelihood assets attributes				
Human livelihood assets	Hgend	Gender	Female=1, 0 otherwise, Male= 1, 0 otherwise	+
	Hedu	Education	1= 0, 2= primary, 3= secondary, 4= college, 5 =University	+
	Hatl	Ability to labor	family size	+
	Hmxe	Health- medical expenditure	KES	-
	Hahh	Age of household head (years)	No of years	+
Natural livelihood assets	Nlsze	Land size	No of Acres	-
	Nfc	Forest cover	No of trees	-
	Nias	invasive alien species	No of acres	-
	Ngzar	Grazing area	1= Extensive, 2= Intensive, 3= mixed, 4= others	-, +
	Ngfod	Growing of fodder	No of acres	+
	Ndisas	Natural disasters (Vulnerability)	1= drought, 2=floods, 3=diseases, 4 = conflicts	-
Physical livelihood	Pinfra	Infrastructure (roads,	Kms	+

assets		market)		
	Pliv	Livestock own by household	No of livestock	+
	Pbuild	Type of shelter and buildings,	1= grass Hut, 2= mud wall, Iron roof, 3= bricks wall, iron roof, 4= bricks wall, tile roof, 5= others	+
	Pws	Distance to water supply	Kms	+
	Pene	Source of Energy	1= firewood, 2= paraffin, 3= solar, 4= gas, 5= electricity, 6 =others	-
	Patinf	Access to information	1= Mobile phone, 2= Internet, 3= WhatsApp, 4= others	+
	Ptopt	Total output	KES	+
Financial livelihood assets	Fsav	Amount of Savings	KES	+
	Fvliv	Value of livestock owned	KES	+
	Fvcs	Value of crops in store,	KES	+
	Fcred	Access to credit,	KES	+
	Fremit	Amount of remittance	KES	+
Social Livelihood assets	Sgroup	Membership in groups,	No of groups	+
	Sfow	Food for work,	1= cash, 2= kind,	-
	Sdov	Donation's voucher	1= gov subsidy, 2= donors	+
	Spidec	Participation in decision	1= meeting, 2= seminar, 3=training, 4= planning 5= others	+
	Scresol	Conflict resolution	1= committee member, 2= campaign, 3= lobby & advocacy	-

Source: Author's conceptualization

Appendix IX: Sustainable Livelihood Framework Theory

Table 7:1 Chronology of Evolution of Sustainable Livelihood Framework Theory

Year	Recognition and evolution trend
1987	The World Commission on Environment and Development publishes its report: *Our Common Future* (the 'Brundtland Commission report') (1987)
1988	IIED prints papers from its 1987 forum, *The Greening of Aid: Sustainable Livelihoods in Practice* (Conroy and Litvinoff, eds., 1988)
1990	UNDP prints the first Human Development Report
1992	UN hosts Convention on Environment and Development IDS produces 'Sustainable Rural Livelihoods: Practical concepts for the 21st century (Chambers and Conway, 1992)
1993	Oxfam incorporates the SL strategy to formulate the general goals, enhance project approaches and employee tutorship
1994	CARE embraces household upkeep certainty as a programming structure in its charity and development work
1995	UN hosts World Summit for Social Development UNDP adopts Employment and Sustainable Livelihoods as one of five priorities in its overall human development mandate, to serve as both a conceptual and programming framework for poverty reduction IISD publishes *Adaptive Strategies and Sustainable Livelihoods* (Singh and Kalala, 1995), the report of a UNDP-funded program SID launches project on Sustainable Livelihoods and People's Everyday Economics
1996	*Adaptable Livelihoods: coping with food insecurity in the Malian Sahel* (Davies, 1996) is published by Macmillan DFID bids manifesto for a vital ESCOR research program on Sustainable Livelihoods. IDS led consortium wins the main award, with another award to ODG IISD publishes *Participatory Research for Sustainable Livelihoods: A Guidebook for Field Projects* (Rennie and Singh, 1996)
1997	New Labour administration issues its first White Paper on international development, *Eliminating World Poverty: A Challenge for the 21st Century*
1998	DFID's Natural Resources Department opens consultation on sustainable livelihoods and establishes a Rural Livelihoods Advisory Group Natural Resources Advisers annual conference takes Sustainable Livelihoods as the subject matter and later issues contributory papers: *Sustainable Rural Livelihoods: What Contribution Can We Make?* (Carney (ed.), 1998) SID publishes *The Sustainable Livelihoods Approach, General Report of the Sustainable Livelihoods Project 1995–1997* (Amalric, 1998) UNDP publishes *Policy Analysis and Formulation for Sustainable Livelihoods* (Roe, 1998) DFID establishes the SL Virtual Resource Centre and the SL Theme Group IDS publishes 'Sustainable rural livelihoods: a framework for analysis' (Scoones, 1998) The FAO/UNDP Informal Working Group on Participatory Strategies and Methods to Support Sustainable Livelihoods and Food Security converge
1999	DFID forms the Sustainable Livelihoods Support Office and nominates Jane Clark as its Leader DFID issues the initial *Sustainable Livelihoods Guidance Sheets* (DFID, 1999a); *Sustainable Livelihoods and Poverty Elimination* (DFID, 1999b);

	and *Livelihoods Approaches Compared* (Carney et al., 1999) Presenters at the Natural Resources Advisers' Conference report progress in implementing SL approaches, and DFID later publish these in *Sustainable Livelihoods: Lessons from Early Experience* (Ashley and Carney, 1999) ODI publishes 'Sustainable Livelihoods in Practice: early application of concepts in rural areas' (Farrington et al., 1999) DFID establishes the Sustainable Livelihoods Resource Group of researchers/consultants *Mixing it: Rural livelihoods and diversity in developing countries* (Ellis, 2000b) is published
2000	DFID authorizes and finances Livelihoods Connect, a website presented as a learning platform for SLA FAO orders an Inter-organization Conference on Operationalising Sustainable Livelihoods Strategies, including DFID, FAO, WFP, UNDP, and IFAD DFID prints *Sustainable Livelihoods – Current thinking and practice* (DFID, 2000a); *Sustainable Livelihoods – Building on Strengths* (DFID, 2000b); *Achieving Sustainability: Poverty Elimination and the Environment* (DFID, 2000c); and more SL *Guidance Sheets* The Sustainable Livelihoods Resource Group creates a subset on PIP (Policy, Institutions, and Processes). IDS issues 'Analyzing Policy for Sustainable Livelihoods' (Shankland, 2000), the concluding account from its ESCOR initiative Oxfam publishes *Environments and Livelihoods: Strategies for Sustainability* (Nafees, 2000). The Government issues its second White Paper, *Eliminating World Poverty: Making Globalisation Work for the Poor* (DFID, 2000e)
2001	DFID authorizes an investigation on the development of the SLA strategy; practical regulation possibility to reinforce sustainable upkeep *Sustainable Livelihoods: Building on the Wealth of the Poor* (Helmore and Singh, 2001) is issued DFID arranges SLA evaluation converging officials, analysts, and experts

Appendix X: The Household –Questionnaire

The semi-structured questions administered to household heads

Section 1: Household Information

1. Name of the household head.....Age .....
2. Sex: Male..... Female.....
3. Family size……children ……. ……
4. Education level.....current occupation.....

Section 2: Land use Changes

1. Land use……. land size ……land ownership status
2. Land productivity……Kgs/acre……. soil…… water degradation
3. How do changes in land use affect settlement patterns in terms …. Location, type of houses, source of fuel …. forests cover, and source of building materials
4. How do changes in land use affect the vulnerability of local communities to disasters (droughts, floods, diseases) in terms of intensity, capacity to absorb the economic loss of assets, conflicts (ethnic, boundaries), and risks?
5. How do changes in land use policies by the Government at different levels of affecting your household livelihood activities?
6. How do changes in land use institutions, including political, legislative & representative bodies, executive agencies, judicial bodies, civil society & membership organizations, NGOs, law, money, political parties, commercial enterprises & corporations, affect your household livelihood assets?
7. How do changes in land use processes in terms of the "rules of the game," decision-making processes, social norms & customs, gender, caste, class, and language affect household livelihood assets?

Section 3: Household Livelihood Assets

1. How do changes in land use affect your household human capital

Changes in land use				
Health- Medical expenditure				
Nutrition,				
Education level				
Knowledge and skills,				

Capacity to work and				
Capacity to adapt?				

2. How do change in land use affect your household physical capital in terms of:

Affect your household physical capital				
Transport - roads, vehicles, etc.,				
Secure shelter & buildings,				
Water supply & sanitation,				
Energy, communications) and				
Tools as well as technology (tools and equipment for production, seeds, fertilizer, pesticides, traditional technology)				

3. How do changes in land use affect your household natural capital in terms of:

affect your household natural capital				
Production system,				
Availability of water &				
Aquatic resources,				
Trees and				
Forest products				
Biodiversity and				

Environment conservation?				

4. How do changes in land use affect your household financial capital in terms of:

affect your household financial capital				
Savings,				
Credit/debt and				
wages?				

5. How do changes in land use affect your household social capital in terms of

household social capital				
Networks and connections (patronage, neighbourhoods, kinship),				
Relations of trust and mutual support,				
Formal and informal groups,				
Common rules and sanctions,				
Collective representation,				
Mechanisms for participation in decision-making and Leadership?				

Section 4: Government decisions

1. What strategies did the government use to address land use changes problem in Kenya after independence?
2. Specify the strategies under each land use category
3. Are strategies adopted driven by foreign ideologies and technologies?
4. Are these strategies effective in addressing local communities' needs?
5. Are there mismatches between strategies adopted by the government with local communities' livelihood practices under the prevailing conditions?
6. Are strategies responsive to the local communities' aspirations?
7. What is the nature of the strategies adopted?
8. Do these strategies provide a long-term solution to land use changes problem?
9. Is there a time lag between strategies formulation and implementation?

Section 5: Conflicts

1. How do water and pasture conflicts affect the effectiveness of strategies?
2. Is there a disconnect between government strategies and local communities' adaptive strategies?
3. Do government strategies recognize and integrate local communities' experiential knowledge in planning and execution intervention strategies?
4. Do you think inadequate recognition and integration of local communities' experiential knowledge leads to wrong government intervention?
5. What are the livelihood outcomes for the different categories of land?
6. Are the livelihood assets able to sustain shocks, changes, or trends?
7. What policies, institutions, and processes do not allow assets to be used as they might?
8. Livelihood options combined in a "bad" or unsustainable strategy

Appendix XI

Table 7:2: Distribution of Population by Sex per Subcounty

NATIONAL/COUNTY	SEX			TOTAL
	MALE	FEMALE	INTERSEX	
Baringo	336322	330428	13	666763
Baringo central	48120	48829	2	96951
Baringo north	52369	52500	2	104871
Tiaty	78818	74524	2	153342
Eldama Ravine	65295	64238	2	129535
Baringo south	45706	45246	3	90955
Mogotio	46014	45088	2	91104

Source: National Population census, 2019

Appendix XII

Table 7:3: Distribution of population, number of households, and average Household size by sub-county in Baringo County

National/County	Population	Number of households	Average households' size
Baringo	666763	142518	4.7
Baringo central	96951	23555	4.1
Baringo north	104871	23500	4.5
Tiaty	153342	26651	5.8
Eldama Ravine	129535	30774	4.2
Baringo south	90955	19854	4.5
Mogotio	91104	18184	5.0

Source: National Population Census, 2019

Appendix XIII: Cochran, 1963 Formula of Sample Size Determination

The sample size was calculated based on the proportions formula for large populations (Cochran, 1963). The equation yields a representative sample for proportions. Thus,

$n = Z^2pq/d^2$:

Where n = the desired sample size,

Z = the normal standard deviation at the required confidence interval (95%) = 1.96, p = the proportion in the population estimated to have characteristics measured,

q = 1- p and d = the level of statistical significance set or the level of precision.

For this study p = 100,779 /141,877 = 0.7

Hence q =1-0.71 = 0.3

The sample size for the study was therefore;

$n = 1.96^2 * 0.7 * 0.3 / 0.05^2$

= 323 households

The sample size of 323 was deemed to represent the entire population, and the information gathered gave a relatively true reflection of the prevailing situation in the County. The sample was computed by taking the population per Sub County and dividing it with the total population, then multiplied by the sample size of 323. This was distributed proportionally as shown per sub-county.

Table 7:4 Sampling distribution per Sub County

Sub county	**Households**	**Sample size**	**Percentage**
Baringo South	19,854	64	19.7
Baringo North	23,500	75	23.3
Tiaty	26,651	85	26.5
Eldama Ravine	30,774	99	30.5
Total	**100,779**	**323**	**100.0**

Source: Author's computation.

Appendix XIV:

Table 7:5: Critical Values for the Cochran Test for Variance Outliers

Table Critical values for the Cochran test for variance outliers

Degree of fredom ν = n – 1.

Level of significance α = 0.01

	ν_x													
k	1	2	3	4	5	6	7	8	9	10	16	36	144	∞
2	0.9999	0.9950	0.9794	0.9586	0.9373	0.9172	0.8988	0.8823	0.8674	0.8539	0.7949	0.7067	0.6062	0.5000
3	0.9933	0.9423	0.8831	0.8335	0.7933	0.7606	0.7335	0.7107	0.6912	0.6743	0.6059	0.5153	0.4230	0.3333
4	0.9676	0.8643	0.7814	0.7212	0.6761	0.6410	0.6129	0.5897	0.5702	0.5536	0.4884	0.4057	0.3251	0.2500
5	0.9279	0.7885	0.6957	0.6329	0.5875	0.5531	0.5259	0.5037	0.4854	0.4697	0.4094	0.3351	0.2644	0.2000
6	0.8828	0.7218	0.6258	0.5635	0.5195	0.4866	0.4608	0.4401	0.4229	0.4084	0.3529	0.2858	0.2229	0.1667
7	0.8376	0.6644	0.5685	0.5080	0.4659	0.4347	0.4105	0.3911	0.3751	0.3616	0.3105	0.2494	0.1929	0.1429
8	0.7945	0.6152	0.5209	0.4627	0.4226	0.3932	0.3704	0.3522	0.3373	0.3248	0.2779	0.2214	0.1700	0.1250
9	0.7544	0.5727	0.4810	0.4251	0.3870	0.3592	0.3378	0.3207	0.3067	0.2950	0.2514	0.1992	0.1521	0.1111
10	0.7175	0.5358	0.4469	0.3934	0.3572	0.3308	0.3106	0.2945	0.2813	0.2704	0.2297	0.1811	0.1376	0.1000
12	0.6528	0.4751	0.3919	0.3428	0.3099	0.2861	0.2680	0.2535	0.2419	0.2320	0.1961	0.1535	0.1157	0.0833
15	0.5747	0.4069	0.3317	0.2882	0.2593	0.2386	0.2228	0.2104	0.2002	0.1918	0.1612	0.1251	0.0934	0.0667
20	0.4799	0.3297	0.2654	0.2288	0.2048	0.1877	0.1748	0.1646	0.1567	0.1501	0.1248	0.0960	0.0709	0.0500
24	0.4247	0.2871	0.2295	0.1970	0.1759	0.1608	0.1495	0.1406	0.1338	0.1283	0.1060	0.0810	0.0595	0.0417
30	0.3632	0.2412	0.1913	0.1635	0.1454	0.1327	0.1232	0.1157	0.1100	0.1054	0.0867	0.0658	0.0480	0.0333
40	0.2940	0.1915	0.1508	0.1281	0.1135	0.1033	0.0957	0.0898	0.0853	0.0816	0.0668	0.0503	0.0363	0.0250
60	0.2151	0.1371	0.1069	0.0902	0.0796	0.0722	0.0668	0.0625	0.0594	0.0567	0.0461	0.0344	0.0245	0.0167
120	0.1225	0.0759	0.0585	0.0489	0.0429	0.0387	0.0357	0.0334	0.0316	0.0302	0.0242	00178	0.0125	0.0083
∞	0	0	0	0	0	0	0	0	0	0	0	0	0	0

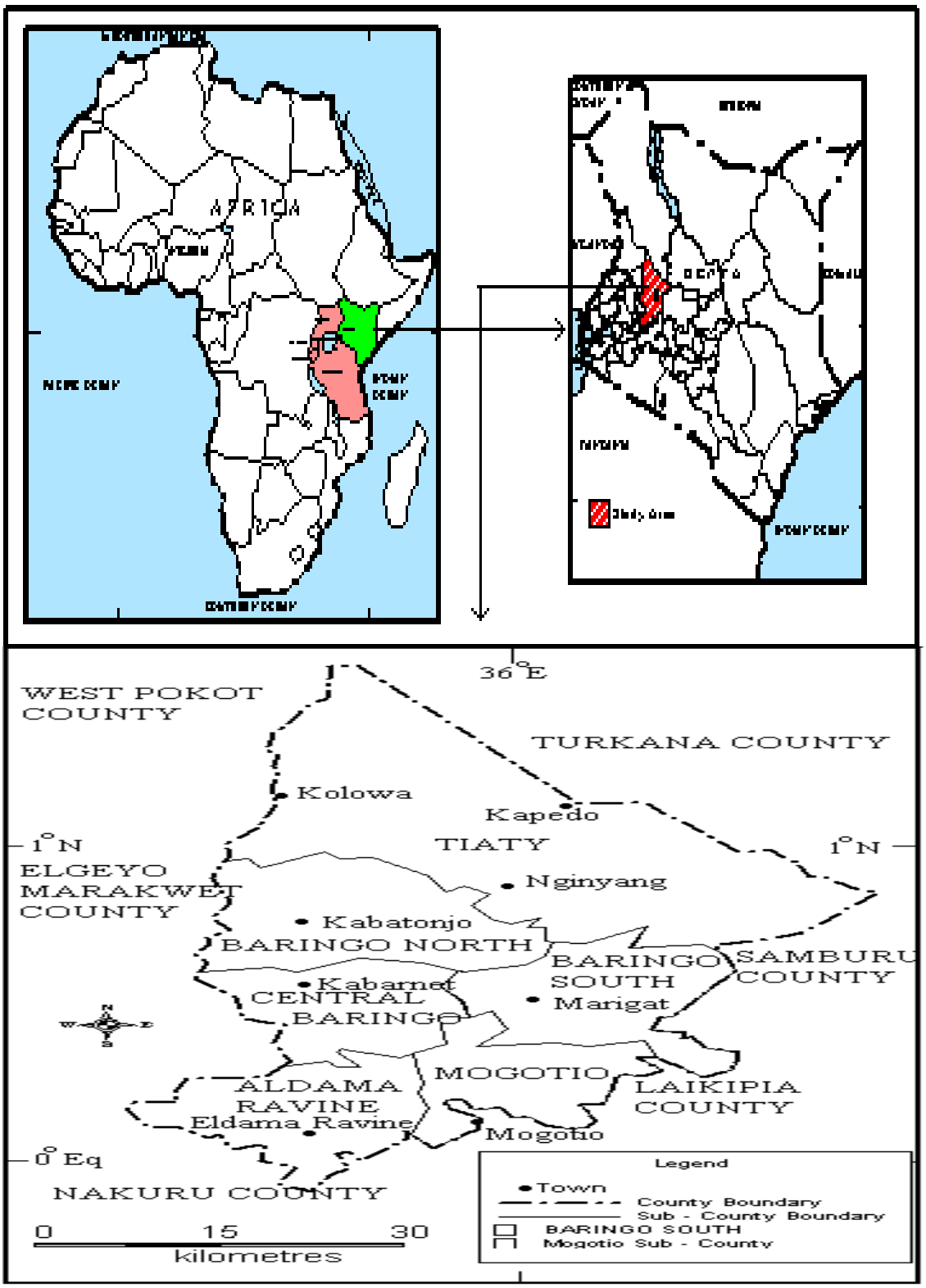
Level of significance α = 0.05

	ν_x													
k	1	2	3	4	5	6	7	8	9	10	16	36	144	∞
2	0.9985	0.9750	0.9392	0.9057	0.8772	0.8534	0.8332	0.8159	0.8010	0.7880	0.7341	0.6602	0.5813	0.5000
3	0.9669	0.8709	0.7977	0.7457	0.7071	0.6771	0.6530	0.6333	0.6167	0.6025	0.5466	0.4748	0.4031	0.3333
4	0.9065	0.7679	0.6841	0.6287	0.5895	0.5598	0.5365	0.5175	0.5017	0.4884	0.4366	0.3720	0.3093	0.2500
5	0.8412	0.6838	0.5981	0.5441	0.5065	0.4783	0.4564	0.4387	0.4241	0.4118	0.3645	0.3066	0.2513	0.2000
6	0.7808	0.6161	0.5321	0.4803	0.4447	0.4184	0.3980	0.3817	0.3682	0.3568	0.3135	0.2612	0.2119	0.1667
7	0.7271	0.5612	0.4800	0.4307	0.3974	0.3726	0.3535	0.3384	0.3259	0.3154	0.2756	0.2278	0.1833	0.1429
8	0.6798	0.5157	0.4377	0.3910	0.3595	0.3362	0.3185	0.3043	0.2926	0.2829	0.2462	0.2022	0.1616	0.1250
9	0.6385	0.4775	0.4027	0.3584	0.3286	0.3067	0.2901	0.2768	0.2659	0.2568	0.2226	0.1820	0.1446	0.1111
10	0.6020	0.4450	0.3733	0.3311	0.3029	0.2823	0.2666	0.2541	0.2439	0.2353	0.2032	0.1655	0.1308	0.1000
12	0.5410	0.3924	0.3264	0.2880	0.2624	0.2439	0.2299	0.2187	0.2098	0.2020	0.1737	0.1403	0.1100	0.0833
15	0.4709	0.3346	0.2758	0.2419	0.2195	0.2034	0.1911	0.1815	0.1736	0.1671	0.1429	0.1144	0.0889	0.0667
20	0.3894	0.2705	0.2205	0.1921	0.1735	0.1602	0.1501	0.1422	0.1357	0.1303	0.1108	0.0879	0.0675	0.0500
24	0.3434	0.2354	0.1907	0.1656	0.1493	0.1374	0.1286	0.1216	0.1160	0.1113	0.0942	0.0743	0.0567	0.0417
30	0.2929	0.1980	0.1593	0.1377	0.1237	0.1137	0.1061	0.1002	0.0958	0.0921	0.0771	0.0604	0.0457	0.0333
40	0.2370	0.1576	0.1259	0.1082	0.0968	0.0887	0.0827	0.0780	0.0745	0.0713	0.0595	0.0462	0.0347	0.0250
60	0.1737	0.1131	0.0895	0.0765	0.0682	0.0623	0.0583	0.0552	0.0520	0.0497	0.0411	0.0316	0.0234	0.0167
120	0.0998	0.0632	0.0495	0.0419	0.0371	0.0337	0.0312	0.0292	0.0279	0.0266	0.0218	0.0165	0.0120	0.0083
∞	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Kanji, Gopal K. **100 Statistical Tests**. London : SAGE Publication Ltd., 1993.

Appendix XV: Map of Baringo County

Figure 7.6: Map of Baringo County Showing its Location, Neighboring Counties and Sub Counties (Constituencies)



Appendix VI: Research Permit from NACOSTI

THIS IS TO CERTIFY THAT:
MR. EDWARD LEKAICHU OLE KATEIYA
of MAASAI MARA UNIVERSITY,
861-20500 NAROK,has been permitted
to conduct research in Baringo ,
Elgeyo-Marakwet , Kericho , Nakuru ,
Samburu , Turkana , Uasin-Gishu ,
Westpokot Counties

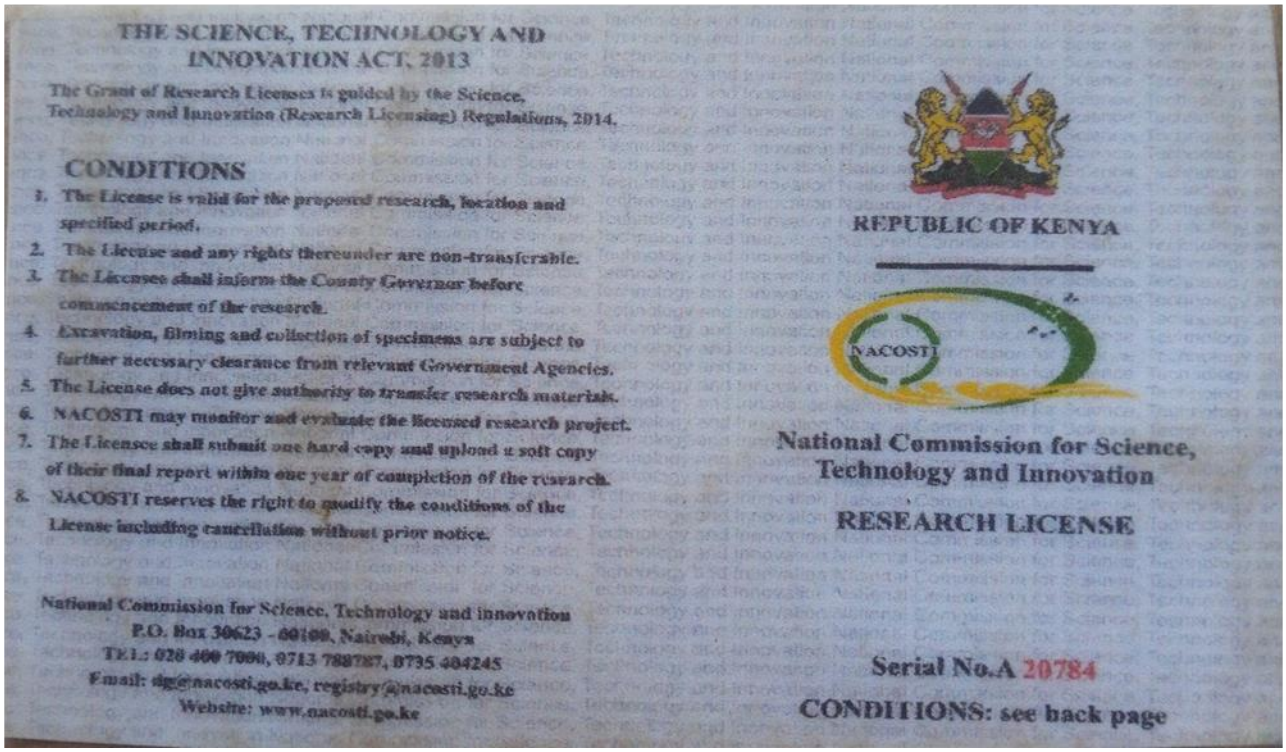
on the topic: DYNAMICS OF LAND RESOURCE MANAGEMENT ON THE LIVELIHOOD OF LOCAL COMMUNITIES IN BARINGO COUNTY

for the period ending:
20th September,2019

Applicant's Signature

Permit No : NACOSTI/P/18/77620/24149
Date Of Issue : 24th September,2018
Fee Recieved :Ksh 2000

Director General
National Commission for Science,
Technology & Innovation



THE SCIENCE, TECHNOLOGY AND INNOVATION ACT, 2013

The Grant of Research Licenses is guided by the Science, Technology and Innovation (Research Licensing) Regulations, 2014.

CONDITIONS

1. The License is valid for the proposed research, location and specified period.
2. The License and any rights thereunder are non-transferable.
3. The Licensee shall inform the County Governor before commencement of the research.
4. Excavation, filming and collection of specimens are subject to further necessary clearance from relevant Government Agencies.
5. The License does not give authority to transfer research materials.
6. NACOSTI may monitor and evaluate the licensed research project.
7. The Licensee shall submit one hard copy and upload a soft copy of their final report within one year of completion of the research.
8. NACOSTI reserves the right to modify the conditions of the License including cancellation without prior notice.

National Commission for Science, Technology and Innovation
P.O. Box 30623 - 00100, Nairobi, Kenya
TEL: 020 400 7000, 0713 788787, 0735 404245
Email: dg@nacosti.go.ke, registry@nacosti.go.ke
Website: www.nacosti.go.ke

REPUBLIC OF KENYA

NACOSTI

National Commission for Science, Technology and Innovation

RESEARCH LICENSE

Serial No.A 20784

CONDITIONS: see back page

Appendix XVII: Research permit from the University

MAASAI MARA UNIVERSITY

(OFFICE OF THE DIRECTOR, POSTGRADUATE STUDIES)

TEL. No.0722346 419
Email: graduatestudies@mmarau.ac.ke

P. O. Box 861-20500
NAROK, KENYA

Ref: Ref/MMU/AA0328/45/ VOL 1 (28)

Date: 27TH JUNE 2018

Council Secretary,
National Council for Science, Technology & Innovation
P.O. Box 30623-00100
NAIROBI-KENYA

Dear Sir/Madam,

RE: APPLICATION FOR RESEARCH PERMIT: REG. NO.TP01/MP/MN/3897/2017

EDWARD LEKAICHU OLE KATEIYA.

I wish to recommend the above candidate for a permit to enable him collect data for his research. He defended his proposal at the School of Tourism and Natural Resources Management successfully and has made the necessary corrections. The title is: ***Dynamics Of Land Resource Management On The Livelihood Of Local Communities In Baringo County.***

He therefore qualifies for a permit to conduct research. Any assistance accorded to him will be highly appreciated.

Thank you.

MAASAI MARA UNIVERSITY
P.O Box 861 - 20500
NAROK
27 JUN 2018
DIRECTOR
OFFICE OF POSTGRADUATE STUDIES

Dr. Kodak O.B

AG. DIRECTOR POSTGRADUATE STUDIES