ECONOMIC EVALUATION OF COMPETING LAND- USE OPTIONS AND THEIR DRIVERS IN AMBOSELI ECOSYSTEM, KENYA

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A56/74902/2012

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF A MASTER OF SCIENCE DEGREE IN AGRICULTURAL AND APPLIED ECONOMICS AT THE UNIVERSITY OF NAIROBI

NOVEMBER 2017

DECLARATION AND APPROVAL

Declaration:

This thesis is my original work and has not been presented for examination in any university.

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DEDICATION

This work is dedicated to my dad, my husband, two children and the university supervisors for their continued and unwavering support throughout the academic journey

ACKNOWLEDGEMENT

I would like to give thanks to the Almighty God for the gift of life and good health without which, this work would not have been possible.

My sincere appreciation goes to my advisors, Dr. John Mburu and Prof. Chris Ackello-Ogutu, for their mentorship, guidance, and moral support. In you I found academic parents.

I am also grateful to DAAD, Higher Education Loans Board (HELB) and the Africa Economic Research Consortium (AERC) for awarding me the scholarship to pursue Masters in Agricultural and Applied Economics and for providing my research funds.

I acknowledge the support of the lecturers at the University of Nairobi, Department of Agricultural Economics, and at the University of Pretoria, for the valuable academic contribution to my studies. I am also grateful to my fellow students in the Agricultural Economics Department particularly Henry Mwololo and Mercy Mbugua for your encouragement, guidance and support.

I would like to thank my Dad, Mr. George Njuguna, Mrs Carol Ochenje and the seven research assistants for the good work and support during the data collection process in the vast Amboseli. Not forgetting the Group Ranches Officials and Mr. Macharia of District Agricultural Office, Loitoktok for your support and allowing me time in your busy schedules.

Without all of you, this study would not have been possible

ABSTRACT

Determining an appropriate allocation of land between alternative competing uses is a fundamental problem that continues to be a challenge in many developing countries. Amboseli Ecosystem, one of Kenya's rangelands has been experiencing changes in its economic activities. Traditionally pastoralism and wildlife conservation has been the key source of livelihood for people in the ecosystem. Crop production is a more recent economic activity being integrated in the ecosystem. These changes are attributable to the macro and micro economic, social and demographic factors. Therefore, the question of the economic benefits to the land owners for engaging in different land uses arises. This creates the need to do an economic evaluation of the land- use options and their drivers within the ecosystem. The major land – use options identified included livestock keeping, crop production and wildlife conservation. The study used gross margin analysis to determine the value of these competing land use options. This was coupled with multinomial logistic regression analysis to determine the drivers of these competing lands -use options. The study used both primary and secondary data. Primary data was obtained at the household level using semi-structured questionnaires, focused group discussions and key informant interviews and secondary data from the District Agricultural Office, Loitoktok. Primary data was collected in 2014 from a sample size of 295 households using probability proportional to size sampling in a systematic random procedure. Data was entered; cleaned and analyzed using statistical packages; SPSS, STATA and Ms Excel.

Different socio-economic (age, annual net income and education), microeconomic (distance to nearest market centre, access to credit) and land characteristics (distance to the main source of water, land tenure and land size) influenced the decision on the choice of land- use. The results showed that all the three economic activities have significant contribution to the household's welfare. In the case of the crops and livestock production, the choice of the eco-

nomic activity to practice and its intensity is entirely dependent on the decision by the household. This is unlike wildlife conservation that has some influence from the government through KWS.

Livestock keeping is seen to be a more stable source of income for the households compared to wildlife conservation. This is because for every unit increase in the annual income of the household, livestock keeping is preferred to wildlife conservation. Similarly, the gross margin analysis results showed a higher net income from livestock per household compared to wildlife conservation. The government should therefore put in place mechanisms that encourage wildlife conservation and would lead to more direct benefits from wildlife. These are such as prompt compensation for farmers after loss of their animals or injuries caused by wildlife or direct payments to farmers who lease their lands for wildlife conservation.

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List of Acronyms and Abbreviations

ANP	Amboseli National Park
AWF	African Wildlife Foundation
CBA	Cost Benefit Analysis
CBC	Community Based Conservation
DAO	District Agriculture Office
FAO	Food for Agriculture Organization
GDP	Gross Domestic Product
GR	Group Ranch
ICDPs	Integrated Conservation and Development Projects
IIA	Independence from Irrelevant Alternatives
IUCN	International Union for Conservation of Nature
KNBS	Kenya National Bureau of Statistics
KWS	Kenya Wildlife Service
MNL	Multinomial Logistic Regression
MWCT	Maasai Wilderness Conservation Trust
NPV	Net Present Value
PES	Payment for Ecosystem Services
RUM	Random Utility Model
SPSS	Statistical Package for Social Scientist
TEV	Total Economic Value
USD	United States Dollar

CHAPTER ONE

INTRODUCTION

1.1 Background

Determining an appropriate allocation of land between alternative competing uses is a fundamental problem that continues to be a challenge in many developing countries (Barbier & Burgess 1997). Natural resources such as forests, wildlife and commercially exploited fishery are valuable assets that provide flows of services to people (Hanley and Barbier, 2009). Long term economic gains can only be achieved if these assets are used efficiently and sustainably. Land is one such resource in agriculture whose efficient allocation in combination with other agricultural resources, determine the level of output or overall productivity and returns to the farmer.

Land changes are cumulatively a major driver of global environmental change. The most important form of land conversion is the expansion of crop and pastoral land in natural ecosystems (Lambin & Meyfroidt 2011). This follows from the increased population and the need to expand production to meet the increasing demand. Globally, conversion of forest land into agricultural land is the most common.

Within East Africa, the rangelands are characterized by rapid processes of fragmentation and contraction. Pastoralism and wildlife conservation which was once the dominant land use is retreating in many areas. Extension of the croplands into these grazing lands is one of the key drivers of these dynamics (Greiner *et al.,* 2013). Changes in land policies, high human population growth rates and rapid changes in people's expectations and preferences over the past few decades have resulted in the expansion of cultivation, growth in the number of permanent settlements, urbanization and diversification of land use activities around conservation areas

(Kristjanson *et al.,* 2002). This is not any different for the Amboseli Ecosystem that is experiencing a long term shift pushed by a transition in human land use from extensive pastoralism by Maasai people to intensive pastoralism carried out within legally prescribed private parcels of land (Burnsilver *et al.,* 2008).

With the increased dynamics of land use, impacts of climate change are evident in the Kenyan rangelands. Following the increased livestock population and reduced grazing areas as a result of new economic activities such as crop production, livestock production is likely to have an impact on climate change through increased methane gas production and land degradation (Rust & Rust, 2013). Consequently, the spatial variability of climate change impacts within the rangelands is likely to create un equitable distribution of feed resources and therefore increased competition for pastures among different user groups, increased water scarcity and heat stress on the animals (Maitima and Olson, 2008). In addition, climate change will lead to additional and potentially very large economic costs with losses estimated to about 3% of GDP each year by 2030 in Kenya (Stockholm Environment Institute, 2009).

Several economic activities take place within this ecosystem including livestock keeping, tourism though wildlife conservation and other tourism related activities such as Maasai *manyattas* and curio shops, crop production, both rain fed and irrigated, bee keeping, charcoal burning, mining of limestone and quarrying (Mburu, 2013). Livestock subsector provides the most important economic activity among the pastoral communities in Kenya. It is estimated to contribute 12% of the total GDP, 40% of the agricultural GDP and provides 50% of labor in the agricultural sector (Kenya Veterinary Vaccines Production Institute, 2014). It is a main source of food and the cattle are Kenya's most important source of red meat. In addition, livestock is a source of credit for most pastoral communities given its ability to 'cash in' on the value of the animals as needed. Livestock also acts as insurance and a means of sharing risk (Behnke and Muthami, 2011). Traditionally the animals are kept as a store of wealth and culture related activities such as payment of dowry. Lack of market access due to poor infrastructure, livestock diseases and climate change effects characterized by frequent droughts are some of the major challenges facing the livestock sub-sector in Kenya.

Crop production, a more recently developed activity is also an important economic activity with both rain fed and irrigated agriculture in Amboseli Ecosystem. According to Bulte *et al.,* (2006) the Maasai choose between two decision alternatives. First, they can rent out their land to farmers or they farm their land themselves. Depending on the location of the land within the ecosystem, irrigated or rain-fed agriculture is feasible. This results in an area- specific flow of profits. Arable land for crop production within the Ecosystem consists of the arable strips of land at the slopes of Mt. Kilimanjaro and all the irrigation scheme (Amboseli Ecosystem Management Plan, 2008-2018).

In Kenya, almost all the National Reserves and Parks are too small to comfortably host all the wild animals and therefore have to rely on the surrounding community and privately-owned lands for migratory corridors and dispersal areas. This implies that majority of this lands are subject to multiple uses both wildlife related or otherwise. In Amboseli Ecosystem, the six Group Ranches act as the buffer zone for the Amboseli National Park. Communities in this buffer zone engage in different socioeconomic activities to sustain their livelihoods either privately or communally. From the Kimana Integrated Wetland Management Plan (2008-2013), wildlife conservation is an important economic activity in the Amboseli Ecosystem. It offers off- farm employment opportunities for the residents in the area. There are highly successive wildlife related community based enterprises that generate significant revenue for group ranch members. Currently there are about eight centers of conservation outside the national park. Lodges have been built around the conservation centers and they provide employment and outlet shops for sale of handicrafts, food stuffs and traditional performances. The main wild animal in Amboseli Ecosystem is the elephant with some estimated population of 1500 individuals (Fitzgerald, 2013). Other animals include birds, lions and giraffes.

Economic benefits from wildlife conservation are hardly estimated at the household level (Mburu, 2013). Aggregate figures are estimated at the national level and the landowners are mostly left with a feeling of having to bear the cost of wildlife conservation. This has made wildlife conservation an unattractive choice of land use in a time when returns from crop production are so high even in the sections of the Ecosystem where tourism activities heavily dominate (Norton-Griffith and Said, 2010). Further, low returns from wildlife conservation are attributed to policy and management problems which diverts a big portion of the revenue from wildlife to the real producers of wildlife (Norton-Griffith and Said, 2010).

All group ranches in the ecosystem were under the process of subdivision except for Eselenkei and Kuku A (Ntiati, 2002). This means shifting from the current communal property rights regime to private ownership. The implication is the landowners' ability to make independent decisions regarding the economic activities to engage in. This study does not focus on wildlife conservation within the Amboseli National Park (ANP) but rather on the surrounding community that economically engage in wildlife conservation either privately or communally. Given the above economic activities which seem to have importance in equal measure to the landowners, then the question of the economic gains from the different competing land uses arises.

1.2 Problem Statement

Land allocation is perceived to be optimal when the aggregate discounted social returns (total net present benefits) from its alternative uses over time are maximized (Barbier & Burgess, 1997) Amboseli Ecosystem is mainly an arid and semi-arid zone characterized with very minimal rainfall with spans of recurrent drought. Traditionally pastoralism and wildlife conservation have been the most important economic activities within the ecosystem.

Recently a lot of changes are being experienced in the area. This has led to a change in the socio-economic lifestyle of the pastoralists and an introduction of other economic activities like crop production and wildlife conservation. While macroeconomic forces driving these transformations in the Ecosystem are well documented, (Norton-Griffiths, 2000; Campbell *et al.,* 2003; Boone *et al.,* 2000; Van der Valk, 2008; Norton- Griffiths and Said, 2010; Farmer and Mbwika, 2012; FAO, 2013), the microeconomic drivers have been neglected by researchers.

Further the Kenyan government is seeking privatization of land in the Amboseli which is seen as initial steps to development (Boone *et al.*, 2005). In addition conservationists (Okello, 2006; Western *et al.,* 2009; Lewis 2013; Fitzgerald 2013) are concerned with the increased threat to the wildlife populations and biodiversity in general as a result of sedentarization and subdivision of pastoral lands. At the same time reports on the significance of wildlife in Kenya through tourism is given at the national level, little can be said about the direct benefits the land owners get for their participation in conservation.

A study by Mburu (2013) showed that there are three major economic land- use options in the Amboseli ecosystem. These are wildlife conservation, crop production and livestock keeping.

He further noted that most of these economic activities are not pursued separately but one or two are interacted. Land being a major natural resource in the Amboseli Ecosystem, the value of the different land uses is not clear.

While several studies have focused on the human-wildlife conflict associated with the change of the property right regime in Amboseli Ecosystem (Ogutu, 2002; Bulte *et al.,* 2006; Burnsilver *et al.,* 2008; Kioko *et al.,* 2008; Western *et al.,* 2009; Amwata and Mganga 2014; Okello *et al.,* 2014; Gich *et al.,* 2014; Sitienei *et al.,* 2014) few comprehensive studies on the economic gains by the land owners, given competing land use options, has been done. With little knowledge on the economic value of different uses of land in Amboseli Ecosystem, sustainable planning and feasible use of the land resource may not be achieved.

1.3 Purpose of the Study

The purpose of the study is to conduct an economic evaluation of competing land use options and their influencing factors in Amboseli Ecosystem

1.4 Objectives

i. To compute economic value of competing land use options in Amboseli Ecosystem.
ii. To assess the drivers of competing land use options in Amboseli Ecosystem.

1.5 Research questions

i. Are the competing land use options in Amboseli Ecosystem profitable?
ii. Do socio-economic variables and demographic factors influence the land use option?

1.6 Justification

Approximately 80% of the area in Kenya is classified as arid and semi-arid lands with abundance of natural resources particularly wildlife (Ministry of Agriculture, Livestock and Fisheries, 2015). Economic viability and the ability to continue deriving goods and services from these resources in a sound and sustainable manner can only be achieved if proper management of these resources is employed. With the increased population growth, high poverty levels and the increased threats from climate change, diversification of livelihoods is necessary. This is in line with Kenya's blueprint, vision 2030 that calls for increasing value in agriculture and tourism in the economic vision and strategy and increasing equity and poverty elimination in the social strategy. Similarly, the study findings will also inform policy in line with the Sustainable Development Goal (SDG) one of no poverty and twelve of responsible consumption and production particularly in matters regarding natural resources. In addition, the findings will inform decision making on appropriate policies for long-term planning of the Amboseli Ecosystem which is in line with the Amboseli Ecosystm Management Plan (2008-2018).

1.7. Scope and Limitations of the Study

The question of what economic gains landowners in Amboseli ecosystem derive from the various land –use options and the determinants of choice of a particular land use option was the focus of this study. This was done by looking at the economic value of the various land-use options. In addition, the study focused on macro and micro economic forces.

Due to financial limitations, the macro issues were discussed from the literature and a field survey was conducted to establish micro- economic forces driving the change. The study did not look at the optimal allocation of the competing land use options and the impact of the economic gains on the livelihood of the landowners. The study did not have its focus on wildlife conservation within the Amboseli National Park but rather on wildlife conservation as an economic activity for the community whose land resource act as the buffers zone or dispersal area for the wildlife.

CHAPTER TWO

LITERATURE REVIEW

2.1 Economic importance of rangelands in Kenya

Rangelands are defined as terrestrial systems characterized by a climate regime where the potential evapotranspiration exceeds precipitation, annual precipitation ranges from less than 50 to 600 millimeters, and air temperatures range from -40 to 50 degrees centigrade. The vegetation is dominated by woody shrubs, grasses, cacti and leaf succulents, and drought resistant trees (FAO, 2016)

In Kenya, rangelands occupy 70 percent of the country's land area and support a big portion of the population with pastoralism, tourism through wildlife and most recently crop production as the main economic activities (Ministry of Agriculture, Livestock and Fisheries, 2015). Kenya is a country that is well endowed with wildlife resources which at the moment stand as the first export earner through tourism. This is followed closely by tea and horticultural crops. Tourism contributed 13.7% of GDP (Ksh 403.7 billion) in 2011 directly and indirectly (Ruggles-brise 2012). It is also a major contributor to employment especially in the hospitality industry. The main attraction of the tourists is the wildlife with national parks spread all over the country. There are about 23 terrestrial National Parks and 28 terrestrial National Reserves (Kenya WIldlife Service, 2014).

Besides employment rangelands play a big role in the food security situation with 70 percent of the meat consumed in Kenya coming from these rangelands (Makokha *et al.*, 2013). Plenty of biodiversity is found in the rangelands making it a unique African country. Indigenous animal genetic resources that are well adapted to the harsh climatic, nutritional and disease challenges are found in these rangelands. These are used to improve other breeds for similar adaptations.

Other enterprises practiced in the rangelands and make substantial source of revenue for the communities living in rangelands; include local craft products such as curio shops for tourism and other markets. Bio-enterprises such as honey production, medicinal plants, aloes, snake-venom and butterflies also play a big role in the livelihoods of people in the rangelands. Quarrying and mining are quite common in the rangelands following the increased infrastructural developments taking place in urban centers. Socio-cultural benefits such as Maasai *manyattas* and the Maasai people are a good tourist attraction (Mburu, 2013).

2.2 Management aspects of rangelands in Kenya

In order to ensure continued and sustainable use of natural resources in the vast Kenyan rangelands, different management aspects are employed that vary from one region of the country to the next. For instance, the northern and coastal rangelands are governed by an umbrella body termed as Northern Rangeland Trust. The trust was established in the year 2004 with a mission of developing resilient conservancies which transform people's lives, secure peace and conserve natural resources. The trust is able to achieve its mission through raising for the conservancies, providing them with advice on how to manage their affairs, supporting a wide range of training and helping broker agreements between conservancies and investors. The trust also serves the role of monitoring performance, providing donors with a degree of oversight and quality assurance (Nothern Rangelands Trust, 2016).

Unlike the organized rangelands management in the Northern and Coastal areas of the country, the Southern Rangelands where Amboseli Ecosystem lies is still under the Group Ranches management. Noticeably, is the Amboseli Ecosystem Trust that was established as an implementation body for the Amboseli Ecosystem Management Plan of 2008-2018. Its mandate is to act as an umbrella body that brings together the Amboseli communities and partnering organizations (Amboseli Ecosystem Trust, 2012)

2.3 Paradigms in wildlife conservation

Several paradigms in wildlife conservation have evolved with time. For a long time, the strategy adopted in wildlife conservation was the protected area system which involved top-down command and control measures. These measures included fencing off specific areas to restrict their use. This system was also used in other natural resources such as forest conservation.

Wildlife in many protected areas including Amboseli Ecosystem, depend on access to food and water found on private lands just outside these protected areas. The success of conservation efforts is determined by the balance between benefits and costs as perceived by these private agents. However, the protected area system offered very few incentives to the local communities near these resources as they denied them access to the ecosystem services. This adversely impacted on the local communities especially the poor households therefore offering very little incentives to use the ecosystems in a sustainable way (Randall & Philip 2010).
This limitation of the protected area system led to the emergence of new conservation approaches. These approaches include Integrated Conservation and Development Projects (ICDPs),Community –based Conservation (CBC), Community Conservation and Community- based Natural Resource Management (CBNRM) (Meguro, 2009.).

These new paradigms in wildlife conservation were seen to offer sustainable alternatives to traditional protectionist approaches with an understanding that human and nature should be seen as an integrated system (Hughes and Flintan, 2001; Riemer and Kelder, 2008). However, pastoralists have expressed dissatisfaction in their economic and wellbeing due to restrictions on land use imposed by the managing authorities (Riemer and Kelder, 2008).

A more recent approach to wildlife conservation is the community sanctuaries supported by associations. An example is the Kimana Community Sactuary supported by Amboseli Tsavo Group Ranch Conservation Association. The association was established with an aim of promoting wildlife conservation, community benefits and deployment of scouts to combat poaching (Amboseli Ecosystem Trust, 2017). Kimana Community sanctuary within Amboseli Ecosystem was established with the aim of discouraging cultivation within Kimana Group ranch. An environmental impact assessment suggested a sanctuary was the best land use option as it proved to have more rewards as opposed to cultivation. However, issues relating to local ownership, equitable benefits sharing, good governance and political control over the access and use of these natural resources posed major challenges to the community sanctuaries (Ondicho, 2012). As much as the community is engaged in management of wildlife in the new approaches, at the household level, landowners' ability to integrate wildlife conservation in the land use decision making process is yet to be seen.

2.4 Key issues in land use in Kenya's rangelands

2.4.1 Land subdivision

Group ranches formed under an Act of parliament were supposed to allow members gain collective group title to their land. Specifically they were supposed to increase the productivity of pastoral land by increasing off-take; reduce the possibilities of landlessness among the

Maasai due to allocation of individual ranches to some pastoralists; improve the earning capacity of pastoralists and reduce environmental degradation from overgrazing on communal lands (Ntiati 2002; Norton-Griffiths & Said 2010) Furthermore the group ranches were meant to encourage development of infrastructure for both livestock in form of dipping tanks and water sources and people by construction of facilities such as schools and hospitals (Boone et al. 2005). However, only some these objectives were realized.

Land subdivision is seen to elicit positive and negative consequences from the household level to the national level. At the household level, subdivision secured and strengthened an individual's property rights against in-migration, land alienation by political or economic elites and conservationists. Secondly it allowed individuals to assume personal control of their social and economic future in capturing the economic benefits of agriculture, livestock and wildlife production directly at the household level (Norton-Griffiths & Said 2010).

Declining livestock carrying capacity and declined wellbeing of household members in subdivided group ranches were undesirable effects of land subdivision (Boone *et al.*, 2005). With continued reduction of land sizes, households were forced to sell more animals to satisfy their cash needs (Thornton *et al.*, 2006). Consequently, herd sizes reduced significantly and they could no longer support livelihoods. Eventually households were forced to seek alternative economic activities to use on smaller parcels of lands when faced with declining livestock numbers and productivity.

At the national level, subdivision led to the loss of dispersal areas for the wildlife and reduced area for grazing the livestock especially during the dry spells. Leading to overgrazing and consequently degradation of land (Norton-Griffiths & Said 2010). Cultivation of land following subdivision of group ranches was considered as the most important threat to wildlife conservation in Kenya's ecosystems including Amboseli and Mara. This was attributable to higher financial rewards cultivation offers at the household level compared to wildlife conservation (Seno and Shaw, 2002).

Breakdown in communal systems; failure of the group ranch system to deliver equitable benefits and improved livelihoods, non-adaptable socio- economic changes such as a more sedentary way of life are some of the reasons behind land subdivision (Fitzgerald et al. 2013). Socio-economic changes were partly attributed to a response to government policies that prescribe for a sedentary lifestyle.

Policies advocating for sustainable pastoralism and wildlife conservation when faced with the threat of land subdivision are critical. Otherwise, households will continue choosing land use options with the highest economic returns regardless of its sustainability and the detrimental effects it may have on the environment.

2.4.2 Conversion of land to agricultural use

Dry lands cover about 40 percent of the world's land surface and are home to more than 2 billion people with 90 percent being in the developing countries (Francisco *et al.*, 2013.). Growing demands for food, feed, fuel, fibre and raw material create local and distant pressures for land- use change. The ability to retain natural resources such as forests, grasslands, rangelands with wildlife in that state is dependent on how competitive the uses and values provided by these natural resources compared to uses and values provided by other uses of the land such as agriculture and development.

Ecosystems in Kenya are widely experiencing land use changes favoring crop production. In Amboseli Ecosystem, horticultural crop production around water areas mainly swamps and rivers dominates. In Mara Ecosystem, large scale production of barley and wheat dominates. In both ecosystems crop production is at the expense of wildlife conservation and livestock production (Serneels and Lambin, 2001). These changes are attributable to the increased need for livelihood diversification exacerbated by the increasing human population and increased poverty levels leading to more sedentary ways of life. In contrast, the government, bilateral donors and international NGOs seem to have a notion that pastoralists livestock production is environmentally damaging as opposed to wildlife based form of land use which is seen to be more ecologically and economically sustainable (Homewood *et al.*, 2012).

Land use changes will continue having impacts on wildlife conservation through continued interference on the wildlife corridors leading to increased human wildlife conflicts in Amboseli Ecosystem (Noe, 2003; Okello, 2005). While detrimental consequences of converting the rangeland into agricultural crop use are evident, as long as the issues such as increased poverty and food insecurity are not addressed, these trends are not likely to change. This is especially when faced with challenges in livestock production such as lack of markets for beef, declining livestock numbers; increasing costs of pastoralism and shrinking land and water resources for livestock (Okello, 2005).

2.4.3 Human –Wildlife conflict

Human wildlife conflict has been defined to be a concept that occurs when wildlife encroaches human needs with costs to both the communities and the wild animals (Lamarque *et al.*, 2009). This is a crisis that occurs all over the world but the magnitude of the problem differs from one place to the other. In Africa this problem is more pronounced and prevalent in comparison to other developed countries (Lamarque *et al.,* 2009). In Kenya, the human- wildlife conflict is not any different and huge economic losses are registered every year as a result. This is both at the household level, community level and the national level. In Amboseli Ecosystem, a total of 4,272 livestock animals were killed by predators between 2009 and 2012 amounting to Ksh 33.3-40 million in loss (Gichohi *et al.,* 2014). In areas, adjacent to Meru National Park, crop losses worth Ksh12.9 million between 2010 and 2011 were recorded (Sitienei *et al.,* 2014) while Baringo county had losses in crops worth Ksh 12.5 million (Amwata and Mganga, 2014).

The government, conservationists and international donors have put some efforts in compensating farmers for losses specially livestock predation. However, the government through KWS does not compensate crop losses and consequently farmers have to bear full costs associated with wildlife conservation. Given the kind of losses recorded and increased government attention towards wildlife conservation as opposed to pastoralism and crop production, wildlife conservation continues being an unattractive choice for landowners as little if any tourism revenue trickle down to them (Norton-Griffiths and Said, 2008). This is unlike agriculture which provides substantial amounts of food, direct household income and jobs for the community and is therefore perceived to have more economic benefits (Okello and Kioko, 2011).

2.5 Empirical review of relevant literature

2.5.1 Review of Economic Valuation of land use

Ecosystems are among natural resources which provide services to the human kind. These services are important as they provide outputs that directly and indirectly affect human well-being. In an attempt to compare economic returns derived from pastoralism and agricultural use of land in one of Ethiopia's rangelands, Behnke and Kerven (2011) conclude that pastoral livestock keeping is more profitable compared to irrigated crop production and that there are more environmental implications related to crop production in the ASAL area. These include soil salinization, water logging, lost soil productivity and weed infestation. In addition, Okello and Kioko (2011) in Amboseli Ecosystem of Kenya, deduce that use of land for agricultural crop production at the expense of wildlife conservation and pastoralism seems to have a short term economic benefits to the community from the subsistence and commercial farming. However the alarming rate with which the few water resources are being utilized, increases competion and potential people to people, people to wildlife, people to livestock and livestock to wildlife conflicts.

In Mara-Serengeti Ecosystem, Gohil and Bhanderi (2011) using the Livelihoods Framework Analysis rank pastoralism and livestock trade as most popular choice of livelihoods followed by agriculture which is thought to be a supplement source of income for the households. Wildlife conservation and related activities is least preferred following its associated human-wildlife conflicts. In contrast, Onjala (2004) empirical results in Mara Ecosystem, demonstrate that cultivation of crops; cabbage and tomatoes are ranked first and second while livestock keeping mostly dairy comes in third.

Kristjanson's *et al.* (2002) apply integrated economic and ecological data in informing land-use activities that would lead to protection of wildlife corridors and dispersed areas and at the same time maximize returns from the land in Kitengela wildlife dispersal area. Livestock production is noted to be the dominant economic activity and subsistence crop cultivation is seen to be a central part of livelihood diversification strategies.

These authors have employed different methods in determining the economic value of land uses. Gaps have been noted in most of these methods making the results questionable. For instance Behnke and Kerven (2011), use gross margins to estimate the profitability of various land uses. However, secondary data sourced from past studies is used to build a herd model in livestock production which may pose challenges of data inaccuracy. Kristjanson's *et al.* (2002) apply partial budgeting and cluster analysis methods to estimate economic returns to the different land use options though uses a small sample size of thirty which fails to give any meaningful econometric analysis. The current study uses gross margins estimated at house-hold levels covering both the direct and indirect use values of land in Amboseli Ecosystem.

2.5.2 Review of drivers of competing land use options

Economists define land as an economic good with special characteristics compared to other economic goods, this is because its supply is fixed. More often a rational utility maximizing agent attaches economic value to land as a resource. It is the market value that is used in land use decision making. Li *et al.* (2013) show that increasing urban land value is a major driver of farmland development, reflecting increasing responses of land use decisions. However an earlier similar study by Flores (2009) differed in findings which concluded that location of new urban development is guided by a preference over lower density areas yet in proximity to current urban development. Li *et al.* (2013) concluded that rising rural income was the primary driver of farmland conversion to forests and grasslands in China. In Kenya this may not be the case as high rates of population growth and environmental degradation are some of the major drivers of the trends towards sendentarization and farming (Greiner *et al.*, 2013).

Barbier and Burgess (1997) examined the economics of tropical forest land use options considering sustainable forest management for timber harvesting and conversion of forest land to agriculture for crop production. Forestry practices and policies put in place are seen to encourage forest conversion to agriculture at the expense of environmental benefits that could be acquired from sustainable forest use. Similarly, Mburu *et al.* (2003) consider forests, bush land and agriculture as the land use choice set in Kakamega, Kenya. Socioeconomic, demographic, geographical and agricultural shocks are found to be major driving forces of land use/ cover changes. Bashaasha *et al.* (2006) report that socio-economic factors together with farmers' attitude and plot characteristics are contributing factors to a farmer's land use decision.

Gaps are evident from these studies making the results questionable or not applicable in the current area of study. For instance, Barbier and Burgess (1997) study was conducted across tropical forest countries, the complementary inter temporal model developed gave a global perspective of the forest land use and cannot be applied regionally or locally. Mburu *et al.* (2003) relies on village leaders and elders to give information on the socioeconomic and demographic data over the 30-year period. This could have been inaccurate since no prior recording of these information was done while Bashaasha *et al.* (2006) show a situation in the highlands. A study in the ASALs has not been done therefore, the need for the current study which will inform on the factors that determine the choice of a particular land use option.

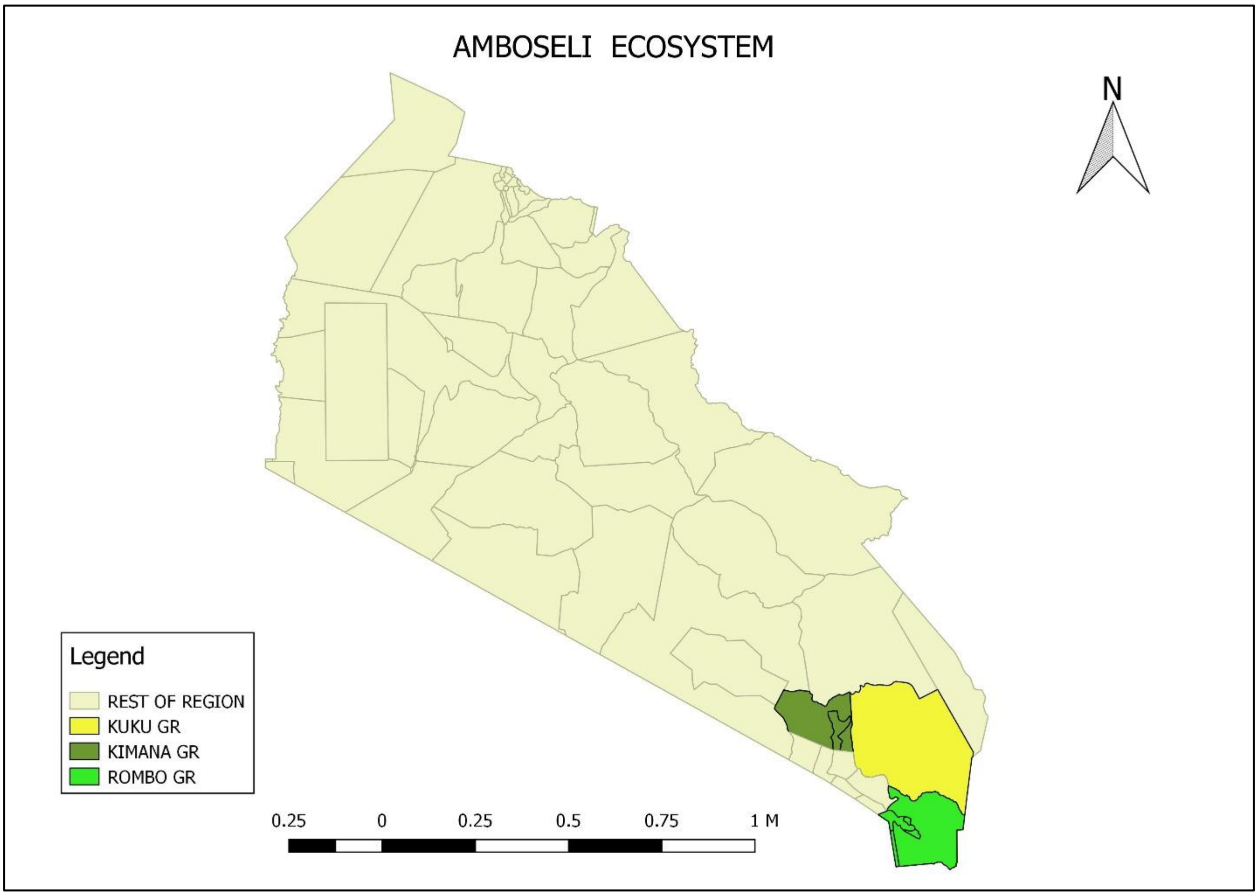
CHAPTER THREE

METHODOLOGY

3.1 Area of Study

The area of study is Amboseli Ecosystem located in Kajiado County in southern Kenya. This ecosystem is approximately 8,500 km^2 (BurnSilver et al., 2008). Administratively, the Amboseli Ecosystem consists of Amboseli National Park and the surrounding six group ranches namely: Kimana (Tikondo), Kuku A and B, Olgulului (Olalarrashi), Imbirikani, Rombo, and Eselenkei in Loitokitok.

Figure 1: Group Ranches of the Amboseli Ecosystem targeted in the study



Source: Generated by the author using QGIS from Kajiado Ranches Shapefiles

Amboseli Ecosystem is a typical African arid rangeland and falls under the agro ecological zone V and VI. Rainfall is low (350mm on average per annum) and unpredictable in time and space (Bulte *et al.,* 2006). The rainfall is twice a year with a classic bimodal pattern found around the equator in East Africa. Precipitation peaks are in March –April and October – December. Lower elevations between Amboseli National park and Chyulu hills receive less than 500mm. In this ecosystem, rainfall is inconsistent and drought is a recurrent problem. The temperatures range from 20-30^{0}c with as low as 10^{0}c being experienced in the Eastern slope of Mt. Kilimanjaro. Coolest period is between July and August and the hottest months being November to April (District Agricultural Office- Loitoktok, 2014).

Water is available in swamps which sustains the ecosystem and its habitats. Swamps are fed by subsurface water that percolates through volcanic rock from the forested catchment of Mt. Kilimanjaro. There are several types of soils in the ecosystem: Luvisols, Cambisols, Volcanics, saline and sodic lacustrine and Pleistocene volcanics. The Pleistocene volcanic are found at the foot of Kilimanjaro which favors production of maize (Burnsilver *et al.,* 2008). In addition, alluvial clays accumulate in seasonal runoff which traps nutrients and support grass growth for a while after the rains (Kimana Integrated Wetland Management Plans, 2008-2013).

Amboseli ecosystem posed as a good study area because of the dynamism it has been experiencing in the last two decades. First, there is the subdivision of the communal land to private land hence a change in land-uses. This is from extensive pastoral farming to agro-pastoral farming. Secondly the ecosystem has experienced addition of crop production as an economic activity and growth in tourism. Similarly, Amboseli Ecosystem houses strategic wildlife resources.

Amboseli Ecosystem has a total of 12 irrigation schemes (Table 1) where crop production takes place (District Agricultural Office- Loitoktok, 2014). The most popular crops grown under these irrigation schemes include tomatoes, onions, green maize, beans and Asian vegetables (Okello and Kioko, 2011). The main sources of water for irrigation are rivers and springs. Kimana Group Ranch has the highest number of irrigation schemes and highest area under irrigation possibly because it is fully subdivided and farmers can make an autonomous land use decision. Being an ASAL region the rampant crop production being practiced has posed as a threat to the natural resources and biodiversity in the Amboseli Ecosystem. This is from the constant competition for the pasture and water from livestock production and wildlife conservation leading to human wildlife conflicts (Okello *et al.*, 2011; Okello and Kioko, 2011).

Three Group Ranches; Kimana, Kuku and Rombo were purposively chosen for the study. These three areas were chosen because each group ranch has distinct features which would help bring out the dynamism in the ecosystem forming a good representative of the entire ecosystem.

Kuku Group Ranch is directly in the wildlife corridor between the Kilimanjaro area/Amboseli National park and Chyulu hills/Tsavo national park (Okello, 2005). There is a total of 6000 registered members in Kuku Group Ranch which comprises both Kuku A and B. Subdivision of land has not yet taken place in this Group Ranch and communal use of land is still practiced. Kuku Group Ranch is relatively dry and minimal farming, if any takes place. This is with an exception of settlements along the riverine where irrigated agriculture takes place. Livestock keeping is dominant in the area. Maasai Wilderness Conservation Trust (*Campi ya Kanzi*) is the dominant leasing agency for wildlife conservation and apart from the direct income, the trust also supports other social pillars of life specifically health and education.

Table 1: **Irrigation schemes in Amboseli Ecosystem**

Group Ranch	Irrigation scheme	Area under irrigation (Ha)	Water source	Crops grown
Kimana	Isinet	80	Isinet river	Onions, tomatoes, beans, maize and chilies
	Kimana	400	Kimana River and Tikondo Springs	Onions, French beans, bananas, tomatoes, maize, beans, chil-lies, citrus, water melon
	Impiron	100	Empiron springs	Onions, French beans, baby corn, tomatoes, maize, beans, chilies, citrus,
	Ilchalai	120		
	Namelok	429	Engumi and Olmakao springs	Food crops, French beans, to-matoes, onions
Kuku	Inkisanjani	200	Nolturesh Riv-er	
	Elangata Enkima	150	Nolturesh Riv-er	Onions, tomatoes, food crops
	Olorika	150	Nolturesh Riv-er	
	Iltalal	80	Iltilal springs	Tomatoes, food crops
	Illasit	40	Illasit springs	Onions, kales, tomatoes, food crops,

Rombo	Entarara	80	Springs	French beans, tomatoes, food crops
	Rombo	596	Rombo and Ngareleni springs	Asian vegetables, onions, tomatoes, food crops, baby corn, French beans

Source: District Agricultural Office, Loitoktok (2014)

Towards the border of Kuku Group Ranch and Tsavo East National Park lies Mzima springs which serves as an attraction site and also as water hole for many wild animals in the area (Mburu, 2013).

The second Group Ranch is Kimana that borders Amboseli National Park on the West, Mbirikani Group Ranch in the north and Kuku Group Ranch in the East. It lies on a 251km^2 land within the Amboseli Ecosystem. This group ranch is fully subdivided with a population of 848 registered members by the time of sub division. The group ranch was subdivided into 4 zones; dry land area where every member got 60 acres, wetland area with 2 acres for every member, 6000 acres for the Kimana Community Sanctuary. The last zone was the town area zone where town centers were divided into 5 centers which were further divided into plots for each member of the group ranch.

The ranch has several attributes which makes it a good study area. Its proximity to Amboseli National Park and the presence of Kimana Community Sanctuary makes it have a good dispersal area for the wildlife therefore the landowners in the group ranch are likely to practice wildlife related activities. Mburu (2013) notes there are more than three cultural centres in this group ranch. The combination of springs and swamps in Kimana Group Ranch with a complex pattern of soils and vegetation allows presence of wild animals and irrigated crop production (Kimana Integrated Wetlands Management Plans, 2008- 2013). In addition, land-owners have fenced off the areas around the swamps and intense irrigation is taking place (Fitzgerald *et al.,* 2013). This group ranch has several lodges which fund the community indirectly and directly. There are several landowners associations which enable them in dealing with conservation leases for their land (Fitzgerald *et al.,* 2013). Given the proximity to major towns like Nairobi and presence of tarmacked road and in combination with availability of water for irrigation, Kimana Group Ranch has attracted several non –Maasai residents who mostly include the Kikuyu and Kamba people.

The third Group Ranch in the study was Rombo Group Ranch. It lies on 523.9km^{2}area of mostly semi-arid land. It is situated in the southeastern corner of Loitoktok division of Kajiado County and borders Kuku Group Ranch on the North and Tanzania in the south. There was a total of 3,565 registered members as of 2014 according to District lands adjudication office, Kajiado County. This group ranch is noted to practice a lot of rain fed and irrigated agriculture from river rombo that flows from the slopes of Mt. Kilimanjaro. A bulk of tomatoes, onions and Asian vegetables are found in the group ranch. Livestock keeping is also present but tourism lacks a good structure with very few investment opportunities from wildlife presented. Kenya Wildlife Service (KWS) is the main leasing organization here though it is present in the other group ranches as well.

As much as there are these opportunities in the different group ranches, the challenges faced are more or less the same with the most outstanding ones being deterioration of water quality, human-wildlife conflicts, recurrent floods and drought, land degradation, deforestation and degradation of springs (Kimana Integrated Wetlands Management Plans, 2008- 2013). Differences in the group ranches makes the ecosystem a good case study for comparisons purposes of the different economic gains from the competing land uses and understanding of the choice of land-use and their determinants.

3.2 Conceptual Framework

This study borrowed from welfare economics theory to explain the landowner's behavior as they choose the land use option that has the most benefits to them. Farmers' choice of the land- use option is determined by several factors which are assumed to lead to utility maximization. Economic valuation offers a way to compare the diverse benefits and costs associated with ecosystems (Pagiola & Bishop 2004). Total Economic Value (TEV) is a framework that is used to classify ecosystem goods and services. The TEV of ecosystems and biodiversity is the sum of the values of all service flows that natural capital generates both now and in the future if appropriately discounted (Brander *et al.,* 2010).

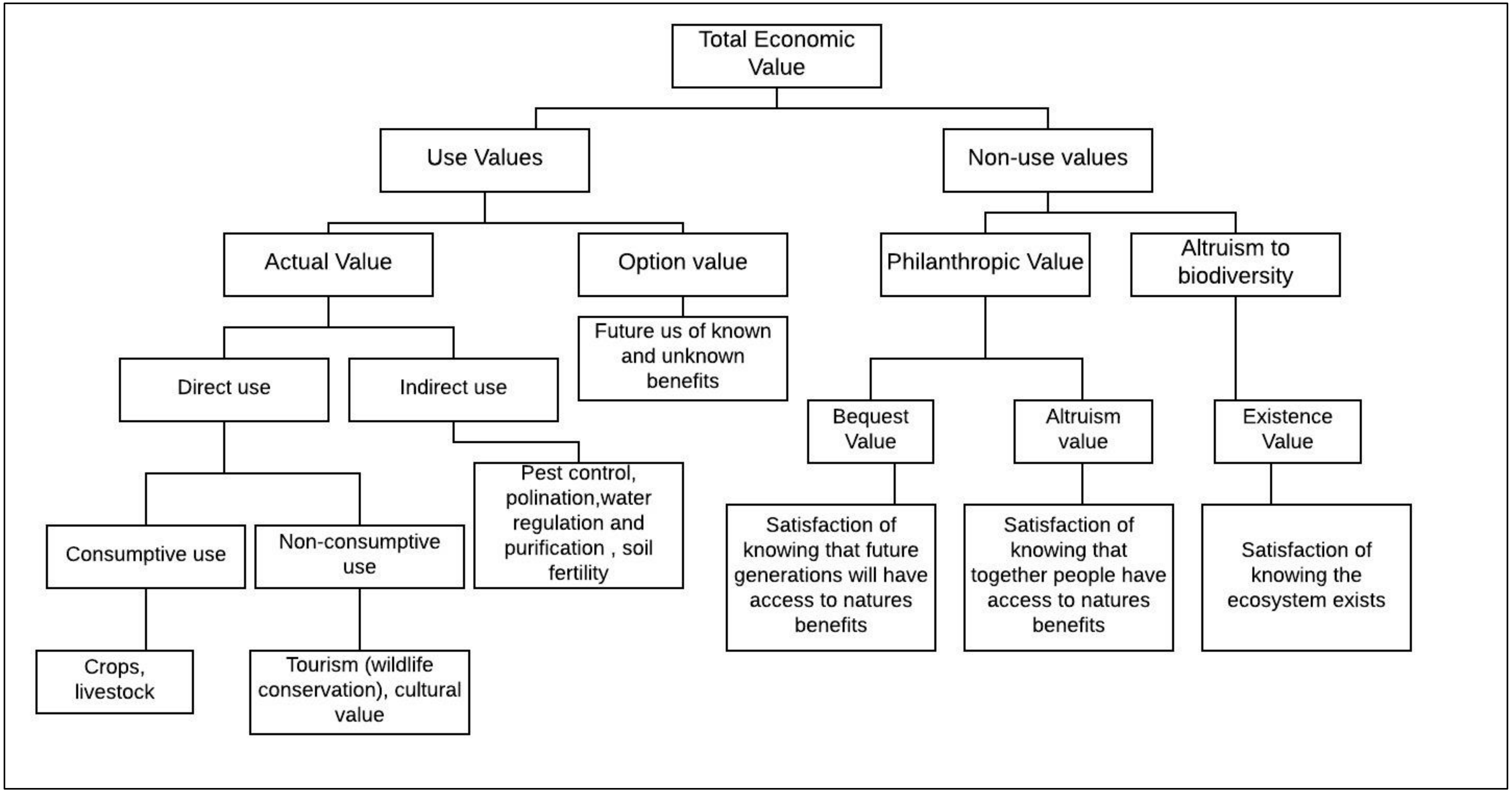
Several analysts use different classifications but generally as shown in Figure 2, include: Use Values which can either be direct use value that results from direct human use of biodiversity (consumptive or non-consumptive) or indirect use value which is derived from regulation services provided by species and ecosystems. The second category is non-use value which is further classified into bequest value that shows intergenerational concerns, altruist value that shows intragenerational equity concerns and existence value that is related to the satisfaction that individuals derive from the mere knowledge that species and ecosystems continue to exist (Brander *et al.,* 2010). Land in Amboseli Ecosystem is a natural resource that provides goods and services to the pastoralists in the area. Therefore, falls under the category of actual use where the pastoralists engage in different economic activities to derive a livelihood. The current study focused on the use values and specifically the direct use.

From Figure 2, livestock production has direct consumptive use. This means the decision to use land in livestock production activities is determined at the household level. With extensive livestock production systems in Amboseli Ecosystem with characteristics of nomadism, herding and disease control costs are the most critical determinants of profitability. Specifically, watering and herding labor, mineral supplementation, vaccination and disease control using acaricides and drugs. Revenue collected from the sale of livestock and the by-products such as milk, hides and skin and manure measure the income stream from livestock production. Current market prices are used in computing the economic value of livestock production.

Similar to livestock production, engagement in crop production in Amboseli Ecosystem is completely at the discretion of the households. It also has a direct consumptive use and therefore measurement of its profitability is relatively easy compared to wildlife conservation. Gross income is computed from the sales proceeds from crops under consideration. In the current study, consideration is placed on maize, beans and tomatoes. Variable costs in production of these crops include seeds, fertilizer, agrochemicals, ploughing and labor. The market prices are also used in valuing. Home consumption and crops sales were however not separated.

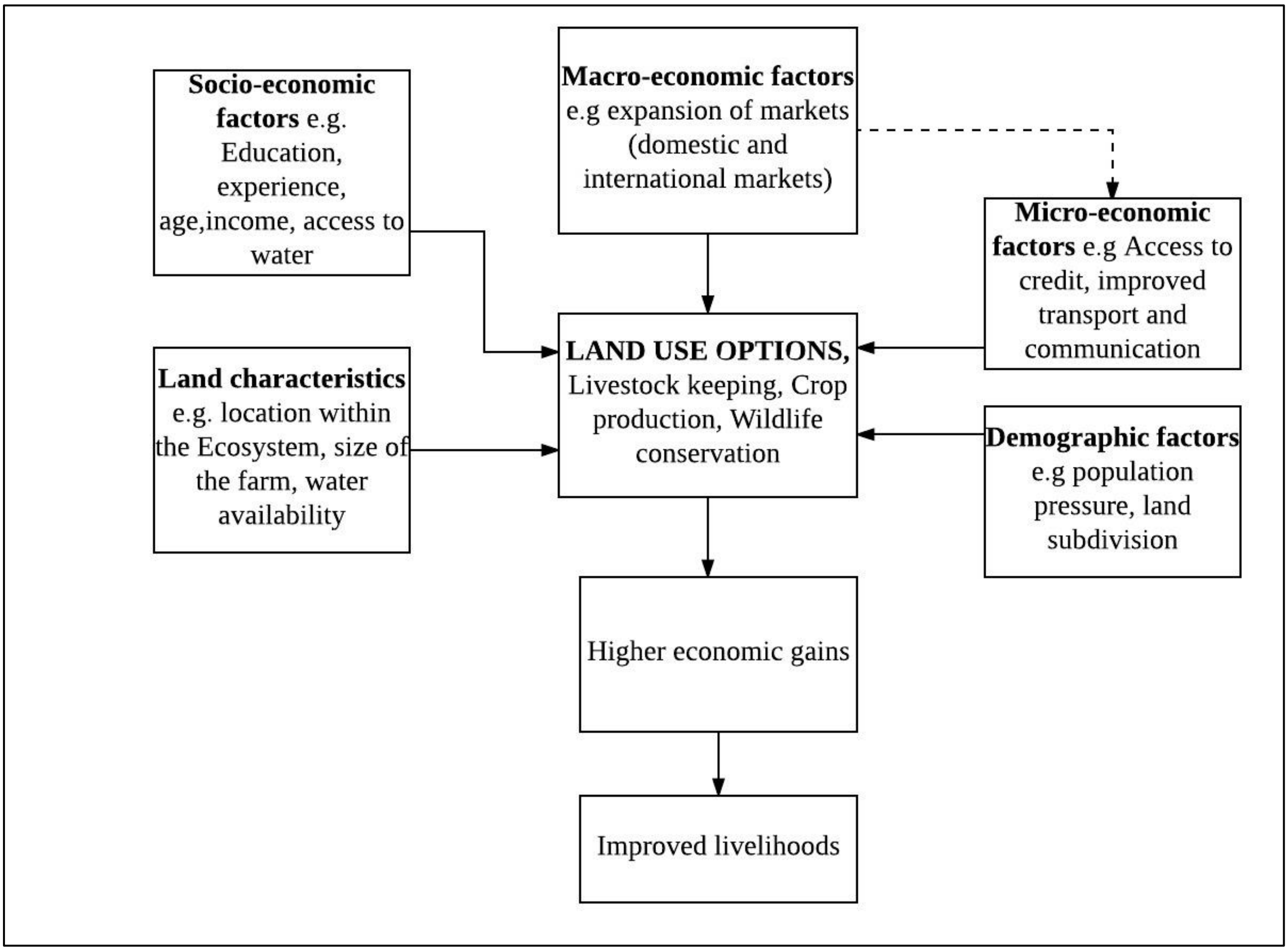
In Figure 2, Wildlife conservation has direct use but non- consumptive. Benefits streams from wildlife conservation provide incentives for households to conserve. Tourism related activities including game scouts, Maasai *Manyattas* and curio shops, direct lease fees and benefits tricking down to the households in form of schools, dispensaries, school fee bursaries and employment in tourist hotels act as proxies in measurement of these benefits. Costs of wildlife conservation also act as an indicator of the economic value and profitability level of wildlife conservation. Households incur wildlife related costs from human and livestock injury and death. Similarly, transboundary diseases from interaction of the wildlife and the livestock is a cost born by the households.

Figure 2: Total Economic Value of Natural Resources



Source: Adapted from the Africa Wildlife Foundation technical paper series (2011)

Figure 3 : Conceptualization of the determinants of land-use options in Amboseli Ecosystem



Source: Authors own conceptualization 2014

In addressing the second objective of drivers of competing land use options, several factors were considered as conceptualized in Figure 3. These are; socioeconomic factors, demographic factors, land characteristics, macroeconomic and microeconomic factors. These factors are assumed to affect the choice of land use which is livestock keeping, crop production or wildlife conservation. The land area under consideration in the study is the group ranches only, that have communal ownership excluding the Amboseli National Park which is a gazetted conservation area.

In Figure 3, socioeconomic and demographic variables such as age of the household head, education level, household size and income are hypothesized to influence the decision in the choice of land use option. Micro-economic variables including credit accessibility, transport and communication networks may influence decision on the best economic activity to engage in. This would follow from the ease with which a household can access markets if the road infrastructure is in place, or ease with which a household can obtain credit to expand their production activities with the available collateral. Land characteristics such as the size of the land, number of land parcels and water availability would easily determine the most profitable engagement at minimum costs. For example, (Figure 3) if a household has huge tracks of land, livestock keeping or wildlife conservation could be an easier undertaking as dispersal area for grazing is available. This is true for water availability where irrigated crop production could be preferred given the reduced costs in pumping water. It is expected that the choice of a particular land use will lead to higher economic gains and ultimately improved livelihood for the household in the Amboseli Ecosystem.

3.3 Empirical Framework

This study looked at determinants of the land- use choice by the landowners in one of its objectives. Therefore, it borrowed largely from the Random Utility Model theory (RUM). This is because RUM is used to analyze choice among many alternatives and the decision maker which in this case is the landowner is assumed to maximize a welfare enhancing factor. This factor could either be utility, profits, income or even output. Random Utility model is preferred by researchers because it enables measurement of the effects of introducing new alternatives (Haab and McConnell, 2002).

Given two land-use options L_1 and L_2 with their associated utilities U_1 and U_2, respectively, if U_1 is higher than U_2, then the landowner will choose land- use option L_1 based on the random utility model theory. Since there are aspects of utility that the researcher does not observe, then the utility is decomposed into two parts: a deterministic part (V_{ij}) and a stochastic part (ε_{ij}). This is as shown in **Equation 1**.

$$U_{ij} = V_{ij} + \varepsilon_{ij}$$

Equation 1

Where U_{ij} is the utility that land owner *i* derives from land-use option *j* while V_{ij} is a representative utility showing some attributes of the alternatives as faced by the land-owner and some attributes of the land owner (decision maker). ε_{ij} is the error term that captures the factors that affect utility but are not observed by the researcher therefore not included in V_{ij} (Train, 2009). In the second objective of this study, there are three land-use options identified and available to landowners. Therefore, a landowner *i* would choose an alternative land-use option *j* so as to maximize his/her utility U_{ij}.

3.4 Empirical Models

3.4.1 Evaluation of economic value of competing land use options

Gross margin analysis was used in the study to evaluate the economic value of competing land use options. Gross margin analysis is a useful measure of profitability that aid in enterprise planning. This is given its ability to give an outcome of profit maximization at an acceptable level of risk. Gross margins are computed by obtaining the difference between the annual gross income for the enterprises under consideration and the variable costs directly associated with the enterprise (Treloar *et al.,* 2017). The land use options identified earlier include livestock keeping, crop production and wildlife conservations. The net benefits of these options were then compared. While it's noted that Cost Benefit Analysis would give a better estimation of economic values of the different land use options, the current study was limited on the time period that would give significant results. Therefore, gross margins were opted for.

In computing gross margins for livestock keeping, gross annual output or revenue was computed by aggregating the volumes and prices of the animals, milk, hides and skin and manure sales. The livestock variable costs considered were disease control costs and the labor used in herding of the milking cows and shoats that are normally left around the *boma* when the rest of the animals are moved to far pastures within the ecosystem. Specifically, the quantities and unit prices of acaricides, mineral supplements, dewormers, vaccines, drugs, watering and labor were computed to obtain the livestock variable costs. Net livestock income was then obtained by deducting the total variable costs from the gross annual output.

For crop production gross margins, three crops were found to be dominant from the focused group discussions conducted. These were maize, beans and tomatoes. The total revenue from these crops was computed from the yields recorded and the prevailing market prices. The total variable costs were computed from the quantities of seeds, fertilizer, insecticides, ploughing and labour and the prevailing input prices used in production of these crops. Gross margins were then obtained by deducting total variable costs from the total revenue for an acre of land under crop production.

Wildlife conservation has a non-consumptive use and may lack direct market value. This posed as a challenge in trying to quantify the costs of wildlife conservation. Income from tourism related activities was used as a proxy to measure the benefits of wildlife conservation. Specifically, the study considered direct income from lease fees by different leasing organizations in the three Group Ranches, benefits that trickled down to households in form of employment of school teachers, employment of dispensaries staff, school fee bursaries, employment in tourist hotels and livestock. The study attempted to aggregate wildlife costs by households by considering any form of human injury and death, livestock injury and death.

3.4.2 Determinants of the drivers of competing land use options

The study used multinomial logit model (MNL) to estimate the significance of the factors believed to influence the landowner's choice of a land- use in the Amboseli ecosystem of Kenya. The model is designed to estimate the parameters of multivariate explanatory variables in situations where there are unordered categorical responses and the independent variables are continuous or categorical. This model is appropriate when data are individual specific (Greene, 2003) and the values of the independent variables are assumed to be constant among all the alternatives in the choice set. The coefficients are interpreted as weights that depict the probability of choosing one among the several alternatives. This model is preferred because of its computational simplicity in calculating the choice probabilities that are expressible in analytical form. The likelihood function which is concave also makes MNL specification easier.

According to (Greene, 2003), the general model for land- use choice is

$$P(Y_i = 1) = \frac{e^{\beta_j X_i}}{\sum_{k=0}^{J} e^{\beta X_i}},\ j = 0,1 \ldots J$$

Equation 2

Since there are three categories in the dependent variable, two equations will be estimated providing probabilities for the J+1 choice for a decision maker with characteristics $X_{i.}$ The βs are the coefficients to be estimated through maximum likelihood method. The model can be simplified into the following.

$$Z_{ij} = X_i\beta + Y_i\alpha + W_i\gamma + V_i\delta + \varepsilon_i$$

Equation 3

Where Z_{ij} is the probability that a household i chooses to use land through economic activity j. X_i, the household socioeconomic characteristics, Y_i is the land characteristics, W_i is the demographic characteristics and V_i is the micro-economic factors. β, α, γ and δ are the parameters to be estimated and ε_i is the error term. The land-use options include: Livestock keeping which for this study were used as the base, wildlife conservation and crop production.

3.4.3 Diagnostic tests of Multinomial Logistic model

Multinomial Logistic Regression model does not make any assumptions of normality, linearity and homogeneity of variance for the independent variables (Swab, 2001). Several diagnostic tests were carried out to test fitness of the model. These included goodness of fit test, independence from irrelevant alternatives (IIA) test, multi collinearity test, and heteroskedasticity test. Goodness of fit test was done to gauge how the model fits the data. Post-estimation of MNL model was done in Stata to compute a variety of measures of fit. IIA is the most notable limitation of MNL. It states that the ratio of the probabilities of choosing any two alternatives is independent of the attributes of any other alternative in the choice set (Nhemachena, 2008). Hausman test was carried out to determine IIA assumption. Finally, Variance inflation factor (VIF) was the diagnostic test used to determine presence of multi-collinearity among the independent variables in the model.

3.4.4 Variable description for the MNL

The study hypothesized that different household socio-economic and demographic characteristics, farm characteristics and micro-economic factors influenced the decision on the choice of the land use option. These characteristics were used in the study as the explanatory variables. The basis for this assumption was from the previous studies in different literature.

The specific variables used in the estimation of the MNL model together with their a priori signs are explained in Table 2

By fitting the variables, the model can be presented as

$$Landuse\_Option = \beta_0 + \beta_1 Age + \beta_2 HouseholdSize + \beta_3 LandSize + \beta_4\, Land\ Tenure + \beta_5 Distance\ to\ Water + \beta_6 Credit + \beta_7 Extension + \beta_8 DistUrbanTown + \beta_9 PrimaryOccu + \beta_{10} LogNetIncome$$

Age of the household head is hypothesized to positively influence the choice of livestock production and wildlife conservation relative to crop production. Older landowners are expected to have more experience in livestock keeping and wildlife conservation as the main engagement compared to crop production. This is because given crop production as a more recently introduced economic activity, older farmers may tend to be more conservative, less flexible and more skeptical about the benefits of crop production (Howley *et al.*, 2012).

Similarly, older famers may have larger pieces of land because they were there at the onset of group ranches. Registered group ranch members were few then. With the large tracks of land and subdivision not allowed, they may prefer keeping livestock and wildlife conservation as pasture is available.

Table 2: Expected Explanatory Variables

Variable Name	apriori Sign
Dependent variable	
Land use options	
Independent variables	
Age of the household head (Years)	+
Household size (number)	+
Land size (Acres)	+/-
Land tenure (1=secure 0=else)	-
Distance to water source (Km)	+
Credit (1=accessed 0=else)	-
Extension services (1=accessed 0=else)	+/-
Distance to urban town (Km)	+
Primary occupation (1=Farm 0=else)	+/-
Net income (Ksh)	+/-

In addition, studies have shown that as people become older, they become more understanding and tolerant to conservation issues and therefore are likely to engage in wildlife conservation as opposed to crop production (Mutanga, *et al.*, 2015).

Household size was hypothesized to positively influence the use of land for livestock production compared to crop production and wildlife conservation. This is because traditionally large herd sizes among the Maasai families is an indicator of high social status and wealth. Therefore, a larger household may be necessary to ensure presence or availability of enough family labor to take care of the animals.

As land size reduces, chances of engaging in crop production relative to livestock keeping and wildlife conservation are higher. Studies show that larger farms allocate more land to pasture and cattle ranching than small size farms (Ebanyat *et al.,* 2010). This is possibly because the large tracks of land provide the pasture needed for livestock keeping and they would also provide substantial wildlife dispersal areas.

Land tenure is hypothesized to negatively influence choice of livestock production and wildlife conservation relative to crop production. Farmers with title deeds used as a proxy for secure land tenure are likely to practice crop production. Secure land tenure is thought to increase the freedom of the land owner in decisions making on the use of the parcels of land. As reported in Maasai Mara Ecosystem, farmers with secure land tenure practiced commercial crop production compared to livestock keeping and subsistence agriculture (Serneels and Lambin, 2001).

Distance to the water source is hypothesized to positively influence choice of livestock production and wildlife conservation as opposed to crop production. Traditionally the Maasai had only livestock and wildlife conservation but recently crop production has been widely adopted by both the Group Ranch Maasai natives and immigrants. It's noted that crop farming in the Ecosystem takes place around water sources such as swamps, rivers and springs. With the ASAL nature of the Ecosystem, as one moves further away from the water sources livestock production and wildlife conservation may be preferred. This is coupled with the fact that with increased distance from water source, irrigated crop production would become too costly.

Access to credit is hypothesized to negatively influence choice of livestock production as opposed to crop production and wildlife conservation. This is because livestock farmers can easily 'credit in' on the value of their animals (Behnke and Muthami, 2011) and do not necessarily have to rely on other forms of credit such as main stream banking which requires a lot of documents and collateral to guarantee.

Increased distance to the market centre and nearest urban town also is hypothesized to favor livestock keeping and wildlife to crop production. Serneels and Lambin (2001) observed that the likelihood of practicing crop production as opposed to livestock production and wildlife related activities decreased five times for every 10km increase in distance to the nearest urban town in Mara Ecosystem. This is expected because the cost of transport for the crops to the markets increases as distance from the farm increases. Unlike livestock which can be taken to the market by trekking, it is more difficult for crop produce and other better means of transport may have to be used.

Household net income is assumed to be sourced from both off-farm activities and farm activities. This then becomes difficult to give an apriori sign because wildlife conservation related activities such as tour guides, scouts, and hoteliers are quite abundant and may provide stable source of income and less dependence on agriculture (Hettig *et al.,* 2015). At the same time sale of livestock whenever there is a need may also create a stable source of income. Similarly, crop production may be preferred to livestock and wildlife because of the revenue collected within a short period of month (3 months at most) which makes up the growing season of crops especially horticulture. Location of the land within the Ecosystem also determines the net income from either of the three land uses.

3.5 Data Sources

The study used secondary and cross sectional primary data collected from the households in the three of the group ranches; Kimana, Kuku and Rombo Group Ranches. A semi-structured questionnaire was administered to collect household socio-economic data, land characteristics, household demographic characteristics, microeconomic factors and any other data necessary in modeling the factors influencing the choice of land use.

For gross margins analysis, secondary data and primary data were used. The secondary data was specifically obtained from the District Agricultural Office, Loitoktok. The questionnaire contained both open ended questions and closed questions with regards to the land subdivision, household characteristics such as age of the land owner, level of education, experience and primary occupation. Farm characteristics such as water accessibility, number of land parcels, size of the land owned and the different land use allocations. Credit access, extension services and market access such as distance to the nearest markets was collected. Data on the household income and the specific sources of this income was also collected.

3.6 Sampling Procedure

The sampling frame for the study consisted of all members of three targeted group ranches in Amboseli Ecosystem i.e Kuku, Rombo and Kimana Group Ranches with a household as the sampling unit. The sampling frame was obtained from County Lands Office, Kajiado.

Probability proportional to size sampling was used to determine the number of landowners to be interviewed in each group ranch. From the scoping exercise prior to the survey, it was established that Kimana group ranch was fully and completely subdivided hence no more registration of members was done. This is unlike the other two group ranches where the land registry is updated every often with new members.

As informed from the scoping exercise and secondary data from District Agriculture Office Loitoktok, Kimana group ranch members' population has grown by a factor of 2.86 members. This was multiplied by the number of registered group ranch members in Kimana. This was with an attempt to avoid bias in sampling. To determine the sample size, the Cochran formula (Cochran, 1963) which was developed for large populations was used. This is given in Equation 4.

$$n_0 = \frac{z^2pq}{e^2}$$

Where:

n_0=the sample size

z= the standard normal deviate at the required confidence level

p= the proportion in the target population estimated to have a desired characteristic

q= 1-p

e= the level of statistical significance set.

Equation 4

In the Amboseli ecosystem, the variability in the proportion of land owners that chose any one of the land-use options was not known. Therefore p was assumed to be 0.5 which is the maximum variability (Israel 2013). The desired confidence level used was 95% with 0.057 precision levels. This gave a resulting sample size of 295.

$$n_0 = \frac{(1.96)^2(0.5)(0.5)}{(0.057)^2}$$

$$n_0 = 295$$

Table 3: Sample Size in each Group Ranch

Group ranch	Population size (N)	Sample size (n)
Kimana	2425	$\frac{2425}{9419} \times 295 = 75$
Rombo	3565	$\frac{3565}{9419} \times 295 = 111$
Kuku	3429	$\frac{3429}{9419} \times 295 = 107$
Total	**9419**	**295**

Systematic random sampling was then done to determine the farmers to be interviewed from the sample in each group ranch. From the sampling fraction calculated, every 32nd farmer in the register was chosen with farmer number 10 as the starting point as informed by the random numbers table. From Table 3, a total of 295 land owners was sampled for interviews. Seventy-five (75) from Kimana, one hundred and eleven (111) from Rombo and one hundred and seven (107) from Kuku Group Ranch.

3.7 Data Analysis

Data collected was analyzed using statistical packages; SPSS version 21, STATA and excel. Gross margins analysis was done to determine the economic value of the different land use options considered in the study area. Descriptive statistics were done to compare the farmers' characteristics in the different group ranches. This included frequencies, means, percentages, tables and standard deviation. Multinomial Logistic Regression Analysis was done to determine factors influencing choice of a particular land use option.

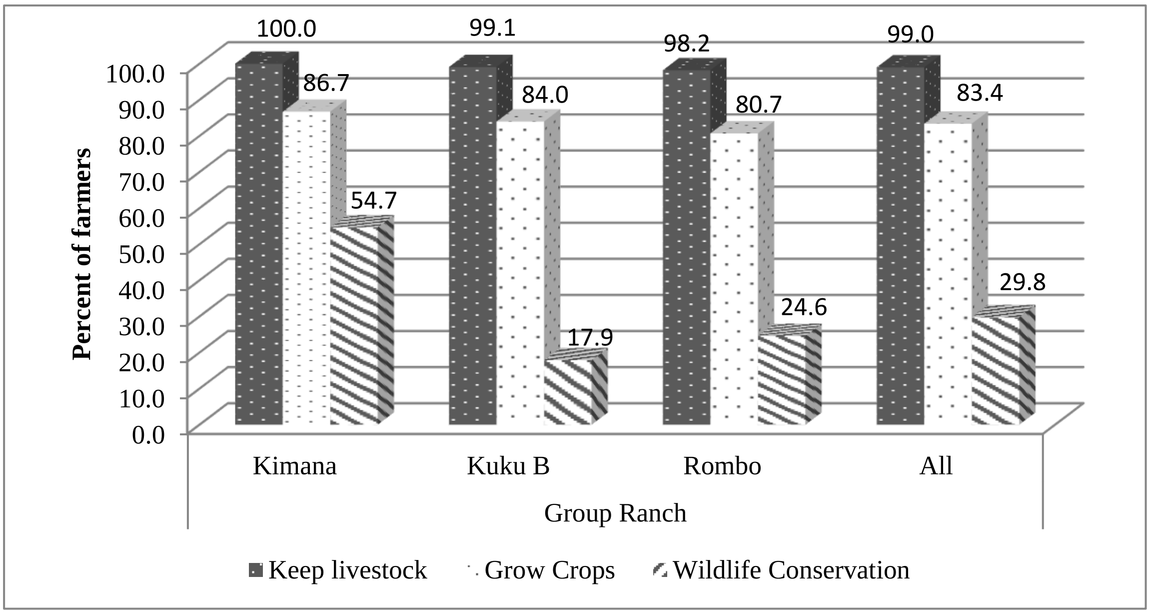
CHAPTER FOUR

RESULTS AND DISCUSSION

4.1.1 Major land use options and their characteristics

In the Amboseli Ecosystem, it is observed that most of the households did not engage in one economic activity but one or two of them are combined. Livestock keeping was the dominant economic activity practiced (99%) in combination with another activity. Crop production had 83.4% practicing while wildlife conservation had 29.8% of the households practicing (Figure 4).

Figure 4: Proportion of farmers engaging in different land use options



This is contrary to the expectation given the nature of the ecosystem which is largely arid and semi- arid area with minimal rainfall and the presence of the wildlife in the ecosystem. The increased crop production can be attributed to the changing lifestyles of the Maasai community which is partly influenced by the immigration of non Maasai residents in the area and partly by the changes in diet preferences (Kimana Integrated Wetland Management Plans, 2008-2013)

Dominance in livestock production was an expected result because not only is pastoralism economically important, but also culturally and spiritually and has always for several years been the first choice of land-use (Kimana Integrated Wetland Management Plans 2008-2013 2013).

4.1.2 Livestock production in Amboseli Ecosystem

Livestock production in the ecosystem involves cattle, goats, sheep and chicken. Local breeds are mostly kept with few crosses and exotic for the cattle.

Table 4: Descriptive statistics of livestock production in the Ecosystem

Group Ranch								
Livestock Type	**Kimana n=75**		**Kuku n=107**		**Rombo n=111**		**All N=295**	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Bulls	13.13	24.28	9.56	15.93	13.33	20.68	11.92	20.17
Cows	26.63	39.77	21.51	31.12	28.35	39.19	25.45	36.65
Calves	5.64	10.49	3.49	4.76	4.95	7.047	4.60	7.473
Goats	59.04	78.71	72.87	65.77	80.28	70.05	72.16	71.15
Sheep	40.83	54.49	50.35	55.70	54.70	58.73	49.57	56.65
Chicken	4.89	20.21	5.52	10.52	4.68	9.25	5.04	13.27
TLU	31.63	46.63	35.71	43.47	46.34	46.78	**38.75**	45.85

From Table 4, Livestock numbers were converted into Tropical Livestock Units (TLU) [1], a concept which according to Food and Agriculture Organization (FAO) provides a convenient method of quantifying a wide range of different livestock types and sizes in a standardized

[1] 1 TLU is equivalent to 250kg live weight.

manner. The size of herd per household ranged from 0.28 to 299.57 TLU. The Ecosystem has an average herd size of 38.75 TLU per household. This is slightly lower than what was reported in Kitengela (44.4 TLU) by Kristjanson *et al.* (2002).This can possibly be explained by the changes in lifestyles and incorporation of other economic activities such as crop production over the years. Rombo Group Ranch reported the biggest herd size (46.34TLU) compared to Kimana and Kuku group ranches.

The difference in herd sizes between Rombo and Kimana Group Ranches was expected given the difference in the locations within the Ecosystem and the level of integration of other economic activities. Kimana Group Ranch tends to be in a more strategic location nearer to the major Nairobi city with a tarmacked road infrastructure compared to Rombo Group Ranch. Therefore, Kimana Group Ranch becomes more open and accessible to economic activities such as crop production, hotel and tourism and quarrying.

The difference in herd sizes between Rombo Group Ranch and Kuku Group Ranch is contrary to expectation because Kuku Group Ranch lacks reliable water sources in form of swamps and rivers for irrigation purposes relative to Rombo Group Ranch. Similarly, given the presence of land leasing organizations in wildlife conservation, it is possible that off farm jobs created in the hotel and tourism absorb a big number of employees in Kuku GR leaving little herding labor and hence a smaller herd size in the area.

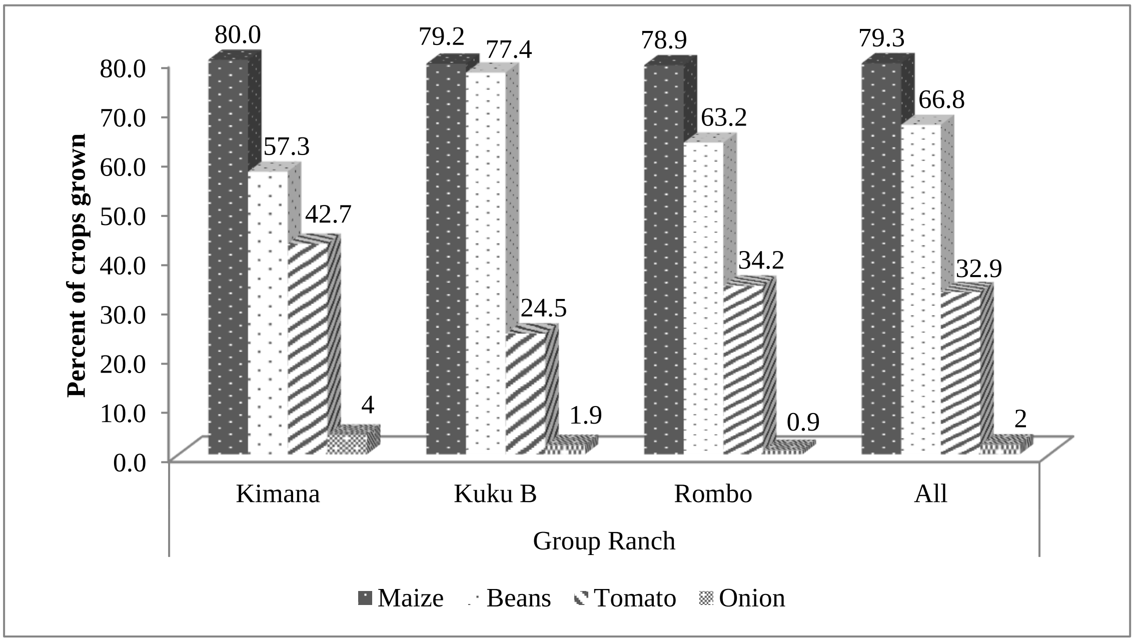
It was noted that there is a significant positive correlation between herd size and household size ($r=0.2147$, $p<0.01$) which means that households with more dependents had a larger number of animals. This can be argued that the large herd size was due to availability of enough labor to take care of the animals within the household. Similar results were reported in Kitengela by Kristanjonson et al. (2002).

The female cattle both mature and immature were found to be in large numbers as compared to the males and young ones across the three group ranches (Table 4). This is a normal occurrence as the females ensure the survival of the herd in case of a calamity like drought or disease attack. This was a similar case for both sheep and goats (Table 4). Cattle are the most important animals in the herd possibly because they fetch a higher price in the market creating a good source of income for the households in the ecosystem. This also possibly because of the culture and traditions of the Maasai community.

4.1.3 Crop production in the Ecosystem

Crop production in the ecosystem has lately become an important economic activity. The major crops identified in the study area include maize, beans, tomatoes and onion.

Figure 5: Major crops grown in the Ecosystem



As shown in Figure 5, approximately 79.3 % of the farmers grow maize, 66.8 % beans and 32.9 % tomatoes. Horticultural crops are grown including onions and tomatoes for commercial purposes. This follows good market in the urban centers mainly Nairobi and Mombasa. Irrigated agriculture is practiced around the swamps with the river and springs as the main sources of water.

Table 5: Crop production in Amboseli Ecosystem

	Group Ranch							
Crop Type	**Kimana**		**Kuku**		**Rombo**		**All**	
	Area (Ha)	**Quantity (Tons)**	**Area (Ha)**	**Quantity (Tons)**	**Area (Ha)**	**Quantity (Tons)**	**Area (Ha)**	**Quantity (Tons)**
Maize	1.0	1.80	1.04	1.85	0.93	1.95	0.98	1.87
Beans	0.84	0.97	0.88	1.0	0.81	1.33	0.85	1.12
Tomatoes	0.64	1.7	0.63	2.9	0.83	3.3	0.71	2.72

As shown in Table 5, the average area under crop production in Amboseli Ecosystem was 0.98 ha, 0.85ha and 0.71ha for maize, beans and tomatoes respectively. The average quantity produced was 1.87 tons, 1.12 tons and 2.72 tons for maize beans and tomatoes respectively. It is worth noting that tomatoes had the least allocation in land size across the three group ranches but had the highest average output in tons. This is some sort of validation of the tomato gross margins from the District Agricultural Office. The households also ranked tomato production as the most important crop. Rombo Group Ranch is seen to have higher average yields in all the three crops compared to the other group ranches (Table 5). This is possibly because of presence of enough water for irrigation and the fact that Rombo is the only group ranch without any wildlife conservation investment from leasing organizations hence more reliance on crop production and livestock keeping.

Table 6: Method of crop production in the Ecosystem in percentage

Crop	**Method of crop production**	**Group Ranch**			
		Kimana	**Kuku**	**Rombo**	**All**
Maize	Rainfed	18.3	63.1	46.7	45.3
	Irrigated	61.7	26.2	36.7	39.3
	Both Rainfed and Irrigated	20.0	10.7	16.7	15.4
Beans	Rainfed	25.6	63.4	53.5	51.5
	Irrigated	48.8	25.6	33.8	33.7
	Both Rainfed and Irrigated	25.6	11.0	12.7	14.8
Tomatoes	Rainfed	6.3	11.5	2.6	6.2
	Irrigated	**81.3**	**76.9**	**74.4**	**77.3**
	Both Rainfed and Irrigated	12.5	11.5	23.1	16.5

From Table 6, the method of production is an important consideration in the study given the arid and semi- arid nature of the ecosystem. Those growing maize and beans in Kuku and Rombo Group Ranches indicated more reliance on rainfed production of the crops. However, Kimana Group Ranch almost everyone practiced irrigation on the crops identified by the farmers. This is possible given the presence of a swamp in the ranch that provides sufficient water for irrigation. The high number of households practicing irrigated agriculture in Kimana Group Ranch can also be attributed to the fact that this group ranch is fully subdivided. Farmers are at liberty to rent out parcels of land for crop farming to non- Maasai residents.

Tomatoes in all the three ranches as shown in Table 6 were majorly grown using irrigation. This is because tomatoes are grown for commercial purposes and hence irrigation is used to ensure produce availability throughout the year.

4.1.4 Wildlife conservation in the Ecosystem

Kenya Wildlife Service (KWS) has a formal contract with the Group Ranches in Amboseli Ecosystem allowing wildlife to roam and graze within the land. Most Group Ranch members have further contracts with leasing organizations besides KWS and in exchange get benefit streams both in cash and in kind.

Table 7: Land leasing and income from Wildlife conservation

	Group Ranch			
Land lease and Income	**Kimana**	**Kuku**	**Rombo**	**All**
	n=75	**n=107**	**n=111**	**N=295**
Average Leased land (acres)	61.9	23.8	28.4	43.4
Leased land Income (Ksh /year)	31,026	13,847	11,721	21,465
Income (Maasai manyattas) (Ksh/year)	5,000	55,000	20,000	31,000

From Table 7, an average of 43.4 acres of land are leased out among the three group ranches. Kinama is reported to have the highest number of acres leased out at 61.9 acres and the highest amount of income at Ksh 31,026 per year. Contribution of wildlife as an economic activity was noted to be mainly through provision of employment for household members in tourist related activities such as tour guides, games scouts, curio shops, Maasai *manyattas* and in various hotels in the ecosystem. An average income of Ksh 21,465 ($214.65) per year per household from leasing the land was given (Table 7).

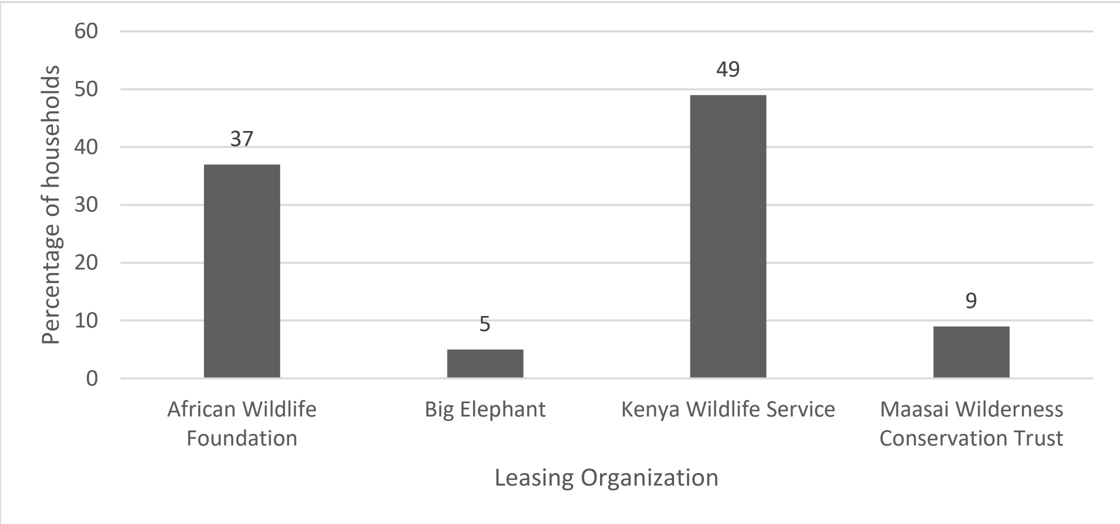
Table 8: Risks and wildlife conservation costs to households (percent)

	Group Ranch			
Risks and wildlife conservation costs	**Kimana**	**Kuku**	**Rombo**	**All**
	n=75	**n=107**	**n=111**	**N=295**
Risks in allowing wild animals to roam in land	94.9	92.9	80.0	89.7
Treatment of household members' injury	2.7	2.9	4.4	3.4
Death of household members'	1.4	1.0	2.8	1.8
Treatment of livestock injury	27.0	25.5	26.5	26.3
Death of livestock	50.7	58.5	56.3	55.6
Compensation	28.2	46.8	3.1	25.5

Allowing wildlife to roam within ones' land poses as a risk to the households inform of human injury and death and/or livestock injury and death. As shown in Table 8, a high percentage of households (89.7%) acknowledged having wildlife roam in their lands as a high-risk venture. However, interestingly few death and injury incidences to human and livestock was reported across the three group ranches (Table 8). Among those who lost their animals or family members, only a small number reported any form of compensation (25.5%) from the authority in charge.

From Figure 6, Kenya Wildlife Service (KWS) was a major leasing organization at 49 percent and it run across all group ranches considered. This is possibly because it's the main government organization that deals with conservation matters in the country. African Wildlife Foundation (AWF) came in second at 37 percent and was basically found in Kimana group ranch. Maasai Wilderness Conservation Trust (MWCT) was found in Kuku group ranch and had a 9 percent representation.

Figure 6: Land leasing organizations in Amboseli Ecosystem



Role of leasing organizations in Amboseli Ecosystem

Different Land Leasing Organizations had different roles played within the Amboseli Ecosystem. From the key informant interviews, the main leasing organization in Kuku Group Ranch was Campi ya Kanzi which through a trust called Maasai Wilderness Conservation Trust (MWCT) is able to offer several direct benefits related to community and the environment.

Through their payment for ecosystem services program, the organization has employed 101 rangers who ensure there is no poaching, cutting down of trees and fires within Kuku Group Ranch. Secondly, the MWCT pays a conservation fee through one of its programs called "wildlife pays", a compensation program that compensates the community on loss of their livestock to the wildlife. MWCT in conjunction with the government offers residents of Kuku Group Ranch education through employment of teachers in schools. Education bursaries for students in high schools and colleges are also provided through MWCT.

On health matters, employment of medical staff in four dispensaries in the area which include a doctor, clinical officer, nurses and lab technologist is done. The health program also provides sanitation services for the community mainly reusable sanitary towels for school going girls, medical facilities including a working laboratory and ambulances. Outreaches like HIV, maternity, family planning, cervical cancer tests and female genital mutilation programs are also provided through MWCT. This is done with the aim of encouraging the landowners to easily co-habit with wildlife and not to view wildlife as animals that interfere with other economic activities mainly livestock keeping.

Kimana group ranch has African Wildlife Foundation (AWF) as the main leasing organization through their Payment for Ecosystem Services (PES) program where participating group ranch members are paid directly through their bank accounts for leasing their land (Fitzgerald *et al., 2013)* From the key informants, most leasing is done on 60 acres per household but can go as high as 240 acres.

4.2.1 Household socioeconomic characteristics

Household socioeconomic characteristics are presented in Table 9. Household headship was male dominated, standing at 97.3%. Results showed a mean age of 45.17 years for the household heads meaning that most of the heads are within the active working age category. Majority of the household heads (62.3%) had never been to school, 15.1% had attained some primary school level of education and 7.5% had completed the eight years of primary school education. A very small percent (4.8%) of the household heads had acquired some professional skills from a post-secondary institution.

The low levels of education for over half of the households in the Amboseli Ecosystem are in line with the statistics from Kenya National Bureau of Statistics (2013) where 31% of Kajiado County residents have no formal education. This is because of cultural reasons where education is not given a priority as the nomadic way of life does not allow them to be in one area. The vastness of the area also makes schools far from homes and students have to trek long distances leading to eventual school drop outs.

Table 9: Descriptive statistics of the household head

		Group Ranch (Percentages)			
Variable	**Category**	**Kimana (n=75)**	**Kuku (n=105)**	**Rombo (n=112)**	**All (N=295)**
Education	Never been to school	63.0	57.5	66.4	62.3
	Primary School	16.4	16.4	23.0	22.6
	Secondary School	13.8	10.4	4.5	8.9
	Post- secondary	5.5	4.7	4.4	4.8
Experience	Livestock keeping	29.72	25.73	27.09	27.28
	Crop production	18.18	15.13	13.96	15.49
	Wildlife conservation	6.27	5.33	4.43	5.23
Primary occupation	Livestock keeping	13.7	12.3	16.8	14.4
	Mixed farming	82.2	82.1	77.9	80.5
	Formal salaried employment	4.1	2.8	0.9	2.4
	Self-employed business	0	0.9	2.7	1.4
Gender	Male	91.9	98.1	100	97.3
Ethnic Affiliation	Maasai	97.3	99.1	100	99
	Others	2.6	0.9	0	1
Mean Age		47.81	43.44	45.15	45.17

Source: Own survey data (2014)

Statistics indicate that 63.8% of population in Kajiado district trek for 5 or more kilometers to the nearest public primary school (Kenya National Bureau of Statistics 2005). According to the 2009 census conducted in Kenya, 35.1% had never attended school in Kajiado south with females recording a higher percentage (40.3%) compared to the male counterparts (29.8%) (Kenya National Bureau of Statistics 2010)

Mixed farming stood out (80.5%) as the primary occupation for the households across the three group ranches considered (Table 9). Approximately 14.4% indicated livestock keeping was their primary occupation while a small proportion (3.8%) indicated they had an off-farm activity such as formal salaried employed and self-employed business as their primary occupation. Approximately 99% of the respondent had a Maasai ethnic affiliation. The household heads had an average of 27.28 years of experience in livestock production, 15.49 years in crop production and 5.23 years in wildlife conservation.

4.2.2 Household demographic characteristics

Table 10: Demographic characteristics of households

	Group Ranch							
Variable	**Kimana**		**Kuku**		**Rombo**		**All**	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Household size	4.95	1.859	4.6	2.10	4.91	2.089	4.81	2.037
No. of males	2.73	1.519	2.45	1.474	2.5	1.371	2.54	1.447
No. of females	2.13	1.178	2.15	1.344	2.40	1.419	2.24	1.336
Dependency Ratio	0.78	0.784	0.83	0.93	0.77	0.815	0.79	0.8496

Source: Own survey data 2014

The average household size was 4.81 members in all the group ranches considered. This is much lower compared to the average national household size of 5.1 members (Kenya National Bureau of Statistics, 2005). This may be the case because the Maasai culture allows polygamous way of life in a household[2].

The mean age dependency ratio in the ecosystem was 0.79 which is slightly lower than the national age dependency ratio which according to the World Bank (2014) is 0.81. This ratio implied that there is a burden on the working members of the household to support and provide the social services such as health, food, education needed by children and older persons who are economically dependent. The household composition presented in Table 10 shows there are more males in a household within the ecosystem as compared to the females across all the group ranches.

4.2.3 Farm characteristics

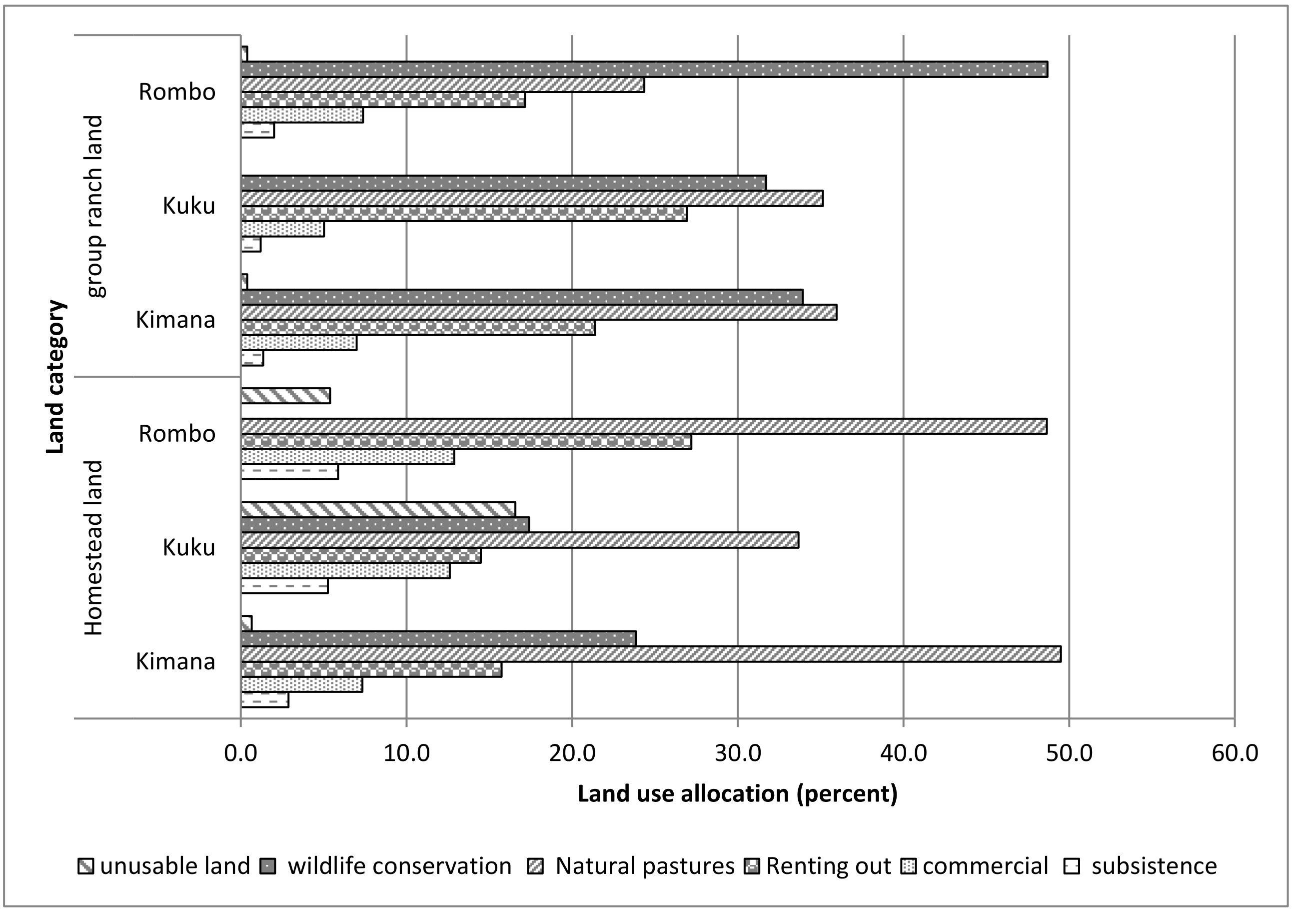
Table 11: Mean Land size owned by households in Amboseli Ecosystem

	Group Ranch			
Land size (acres)	**Kimana n=75**	**Kuku n= 111**	**Rombo n=105**	**All N=295**
Average no. of land parcels owned and/or accessed	2.05	1.58	1.55	1.69
Average land size	62.13	21.53	25.13	33.1
Average land size (homestead)	25.83	13.34	14.14	27.46
Average land size (group ranch land)	47.09	24.23	24.43	33.52
Average land size (other parcels)	17.91	8.76	13.52	21.48

[2] Definition of a household did not consider everyone in a *boma* but the family members who cooked together and drew food from common source.

From Table 11, the total number of land parcels owned and or accessed by the household ranged from 1 - 4 parcels. The mean size of land owned by the households was 33.1 acres and the size ranged from 1 -314 acres. In the survey the land was divided into three categories i.e. homestead location land, group ranch land and any other parcel of land. Ownership of the land where homestead is located was mostly to the household head and a formal title deed was possessed. A larger number of households had communal ownership of land inform of group ranch land. Different land uses in a period of one year is summarized in Figure 7.

Figure 7: Percent of Land use allocations in Amboseli Ecosystem



Land in the ecosystem was allocated to different uses including; subsistence crop production, commercial crop production, renting out of the land, natural pastures and wildlife conservation activities such as hotels and conservancies. As expected, the homestead land had crop

production taking place in all the group ranches though natural pastures were standing out with almost 50% of the homestead land allocated to natural pastures in all the group ranches (Figure 7). This is because as indicated earlier, livestock keeping is a dominant activity and the most important. Therefore, it’s natural that more land will be left for grazing purposes.
From Figure 7, wildlife related activities, natural pastures and renting out of land were the main activities practiced under group ranch land category. This is in line with expectation as these lands are mostly communally owned therefore wildlife conservation and livestock keeping is an easier undertaking.

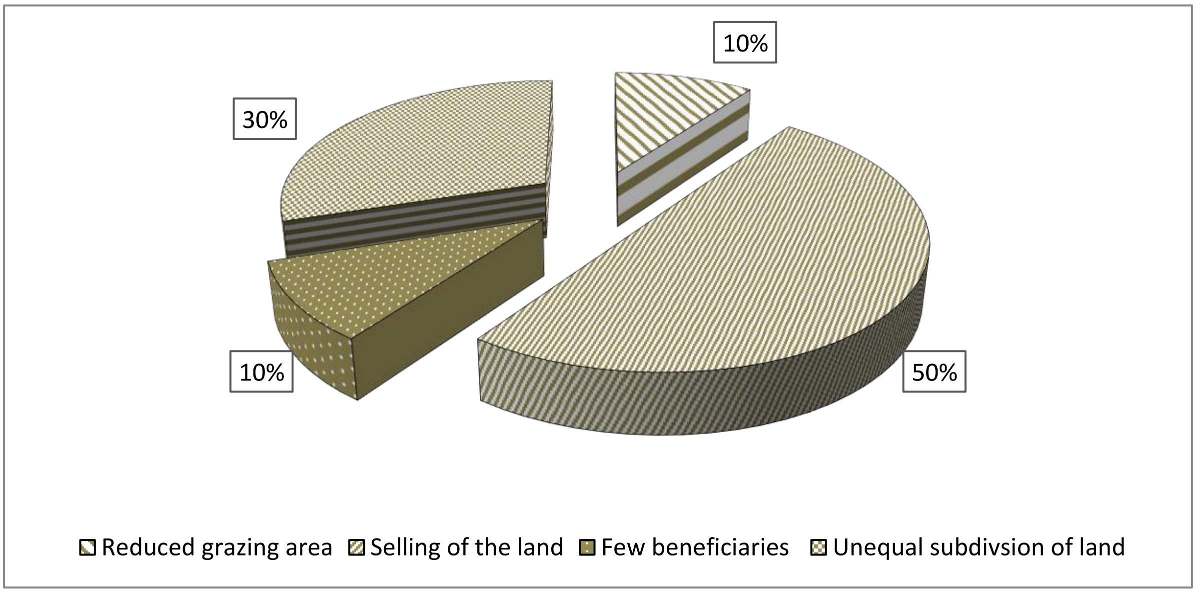
Renting out of the land is highest in Kimana Group Ranch with acres rented out ranging from 0-60. Given fully subdivided status of Kimana Group Ranch, the landowners are at liberty to rent out as much as they wish. Secondly, the proximity of Kimana Group Ranch to the major markets of Emali, Nairobi and Mombasa, presence of enough water for irrigation and lately the tarmacked highway, attracts non- Maasai immigrants who rent the land for commercial crop production with a focus on horticultural crops.

4.2.4 Land subdivision

Land subdivision among the group ranches in Amboseli Ecosystem is a matter that elicits mixed reactions from all the stakeholders’ concerned (government, conservationists, landowners). It was necessary to understand the take of the landowners in the matter. This is because subdivision leads to a change in property rights regime from communal ownership to private ownership regime. This greatly affects a farmer’s decision on the best economic activity to engage in. From the key informants’ interview, Kimana Group Ranch is fully subdivided while Rombo and Kuku Group Ranches are not. Majority of households confirmed they would like subdivision to take place because subdivision created an opportunity to own and manage land as they wished unlike when under communal ownership. On the other hand, those opposed to the idea of subdivision stated selling of land would take place leading to reduced grazing area.

Kimana, a fully subdivided Group Ranch had majority of households in support of the subdivision. Among those who supported the move gave ability to allocate, develop and manage personal property was as major reason for supporting the move. This finding agrees with what was reported in Mara Serengeti Ecosystem where 85% had supported subdivision citing security of land ownership and facilitation of land development as the main reasons for supporting subdivision (Seno & Shaw, 2002). A small portion (13.9%) felt it was a bad move to subdivide the land, with rampant selling of the land (50%), unequal subdivision (30%), reduced grazing area (10%) and few beneficiaries from the subdivision (10%) being the major reasons for not supporting land subdivision in Kimana Group Ranch (Figure 8).

Figure 8: Reasons for not supporting subdivision of land



4.2.5 Property rights and land use decision

Property rights play a critical role in providing an incentive for sustainable management of land and natural resources use as well as poverty alleviation (Aggarwal and Elbow, 2006). If property rights are not well defined, conflict in use of resources is likely to occur or overexploitation of the resource may take place leading to the concept of tragedy of the commons. Similarly, secure property rights ensure participation in critical decision-making processes related to the management of land and natural resources.

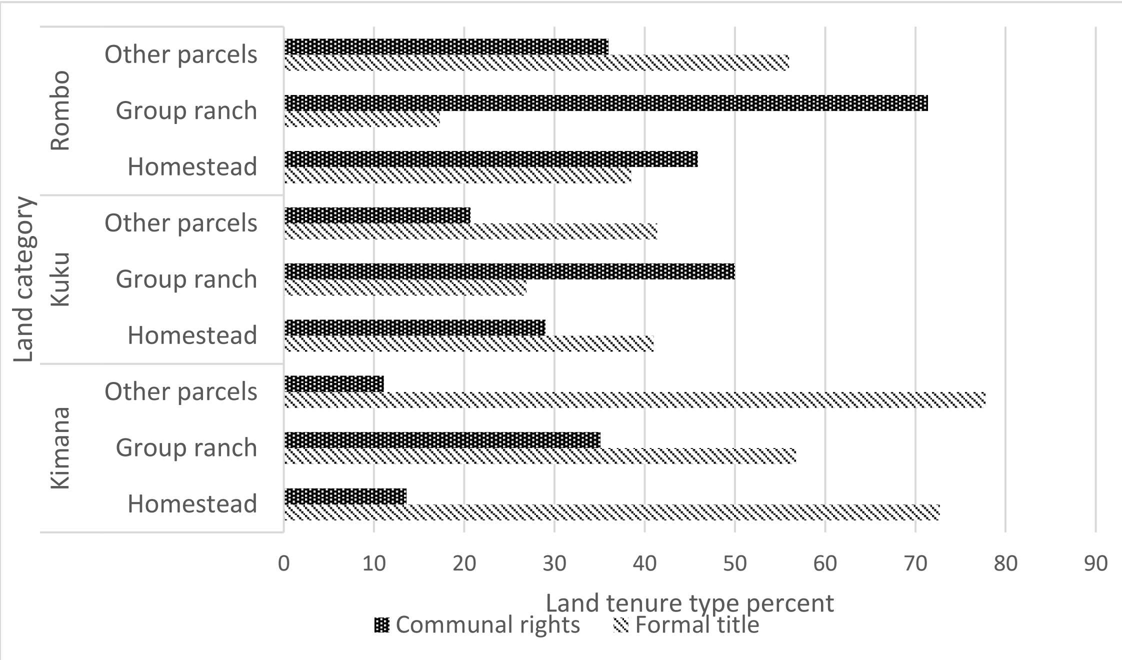


Figure 9: Land tenure types in the three Group RanchesError! Not a valid bookmark self-reference.

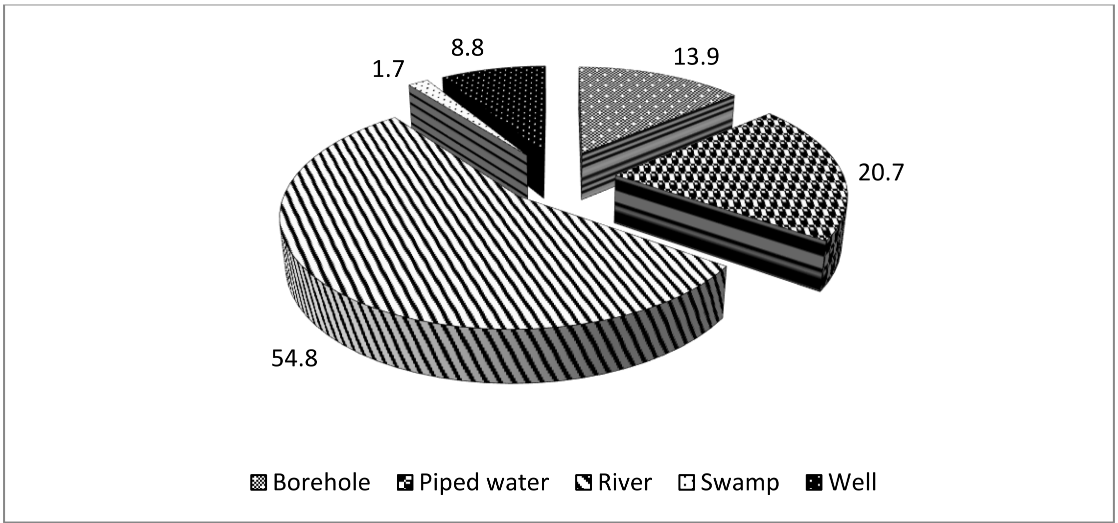
As shown in Figure 1Figure 9, the type of land tenure in the land categories considered, homestead land had 72.7% of households with a formal title deed in Kimana Group ranch, 41% in Kuku and 38.5 % in Rombo. For land tenure with communal rights, Rombo Group Ranch had the biggest share at 71.4%, 50% from Kuku and 35.1% of households in Kimana. With full land subdivision in Kimana Group Ranch, most of the households own a formal title deed unlike in Kuku and Rombo. Land tenure is seen to be a driver in the conversion of pastoral land to agriculture. This is because the increase in subdivision and privatization of the group ranches makes access to communal grazing land difficult (Okello and D'Amour 2008). Consequently, more agriculture is practiced in Kimana Group Ranch, especially irrigated tomato production compared to the other group ranches.

4.2.6 Water sources

Minimal amounts of rainfall received in Amboseli Ecosystem (500mm/year) attributable to the arid and semi-arid nature creates the need for an alternative source of water if any meaningful agriculture is to take place. From the key informant's interviews, the group ranches in the study sourced their water for farming and for animals use from the rivers in the area.

A large number of households (54.8%) identified the river as the main source of water. Approximately 20.7% used piped and 13.9% used borehole water while 4% of people used streams/river (Figure 10).These are contrary findings to what was reported by (Kenya National Bureau of Statistics 2005) in Kajiado that only 11.4% of people used streams/river. This meant that the distance to nearest source of water was crucial in determining the land use activity. The distance to the nearest source of water ranged from 0 to 14km in all the

Figure 10: Water sources in the Amboseli Ecosystem



group ranches in the study. Kimana Group Ranch was noted to have the shorted mean distance followed by Rombo and Kuku. This implied that it was easier for landowners in Kimana to access water for irrigation compared to those in Rombo and Kuku. This possibly explains why there is more irrigated agriculture in Kimana compared to other group ranches.

4.2.7 Market access

All the distance categories captured in the study were highest in Kuku Group Ranch compared to Kimana and Rombo (Table 12). An average of 17km to the nearest urban town was recorded in Kuku. This shows how vast the group ranch is which makes accessibility to various social amenities such as health care difficult. Access to both the input and offtake market is also constrained in this case as the mean distance to the nearest input shop was 1.32km in Kuku.

The type of road determines how accessible a market is in spacio-temporal and monetary terms. Kimana Group Ranch had 23% of households accessing all season tarmac road compared to Kuku with only 3.9% accessing tarmac road. As expected the cost of transport was highest in Kuku group ranch given the type of road and the distance to the nearest urban town (Table 12).

Distance to the nearest market, type of road and the cost of transport are all important parameters in determining the economic activity to engage in. An activity with less costs being more preferred. A negative correlation of 0.161 is observed, whereas the distance increases chances of choosing livestock production increase as opposed to crop production.

Table 12 : Market access in Amboseli Ecosystem

Distances (mean)	**Kimana**	**Kuku**	**Rombo**
Distance to main Market	5.4	7.5	4.5
Distance to input shop	1.14	1.32	1.14
Distance to health center	3.45	6.36	5.1
Distance to urban town	7.5	17	9.8
Cost of transport	129.47	237.49	151.93
Road type (percent)			
All season Tarmac	23	3.9	6.1
All season Marram	48.6	48.6	51.8
Seasonal marram	28.4	28.4	42.1

4.3 Gross margin analysis of land use options in Amboseli Ecosystem

4.3.1 Livestock production

Livestock gross margins in the Amboseli Ecosystem are presented in Table 13

Table 13: Livestock keeping gross margins in Amboseli Ecosystem

	Group Ranch	
Item	**Kimana**	**Rombo**
Cattle sales	103600	55050
Sheep sales	23662	7949
Goat sales	18393	4284
Milk sales	9659	22412
Manure sales	150857	150857
Hide and skin	12015	12015
Gross Income/household (Ksh)	**318186**	**252567**
Variable costs		
Acaricides	19373	22271
Mineral supplements	44202	50226
Dewormers	14278	15984
Vaccine	2262	2524
Drugs	10026	10849
Watering	44810	52510
Labour	45333	45333
Total Costs/ year/ household	**180285**	**199696**
Gross margin/household(Ksh)	**137901**	**52870**
Gross margin/TLU	4360	1480

Source: Own data from survey 2014

At the household level Kimana group ranch had a gross annual output valued at Ksh 318,186 compared to Rombo at Ksh 252,567. Generally, there is a higher annual gross output in Amboseli compared to those reported in Kitengela at Ksh 172,625 for a good year (Kristjanson *et al.,* 2002). In Kimana the higher gross annual output may be attributable to its strategic location in between two big towns of Emali and Loitoktok therefore creating a good market access for its animals. In addition, because of these markets location most if not all the other group ranches bring their animals in Kimana for sale. Given this high number of animals' in Kimana, prices are expected to be high compared to Rombo.

The variable costs in Kimana Group Ranch were lower (Ksh 180,284) compared to Rombo at KSh 199,696 in costs annually. These costs were much higher than those reported in a study in Kitengela of Ksh 65,254 (Kristjanson *et al.,* 2002). This could be the case given the difference in geographical distance between Kitengela and Amboseli. Where Amboseli is far off and remote from Nairobi hence higher inputs prices. Mineral supplements, watering of the animals and labor recorded the highest costs in both Group Ranches (Table 13). Kimana had a higher net income of Ksh 137,901 annually compared to Rombo which had a net income of Ksh 52,870 annually. The net income per TLU was quite high in Kimana at Ksh 4,360 while that of Rombo was Ksh 1,480.

4.3.2 Crop production

Table 14 shows the summarized gross margins for different crops in Amboseli varying across the group ranches. Kimana group ranch reported a very high turnover per acre of land cultivated with the gross margin ranging from Ksh 157,208 at a low level of production to about Ksh 711,666 at a high level of production.

Table 14: Gross margins for various crops in Amboseli Ecosystem

Group Ranch	Crop	Gross margins/Acre (Ksh)		
		Low(I)	**Medium(II)**	**High(III)**
Kimana	Tomato(irrigated)	157,208	338,578	711,666
	Bulb onions(irrigated)	66,712	184,754	383,400
Kuku	Maize bean intercrop	11,548	26,160	45,600
	Pure bean stand	6,458	18,194	32,412
Rombo	Dry maize	10,126	37,426	61,789
	Cabbage(Irrigated)	15,095	53,739	

Source: District Agricultural Office, Loitoktok 2014

This result could be the case for Kimana because as seen earlier proximity to a source of water for irrigation is quite good compared to the rest of the group ranches. Also, it is possible that most of the land rent out is used for irrigated production especially by non- Maasai residents who culturally engage in crop production therefore may be more experienced and knowledgeable in use of improved technologies such as fertilizer. Maize bean intercrop in Kuku Group Ranch had a higher gross margin per acre of land at low and medium level of production compared to separately grown crops. This is possibly because of the intercropping system benefits such as nitrogen fixation that lead to higher yields.

The gross margin results from own computation (Table 15) were not far off from the reported in District Agricultural Office, Loitoktok (2014). Tomatoes are still leading with the gross output ranging from Ksh 168,573 in Kimana to Ksh 322,012 in Rombo group ranch. This similarity in results affirms that irrigated crop production is quite a profitable agricultural engagement in the Ecosystem. With this kind of results, it will continue being more attractive for investment at the expense of other economic activities. Most of the farmers do a maize bean intercrop and if the costs were accounted for, then most farmers practice medium level of production.

Table 15: Gross output of the main crops in the study

Group Ranch	Gross output		
	Tomatoes	**Maize**	**Beans**
Kimana	168,573	47,523	53,447
Kuku	278,277	50,674	51,326
Rombo	322,012	52,932	65,271

Source: Own data and computation (2014)

The crop gross margins in Amboseli Ecosystem can be compared to those reported in other rangelands in Kenya. For instance, Mara river basin farmers earned lower incomes on an acre compared to farmers in Amboseli Ecosystem (Onjala, 2004). Cabbage in Mara was the best performing crop at Ksh 147,994 compared to one in Amboseli at Ksh 53,739 (Onjala, 2004). In contrast maize in Mara had very low gross margins with Ksh 4880 returns on an acre of land with Onions reporting a loss of Ksh -4539 (Onjala, 2004).

This is unlike in Kimana group ranch which reported a very high turnover in onions production ranging from Ksh 66,712 to Ksh 383,400 on high level of production. This is possibly because in Mara basin the factors of production best suited such as the type of soil and amount of rainfall could be suitable for different crops such as wheat and barley. It may also be that the community here does not care too much about crop production and would rather practice other activities such as livestock keeping and tourism related activities. Kristjanson *et al.* (2002) reported that landowners in Kitengela did not put much emphasis on crop production and if there was any crop production it was for subsistence purposes. (Mizutani et al. 2003) reported that in Laikipia district, three group ranches had zero net income from crop production except Mbirikani, a group ranch in Amboseli which had a net income of Ksh 5,986. These results indicate that in Amboseli Ecosystem socio-economic lifestyles of the

Maa speaking community is changing and crop production is integrated and relied more as a source of income unlike in other rangelands.

4.3.3 Wildlife conservation

The study attempted to aggregate all the benefits and costs that accrue to group ranch members who are involved in wildlife conservation.

4.3.3.1 Benefits of wildlife conservation

The results as presented in (Table 16) show that Kuku group ranch received the most direct benefits compared to Kimana and Rombo. Kuku recorded the highest benefits per household at Ksh 7,086 (USD[3] 70.86) in a year with Kimana and Rombo recording Ksh 1,305 (USD 13.05) and Ksh 645 (USD 6.45) per year respectively.

This large difference in the incomes from the group ranches is possibly because of the organization and management of the group ranches. According to a key informant interview from Rombo Group Ranch, it lacked any land leasing organizations for purposes of wildlife conservation and only relied on KWS. The informant attributed this to the poor management of the Group Ranch which affects the number of investors willing to lease land for purposes of conservation and tourism. This finding concurs with Mburu (2013) who reported that Rombo Group Ranch is the only group ranch without direct income from lease and tourists bed-night charges. Kimana Group Ranch is seen to largely have the benefits inform of lease fees from African Wildlife Foundation disbursed biannually to the land owners' bank accounts.

In contrast, Kuku Group Ranch has direct benefits in form of employment creation to teachers, health officers, game scouts and in the hotels or lodges serving as tour guides, watchmen,

[3] 1 USD is equivalent to Kes 100

cooks and cleaners. Discussions with key informants also revealed that presence of KWS in the group ranches was well appreciated as the rangers provided security to the community. This is not only against attack by wild animals but also other general insecurity incidents.

Table 16: Wildlife conservation benefits in Amboseli Ecosystem in 2014

Group Ranch	Lease organization	Service	Total/Year (Ksh)
1. Kuku GR	MWCT	School teachers	12,000,000
		Dispensaries	3,000,000
		Officials account	1,000,000
		Management Running costs	1,200,000
		Bursaries and employment	4,800,000
	KWS	Bursaries	2,300,000
	Total benefits		*24,300,000*
	Benefits/HH		***7,086.61***
2. Kimana GR	KWS	Bursaries	2,300,000
	AWF	Lease fees	846,000
	Total benefits		*3,146,000*
	Benefits/HH		***1,305***
3. Rombo GR	KWS	Bursaries	2,300,000
	Total benefits		*2,300,000*
	Benefit/HH		***645***

Source: Own survey Data 2014

Zimbabwe reported revenue from wildlife conservation to be USD 56, USD 123 and USD 177 per household per year in three scenarios based on CAMPFIRE revenues (Poshiwa et al., 2013). The conclusion was that the recorded wildlife revenue was a substatial amount used as a livelihood diversification strategy to livestock keeping and crop production when rains failed. This income had a potential to reduce household income fluctuations due to drought though to a limited extent. Hubert (2012) in his attempt to empirically estimate the costs and benefits from tourism in Kenya's national parks concluded that benefits outweighed the costs. Therefore if wildlife conservation bottlenecks in Kenya as identified by Norton-Griffiths and Said (2008) are dealt with, wildlife has the potential to highly contribute to the households revenue not only as a livelihoood diversification strategy but as a main source of income.

4.3.3.2 Wildlife conservation costs

In as much as the benefits in wildlife conservation are many and wide in scope so are the costs. Land owners in most cases are seen to shoulder the costs of wildlife conservation. As indicated in Table 17: Wildlife conservation costs in Amboseli Ecosystem in 2014Table 17, Rombo incured the most direct costs in livestock injury with minimal or no compensation. No costs in treating a human injury was reported from Kimana Group Ranch. As much as human death is a cost to the land owners, the amount of money compensated may serve as an incentive by the conservationists which would encourge wildlife conservation. Case in point is Kuku Group Ranch that reported a compensation fee of Ksh 5million possibly from MWCT compared to Kimana that reported compensation of about Ksh 200,000 under KWS and AWF.

Discussions from key informants reveleaved that compensation for various costs incured to both human and livestock took too long to be actualized making the compensation claiming costs too high. In most cases the residents just incured the transboundery diseases transmission from wildlife to the livestock and vice versa are also costs incured by the landowners. Though valuing these costs in monetary terms is difficult, land owners still take the risks especially during the dry periods when they have to go into the restricted areas of the park to access pasture.

Table 17: Wildlife conservation costs in Amboseli Ecosystem in 2014

		Kimana	**Kuku**	**Rombo**
Human injury				
	Doctors fee	0	7000	22400
	Cost of medicine	0	110000	25500
	Cost of missing work	0	30000	35000
	Cost of transport to health clinic	0	15000	6000
	Cost of transport to pharmacy	0	1000	2050
	Total	**0**	**163000**	**90950**
Human Death (compensation fee)		200000	5000000	19900
Livestock injury				
	Cost of medicine	15422	17250	49880
	Veterinary doctor fee	4666.67	2000	30000
	Airtime for calling the Vet doctor	300	20	250
	Cost of transport to Agrovet	2135	3716.67	1845
	Total	**22523.67**	**22986.67**	**81975**
Total wildlife conservation costs		**222,523.67**	**5,185,986.67**	**192,825.00**

Source: Own data from survey 2014

4.4 Drivers of competing land use options in Amboseli Ecosystem

4.4.1 Results of model diagnostic tests

Results of the goodness of fit model show that the log-likelihood of the fitted model was -198.03. The likelihood ratio was 60.31 with 20 degrees of freedom. This means that for both equations; crop production relative to livestock keeping and wildlife conservation relative to livestock keeping; at least one of the predictors' regression coefficients is not equal to zero. A small p value from the likelihood ratio test shows that at least one of the regression coefficients in the model is not equal to zero. The current model had a p value= 0.000 therefore the null hypothesis that all the regression coefficients across both models are simultaneously equal to zero was rejected. The Pseudo R^2 of 0.256 was within a satisfactory range because according to Macffaden (1974), Pseudo R^2 lying between 0.2 - 0.4 is satisfactory.

The multinomial logistic regression parameter estimates (coefficients and the marginal effects) are shown in Table 18: Parameter estimates for determinants of choice of land- use optionTable 18 and Table 19 respectively. The coefficients provide the direction but not the magnitude or the actual effects. The marginal effects measure the actual effects of a unit change in each of the explanatory variables relative to the base outcome on the choice of a land-use option.

For the multicollinearity test, results showed VIF for every independent variable was less than 2 and the mean VIF was 1.15. This means the variables used did not have a problem of correlation because VIF greater than 10 indicates high correlation (IDRE, 2016).

The Hausman test for IIA gave a P value of 1 for all land use choices and therefore no need to conclude that MNL model was mispecified. This means IIA was not violated.

Table 18: Parameter estimates for determinants of choice of land- use option

	Crop Production			Wildlife conservation		
Independent Variables	**coefficients**	**P>|Z|**	**Std Errors**	**coefficients**	**P>|Z|**	**Std Errors**
Age	-0.3626	**0.004*** **	0.01267	-0.00634	0.705	0.0167
Household Size	0.0412	0.627	0.0849	0.0422	0.665	0.0974
Land size	-0.000	0.994	0.0065	0.0177	**0.013** **	0.0071
Land Tenure*	0.6361	**0.042** **	0.3126	0.839	0.113	0.5296
Distance to water	-0.2537	**0.021** **	0.1102	0.455	**0.000*** **	0.1171
Credit*	-0.5920	**0.066* **	0.3218	-1.1945	**0.032** **	0.5571
Extension*	0.5322	0.149	0.3689	0.3722	0.462	0.5063
Distance to urban town	-0.0442	**0.082* **	0.0253	0.0127	0.626	0.0261
Primary Occupation*	-1.444	**0.031** **	0.6681	-2.132	**0.012** **	0.8482
Net income	0.0993	0.570	0.1748	-1.355	**0.000*** **	0.3676

N=274

LR Chi2(28)=60.31 Prob>chi2=0.0000

Pseudo R2=0.2560

Log likelihood=-198.033

***,**,* Signficance levels at 1%, 5%, 10% respectively

Livestock production used as base

From the model in Table 18, livestock production was used as the base and crop production and wildlife keeping as the alternative choices. The parameter estimates that significantly affected either positively or negatively the choice of land use options were: age of the household head, land size, land tenure, distance to a water source, access to credit, distance to the nearest urban town, primary occupation and net income for the household.

Table 19: Marginal Effects from Multinomial Logistic Regression Estimates

	Crop Production			Wildlife conservation		
Independent Variables	**dy/dx**	**P>|Z|**	**Std Errors**	**dy/dx**	**P>|Z|**	**Std Errors**
Age	-0.00736	**0.004*** **	0.00257	0.00025	0.774	0.00089
Household Size	0.00780	0.652	0.01729	.0015746	0.755	0.00505
Land size	-0.00030	0.820	0.00132	0.00094	**0.033** **	0.00044
Land Tenure*	0.11668	**0.065*** **	0.06327	0.03467	0.236	0.02929
Distance to water	-0.05972	**0.004*** **	0.02086	0.02842	**0.000*** **	0.00767
Credit*	-0.1002	**0.098* **	0.06054	-0.04716	**0.043** **	0.02333
Extension*	0.10828	0.187	0.08207	0.01061	0.716	0.02922
Distance to urban town	-0.00931	**0.065*** **	0.00504	0.00140	0.313	0.00139
Primary Occupation*	-0.23975	0.147	0.16515	-0.13747	0.271	0.1248
Net income	0.04266	0.223	0.035	-0.0738	**0.000*** **	0.01846

***,**,* Signficance levels at 1%, 5%, 10% respectively

Dy/dx is the discrete change from 0 to 1for a dummy variable

As hypothesized, the probability of choosing crop production relative to livestock keeping decreased by 0.73 percent for every one-year increase in age. This is possibly because the younger generation tend to engage more in activities whose returns are realized in a short period of time like most seasonal crops that take three months to mature while livestock take much longer from birth to maturity before they can be sold. The community of study being a pastoralist one for a long period of time, older farmers tend to be conservative and are slow in adopting new technologies like crop production (Howley et al., 2012). In addition, the older land owners have relatively larger pieces of land compared to their younger counterparts. With the large tracks of land and selling not allowed, they may prefer keeping livestock and wildlife conservation as pasture is available.

For every acre increase in the land area owned, the probability of choosing wildlife conservation increased by 0.094 percent. This means that those with larger tracks of land had adequate dispersal areas for the wildlife to graze and drink and therefore could easily engage in wildlife conservation and its related activities such the Maasai *manyattas*, curio shops or even hotels to attract tourists (Ebanyat et al., 2010).

The probability of choosing crop production to livestock keeping increased by 11.6 percent if the household owned a title deed, a proxy for secure land tenure. This is most likely because crop production is mostly practiced as a private enterprise and therefore landowners with title deeds are more likely to engage in private enterprises (Serneels and Lambin, 2001).

For every one kilometer increase to the nearest source of water reduced the probability of choosing crop production relative to livestock keeping but increased the probability of choosing wildlife conservation relative to livestock production by 5.9 and 2.8 percent respectively. As hypothesized earlier, it's expected that crop production and especially irrigated crop production system is viable when there is readily available water source to reduce cost of pumping the water. Therefore, as the distance to the water source increases, farmers will tend to allocate their land to other economic activities other than irrigated crop production. The increase of the probability of choosing wildlife conservation activities as the distance to water sources increased can be explained by the fact that wildlife roam far and wide looking for water with minimal effort from those conserving them.

Access to credit reduced the likelihood of choosing crop production and wildlife conservation relative to livestock production by 10 and 4.7 percent respectively. This is possibly because farmers could easily 'credit in' on livestock by selling or use the livestock as collateral when acquiring credit in mainstream banking unlike crops whose growth and availability cannot be guaranteed given the arid and semi-arid nature of the ecosystem. Similarly, the ease with which landowners can 'credit in' on livestock makes livestock keeping favorable compared to wildlife keeping.

As distance to the urban town increased by one kilometer, probability of choosing crop production decreased by 0.93 percent relative to livestock keeping. This may be attributed to the state of road infrastructure and the cost of transport associated with ability to access the markets. Group Ranches in the Amboseli Ecosystem are the buffer zones and dispersal areas for wildlife in the Amboseli National Park and also form migratory corridors for the wildlife. Therefore, human interference in form of development such as roads may not be advocated for. Without good road networks, high cost of transportation of crop produce when accessing markets that translates to high production costs may influence the decision for land use favoring livestock keeping to crop production. In addition, livestock can be transported to the market by trekking as opposed to crops which would require quicker and efficient means of transport (Serneels & Lambin 2001).

As the annual household income increased probability of choosing wildlife conservation decreased by 7.38 percent relative to livestock keeping. This is because of the ease with which livestock can be liquidated into cash therefore a quick source of disposable income. Unlike wildlife conservation activities especially leasing of pastoral land for conservation purposes where payments are made annually or in some instances semi- annually hence not a quick and easy source of income (Fitzgerald, 2013).

CHAPTER FIVE

SUMMARY, CONCLUSION AND POLICY RECOMMENDATIONS

5.1 Summary

The results revealed that all the three economic activities have significant contribution to the household's welfare. In the case of the crops and livestock production, the choice of the activity to engage in and its intensity is entirely dependent on the decision of the household. Tomato production especially irrigated had the highest turnover on an acre piece of land among the crops considered. From the crops' gross margins there is a clear indication that in Amboseli Ecosystem, socio-economic lifestyles of the Maa speaking community is changing and crop production is integrated and relied more as a major source of income. Similarly, livestock keeping is seen to provide a higher net income in this Ecosystem compared to other rangelands in Kenya. This is given its proximate distance to some of the biggest markets for consumers of livestock products (Nairobi and Mombasa markets).

Wildlife conservation unlike the crops and livestock keeping, its choice as an economic activity is not entirely dependent on the decision of the household because of the direct involvement of the government in wildlife conservation matters. Several organizations both government and non-governmental organizations are involved in wildlife conservation and benefits of having wildlife conservation trickles down to the landowners. While the Wildlife conservation benefits when valued in monetary terms seem to have the least amount of income in a year per household per year, non-tangible benefits are by far more. This shows a great potential for wildlife conservation in being a stable source of income for the households in Amboseli Ecosystem. This is however, notwithstanding the challenge posed by the wildlife conservation costs which in most cases the households within the group ranches have to bear with little or no compensation.

The study found several factors that positively or negatively influenced the land owner's decision on the economic activity to engage in. From the age of the household head, the younger generation is seen to prefer economic activities with quick returns such as irrigated crop production as opposed to older generation with preference leaning towards livestock keeping and wildlife conservation. Older generation at the same time have larger tracks of land that are best suited for wildlife conservation and wildlife keeping as here is enough grazing land and limited rainfall.

Increased secure land tenure indicated through possession of title deeds have the households prefer crop production as it is more private and at the decision to engage in is completely at the discretion of the household. Availability of water also significantly influenced the decision on the economic activity to engage in. households that did not access water easily as distance to the nearest source increased were seen to engage in livestock production and wildlife conservations as cost of production in this two is significantly lower.

Increased distances to urban markets also had significant influence on the choice of land use option with those closer to the urban markets having preference for crop production as opposed to livestock and wildlife conservation. This is mainly because of the fact that cost of transport would be higher especially in areas with poorly developed road infrastructure. The ability to 'credit in' on livestock by selling the animals whenever a need such as expanding business or a household need arose acted as an incentive to practice livestock production as opposed to crop production and wildlife conservation.

Livestock provided a fair and stable stream of income for the household compared to the other two economic activities under consideration. To elaborate, crop production in this ASAL area is mostly rainfed with few pockets of swamps and rivers that provide irrigation water and therefore cannot be entirely relied on. Similarly, income from wildlife conservation is annual and in most instances, it is not in monetary terms to the household but offered in terms of services such as school bursaries or employment of school teachers and health officers.

5.2 Conclusion and Policy Recommendation

This study evaluated the competing land use options and their drivers in Amboseli Ecosystem in Kenya. This was with an aim of determining the economic gains land owners accrue from different land use options and the drivers of choice in the land use options. In conclusion, socio-economic and microeconomic factors such as net income, land tenure, access to water, access to credit and access to markets in urban towns significantly influence choice decision of dwellers in Amboseli Ecosystem.

To enhance the decision of the households in Amboseli Ecosystem regarding crop production, livestock keeping and wildlife conservation activities, policies should strengthen the social setting of the households by providing water infrastructure such as earth dams and boreholes. In addition, sensitizing and educating the farmers on using water collection technologies during the wet season to ensure constant supply throughout the year should be encouraged.

Similarly, markets should be supported by improving the road network in the Ecosystem. Empirical results revealed that households are seen to engage more in livestock keeping as opposed to crop production as distance to the urban towns increased. This indicates lack of good road infrastructure which affects the cost of marketing associated with high transport costs. Also, farmers far away from major markets should reconsider the economic activities to engage in besides crop production. This is because, with the coexistence of wildlife and pastoralists, construction of roads may have negative implications following interference with the migratory corridors of the wildlife which would eventually escalate human wildlife conflict rather than contain it.

Policies should target to enable households access credit by increasing the collateral base of farmers. For example, allowing pastoralists to use their livestock as collateral in formal financial institutions. Similarly, extension education on the different forms of credit available should be offered to farmers and the types of collateral required to have some form of credit which would lead to increased production in the different economic engagements.

Policy needs to encourage interventions that enhance sustainability of environment, natural resources such as wildlife and improved livestock production. This can be done through reforms on institutions governing land tenure and fragmentation within the Ecosystem. More secure land ownership to the group ranch members without necessarily subdividing the group ranches can encourage increased livestock production following enough grazing areas. In addition, dispersal areas for wildlife conservation will be maintained.

Increasing the use values of wildlife should be advocated for among Maasai community in the Amboseli Ecosystem while mitigating against the costs associated with wildlife conservation. These include prompt compensation for farmers after loss of human life or injuries and loss of their animals or injuries caused by wildlife. Compensation is also seen by conservationists to be an incentive therefore encouraging wildlife conservation. Offering vaccination against transboundary diseases from wildlife. Direct payments to farmers who lease their lands for wildlife conservation can also encourage wildlife conservation because it acts as a stream of income for the households. Lastly, the government should ensure social welfare indicators in form of health facilities, number of schools, clean water and sanitation are availed to the community.

5.3 Suggestions for Further Research

The current study focused on the economic valuation of direct and indirect use values from the TEV framework in the Amboseli Ecosystem. Therefore, a study on economic valuation of non-use values of the Ecosystem which possibly have a great influence in the livelihoods of the residents in this Ecosystem should be done.

Cost Benefit Analysis (CBA) using Net Present Value (NPV) could also be used as a method of analyzing the economic value of different land use options as oppose gross margins employed in the current study. Similarly, a comprehensive study on the cost benefit analysis of wildlife conservation as an economic activity at the household level in Kenya should be done. The CBA could serve to showcase that wildlife conservation can be an economic activity that can be relied on. Not only as a livelihood diversification strategy but as a main source of income for communities in this Ecosystem.

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APPENDICES

Appendix I: Gross Margins for Maize Bean Intercrop

MAIZE BEAN INTERCROP KUKU GROUP RANCH 2012								
Production Level			**LOW (I)**		**MEDIUM (II)**		**HIGH (III)**	
Item	**Units**	**Price/Unit**	**Quantity**	**Total Value**	**Quantity**	**Total Value**	**Quantity**	**Total value**
Gross Income								
Yields - Maize H513	90Kg Bag	3000	6	18000	12	36000	20	60000
Beans *mwitemania*	90Kg Bag	4500	2	9000	4	18000	6	27000
Gross Income				27000		54000		87000
Variable Costs								
Seeds-Maize	10Kg bag	1300	1	1300	1	1300	1	1300
Beans	Kg	150	20	3000	20	3000	25	3750
Fertilizers (DAP and CAN)	50Kg bag	4200			2	4200	4	8400
Chemicals- alphadime	Litre	2000	0	0	0.2	400	0.5	1000
Land Preparation(Ploughing and Harrowing)		4000	1	1500	1	1500	1	1500
Labour				0	0	0	0	0
Planting - Maize and beans	MD	400	10	2000	13	2600	16	3200
Weeding	MD	400	7	1400	16	3200	20	4000
Top dressing	MD	200	0	0	2	400	4	800
Dusting/spraying	MD	200	0	0	1	200	2	400
Harvesting	MD			0		0		0
Dehusking maize	MD	200	4	800	6	1200	10	2000
Shelling & bagging maize	MD	80	6	480	12	960	20	1600
Uprooting/Threshing/bagging	MD	200	3	600	6	1200	8	1600
Gunny bags	Bags	30	8	240	16	480	26	780
Grading	MD	200	2	400	4	800	6	1200
Transport - Farm to store	Bags	10	10	100	16	160	26	260
To market/board	Bags	150	10	1500	16	2400	26	3900
Total Working Capital				13320		24000		35690
Interest on Working capital(16% on W/C)				2131.2		3840		5710.4
Total variable costs(TVC)				15451	0	27840	0	41400
GROSS MARGIN / ACRE				**11548.8**		**26160**		**45600**

Appendix II: Gross Margin for Dry Maize

DRY MAIZE ROMBO GROUP RANCH 2012								
			LOW (I)		MEDIUM (II)*		HIGH (III)*	
Item	**Units**	**Price/Unit**	**Quantity**	**Total Value**	**Quantity**	**Total Value**	**Quantity**	**Total value**
Gross Income								
Yields	90 kg bag	3000	8	24000	20	60000	30	90000
Gross Income				24000		60000	0	90000
Variable Costs								
Seeds	10 Kg	1300	1	1300	1	1300	1	1300
Fertilizers - DAP	50 KG Ba	2500	0	0	0.5	1250	1	2500
-CAN	50Kg bag	1700	0	0	1	1700	1	1700
Insectides - bestox	litre	2200	0	0	0.05	110	0.1	220
- Ploughing 1st	Acre	1500	1	1500	1	1500	1	1500
- Harrowing	Acre	1200	0	0	0	0	0	0
Labour				0		0		0
- Planting	MD	200	8	1600	8	1600	8	1600
- Weeding (1st)	MD	200	10	2000	10	2000	10	2000
- Weeding (2nd)	MD	200	8	1600	8	1600	8	1600
- Gapping	MD	200	0	0	0	0	1	200
- Thinning	MD	200	0	0	0	0	1	200
- Top dressing	MD	200	0	0	3	600	4	800
Dusting/spraying	MD	200	0	0	2	400	2	400
- Dehusking	MD	200	9	1800	10	2000	11	2200
- Shelling & bagging	Bags	80	8	640	20	1600	30	2400
- Gunny bags	Bags	30	8	240	20	600	30	900
Transport - Farm to store	Bags	10	8	80	20	200	30	300
- To market/board	Bags	150	8	1200	20	3000	30	4500
Total Working Capital				11,960		19,460		24,320
Interest on Working capital (16% on W/C)				1,914	0	3,114	0	3,891
Total variable costs (TVC)				13,874		22,574		28,211
Gross Margin (GI-TVC)				10,126		37,426		61,789
GROSS MARGIN / acre				**10,126**		**37,426**		**61,789**

Appendix III: Gross margins for pure bean stand

PURE BEAN STAND KUKU GROUP RANCH 2012								
			LOW (I)		MEDIUM (II)		HIGH (III)	
Item	**Units**	**Price/Unit**	**Quantity**	**Total Value**	**Quantity**	**Total Value**	**Quantity**	**Total value**
Gross Income								
Yields	90Kg	4500	4	18000	8	36000	12	54000
Gross Income				18000		36000		54000
Variable Costs								
Seed – Beans	Kg	150	20	3000	20	3000	25	3750
Fertilizers – DAP	50Kg	2500	0	0	0.5	1250	1	2500
-CAN	50Kg	1700	0	0	0	0	0	0
Alphadime	Lt	2000	0	0	0.25	500	0.5	1000
Land Preparation		0	0	0	0	0	0	0
- Ploughing 1st	Acre	1500	1	1500	1	1500	1	1500
- Ploughing 2nd	Acre	1500	0	0	0	0	0	0
- Harrowing	Acre	1000	0	0	0	0	0	0
Labour		0	0	0	0	0	0	0
- Planting	MD	200	10	2000	15	3000	12	2400
- Weeding (1st)	MD	200	10	2000	10	2000	10	2000
- Weeding (2nd)	MD	200	0	0	8	1600	10	2000
- Top dressing	MD	200	0	0	0	0	0	0
- Harvesting	MD		0	0		0		0
- Uprooting	MD	200	5	1000	8	1600	10	2000
- Gunny bags	Bags	30	4	120	8	240	12	360
Transport - Farm to store	Bags	10	3	30	6	60	10	100
- To market	Bags	100	3	300	6	600	10	1000
Total Working Capital				9950		15350		18610
Interest on Working capital (16% on W/C)				1592		2456		2977.6
Total variable costs(TVC)				11542		17806		21587.6
GROSS MARGIN / acre				**6458**		**18194**		**32412**

Appendix IV: Gross Margins for Tomato

Tomato KIMANA group ranch 2012								
Production level			**Low**		**Medium**		**High**	
item	**units**	**price/unit**	**quantity**	**total value**	**quantity**	**total value**	**quantity**	**total value**
Yields	35 kg crates	1000	200	200000	400	400000	800	800000
Gross income				200000		400000		800000
variable costs								
seeds	200g	1800	1	1800	1	1800	1	1800
Land preparation	acre	3000	1	3000	1	3000	1	3000
Ridging	ridges	5	1000	5000	1000	5000	1000	5000
nursery preparation and management	bed	1000	1	1000	1	1000	1	1000
Fertilizers				0		0		0
CAN	bag	1700	1	1700	1.5	2550	2	3400
DAP	bag	2500	1	2500	1.5	3750	2	5000
Foliar	kg	350	2	700	4	1400	6	2100
Insecticides				0		0		0
duduthrin	Lts	1400	0	0	0.5	700	1	1400
Bestox	Lts	2200	0.2	440	0.5	1100	1	2200
Actara	40g	700	0	0	1	700	1	700
Ortus	Lts	3000	0.5	1500	1	3000	1	3000
Fungicides								
Dithane	kg	600	0.5	300	1	600	1	600
Ortiva	100 ml	900	1	900	1.5	1350	2	1800
Labour				0		0		0
Transplanting	ridges	2	1000	2000	1000	2000	1000	2000
Weeding - 3 times	MD	200	20	4000	24	4800	28	5600
Irrigating	MD	200	8	1600	8	1600	12	2400
Top dressing	MD	150	3	450	4	600	5	750
spraying - 10 times	MD	200	10	2000	10	2000	12	2400
Harvesting & grading	crates	20	200	4000	400	8000	800	16000
On farm transport	crates	20	200	4000	400	8000	800	16000
Total working capital				36890		52950		76150
Interest on working capital				5902.4		8472		12184
Total variable cost (TVC)				42792.4		61422		88334
GROSS MARGIN / ACRE				**157208**		**338578**		**711666**

Appendix V: Gross Margin for green house tomato

GREEN HOUSE TOMATO KUKU GROUP RANCH 2012						
$240M^2$ Tomatoes			**Current level MEDIUM (II)**		**Proposed level HIGH (III)**	
Item	**Units**	**Unit Price**	**Quantity**	**Total Value**	**Quantity**	**Total value**
Capital investment	1 Green house	300000	1	300000	1	300000
Gross Income	Kg	25	13000	325000	18000	450000
Variable Costs						
Nursery management	ksh	1000	1	1000	1	1000
Seeds	Ksh	2500	1	2500	1.25	3125
Fertilizers (DAP,CAN/Urea, foliar)	Assorted	7000	0.8	5600	1	7000
Chemicals – insecticides ,fungicides,	Assorted	25000	0.75	18750	1	25000
Land Preparation	$240M^2$	2000	1	2000	1	2000
Irrigation	$240M^2$	4500	1.25	5625	1.25	5625
Labour	MD	200	20	4000	20	4000
Miscellaneous	Ksh	2000	1	2000	1	2000
Total working Capital	ksh			40475		49750
Interest on Working capital(16% on W/C)	Ksh			6476		7960
Total variable costs(TVC)				46951		57710
Gross Margin (GI-TVC)				278049		392290
GROSS MARGIN / Green house				**278049**		**392290**

Appendix VI: Gross Margins for Bulb Onion

BULB ONION KIMANA GROUP RANCH 2012								
Production Level			**LOW (I)**		**MEDIUM (II)**		**HIGH (III)**	
Item	**Units**	**Price/Unit**	**Quantity**	**Total Val**	**Quantity**	**Total Val**	**Quantity**	**Total value**
Gross Income								
Yields	Nets	1000	150	150000	300	300000	600	600000
Gross Income				150000		300000		600000
Variable Costs								
Seeds	Kg	4000	2	8000	2	8000	2	8000
Seedbed preparation & management	Bed	2000	1	2000	1	2000	1	2000
Fertilizers - DAP and CAN	50kg Bag	4200	1	2500	2.5	5450	4	8400
foliar feed (wuxal)	5 litres	1000	1	1000	1.5	1500	2	2000
Insecticides- polytrin	Lt	2000	1	2000	2	4000	2	4000
Fungicides - antracol and ridomil	kg	2800	2	2000	4	4800	6	7600
Land Preparation				0		0		0
- Ploughing (1st)	Acre	3000	1	3000	1	3000	1	3000
- Ridging/ cross banding/basin making	Basins	300	10	3000	10	3000	10	3000
Labour				0		0		0
Transplanting	Basins	300	15	4500	15	4500	15	4500
Weeding(3 times) @ 10 per basin	Basins	300	20	6000	30	9000	30	9000
- Irrigating/watering	No of times	200	8	1600	10	2000	10	2000
- Top dressing	Basin	5	300	1500	300	1500	300	1500
- Spraying(once per 2 weeks)	No of times	200	6	1200	8	1600	10	2000
Harvesting				0		0		0
- Uprooting	Basins	300	5	1500	5	1500	10	3000
- cutting	Nets	10	200	2000	300	3000	800	8000
Nets for packaging	No.	25	200	5000	300	7500	800	20000
Grading and packing	Nets	5	200	1000	300	1500	800	4000
Weighing	Nets	15	200	3000	300	4500	800	12000
Operating & Maint. Of canals	Acre	1	1000	1000	1000	1000	1000	1000
Transport , cess , market fee	Net	100	200	20000	300	30000	800	80000
Total Working Capital				71800		99350		185000
Interest on Working capital(16% on W/C)				11488		15896		29600
Total variable costs(TVC)				83288		115246		214600
GROSS MARGIN / ACRE				**66712**		**184754**		**385400**

Appendix VII: Variance inflation factor results for multicollinearity test

Variable	**VIF**	**1/VIF**
Age	1.19	0.841259
Household size	1.28	0.780828
Land Size	1.20	0.830828
Land Tenure	1.24	0.807202
Distance to Water	1.09	0.913994
Credit	1.03	0.975455
Extension	1.10	0.905434
Distance to Urban Town	1.13	0.888721
Primary Occupation	1.09	0.916410
Net Income	1.16	0.863675
Mean VIF	1.15	
Critical levels		10

Appendix VIII: Assessment of goodness of fit

Log-Lik Intercept Only:	**--266.160**	**Log-Lik Full Model:**	**-198.033**
D(241):	396.067	LR(20):	136.254
		Prob > LR:	0.000
McFadden's R^2:	0.256	McFadden's Adj R^2:	0.132
Maximum Likelihood R^2:	0.392	Cragg & Uhler's R^2:	0.457
Count R^2:	0.617	Adj Count R^2:	0.139
AIC:	1.686	AIC*n:	462.067
BIC:	-956.697	BIC':	-23.992

Appendix Ix: Hausman test for IIA

Land use Choice	x^2	$P>x^2$
1	0	1
2	0	1
3	0	1

No reason to conclude that MNL model violates IIA assumption

Appendix X: Correlation coefficients for variables used in MNL model

	Land use option	Age	Household Size	Land size	Land Tenure	Dist Water	Credit	Extension	DistUrban Town	Primary Occupation	Net Income
Land use option	1										
Age	-0.0171	1									
Household Size	-0.1543	0.1786	1								
Land size	0.1458	0.3030	0.1059	1							
Land Tenure	0.2353	0.1764	-0.2596	0.2251	1						
Dist Water	0.2501	0.0541	-0.0750	0.0002	0.0208	1					
Credit	-0.1836	-0.0450	0.0640	-0.0915	0.0031	-0.0635	1.0000				
Extension	0.1358	0.0428	-0.2294	0.0238	0.2038	0.0400	0.0032	1.0000			
DistUrbanTown	0.0897	-0.0378	-0.1229	0.0303	-0.0795	0.2391	0.0025	0.0610	1.0000		
Primary Occu	-0.2334	0.0931	0.1893	0.1229	-0.0010	-0.1325	-0.0121	-0.0465	-0.1788	1.0000	
Net Income	-0.2504	-0.0555	0.2281	0.1237	-0.1243	-0.1601	0.0507	-0.1858	-0.1616	0.1386	1.0000

Appendix XI: Survey Instrument

Economic Evaluation of competing Land–use Options and their drivers in Amboseli Ecosystem, Kenya
Survey Questionnaire
UNIVERSITY OF NAIROBI
FACULTY OF AGRICULTURE
DEPARTMENT OF AGRICULTURAL ECONOMICS

SECTION 1: IDENTIFICATION
GROUP RANCH NAME: [___]   1.Kimana   2.Kuku B   3.Rombo

1. Date of Survey (DD/MM/YYYY):	____/_____/2014
2. Enumerator code	
3. Enumerator Name:	
4. Time interview started	
5. Village/Settlement name:	
6. Name of Household head	
7. Name of Respondent	

A 1 Livestock Production

A1.1 Do you keep livestock on your farm? 1= Yes 0= No [__] (*if No, go to section A2)*

A1.2 If yes, provide the following details (*For price, give average farmer's farm gate price*)

Livestock		Male mature		Female mature		Male Immature		Female Immature		Young ones	
Category of livestock	Breed	No.	Price per animal	No.	Price per animal	No.	Price per animal	No.	Price per an-imal	No.	Price per an-imal
Cattle	*Local(kienyeji)*										
	Cross(Borana)										
	Exotic(grade)										
Goats	*Local*										
	Exotic(dairy)/cross										
Sheep	*Local*										
	Wool/Exotic										
Chicken	*Local*										
	Improved indigenous										
	Broilers										
	Layers										

A 2 Crop production

A 2.1 Do you grow crops in your land 1= Yes 0= No [__] *(if No, go to section A3)*

If yes, which were your three (3) major crops grown in the last one year (September 2013-August 2014)?

Type of Crop *(Code A)*	Rank of crop *(1 = Most important, -3= Least important)*	Main seed variety planted (*1=Improved, 2=Recycled improved*	Main method of production (*1= Rainfed production, 2= irrigated production, 3= both rainfed and irrigated*	Area (in acres)	Production	
					Quantity	Specify units of measurement *(see code B)*

1 acre = 4046.86 m^2

Crops Codes A	Measurement Code B
1. Maize **2.** Beans **3.** Tomatoes **4.** Onions **5.** Horticultural crops (specify) e.g. French beans, cabbage, Brinjals etc. ______________________________ **6.** Fruits(specify) e.g. water melon, pawpaws bananas etc. ______________________________	**1.** Kg **2.** Pieces **3.** Bunches (e.g. bananas) **4.** Crates (medium) *(Mombasa)* **5.** Crates (large) *(Nairobi)* **6.** 2-kg tin (gorogoro/kasuku **7.** Pick-up **8.** 10-kg debe/bucket **9.** 15-kg debe/bucket **10.** Donkey carts **11.** 90kg bag

A 3 Wildlife Conservation

A3.1 Do you lease your land for wildlife conservation Yes [____] No [___] *(if No, go to section A3.5)*

A 3.2 If yes provide the following information on output from wildlife conservation

Size of land leased out (Acres)	Income from leasing/Yr/Acre	Main leasing Organizations

A.3.3 Do you have Maasai *manyattas* within your land for tourism purposes? 1=Yes [____] 2=No [____]

A3.3.1 If yes how much money did you earn from the Maasai *manyattas* in the last one year? _Ksh ______________________

A3.4 Do you think there is any risk *(enyamali)* in allowing wild animals to roam in your land? 1=Yes [___] 2=No [_____]

A3.5 Has anyone in your house (including workers) been treated due to attack from wildlife in the last one year? 1=Yes [__] 2=No [__]

A3.5.1 If Yes *(Question A 3.5)* provide the following information about the average amount of costs (in Ksh) you used in treating an attacked person

Symptoms	Doctors fee	Cost of medicine	Cost of missing work	Cost of transport to health clinic	Cost of transport to pharmacy	Other costs
Broken body parts						
Wild animal bite						
Attack by a wild animal						
Others (Specify) __________________						

A3.5.2 Has any member of your household (including workers) died due to an attack from the wild animals in the last five (5) years 1=Yes [__] 2= No [___]

A3.5.3 If Yes *(Question A3.5.2)* what compensation package were you given by the Kenya Wildlife Service (Ksh) _________________

A 3.6.1 Has any of the livestock you keep been treated due to attack from wildlife in the last one year? 1=Yes [____] 2=No [____]

A3.6.2 If Yes (Question A 3.5.1) provide the following information about the average amount of costs (in Ksh) you used in treating livestock attacked

Symptoms	Livestock Attacked (1=cattle,2= goat, 3= sheep)	Cost of medicine	Veterinary doctor fee	Airtime for calling the Vet Doc	Cost of transport to Agrovet	Other costs

Broken body parts						
Wild animal bite						
Attack by a wild animal						
Others (Specify) ________________						

A3.6.3 Has any of your livestock died due to an attack from the wild animals in the last ONE year 1=Yes [____] 2= No [_____]

A3.6.4 If Yes *(Question A3.6.3)* what compensation package were you given or is yet to be given by the Kenya Wildlife Service (Ksh) ____

SECTION B

HOUSEHOLD DEMOGRAPHIC AND WEALTH INFORMATION

B.1 Provide the following information about the household head

ACTIVITY	YEARS OF EXPERIENCE
Livestock	
Crop production	
Wildlife conservation	

Ethnic affiliation [____] 1= Maasai, 2=Kamba, 3= Kikuyu, 4= Others (Specify)

B.2 Please provide the demographic characteristics of household members

A household is a group of people who cook together and eat together and drawing food from a common source – share resources together. Family members who work away or are not dependent on the household for at least 6 month are excluded.(For this purpose, household members are not necessarily the same as family members)

ID	Full Name of household member (Start with household head)	Year of birth (e.g. 1948)	Sex of this person? *(1=Male 2=Female)*	Relationship to current HHH *(Codes C)*	Highest level of education completed *(Codes D)*	Primary occupation (only one) *(CodesE)*
1						

2						
3						
4						
5						
6						
7						
8						
9						
10						

RELATIONSHIP TO HHH (Codes C)	LEVEL OF EDUCATION (Codes D)	PRIMARY OCCUPATION (Codes E)
1. Head **2.** Spouse **3.** Parent **4.** In laws **5.** Child **6.** Grandchild **7.** Employee **8.** Other	**1.** Never been to school **2.** Traditional *(Gumbaru)* **3.** Some primary **4.** Completed primary **5.** Some secondary **6.** Completed secondary **7.** Post-Secondary **8.** Others (Specify)	**1.** Crop farming (incl. food & cash crops; feed & fodder; gardening/vegetable and fruit production) **2.** Livestock keeping (incl. camel, cattle, sheep & goat and renting out livestock for draft power/breeding) **3.** Wildlife Conservation **4.** Mixed farming **5.** Formal salaried employment (incl. civil servant, private sector employee, non-farming labourer, domestic work in external house) **6.** Livestock herder **7.** Self-employed business (non-ag., e.g. small shop owner, includes natural products - charcoal, firewood, water, roadside grass etc.) **8.** Student **9.** None

SECTION C
FARM CHARACTERISTICS

C1 How many parcels of land are owned and/or accessed by the household? _____________________

C2 What is the total size of all the land OWNED/RENTED (in acres)? ________________ acres

C.3 Provide the following information about each land parcel that the household head or his/her spouse owns and/or uses.

	Land 01 (Where homestead is located)	Land 02 (combination of all other parcels)	Land 03 (Group ranch land)	All other land
Size (acres)				
How far from the homestead (km)? (for land 02 pick the largest piece of land)				

Who owns that piece of land (1=HHH, 2=Spouse, 3=Joint HHH and spouse, 5=communal, 6= Relative non-household member, 7=Joint household member and relative))				
What is the type of land tenure for this parcel of land? (see code F)				
Who among the household members currently uses that parcel of land? (see codes G)				
How was the land allocated to the different uses in the last 12 months (specify area in acres)				
1. Homestead (includes houses, livestock sheds e.t.c)				
2. Subsistence crop production (i.e. for household consumption)				
3. Commercial crop production (i.e. for marketing)				
4. Rented out land				
5. Natural pastures				
7. Wildlife conservation related activities (e.g Maasai *manyattas*, hotel				
8. Unusable land (swampy, rocky, hilly, etc)				

CODES

Land tenure type (Codes F)	Land User (Code G)
1. Holds a formal title or allotment letter **2.** Owns but has no formal title/document (e.g. inherited) **3.** Has communal rights to use land (e.g. pastoral land, trust land, group land/ranch) **4.** Has use of land s/he considers his/her own but that has never been allocated (squatters)	**1.** Head of household (HHH) **2.** Spouse of HHH **3.** Joint HHH and spouse **4.** Joint household member and relative **5.** Relative from Household **6.** Non relative from household

C 4 Main source of water [______] 1= Borehole 2= Piped water 3=River 4= Swamp 5=Well 6 Others _____

C.4.1 What is the distance to the nearest source of water [__________Km]

D ACCESS TO CREDIT

Information on access to credit (both formal and informal)

D.1 Have you ever obtained credit for use in crop production/livestock keeping / wildlife conservation 1=Yes [__] 2= No [___] *(if no go to D3)*

D.2 If yes provide the following details

Main source of credit (codes H)	Major form of cred-it(codes I)	Amount (Ksh)	Interest charged	Main purpose of the credit (Codes J)

Source of Loan (codes H)	Major form of credit (Codes I)	Purpose of Loan codes (codes J)
1.Micro-finance institution **2.**Commercial banks **3.**Cooperatives **4.**NGOs **5.**Government credit schemes **6.**Agricultural Finance Corporation **7.**Local money lender **8.**Group/Table banking **9.**Family and friends **10.** Contractual outgrower arrangements **11.** Others (specify) _________	1=Money 2=Material(s) and/or inputs 3=Others (specify) ____________________	**1.**Purchase farm inputs (e.g. seeds, fertilizers e.t.c.) **2.**Buy livestock **3.**For marketing and value addition activities **4.**Others (specify) _____________________ **5.**Buy land **6.**Construction of farm structures **7.**Buy machinery and equipment **8.**Payment of labor costs **9.**Irrigation facilities

D.3 If No (Question 5 1.), why haven't you obtained credit? (Rank codes) [______] [______] [______] [______]

1=Not needing any loan 2=No collateral as required	3= Not a member of the microfinance institution 4= High cost to obtain the loan/ credit 5= Others (specify) ______________________

E EXTENSION SERVICES

E.1 Did you receive extension contact for crop production /livestock keeping/ wildlife conservation in the last one year 1=Yes [___]2=No [___]

E.2 If yes please provide the following information on extension access

What was the type of service?	Who was the main provider? *(codes K)*	Level of satisfaction of use (*codes L*)
Crop production	[____]	[____]

Livestock production (*including vet services*)	[_____]	[_____]
Natural Resource Management (soil, water)	[_____]	[_____]
	1.Public extension agent **2.**Private extension **3.**Coops/Farmer Associations/CBOs **4.**NGO **5.**Farmers (paid)	1=Very dissatisfied 2=Dissatisfied 3=Neutral 4=Satisfied 5=Very Satisfied

F. MARKET ACCESS

F.1 What is the distance to the nearest main market center from the farm? (Kms) ________________

F.2 What is the type of road from the farm to that main market [___] *(Codes M)*

Road type codes M	
1=All season tarmac	3= Seasonal murrum road
2= All season murrum road	4= Others (specify)

F.3 How far is your farm from the nearest input shop in walking (hrs)? _______________________________

F.4 What is the distance from your farm to the nearest health center (Kms)? ___________________________

F.5 What is the distance from your farm to the most important town/urban center (Kms)? _______________________

F.6 What is the cost of transport to the most important town (Ksh)? ___________________________________

G. HOUSEHOLD INCOME

G.1 Which economic activity do you consider to be your biggest source of income in a year? ______________

1. Livestock keeping 2.Crop production 3. Wildlife conservation

G.2 What is the annual net income of this household? ___________________________________

Enterprise	Average income (codes N)		Income range (codes N)
	Code	Amount	
Crops			**1.**Below 10,000
Livestock			**2.**10000-20000
Wildlife conservation			**3.**20000-30000
Off-farm activities e.g shop, teacher, rented houses			**4.**30000-50000
Remittances			**5.**Above 50000

Others			
Total			

H. LAND SUBDIVISION

H.1 Has the land in your group ranch been subdivided? 1 Yes [___] 2. No [___]
If Yes do you think it was a good move or a bad move

____
____
____
___

If No, would you like it if the subdivision took place? 1. Yes_______________ 2. No ________________
If yes why

____
____
_

If No, why

____
____
__

For Kimana group ranch how many sons of the registered member were there [____]

Time interview ended ___________________

THANK YOU FOR YOUR TIME