EFFECTS OF COMMUNAL AND INDIVIDUAL LAND TENURE SYSTEMS ON LAND USE AND FOOD SECURITY IN KAJIADO DISTRICT, KENYA

BY

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DECLARATION

I hereby declare that the work contained in this thesis is my original work and has never been submitted for a degree in any other University.

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DEDICATION

This thesis is dedicated to my husband Julius Ogutu and my children Florence Akoth, Theresa Awuor and Mike Akeyo.

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ABSTRACT

The East African governments have initiated land reform programmes with the objective of creating individualisation of land rights where rules of access, use and transfer are reformulated in order to adapt to rising population densities, land scarcity and agricultural commercialisation. This study assessed the effects of land tenure on land use and food security in Loitokitok Division, Kajiado District, Kenya. Purposive sampling was carried out by grouping locations within Loitokitok Division into two: those practising transhumance and the ones practising agropastoralism. Transhumance refers to seasonal movement with livestock for pastures and water while leaving the bulk of the households in permanent settlements. Agropastoralism refers to mixed farming in permanent settlements but sometimes includes transhumance.

One location was randomly selected from each of the groupings and systematic sampling was carried out. Samples of 35 transhumant and agropastoral households respectively were then selected for the administration of a questionnaire. Also, village elders, chiefs and extension officers were interviewed, and more data were collected from annual reports and previous research studies.

Data were analysed using both descriptives and regressions. Stratification of households showed that land tenure had influence on pastoral household size, herd size, milk yield, income from milk, total income, employment and remittance. In addition, agropastoral households were more food secure with a food poverty incidence of 0.2 while that of transhumant households was 0.6. The linear regression model showed that household size, diversification, total income, gender and land tenure had influence on both transhumant and agropastoral household food security at 5 per cent level of significance.

Based on the results of this study, it is recommended that the government and other stakeholders create awareness on issues of land tenure by gradually introducing the concept of individualisation of land rights in pastoral areas. Also, for improved income in these areas, there is need to increase the livelihood sources through micro industries such as milk processing plants, and hides and skins. This will provide job

opportunities and ready markets for their products. Further, family planning programmes should be provided to ensure household dependency ratio is reduced.

CHAPTER ONE

INTRODUCTION

1.1 INTRODUCTION

The United Nations strives to attain global food security through its agencies such as Food and Agriculture Organisation (FAO), and the World Food Programme (WFP) (FAO, 2000). This goal has remained elusive especially in the arid and semi-arid areas that are often inhabited by the nomadic pastoralists. A good example is the horn of Africa, where a catastrophic famine was experienced in Ethiopia in 1984 and feverish efforts were on to avert future occurrences (Mulaku, 2000). Besides these big international news making famines, there is always some more limited episode of food insecurity in one or more of the countries in the horn of Africa at any given time. Studies have shown that pastoralists lack cereal stocks and their animal prices tumble in drought, grossly eroding their purchasing power (Sunya, 2003). All these, coupled with their scattered distribution in often harsh and inaccessible terrain, generally make them more vulnerable to famine than their agricultural counterparts (Mulaku, 2000).

A plurality of factors acting either singly or in concert has been cited as being responsible for this trend (Ayan, 1981; Bonfiglioli, 1992; Farah and Haji, 1990; Bovin and Manger, 1990). These factors include increased livestock and human populations; breakdowns in traditional authorities regulating access to range resources; and developments inconsistent with proper principles of range management. In addition, reduction of the range resource base due to encroachment by cultivators on the reserve pastures and permanent water resources crucial for dry season grazing have increased the occurrence of droughts claiming a heavy toll on pastoralists and their livestock (Noor *et al.*, 1999).

The usual scenario of the international community responding with food aid when people begin dying *en masse* can never be a long-term solution. Already there are clear signs of donor fatigue in response to famine. The long-term solution lies in the adoption of a long-term development strategy in the pastoral areas such that there will be increased food production and conservation of natural resources in a more sedentarised environment (Mulaku, 2000).

Food security is attained when sufficient growth in food crops and livestock is achieved not only to maintain output per person, but also to reduce food calorie deficits and to lower food imports (Nyariki and Wiggins, 1999). Land tenure refers to the manner in which rights, restraints and responsibilities in land are allocated, held and passed on in any jurisdiction determining who may do what with the land (Dale and McLaughlin, 1999; Juma and Ojwang', 1996; Mulaku, 2000). As all such development must take place on land, one cannot plan and carry it out without regard to prevailing land tenure arrangements (Kigutha, 1994; Mulaku, 2000).

Land use refers to the utilisation of the available land resources at the disposal of an individual for the satisfaction and fulfillment of human wants (Wandera, 1997). The major land uses in the arid and semi-arid areas have been nomadism in the arid regions, transhumance in the semi-arid regions and agropastoralism in sub-humid regions. Nomadism is characterised by frequent migration from place to place of a whole community usually in search of water and pasture. The nomads live in temporary structures that they carry along as they move. Transhumance is the occasional migration of part of a community to far away pasture while leaving the bulk of the community in permanent settlements. The transhumant pastoralists exploit the good grazing grounds of the arid and semi-arid lands (ASAL) in the rainy season, but are forced to move to the savannahs due to lack of water. Not only is the quality of pasture low in savannahs, but also the risk of diseases is much higher. The relationship between transhumant pastoralists and agropastoralists has always been close through the exchange of goods and services, despite the fact that these different types of land use are increasingly in conflict. These conflicts are attributed to the occupation of better soils by agriculturists, which are the key dry season grazing

grounds of the transhumant pastoralists. The net effect is degradation of the ecological system, resulting in food scarcity and increased income insecurity (Swift, 1989). Thus, studies have established that pastoral land use is rational and is an ecological adaptation given arid land constraints (Pratt and Gwynne, 1977; Le Houerou, 1980; Farah, 1996). The dynamics of open range management and indigenous knowledge of land tenure systems are important foundations for the success of these opportunistic strategies (Noor *et al.*, 1999).

Several studies have been carried out in the ASAL focusing on transhumant and agropastoral households. Sandford (1983) found a relationship between grazing and land degradation. He stated that most Sahelian rangelands have been overgrazed, and that "grazing has inflicted much more damage than drought and desiccation" in the ASAL. This study did not document the influence of land tenure on land use and food security. Swift (1977) noted that pastoral mobility is a key strategy to utilise the spatial and temporal forage resources in the ASAL for the survival of pastoral herds. He also stated that pastoral land tenure is at the heart of ecological sustainability of land use in the dry belt of Africa (Swift, 1989). These studies focused on land tenure and land use, but did not show their relationship to food security. Other studies have focused on the causes of household food insecurity and nutrition in the drylands of Kenya (Vedeld, 1990; Nyariki *et al.*, 2002).

Mulaku (2000) identified the three types of tenure models in East Africa as quasi-customary, pure customary and group ranch models. He further suggested that for a community to succeed in attaining food security in marginal areas, it must give due and long-term attention to issues of land tenure, especially in transhumant and agropastoral areas, which tend to be given limited attention by governments due to their supposedly limited potential for food production. In the study, he showed the relationship between tenure and land use, but did not relate the two to food security. Therefore, there is need to understand the effect of land tenure systems on land use and food security.

1.2 PROBLEM STATEMENT

In Kenya, 80 per cent of the total land mass comprises ASAL, which are characterised by low and unreliable rainfall, high temperatures, infertile soils and sparse forage distribution, making these areas suitable for pastoralism (Pratt and Gwynne, 1977). However, it is estimated that 30-40 per cent of Kenya's ASAL is quickly degrading due to institutional administrative boundaries, creation of wildlife reserves, forest gazettement and encroachment by farming (Keya, 1991; Lenaola *et al*, 1996). These expansions have led to herders losing prime grazing lands particularly in the rangelands to make room for flood recession and agriculture, resulting in increased land use conflicts and transformation of the pastoral way of life (Bonfiglioli, 1992; Lenaola *et al*, 1996). The expansion of settlement and dryland farming has not only resulted in conflicts (Helland, 1980) but has also threatened the productive capacity of these areas (UNEP, 1977; Dregne, 1983). These changes have led to majority of pastoral households being unable to meet their cost of living through their land-based activities alone.

However, with the individualisation of land tenure, mobility has been restricted, thereby reducing the available grazing resources for pastoral herds. Furthermore, land reforms have brought controversies in Kenya causing intra- and inter-community conflicts especially with regard to utilisation of grazing resources and water. Food security is of national concern as well. Several development interventions have been undertaken by the government and non-governmental organisations to improve food security in pastoral areas. All these development efforts have been unsuccessful due to lack of pastoral cooperation in the implementation. Since all these interventions take place on land, they can never be successful without considering the prevailing land tenure arrangements.

1.3 JUSTIFICATION OF THE STUDY

This study is justified for several reasons. Most dietary surveys have been conducted to determine household food security among various groups in Kenya. Among the Maasai, most studies are more than 10 years old. A lot of changes have taken place, hence the need to update the current food security status. Also, few studies have investigated the effect of tenure on land use and food security particularly among the pastoral communities. These studies have either analysed these variables independently or in pairs, but none analysed the relationships among the three variables. Lastly, the changing living patterns among pastoralists with increased individualisation of land ownership and increased involvement in agriculture could have an influence on food production and food accessibility by households.

Further, individualisation of tenure through land registration and adjudication has led to privatisation of land, leading to restriction of mobility, which is the key strategy for pastoral survival. These actions were justified by assertion that pastoral lands were empty spaces with no individual resource owners, and that the pastoral way of life represented irrational resource management (Juma and Ojwang', 1996). These changes have resulted in the conversion of dry season grazing areas to croplands. The pastoral attempt to adjust to these changes has not only been unsuccessful, but has also resulted in recurrent droughts (Noor *et al.*, 1999). These occurrences have also been reported in Ethiopia, Sudan, Niger and Mali among others (Helland, 1980; ILCA, 1981; Sandford, 1983; Keya, 1991; Kariuki *et al.*, 1996).

Although a lot is already known, there is a paucity of information on the relationships among land tenure, land use and food security. This study analyses and describes the influence of land tenure systems on the land use and food security status among transhumant pastoralists and agropastoralists in Loitokitok Division, Kajiado District, Kenya. It assesses the different tenure systems in the two study areas and their relationship to household food security. The findings of this study would bridge the knowledge gap, provoke future research and provide policy guidelines to the policy makers when designing development and land use plans for pastoral areas, especially at this moment when the Kenya Government is developing a national land use policy.

1.4 OBJECTIVES

The broad objective of this study is to analyse and describe the effects of land tenure on land use and food security in the rangelands of Kenya, taking a case study of Loitokitok Division, Kajiado District.

1.4.1 Specific Objectives

The specific objectives of the study are to:

a) Identify and describe the types of land tenure systems in the study area, and examine the effect of each on land use.
b) Compare and contrast the livelihoods of transhumant pastoralists and agropastoralists in the study area in relation to household food security.
c) Investigate the types of institutions in the study area and their roles regarding land tenure system.

1.5 HYPOTHESES

The following hypotheses were tested in order to achieve some of the objectives:

a) Land tenure has no influence on land use.
b) Land tenure has no effect on food security status of both transhumant and agropastoral households in the study area.

1.6 ORGANISATION OF THE THESIS

Further to the introduction above, literature review, methodology, results, discussions, conclusions and the recommendations are presented in the thesis. Chapter two reviews literature related to the land tenure, land use and food security in developing countries, including Kenya. Chapter three discusses data collection and methods of data analysis. Chapter four presents results and discussion on different types of land tenure systems and household food security models. Finally, chapter five provides the conclusions and recommendations based on the findings of the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 PASTORAL PRODUCTION SYSTEMS

Pure pastoral production system is where 50 per cent or more of the household gross revenue comes from livestock or livestock related activities and more than 15 per cent of household food energy consumption consists of milk or milk products produced by the household (Bonfiglioli, 1992). An agropastoral production system is where more than 50 per cent of household gross revenue comes from farming, and 10-50 per cent from pastoralism (Noor *et al.*, 1999).

Pastoral production systems can be grouped into three types of economies. The first type is a dichotomised economy in which affluent nomads are drawn to agrarian investment or where pastoralists whose animal holdings are insufficient become tenant farmers as a supplement. It is characterised by strong central authority in which land is highly valued. The second type is the mixed economy where pastoralism and cultivation are combined. It is common in areas of low population density and weak penetration of central authorities. Lastly, is the intersection economy, which is a local integration of nomadic pastoralism and casual labour. This economy has a paradoxical relationship to sedentarisation in that resources obtained through participation in the agrarian sector are frequently used to maintain pastoral households (Salzman, 1980). In the past, Maasai pastoralists exchanged or bought commodities from agriculturalists, but in the last twenty years, the pastoral Maasai have gradually started cultivating (Ndagala, 1992; Maghimbi, 1990; Ibrahim and Ruppert, 1994). This shows that dynamic changes always occur in pastoral production systems.

2.2 PASTORALISM

Pastoralists have evolved ways of coping with risky environments and conserving their resources. Survival strategies vary from region to region depending on the history, natural environment and the local people. These strategies are also dynamic

with modifications evolving in response to gradual transformations in the environment and the social context (Bovin and Manger, 1990). Traditional adaptive strategies have been adopted as a response to the uncertain characteristics of the dryland areas. Traditional adaptation practices stress mobility, social co-operation and high labour inputs. These coping mechanisms attempt to deal with crisis arising from drought, famine and marginalisation. Apart from these, other strategies have arisen to deal with environmental degradation, while some are new adjustments to the more immediate impacts of development projects (Helland, 1980).

Other pastoral coping mechanisms include maintenance of more than one livestock species; splitting of livestock holdings into units based on species and management (Morton, 1990; Niamir, 1991); establishment and maintenance of a social system for resource sharing (Dahl and Hjort, 1979; Raikes, 1981); maintenance of large herds as possible to restock after the drought (Niamir, 1991) and reduction in the number of reliant household members during drought periods by sending away all able bodied people not required to work in adjacent agricultural areas (Kariuki *et al.*, 1996). Pastoral strategies of risk aversion generally focus on herd modifications through diversification of species, dispersion, distribution and expansion to provide protection against heavy losses. These strategies are analogous to agricultural practices such as multi-cropping and reserve granaries in areas of risky agricultural production.

Herd modification is central to understanding both pastoral strategies and redistribution systems. Herding activities are thus a response to the household's necessity of adapting food production to the ecological limitations of marginal drylands (Dahl and Hjort, 1976). Herd diversification has advantage of spreading the available food resources throughout the year. This is achieved because different livestock species have different forage requirements, adaptation to different ecological conditions and behavioural differences creating varying degrees in management (Noor *et al.*, 1999). This has motivated the pastoralists to optimise number of livestock per unit area of the ASAL (Cossins, 1983).

The attempt by the pastoralists to optimise livestock numbers per unit of arid land has been misunderstood by government officials and some scholars. They have viewed

pastoralists as having excessive numbers of livestock that overgraze and ultimately degrade the land by practising an inefficient "out of date" type of economy (Lane, 1991). This has led to policies for destocking of pastoral herds and transformation of pastoral land use through village settlement schemes, rangeland enclosures and alienation of pastures for non-pastoral purposes. Although pastoralists have been able to either accommodate or avoid most of these impositions, they have to date failed to prevent widespread alienation from their lands. This inability stems from the difficulty they have in defending variable and sometimes transitory occupation of land, and the particular susceptibility of common land to encroachment by settlers and appropriation by the state (Lane, 1991). The result of misconceptions about the nature of pastoralism and pastoral land tenure have not only provided justification for its transformation, but also facilitated the alienation process itself. Furthermore, these misconceptions have led government actions and policies that are contrary to pastoral way of life (Dahl and Hjort, 1976).

2.3 LAND TENURE

Land is a productive asset essential for the production of both food and raw materials. It determines income distribution and access to food in the rural areas. It therefore follows that nutrition among the rural people is closely related to land tenure status and the size of land holdings (Kigutha, 1994). For this reason, the distribution of rural wealth and food poverty incidence are related to socio-economic order that determines the type of access to land and its use in society (FAO, 1986; Kigutha, 1994; Otsuka and Place, 2001).

Land tenure system is defined as possession or holding of the rights associated with each parcel of land. It has three dimensions, namely people, space and time (Ogolla and Mugabe, 1996). It helps define people's relationship to the land and the limits of rights any person has to a given parcel of land. Time aspect determines the duration of one's right on land, whether freehold or rental. In freehold, landowners have full private ownership that is free of any obligations to the state other than payment of taxes and observance of land use controls, imposed in the public interest. In rental arrangements, there is an agreement for temporary use by a lessee, who pays rent to

the lessor (Juma and Ojwang', 1996) and the spatial dimension limits the physical area over which the rights are to be exercised (Robinson, 1994; Ogolla and Mugabe, 1996; FAO, 2001).

2.3.1 History of Pastoral Maasai Land Tenure

From the dawn of colonialism through independence, the Maasai experienced continuous disruption of their indigenous cultural ties to the ecosystems. The colonial authorities perceived the Maasai as fearless and warlike. Traditionally, the Maasai had no centralised government. The political authority was vested in elders who reached decisions by consensus. The colonial and post-colonial authorities viewed the Maasai as obstacles to development. This was because of their adherence to traditional customs and economic way of life presented problems of administrative control, public security and administration of justice (Porohoryles and Szeskin, 1973).

The economic style of the Maasai depends on communal systems of land holding that maximises the feeding of the whole community. Maasai land was divided among clans in such a way that each portion constituted a self-sustaining economic and environmental unit. This was achieved by determination of claims according to the existence of water points and availability of water for the herds of each clan.

Mulaku (2000) categorised land tenure systems in pastoral areas of East Africa into three models, namely customary model, quasi-customary model, and group ranch model. The customary model was previously common among the Maasai of Kenya and Tanzania; land belonged to a large family, most of whose members had already died, some were alive, and a great majority, yet to be born (Porohoryles and Szeskin, 1973). The tribal elders allocated grazing resources such as watering points, multipurpose trees and shrubs to various family groups within the clan. The clan elders also regulated the migration patterns of different clans as dictated by the forage conditions. However, this model ceased to exist when East African governments declared pastoral areas as trust land in 1968.

The quasi-customary model was introduced after declaration of pastoral areas as trust land by East African governments. There was little change in the ways pastoral communities held land. The government failed to penetrate pastoral areas due to poor communication, making aid agencies and non-governmental organisations more visible in these areas. Despite the invisible hand of the government, it was able to interfere with management of land. This led to confusion and conflicts of interest, making the Kenyan government to introduce the concept of group ranching.

In 1968, the Kenya Government developed the group ranch model in an attempt to commercialise livestock production as well as sedentarise the Maasai. The Group Representatives Act (GOK, 1968) governs the constitution and administration of groups, while adjudication rights and registration are governed by agricultural legislations. The group elects its members as group representatives, who are registered by the government as trustees. The trustees regulate and control land use and also mortgage the land on behalf of members. Disputes among group members in relation to land are settled through the regular government court system. Examples of group ranches are found in Kajiado and Narok Districts. At present this model is facing problems due to conflicts arising between group members and their trustees who are corrupt. As a result, group ranch sub-divisions are underway, with individuals preferring to own pieces of land. Examples of already sub-divided group ranches are Rombo and Kaputiei in Kajiado District.

2.3.2 Land Tenure Regimes

African land tenure is complex and could perhaps be best described at various points on a *tenure continuum*. This continuum tends to be reduced at the national level to three essential types: customary tenure, private tenure and state controlled land, in which the latter may potentially be subject to either of the foregoing (Juma and Ojwang', 1996). The difference between customary tenure and open access is that under customary tenure those in power ("the owners") exercise their rights to exclude non-members, who in turn have a duty to respect that exclusion. The members ("the co-owners") are responsible for the exercise of both rights and duties related to the use and maintenance of the natural resources held in common by the members. The

breakdown of the tribal institutions in regulating a communal resource gives rise to open access (Bromley, 1989).

There are three classifications of land tenure based on property regimes, namely private property, communal property and state controlled property (Ogolla and Mugabe, 1996). Private or individual property (ownership) denotes a bundle of rights defining the owners' rights, privileges and use of a resource. State property occurs in situations where the government regulates and controls access to land. The state claims exclusive rights to land resource through sovereign application. The government may directly control and utilise land through its administrative arms or grant use rights to communities or individuals. In this process government took most of properties previously held by communities. Therefore, common property is controlled by a single entity and its access is limited to an identifiable community, which has set rules on the way the resource is managed and can exclude others from accessing the resource (Ongugo and Mwangi, 1996).

In the absence of property rights in resource use, the situation that exists is open access or *res nullius*. Nobody owns the resource, and access is on first come first served basis. However, unlike common property, open access resource users are not subject to any limits in the usage of property. In addition, open access users have no responsibility to a collective group to utilise resources in a manner that does not adversely affect the rights of other users. Failure to regulate resources results in open access, hence the tragedy of the commons.

2.3.2.1 Tragedy of the commons

Even if the rationality of pastoral production is accepted by many, a few have argued against traditional pastoralism (Lane, 1991). Lane and Swift (1989) found that African pastoralists have land tenure systems that are incapable of efficient land use. This is because pastoralists move their herd in response to the spatial and seasonal variation in range resources due to common land tenure arrangement. The problem has been the inability of the pastoralists to control individual land use of the commons. Individual herders are interested in increasing their livestock holdings, and it is thought that there is no limit to the use of the common resource. Therefore, stock

numbers will inevitably increase until they overgraze and degrade the land. The tragedy of the commons is based on two assumptions: that access is open to all without restraint and herders possess self-interest (Hardins, 1926).

2.3.3 Land Tenure and Agricultural Productivity

The most common way that security and land tenure issues are linked in the literature is in discussions of security of tenure on farmland (Atwood, 1990; Conway and Barbier, 1990; Migot-Adholla *et al.,* 1991; Migot-Adholla *et al.,* 1994). However, discussions of security-tenure connections in relation to communal, state and open access are more limited. The importance of common property resources for the poor is sometimes mentioned in literature on security and livelihoods or on common property (Davis *et al.,* 1991; Djoura *et al.,* 1991; Migot-Adholla *et al.,* 1994; Robinson, 1994), but seldom is any detailed analysis of the relationship between these tenure systems and food security done.

Currently, there is little consensus among scholars on the effects of land tenure on productivity in Africa, and particularly in Kenya. Conclusions tend to vary depending on the period of analysis. For instance, between 1960 and early 1970s production rose at a high rate, which some scholars attributed to land reform. In the highlands and high-density settlement schemes, small-scale farmers realised higher yields than those in low-density, large-scale farms. However, in the 1980s and 1990s, production levels failed to match increases in population due in part to land tenure problems such as continuous land sub-divisions and poor agricultural land use policies (Ondiege, 1996).

Other scholars have questioned the casual relationship between individual tenure and increased agricultural productivity (Heyer *et al.,* 1976). These researchers argue that increased agricultural productivity in Kenya seen during the 1950s and 1960s was due to the lifting of the ban prohibiting Africans from growing high-value crops, rather than the introduction of individual tenure systems. Also, most surveys have been carried out in the rainfed farming areas rather than in the ASAL (Migot-Adholla *et al.*, 1991). A weak relationship was found between individualisation of land rights and agricultural productivity in Kenya and Ghana. In contrast, the result from Rwanda

showed that individualisation of land rights improved agricultural production in areas with low land-labour ratio. These researchers also found that communal tenure systems are flexible and responsive to changing economic conditions. For example, with increased population pressure and commercialisation, communal rights systems evolve to individual rights. Tiffen *et al.* (1994) confirmed this view that by 1930 in Machakos, customary tenure had already recognised private rights, particularly in cultivated areas.

Feder *et al.* (1988) and Feder and Fenny (1991) noted a positive relationship between land rights and productivity in Thailand. They found that with individualisation of land rights, individuals are motivated to use land improvements and inputs that increase output per unit area of land. These findings were challenged by Migot-Adholla *et al.* (1994) and Bruce *et al.* (1994) who concluded that the effects of land rights do not appear to constrain agricultural productivity. They argued that farmers are likely to feel secure in their ability to continuously cultivate their land regardless of the rights category. The above was further refuted by Mulaku (2000) who suggested that individualisation of group ranches is the best way to improve food security in pastoral areas by explaining that with registration of individual pieces of land, households would concentrate on agriculture and avoid infiltration of other groups through land purchases.

Pastureland tenure is described as most politically sensitive and socio-economically complex. Land tenure system, as already discussed, can have a profound consequence on food security by affecting, which livelihood assets people will rely upon and will invest in. For example, where pastureland is open access, users will usually be unwilling to invest in the land because there is no way to exclude "freeriders". When open access is compared to customary tenure where inter-community boundaries are strictly enforced, access is more limited, but it is more feasible to invest in land. Land will tend to hold more value as a resource in customary tenure than under open access. In conclusion, land tenure system is likely to influence the nature of land use, whether livestock production or mixed farming that influence livelihood strategies (Robinson, 1994).

2.4 LIVESTOCK PRODUCTION

Livestock production is characterised by three principles, namely: adaptation to the environment that involves matching the erratic and seasonal patterns of primary productivity for continuous forage supply for the livestock; risk aversion that involves adoption of special management strategies of herd modifications; and adaptation to the institutional environment allowing institutional linkages that control and regulate common grazing resources (Porohoryles and Szeskin, 1973; Jahnke, 1982). Failure of the local institutions to perform their roles, "the tragedy of the commons" sets in the communally owned resources (Hercovits, 1926). Therefore, sound livestock management is necessary for sustainability.

Livestock has over the years played important functions in pastoral households. These include output, input, social, cultural, risk and security functions. The output function is where livestock provides food and can also be converted into cash to purchase food for households in times of hardship (Dahl and Hjort, 1976; Jahnke, 1982; Tangka *et al.*, 2000). Input function is use of livestock as a capital good in the production process by providing traction and manure for agropastoral households, and raw materials for use in leather industries. Social and cultural functions are use of livestock to pay for bride price, an indication of wealth and status. Lastly, the asset and security functions are when livestock is sold to obtain cash to solve family financial problems and as a guarantee against soft loans. To this extent, livestock contributes to food security through increased livestock output and non-livestock products, employment creation and income generation, assuring access to food (Nyariki, 1998).

2.5 FOOD SECURITY

Since 1970s food security has been an important focus of the international development, although lately this seems to have been overshadowed by environmental concerns. The driving force for food security has been the recurrent famine of the early 1970s and mid 1980s, and discussions on food security often revolve around famine definition, explanation and prevention (Muthoka, 1996; Nyariki and Wiggins, 1999). Discussions on food security have also focused on

various levels from individual to international, but food security is "most often conceptualised as a macro phenomenon-deviation from trend in aggregate consumption" (Clay, 1981). It is frequently discussed in relation to topics such as international markets, macro-economic policy, national food distribution systems and political instability.

Food security may be defined as access by all people at all times to adequate food for active life (Kigutha, 1994; Nyariki and Wiggins, 1997). Although food is a defining concept, it is not all that matters. Food security encompasses food availability through production, storage or imports; and the access that people have to food through their purchasing power in the markets (Nyariki and Wiggins, 1997). Access derives from the entitlements a household has to food, either through its own production of foodstuffs or through command over food in markets or other circuits, decisions over the amount and kind of food produced or bought, the internal distribution of household food amongst residents, and the health of individuals which affects the ability to secure nourishments from food (Nyariki *et al.*, 2002). Therefore food security issues are important for planning and managing natural resources to improve pastoral livelihoods. This is because they underscore the complexity of ever-changing rural livelihoods, especially in terms of changing access to physical resources essential for survival (FAO, 1989).

The food situation in Kenya today is drastically different from that of the mid 1970s. Much effort has been geared towards increasing food production in order to cope with the massive food shortages faced due to rapidly growing population. Policies aimed at increasing agricultural production were stressed and many of the modern improved agricultural technologies have gone a long way in reducing hunger (Kennedy and Haddad, 1994). Reduction in hunger has been attained through increased agriculture, employment as well as indirectly through lower food prices and non-agricultural employment.

In literature, there are several discussions on food security at national and household levels. However, the problem of food security at micro level is formulated in different ways and the focus is not always set narrowly on food. For example, in some

formulations, "food security is essentially a proxy for poverty" (Maxwell, 1990). Some writers have gone further to argue that poverty is the central focal point and that food security must be seen as only one aspect of poverty. In support of the above, Robinson (1994) stated that "there are risks that using food security approach might impart a biased or partial understanding of poverty by neglecting aspects such as asset holding or dependency, or might lead to over-emphasis on consumption-oriented interventions, which prove to be unsustainable.

The concept of "sustainable livelihood security" has been suggested as a replacement for "food security" (Chambers, 1987). This is because poor rural people seldom limit themselves to agriculture in constructing a living; the concept of "livelihood security", therefore, should more accurately reflect the needs and concerns of the rural poor than food security". For the purpose of this study, the term "food security" is used even though it is often associated with more macro issues. This is because the livelihood security concept suggested by Chambers (1987) is relative and quite general. Furthermore, studies that have focused on national food security have either under-estimated or overestimated the actual calories available for the households. For example, Kennedy and Haddad (1994) reported that in studies where national food sufficiency has been seen as a proxy for household food security, 20-30 per cent of the populations consume less than 80 per cent of the calories requirement, even when the per cappita supply is at or above 100 per cent of need. Therefore, the household food security approach would be the most appropriate because it is also dependent upon the people's livelihood strategies, which are defined as ways used by rural poor to cope with the threats that face their livelihoods (Chambers and Conway, 1992). They are general patterns of behaviour that can be based on conscious decisions and habitual practice imbedded in culture.

In discussing how the rural people cope with vulnerability to famine, Swift (1989) refers to three broad categories of assets that can be relied upon: investments, stores and claims. Investments are those assets that are expected to contribute to production and can include education, farming equipment, wells and soil conservation. Stores refer to food stores, jewelry, money and bank accounts. Investments and stores are generally under the control of households. On the other hand, claims refer to a wide

range of wider social and political processes, whose activation depends on some level of collective decisions. Claims in a household include claims on patrons and big men, claims on the government, and claims on the international community. Unfortunately, land, especially common land, does not fit easily into this scheme. Instead, stores, investments and claims are types of assets that may be cashed in when households face a crisis, production assets are sold, granaries are emptied, jewelry is sold, bank accounts emptied, loaned animals recalled, labour debts called in and community support mechanisms activated.

Chambers and Conway (1992) have rearranged Swift's grouping of assets and developed it further in an attempt to produce a holistic model of rural livelihood. It has three components that include people (and livelihood capabilities), tangible assets (stores and resources) and intangible assets (claims and access). These are brought together to produce a living. Robinson (1994) argued that what Chambers and Conway call "livelihood capabilities" might be more familiarly termed "human resources". But either label is incomplete in that it includes people's capabilities and not their goals. People with same capabilities and same assets may choose to produce a living different ways. They may grow different crops, may choose a different balance between cultivation and livestock keeping, or choose a different mixture of agricultural and non-agricultural activities.

Estimation of pastoral household welfare

There are a number of approaches to measuring the economic welfare of the rural households. The approaches used differ in terms of the importance attached to the individuals' own judgement of well-being versus a concept of welfare decided upon by somebody else. The indices used to measure the welfare of people include head count, gini coefficient, poverty gap and squared poverty gap (Nyariki and Wiggins, 1997; http / www. poverty. Com).

The head count index refers to the proportion of the population whose economic welfare is less than the poverty line. It measures how widespread poverty is in any social setting. It is the most commonly used approach in developing countries because

the welfare of the people is best indicated by the nutritional attainments that are easy to estimate. The Gini coefficient is not commonly used because it gives consideration to income levels that are difficult to estimate and also greatly fluctuates over time. The poverty gap index measures how poor the poor are while the squared poverty gap index measures the severity of poverty by giving more weight to the poorest of the poor (Nyariki and Wiggins, 1997; http / www. poverty. com). For this study, the head count index with respect to food consumption (food poverty incidence) was employed to assess the food security status of pastoral households.

Researchers have used the poverty incidence to determine food security status of households. Food poverty incidence is the ratio of food poor households to all households in a community (Sunya, 2003). The ratio gives the food poverty status of the community under investigation (Nyariki and Wiggins, 1997; GOK, 2000a). This approach involves the collection of day-to-day data on household food consumption. The food consumed on a weekly basis was estimated for a period of six months, and then converted to its calorie value based on values by Nyariki *et al.* (2002). The calorie value of each foodstuff consumed was calculated and then summed up to obtain the total calorie consumption per household per day. The total calories consumed per day were then divided by the sum of Active African Man Equivalence (AAME) to obtain the calories consumed per AAME. The value obtained was compared with the standard calorie requirement of 2,250 kcal. If the ratio was less than one, the household was food insecure and if it was one or more the household was considered food secure (GOK, 2000a; Nyariki *et al.*, 2002; Sunya, 2003).

Standard units to compare the nutritional requirements of people of different ages and gender exist. The daily caloric intake by members of households is used as a measure of household food security (Nyariki and Wiggins, 1999). The assumption is that the daily food energy requirement of one AAME is 2,250 kcal (ILCA, 1981; Nyariki and Wiggins, 1997; Sunya, 2003). The consumption weights by ages are 0-4 years, 0.24 AAME; 5-14 years, 0.65 AAME and above 15 years, 1.00 AAME (GOK, 2000a).

Child nutrition has also been reported to be essential in determining household food security, especially when the security of intra-household nutrition is a concern raised

in literature on food security. Attention is given to women and children, the most vulnerable members of the poor households. Such households discriminate among its members in distributing food, when food supply is inadequate, but declines with increased supply. It is estimated that 2.3 million children aged 6-24 months die annually in developing countries due to malnutrition (Tangka *et al.*, 2000).

Several methods have been used in estimating nutritional measurements. Parameters such as Weight-for-Age (W/A), Height-for-Age (H/A), Weight-for-Height (W/H), Head circumference and mid-upper arm circumferences (MUAC) for different age groups have been used as a basis for assessing malnutrition and evaluating effects of dietary treatment in children. Weight, height, head circumference and mid-upper arm circumference for age are the percentages of adequacy of each of these measurements based on the respective standards for the children chronological age (Kigutha, 1994; Tangka *et al.*, 2000).

Droughts, lack of herding, proliferation of firearms, poor infrastructure and lack of organised markets have affected pastoral food security (Sunya, 2003). Food insecurity is exacerbated by increased desertification of the pastoral grazing environments, high population growth and conflicts. According to Sunya (2003), 790 million people suffer from chronic food insecurity, out of which 70 million are from Africa. High frequency of droughts and increased human population have greatly hampered pastoral traditional drought copping mechanisms, namely, mobility, reciprocal rights and exchanges, and linkages. Loss of these mechanisms has made pastoralists more vulnerable to food insecurity. Furthermore, food security studies among the agropastoral communities of East and West Africa have shown that drought impacts most on household food security. Drought reduces crop yields per hectare and milk yields from flocks and herds. It also causes increased livestock mortality rates. For example, in Ethiopia the average mortality during drought is as high as 68 per cent compared to a good rainfall year when average herd mortality is 11 per cent per annum (Sunya, 2003).

Food security is also adversely affected by the loss of flexibility of the grazing range. The establishment of mission stations, police posts and schools among pastoral

communities have attracted some pastoralists to settle more or less permanently, limiting household mobility. As a result, the ability to graze livestock in areas far from the settlements is low. Pastoralists are also increasingly affected by lack of herding labour as a growing number of children go to school with the introduction of free education in Kenya since 2003. These, coupled with poor infrastructure, lead to inefficient transportation and exploitation of pastoralists by middlemen.

In the past, pastoralists were slightly involved in external economies. They were, nevertheless, more food secure than at present (Sobania, 1988; Sobania, 1979; Spencer, 1973). The colonial administration maintained minimum contact with them because their land was unsuitable for alienation, and they produced little that interested the colonial administration. However, pastoralists are now integrated in the broader national economies, which have influenced them to diversify their sources of livelihood for survival.

2.6 PASTORALISTS AND POLICY INTERVENTIONS

Pastoral communal grazing systems are also blamed for overgrazing. They are thought to be incapable of limiting the level of pasture use. The origins of this view are found in Hardin's "Tragedy of the commons", which proposes that private ownership of livestock on common land inevitably leads to overgrazing. This is because there is no incentive to limit use as the individual herder, since the herders fully benefit from the addition of an extra animal in the common grazing resource, whilst the cost of depleting (or degrading) common resources is shared proportionately by all (Sandford, 1983). In fact, most academicians, government officials and aid agencies share a "mainstream view" of how the decline of the rangelands has come about. This view holds that land degradation is caused by pastoralists keeping more livestock than the carrying capacity of the land (Sandford, 1983). Support from this comes from Herskovits (1926) "Cattle complex", which has been erroneously interpreted to explain how pastoralists are primarily motivated to build up herd sizes for their social value beyond their economic needs. Hence, wide disparities of views have grown between pastoralists and the government.

Arguments on over-population and overgrazing in which pastoralists are stereotyped as irrational and destructive users of land has led to lack of support for the pastoralists and their form of production. To the government and policy makers, pastures are regarded as either abused or under-utilised, thereby acquiring scant regard for the rights and needs of pastoralists. This has caused antagonism, reducing government perceptions of pastoralists to that of recalcitrant and irrational adherents to tradition. Pastoralists, on the other hand, fear the government will not take their interest into account when formulating development plans. In this way, relations between pastoralists and the government have at times deteriorated to the point of open conflict (Lane, 1991). These misconceptions inherent in the "mainstream view" can only be replaced if there is greater understanding of the nature of pastoral production and the way land is used. The policies need to reflect new realities to replace the "old orthodoxy" for development and improved performance in pastoral areas (Lane and Shift, 1989).

The scholars of various disciplines hold different views on the causes of land degradation. Hjort (1985) explained the causes of degradation as ecological degradation of a sensitive environment, political and economic marginalisation of a local population, starvation and disaster. For instance, people are forced to penetrate into vulnerable marginal areas to increase the cultivated area for compensating for low yields due to population pressure and the recurrent drought in northeastern Ethiopia (Helland, 1980; Ali, 1995; Lusigi, 1984). Studies done in northern Kenya showed that direct human activities and overgrazing of rangelands are the major causes of land degradation (Lusigi, 1984). Evidence from several areas of dryland Africa showed that an increase in human populations is not always damaging to the resource base. For example, population pressure was found to be a necessary condition for intensification of more conservative land use practices in Machakos, Kenya (Tiffen *et al.*, 1994).

2.7 CONCLUSIONS

Land tenure policies have changed considerably within Kenyan pastoral areas over the last 40 years. Until mid 1960s, lands in the pastoral areas were held communally. After independence, the government encouraged group tenure in pastoral areas, with

the aim of commercialising livestock production. The initial step towards land privatisation was the introduction of the Group Representatives Act in 1968, which provided for adjudication of group ranches under the Kenya Livestock Development Project funded by World Bank. The pastoralists later perceived the concept of group ranching as a way of alienating them from their ancestral land. In this context, the government did not achieve its objective and the pastoralists continued with their traditional land ownership in the group ranches. Because of this, the group ranches collapsed and the Maasai started pressurising for sub-division. The government officially authorised the sub-division of group ranches in mid 1983. After sub-division of group ranches, land fragmentation and sales have increased tremendously (Kristjanson *et al.*, 2002). Research studies among the pastoral communities show that pastoral production systems were rational, but currently, there is increased food insecurity in these areas. Hence, the need to study the relationships among different tenure systems, land use and food security.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter presents a brief description of the study area, the methodology used in data collection, sampling design and the analytical framework. Descriptive statistics and the regression analyses were used to summarise the data and establish interrelationships among variables. Household socio-economic data such as livestock holdings, land tenure systems, household sizes, land sizes, remittances, total cash income, milk yields and income form milk were analysed.

3.2 STUDY AREA

3.2.1 Location

Fieldwork for this study was carried out in Rombo and Imbirikani Locations, Loitokotok Division, Kajiado District in the Rift Valley Province of Kenya. Kajiado District covers an area of 21,105 km^2 (Muthoka, 1996). It has five divisions, namely Ngong, Magadi, Loitokitok, Central and Mashuru. Loitokitok Division is situated in the southern part of the district along the Kenya-Tanzania border, which follows a northwest to southeast axis across the lower slopes of Mt. Kilimanjaro; it is situated between 38.00^0 and 36.45^0 east and between 2.20^0 and 2.70^0 south of the equator. It constitutes the lower northeastern slopes of Mt. Kilimanjaro, together with the Amboseli ecosystem or the Amboseli plains (Hampson, 1975; Chabari, 1986; Berger, 1993). The distance between the two locations is about 60 km and they have similar climatic conditions.

Imbirikani Group Ranch lies along the Emali-Loitokitok road and occupies about 129,895 hectares. It is one of the six group ranches of the division besides Selengei, Olgulului, Kimana, Kuku and Rombo. The bigger portion of the ranch lies within agro-climatic zones IV and V, but some small pockets fall in zone VI. Only two per

cent is classified as ecological zones II and III. These households move with their livestock from one place to another at certain times of the year in search of sufficient pasture and water for their livestock (GOK, 2001a).

3.2.2 Climate

Loitokitok Division receives low rainfall that ranges between 300-900 mm per annum. Characteristically, rainfall is unpredictable, localised, and geographically uncertain. Group ranches between Mt. Kilimanjaro and the Chyulu Hills fall within the rain shadow of Mt. Kilimanjaro. There are two small areas that receive high precipitation of up to 1,100 mm located on the slopes of Mt. Kilimanjaro and Chyulu Hills. Rainfall is bimodal, with two rainy and two dry seasons. The seasonality in this division differs from the rest of the district. The short rains occur in March-May, with the highest intensity in April, while the long rains occur in November-December. The longest dry season is between June and October (Berger, 1993). The short rains are more critical because the number of rainy days indicates that rains are better distributed over this period. Many droughts that have occurred in this area have always been associated with the failure of this rain season. The two seasons coincide with the overhead movement of the sun (Masila, 2004).

3.2.3 Vegetation

Vegetation in Loitokitok Division differs spatially and temporally. Vegetation is classified as wooded and bushed grassland, grassland and dwarf shrub grassland (Pratt and Gwynne, 1977) characterised by dry thorny bushland dominated by *Acacia* and *Commiphora* (Hampson, 1975). *Acacia* dominance may be associated with many years of habitat degradation through overgrazing (Pratt and Gwynne, 1977). The key vegetation types include *Acacia xanthophlea* riverine habitat, *Acacia tortilis* woodland, and *Acacia melifera* bushland. The ground layer is dominated by dwarf shrubs mixed with grasses such as *Panicum maximum*, *Digitaria* species, *Cenchrus ciliaris*, *Enteropogon macrostachyus*,*Chloris roxburgiana* and *Cynodon dactylon*. Livestock has a dominant effect on the health of the grassland with all season grazing

areas being highly degraded (Kioko, 2000). Most of the tree species are deciduous with leaves falling during the dry season.

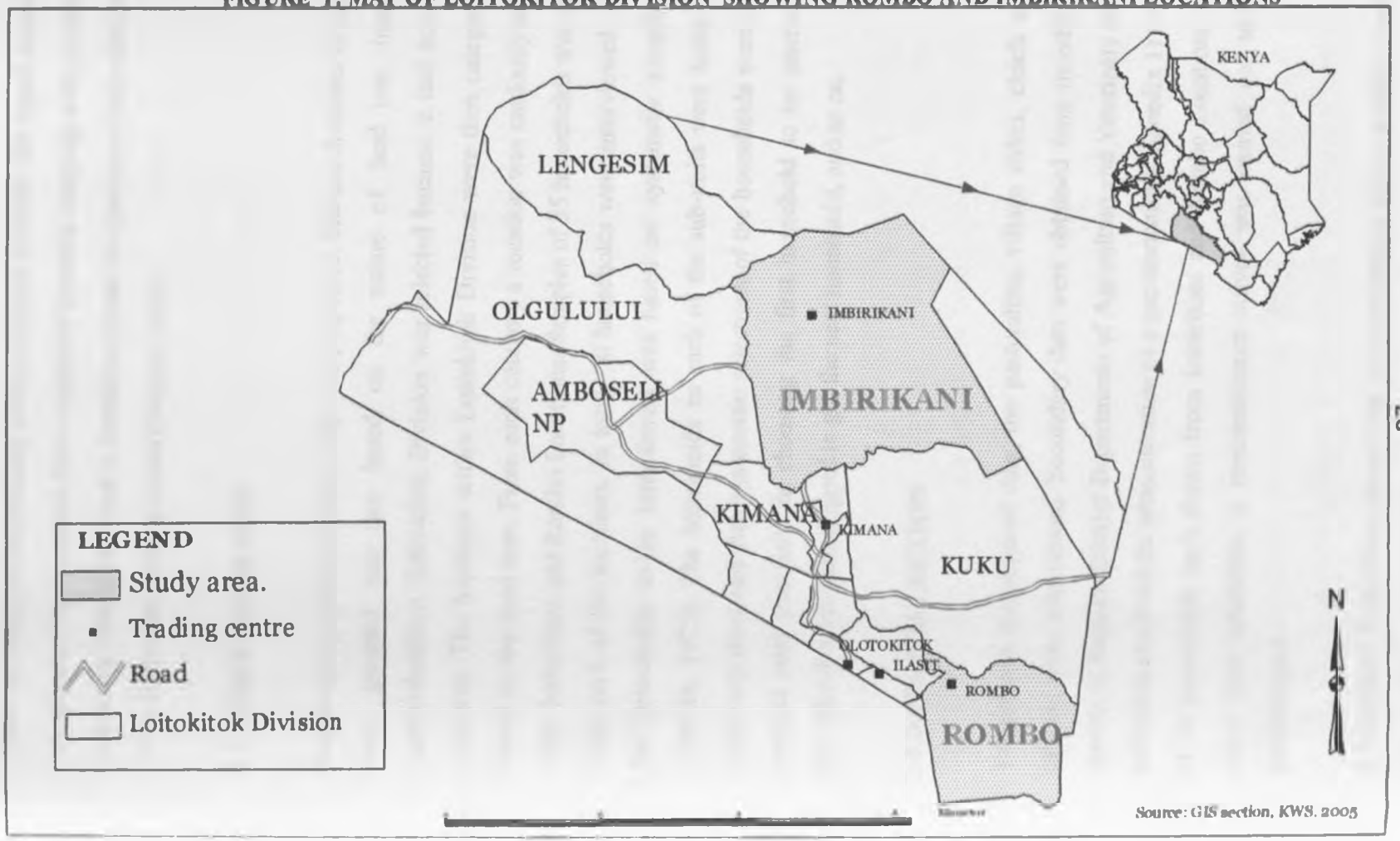
The quality and quantity of vegetation is primarily a function of the available moisture. The quality of forage increases in the rain season and at the riverine or swamps and at high altitudes in the dry season. In the dry season the productivity may greatly vary from place to place due to the localisation of the rains. The vegetation cover will increase and decrease with season (Masila, 2004). The dry season is therefore a period of forage scarcity.

3.2.4 Human Population and Land Use

According to the 1999 population census, the average population density of Loitokitok Division was 7 persons per km^2 1979, which then rose to a population density of 15 persons per km^2 by 1999 (GOK, 1999). The projected average population density in 2001 was 24 persons per km^2 (GOK, 2001b). From the projection, human population is continuously increasing, putting pressure on the land resources.

The area of the division is 0.6 million hectares. About 168,000 hectares is arable and 13 per cent has potential for crop production. Only three per cent of the arable land is currently under cultivation, one per cent is under irrigation, while the remainder of the land is used for grazing (Herlocker, 1999). Currently, the area has been sub-divided into five independent land use systems. These are smallholding zone, individual ranches, irrigation in swamps, group ranches and national parks. After the sub-division and adjudication, Maasai title-deed holders sold their land, resulting in loss of higher altitude wetlands, which provided dry season grazing areas and refuge during drought. Most Maasai cattle are now confined throughout the year to lower drier areas of the division that has a significant impact on the condition of the rangelands in the lower zone. Agriculture is increasingly extending down below the upper zone of smallholder agriculture to the ranch land. Figure 1 is the map of Loitokitok Division showing Imbirikani and Rombo Locations.

FIGURE 1: MAP OF LOITOKITOK DIVISION SHOWING ROMBO AND IMBIRIKANI LOCATIONS



There is a strip of individually owned ranches between the upper zone and the lower rangelands. These ranches have combined livestock keeping with production of maize and beans. Part of the land is leased to private companies or individual entrepreneurs, often from outside the division (Berger, 1993).

3.3 SAMPLING DESIGN

The sampling method in this study was purposive. The six divisions in Kajiado District were grouped into two based on the nature of land use; transhumance or agropastoralism. Loitokitok Division was selected because it had both the land use practices. The locations within Loitokitok Division were then categorised into two based on the land uses. From each category a location was randomly selected. These were Imbirikani and Rombo Locations. Samples of 35 households were then obtained from each of the locations. In total, 70 households were interviewed. The choice of the households to be interviewed was based on systematic sampling procedure (Prewitt, 1975). The households in each of the sub-units were listed from 1 to N (N=group size) and then systematic selections of the households were carried out. A random start was used in choosing the first household to be interviewed. Seven households were then skipped to get the next household, and so on.

3.4 DATA COLLECTION

To generate the required data, the pastoralists, village elders, chiefs and extension officers were interviewed. Secondary data were obtained from monthly and annual reports of Kajiado District Departments of Agriculture and Veterinary Services. Data collection involved the administration of a questionnaire (Appendix 1) to two samples of 35 households each drawn from Imbirikani and Rombo Locations. Prior to the actual data collection, a reconnaissance survey was carried out to pre-test the questionnaire.

A household is the basic production decision-making unit in pastoral systems. Since resource management inputs and outputs occur at the household level (Sunya, 2003),

data must be collected at this level in order to understand pastoral production systems. A good understanding of the perceptions, goals, strategies and decision-making of individual pastoral households is necessary in order to effectively design any development intervention in transhumant and agropastoral areas. Pastoral households were categorised into two wealth groups based on livestock units, "poor" and "rich". Poor households were those owning less than 11 tropical livestock units (TLU) while rich households were those owning more than 30 TLU (Muthoka, 1996).

3.4.1 Types of Data Collected

Information on households' socio-economic and land tenure systems were collected from sampled household heads, village elders, chiefs and extension officers. Secondary data were obtained mainly from the Ministry of Agriculture reports and manuals. Data were collected on the types of land tenure systems and related access rights, and current household sizes, livestock holdings and composition, household cash expenditure, daily household food consumption, livestock cash income, sources of livelihood and sex, age and level of education of the household head.

3.5 DATA ANALYSIS

Descriptive statistics such as percentages, means and stratification were used to compare the survey data from the transhumant and agropastoral households. Regression models were constructed for both continuous and discrete dependent variables. A multiple linear regression was used in the case of the continuous dependent variable while the logistic regression was adopted in the binary model.

3.5.1 Descriptive Statistics

The descriptive statistics on livestock units owned, the pastoralists' perception of food security and household monthly cash incomes and expenditure were derived. Different sources of cash, namely livestock sales, monthly remittances, employment and wages, were compared between transhumant and agropastoral households. Mean

household sizes for both transhumant and agropastoral households were also computed and compared.

Cash income is the money obtained or earned from various household activities. Incomes from various sources such as sale of livestock, labour, employment, remittances and land lease were computed to obtain the total income. The contribution of different income sources to the total cash income was calculated as percentages. In addition, a relationship was drawn to establish how income influences expenditure.

Livestock production is of vital importance to the millions of pastoralists who live in these high-risk arid and semi-arid environments. Livestock holdings were standardised into Tropical Livestock Units (TLU), where 1 TLU is equivalent to 250 kg live weight. The TLU converts different ages and species of livestock into a homogeneous unit for livestock owned across clusters. The average weights of different sex and age categories of cattle, sheep and goats were estimated based on previous studies (King *et al.*, 1984; Bekure *et al.*, 1991 and KARI/ODA, 1996).

3.5.2 Model Specification

Two regression models were used to determine the effect of a number of variables on transhumant and agropastoral household food security. These models are discussed below.

3.5.2.1 Multiple linear regression

A regression analysis that involves one dependent variable (γ) and a set of independent variables (χ) is a Multiple Linear Regression. This model requires the dependent variable to be quantitative and continuous while the set of independent variables may be both quantitative and qualitative. The underlying assumption in a linear regression model is that the relationship between the γ and the χ is either linear or non-linear. The ordinary least squares (OLS) model is as follows:

$$\gamma = \alpha + \beta_1\chi_1 + \beta_2\chi_2 + ... + \beta_n\chi_n + \epsilon$$

Where

α = Constant term

ϵ = Error term

$\beta_1, \beta_2, ..., \beta_n$ = Regression coefficients

$\chi_1, \chi_2, ..., \chi_n$ = Independent variables

The specified model used to estimate food security in this study was:

$$F = \alpha + \beta_1\chi_1 + \beta_2\chi_2 + \beta_3\chi_3 + \beta_4\chi_4 + \beta_5\chi_5 + \beta_6\chi_6 + \beta_7\chi_7 + \beta_8\chi_8 + \beta_9\chi_9 + \beta_{10}\chi_{10} + \epsilon$$

Where:

F = Total available calories for the i^{th} household.

α = Constant term.

χ_1 = Household size in adult equivalents for the i^{th} household.

χ_2 = Dummy variable for sex of the i^{th} household, male =1, female =0.

χ_3 = Remittance received by the i^{th} household.

χ_4 = Total income for the i^{th} household.

χ_5 = Herd size for the i^{th} household.

χ_6 = Dummy variable for land ownership for the i^{th} household, communal =1, individual tenure = 0.

χ_7 = Age of the i^{th} household head.

χ_8 = Level of education for the head of the i^{th} household.

χ_9 = Dummy variable for diversification for the i^{th} household, diversified =1, not diversified = 0.

χ_{10} = Number of malnourished children for the i^{th} household.

ϵ = Error term for the i^{th} household.

3.5.2.2 Logistic regression

Binary choice has become the standard method of analysing discrete binary data, in which the dependent variable evokes a yes or no, or present or absent response. The approaches used to estimate models involving dichotomous response variables are the logit, probit and linear probability model (LPM) regressions. Ordinary least squares regression is not appropriate since the residuals do not satisfy the condition $E(\mu_i)= 0$, that is required to derive the unbiased estimates (Pindyck and Rubinfeld, 1991). The logit and probit models guarantee that the estimated probability lies in the range of 0-1, and that they are non-linearly related to the explanatory variables. Of these two, the logit has a great advantage in that it gives crosstabulation tables to explore data or verify specific hypotheses. It allows one to test the different factors that are used in the crosstabulation and their interaction for statistical significance.

The logistic function was chosen because the properties of the estimation procedure are more desirable than those associated with the choice of a uniform distribution, leading to the specification of a LPM, or normal probability distribution, resulting in a probit model. For more details on the logit formulation, see Pindyck and Rubinfield (1991).

The logit model is derived from a simple Linear Probability Model (LPM), which is expressed as:

$$Y_i =_1 \alpha + \beta X_i + \mu_i$$

This can be expressed as:

$$p_i = E(Y - 1/X_i) = 1/1 + e^{-\beta_1 + \beta_2 X_i} \qquad (3.1)$$

The expression in (3.1) can be rewritten as:

$$p_1 = 1/1 + e^{-z_i}$$

Where

$$Z_i = \beta_1 + \beta_2 X_i$$

Thus if the probability of an event occurring is p_i, then the probability of an event not occurring is $1 - p_i$, expressed as:

$$1 - p_i = 1/1 + e^{-z_i}$$

This can be rewritten as

$$p_i / 1 - p_i = 1 + e^{Z_i} / 1 + e^{-Z_i} = e^{Z_i} \qquad (3.2)$$

Taking the natural log of (3.2) we obtain

$$p_i / 1 - p_i = \beta_1 + \beta_2 X_i + \mu_i$$

Where

p_i = Probability that $Y_i = 1$ (that is the event occurs)

1- p_i = Probability that $Y_i = 0$ (that is the event does not occur)

β_1 = Probability that event occurs when X_i increases say by a unit

μ_i = Stochastic disturbance

3.5.3 Measurement and Definition of Variables used in the Models

The variables that were assumed to influence food security in pastoral and agropastoral households were land tenure system, household size, livestock units, level of education, gender of the household head, number of malnourished children, income diversification and household income.

3.5.3.1 Food security

Food security refers to availability of adequate diet all year round, that is, 2250 kcal/ AAME/Day (ILCA, 1981; GOK, 2000a; Nyariki *et al.*, 2002). Despite the fact that

members of the households may not share out food according to their nutritional requirements, there is no better way of assessing food requirements other than using AAME. The numbers of household members were converted into adult equivalents (AEs) energy requirement per day based on ages were calculated (GOK, 2000b). Household food calories requirement per day is given by multiplying household size in AEs by the daily calorie requirements per AAME (2,250 kcal). The result is then compared to the actual available calories per household per day.

The dependent variable was derived from food consumption reported in the surveys. The lists and quantities of different foodstuffs prepared were converted into their calorie energy content, summed up for each household, and divided by the number of residents expressed as adult equivalents. Those households with a ratio falling below one were considered food insecure, those on or above one were food secure.

3.5.3.2 Household size

Household size reflects resident household members. Kigutha *et al.* (1994) and Kavishe and Mushi (1993) reported that increased household size favours resource contribution to the household. As such, there is more food available for household consumption and, consequently, an improvement in the nutritional status of the household members. They further argued that in cases where the dependency ratio is high, the numbers of consumers of the available resources in the household are more than the contributors; hence, less is available to share among them, thus negatively affecting their nutritional well-being.

For the current analysis of the survey findings at household level, the household size was standardised to AEs. The concept of AE is based on the differences in nutritional requirements according to age and sometimes sex. It assumes the life-cycle stages have an important influence on the needs of members or individuals of the same household (Kristjanson *et al.*, 2002). Various consumption weights have been proposed over time. This study has adopted consumption weights by age where 0-4 years is 0.24; 5-14 years, 0.65; and over 15 years, 1.00 (GOK, 2000b).

3.5.3.3 Total cash income

Total cash income in the current study is regarded as the total amount of money that a household has from both farm and non-farm sources. An increase in household income is usually expected to improve access to food through improved own food production and increased food purchases (Timmer *et al.*, 1985). Nevertheless, some studies (Katone-Apt, 1983; Leslie, 1985; Muthoka, 1996) show that the income available in the household is used differently, depending on whom within the household controls resources or income. For example, research by the International Food Policy and Research Institute (IFPRI) and other studies found that the income controlled by women, particularly in Africa, is more likely to be spent on food. Also, at similar levels of income, households with more women-controlled income are more likely to be food secure (Muthoka, 1996; Nyariki *et al.*, 2002).

3.5.3.4 Livestock holdings

Several research studies have documented the role of livestock in pastoral households (Jahnke, 1982; Hecht, 1989; Legge, 1989; Nyariki, 1998; Sunya, 2003). Also, ILRI (2000) noted that livestock can be moved in response to variable rainfall conditions and can be purchased or sold in response to changing marketing conditions, thereby contributing towards food security and household survival during difficult times such as droughts. Hence, livestock owned by a household is expected to influence household food security.

3.5.3.5 Sex of the household head

Several studies (Vedeld, 1990; Muthoka, 1996; Nyariki *et al.*, 2002) have shown that households headed by females are likely to be more food secure than the male headed households. This is so because female headed households give priority to food purchase in their budget rather than non-food items. In support of the above, Mencher (1985) and Gulati (1980) established that men give priority to purchase of more cattle and other non-food items.

3.5.3.6 Level of education of household head

Education is here taken to mean the level of formal schooling. The level of education attained influences individual decision-making because it tends to reduce farmers' risk aversion, thus enabling them to try out new innovations (Asambu, 1993). Besides, individuals who are well educated acquire enhanced information processing capabilities that enable them to demand and utilise agricultural technologies. By so doing, their technical and allocative efficiency is improved (Ntege *et al.*, 1997). Household heads with below primary education were coded as 0, while those above primary as 1.

3.5.3.7 Age of the household head

Age is the number of years an individual has lived. The age of the household head is likely to affect the household food security status of a household. Asambu (1993) noted that with an increase in age, the head would have more wisdom and experience on farming, leading to increased food production and calories improvement.

3.5.3.8 Diversification

Household diversification is here defined as household involvement in other economic activities besides pastoralism and agropastoralism (see also Noor *et al.*, 1999). Household involvement in more than one economic activity influences the household income level and is likely to influence household food security.

3.5.3.9 Land tenure

Land tenure influences the type of land use by a household. The two types of tenure in the study area are individual (coded as 0) and communal (coded as 1) for agropastoral and transhumant households respectively. As already indicated, Feder *et al.* (1988) noted the existence of a relationship between land rights and productivity. He found that increased individualisation of rights improves farmers' abilities to reap returns from investment on land. This leads to greater demand for land improvements as well

as complementary inputs. Increased individualisation of rights may also improve credit worthiness of a farmer, enhancing his chances of receiving formal credit. Both of these demand and supply side mechanisms interact to increase investments on land thus leading to greater land productivity.

3.5.3.10 Number of malnourished children

Children aged five years or less and those shorter than 110 cm were considered. Their wrists were measured and readings of their mid-upper arm circumference (MUAC) were classified into three categories: severe malnourishment, less than 125 mm; moderate malnutrition, more than 125 mm but less than 134 mm; and well nourished, more than 134 mm for transhumant and agropastoral households. The number of malnourished children is likely to influence household food security.

3.5.3.11 Remittances

Remittances are the donations or gifts given to the household within a specified period of time. Remittance is common in pastoral households especially in severe drought and it includes gifts and presents from friends, relatives and well-wishers. Remittance is expected to influence the household income by improving the food purchasing power.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 INTRODUCTION

This chapter presents the analysis of data in three sections. The first section characterises the land tenure systems in the two study areas. This is followed by a presentation of the respondents' perceptions regarding the factors affecting household food security. The third section describes the sample characteristics with reference to the variables in chapter three for hypothesis testing. It also presents and discusses the results of both the multiple linear and logistic regression analyses.

4.2 PASTORAL PERCEPTIONS

In order to facilitate a better understanding of the pastoral perceptions on land tenure systems and the factors influencing household food security, the data are first evaluated with a view to establishing the different land tenure types in the two study areas. This evaluation leads to characterisation of the existing land tenure systems, which are then presented in the following sub-section.

4.2.1 Current Land Use in Loitokitok Division

Loitokitok Division comprises of transhumant pastoralists, agropastoralists and agriculturalists (mainly involved in irrigation). Transhumant pastoralists and agropastoralists who constitute the sample used in this study fall into a profile that is consistent, to a great extent, with that commonly mentioned (Mulaku, 2000) in literature as describing the inhabitants of semi-arid regions of Kenya. The major land uses in the division are mixed agriculture, irrigation agriculture and livestock keeping under extensive system and group ranching. The two major land tenure systems in the study areas are communal tenure, practised under group ranches by transhumant

pastoralists, and individual tenure system, practised under individual holdings by agropastoralists.

The concept of group ranches was started in Kenya in 1968 as part of a land reform strategy contained in the Swynnerton plan of 1954. The objectives of the group ranches were to increase livestock output per unit area as well as sedentarise the Maasai. These objectives suffered setbacks due to differences in priorities between implementers and ranchers (Aboud, 1982). Smucker (2002) and Vedeld (1990) reported that these land reforms were not suitable for the semi-arid areas due to the flexibility required in time and space by pastoralists and their livestock. Moreover, pastoral mobility was seriously hampered and reduced by land privatisation, thus reducing the total productivity of the ASAL areas. In addition, increase in population and lack of trust among group ranch members due to corrupt practices led to further sub-division of the group ranches, such as Rombo group ranch (RGR), into individual holdings in the early 1980s.

Typically, group ranch representatives were elected from Maasai households within an administrative location and boundaries that cut across clans, and have similar customary belief (Porohoryles and Szeiskin, 1973; Mulaku, 2000). The government registered the group representatives as trustees. The Land (group representatives) Act (GOK, 1968), was enacted to govern the constitution and administration of the groups, while the adjudication of rights and subsequent survey and registration were governed by existing relevant legislation for agricultural areas. The concept of group ranch completely breaks down the customary structure for the administration of pasture. Each group elects about ten of its members as group representatives, who are registered by the government as trustees, holding the land in trust for their members. The trustees allocate land for use by members, maintain a register of family heads, and can mortgage the land on behalf of the group. All disputes arising on land are settled through the regular government court system (Mulaku, 2000).

4.2.2 Transhumant Pastoralists in Imbirikani Group Ranch

The land tenure system in Imbirikani group ranch (IGR) is communal with pastoralism as a source of livelihood. Land use is mainly livestock production with the objective of satisfying subsistence. In the past, blood formed an integral part of their diet, but today blood consumption is rare. Pastoralists in this ranch do not practise crop cultivation, though some of them have portions of land sub-divided along the river valleys for cultivation. These parcels of land are either leased out to cultivators or to their relatives at a cost, but most of them lie fallow because transhumant pastoralists have no time to cultivate, as they have to move long distances looking for pasture and water for their animals. This is worsened further by lack of herding labour as children attend school with the introduction of free education.

The group ranch was initiated for livestock production, but today the ranch has diversified into wildlife-related projects to supplement income from livestock. These projects include bird shooting, wildlife cropping, and campsite charges, even though the income from wildlife projects is low and the flow is irregular. For example, in 1987 IGR leased some land for tourism at an annual cost of Kshs 50,000 while between 1984 and 1986 it received Kshs 23,100 from bird hunting. The current income from private investors stands at about Kshs 1.5 million, and this includes gate fee, bed night levy and lease (Group Ranch Treasurer Pers. Com, 2003). In IGR, as in all group ranches, land and grazing resources are owned communally, but livestock is owned individually. Members earn income from sale of natural products such as firewood, charcoal, sand, and stones, even though the income is low. Despite the various sources of income for the ranch, members complained of poor financial management and unfair distribution of earnings. This is attributed to lack of understanding of the role of the group ranch committee and ignorance of members on their rights. This was evident through the sale of part of the ranch for the development of a wildlife sanctuary without consultation with the group ranch members.

4.2.2.1 Grazing movement in Imbirikani group ranch

The group ranch committee mainly controls grazing movement within the ranch by regulating movement patterns of different clans with their animals. Lactating cows and the calves are left behind to graze around Imbirikani so as to continue providing milk to the household while the *il murans* (warriors) move with the satellite herds for sufficient pasture to Chyulu Hills. The movement starts at the beginning of the dry season and the livestock are grazed as they move until they reach the top of Chyulu Hills. The pastoralists have adapted to this grazing movement at certain times of the year to ensure efficient utilisation of the sparse forage resources.

4.2.2.2 Water resources in Imbirikani group ranch

Initially, the ranch had ten boreholes, but currently only one borehole is functional for watering the animals, others have broken down and there are no resources to repair them. One borehole is not sufficient to water all the ranch animals; therefore individuals have constructed private boreholes to meet the water needs of their animals. This is advantageous as it reduces congestion at watering points, thereby reducing land degradation through reduced trampling. In the dry season, non-members pay for watering their large stock in the private watering points at five shillings per month, and small stock are watered for free. During the wet season, animals are grazed around the homesteads within the ranch. At this time water is plentiful within the ranch and the pastoralists do not incur extra costs on watering.

4.2.3 Agropastoralists in Rombo

Agropastoralists in Rombo share similar cultural and traditional with practices their transhumant counterparts. In the dry season, the transhumant and agropastoral households share grazing resources in Chyulu Hills. The grazing tenure becomes even more complex with kinship. Some transhumant households allow their agropastoral relatives to graze their animals within the ranch through their own private arrangement. This has made the group ranch committee unable to regulate the stocking rate of the ranch.

Agropastoralists in Rombo location practise individual ownership tenure with livestock and crop production as the main livelihood. The households acquired land as a result of the sub-division of Rombo group ranch in the early 1980's. The parcels of agricultural land are owned individually, but the individuals do not possess title deeds. The grazing resources are communally owned and the village elders are charged with the responsibility of managing these resources. Individual tenure system applies only to crop fields while the dry season grazing resources are still shared communally.

The agropastoral households have rights to make decisions on the use of cropland, and the use can be maintained for a long period of time but does not entitle an individual to private property. For common grazing resources, the village elders play crucial roles in controlling and regulating access and use of these resources. The agropastoralists in Rombo have several tenure arrangements for access to and use of resources, which are risk-sharing strategies to buffer against socio-economic, demographic, environmental and political pressures. This is achieved by ensuring that the welfare of community members who are resource poor due to unequal distribution of resources is taken into consideration.

Land redistribution is done on the basis of household size. In many cases, large households accessed more land due to their obligation to feed more people. On the other hand, the traditional authorities have no animals to distribute to members but can make grazing contracts with the rich households to permit the poor households to build their herds and exercise their access rights on common grazing pastures, making animal-grazing rights more complex to handle because animal resources are owned individually while the grazing resources are communal. Table 1 shows the land rights by agropastoral households in Rombo.

Table 1: A summary of land rights by agropastoralists in Rombo Location

	Rainy season		Dry season	
Rights	Range resource (Fallow or bush)	Land for agriculture (Cultivated land)	Range resource (Fallow or bush)	Land for agriculture (Cultivated land)
Access rights	Granted to everyone provided that pastoral activities do not interfere with agriculture (negotiation with village elders)	Usufruct-right holder	Everyone	Usufruct-right holder
Withdrawal rights	Everyone provided that pastoral activities do not interfere with agriculture (negotiation with village elders)	Usufruct-right holder	Everyone	Usufruct-right holder
Management rights	Village elders and chiefs	Usufruct-right holder with no limitations on decisions to land improvements	Village elders and chiefs	Usufruct-right holder with no limitations on decisions to land improvements
Alienation rights	Village elders and chiefs	Usufruct-right holder with no limitations on decisions to land improvements	Village elders and chiefs	Primary or secondary right holders

The issue of land tenure in pastoral households is complex. Despite all the complexity in land tenure arrangements, there is a clear-cut distinction between communal and individual tenure systems. The difference is attributed to the strength of the local institutions and the access options.

4.3 SAMPLE CHARACTERISTICS

4.3.1 The Maasai

The Maasai in the study area are both transhumant pastoralists and agropastoralists who originated from Southern Rift. Their traditional residential pattern is based upon the *ekang*, meaning homestead, an enclosure that holds about 10-12 households. Four or five of these *ekang* are then grouped to form clusters referred to as *emurua*, which represents the basic social unit holding about 40-50 households. These households share common resources such as water points and grazing resources. The Masaai

social organisation is based on the age set system except for women who do not have age sets like men, but are always associated with the age set of the *il moran* (warriors), believed to protect the community, they sang for while they were being circumcised (Muthoka, 1996). The summary of averages for various variables among transhumant and agropastoral households is provided in Table 2.

Table 2: Summary of averages for various household characteristics among transhumant and agropastoral households

Variable type	Transhumant households	Agropastoral households
Household size in AEs	6.34	9.08
Herd size in TLU	36.31	26.45
Milk yield in litres	8.30	3.54
Income from milk Kshs	720.00	5787.00
Livestock cash income Kshs	16820.00	141081.14
Cash income from employment	8400.00	1248.00
Cash income from wages	592.86	743.43
Cash income from remittance	980.00	38.86
Total cash income	27638.57	22605.14
Maize purchase in kgs	362.11	488.89
Beans purchase in Kgs	52.02	68.60
Oil purchase in Kgs	24.66	10.31
Sugar purchase in Kgs	38.14	15.50
Wheat purchase in Kgs	22.14	15.46
Rice purchase in Kgs	44.06	39.00
Maize production in Kgs	-	1009.57
Beans production in Kgs	-	227.14

4.3.2 Household Size

Household size was stratified *a posteriori* into two, small and large, depending on the number of residents. Small households were those with five or less persons while large households had more than five persons. Transhumant households had an average household size of 9 persons with small households constituting 14 per cent and large households 86 per cent. For the agropastoralists, the mean household size was 13 persons with 23 per cent small households and 77 per cent large households. It may be inferred that land tenure system influences the size of the household. In transhumant households where the major land use is pastoralism, the average household size was lower than that of the agropastoral households. The large household size in agropastoral household was to provide extra labour for crop production. Table 3 shows household sizes in relation to land tenure, land use and household food security.

Table 3: Household sizes based on land tenure, land use and food security

Land tenure	Land use	Household size (persons)	Food security; food secure (Fs) ≥1, and food insecure Fi ≤1		Total
			Fs	Fi	
Communal	Livestock production	Transhumant:			
		Small	3(8.6)*	2(5.7)	5(14.3)
		Large	11(31.4)	19(54.3)	30(85.7)
		Total	14(40.0)	21(60.0)	35(100.0)
Individual	Livestock and crop production	Agropastoral:			
		Small	8(22.9)	0(0.0)	8(22.9)
		Large	20(57.1)	7(20.0)	27(77.1)
		Total	28(80.0)	7(20.0)	35(100.0)

* Figures in brackets are percentages

An analysis based on this categorisation showed that smaller households were better off in terms of the total available calories than the larger households in both transhumant and agropastoral households. On the other hand, about 6.3 per cent of the small households were food insecure in transhumant households while all small agropastoral households were food secure. The likely reason is that they had fewer people to feed than larger households.

4.3.3 Education

Education level is still very low among the Maasai of both transhumant and agropastoral households. In transhumant households, about 22.9 per cent of the respondents attained post primary education while the majority (77.1 per cent) did not go beyond primary level. Among the agropastoral households, 94.3 per cent dropped off before completion of primary education while only 5.7 per cent attained above primary education. Table 4 shows household head level of education in relation to land tenure, land use and food security.

Table 4: Education levels of household heads based on land tenure, land use and food security

Land tenure	Land use	Household head education level	Food security, food secure (Fs) ≥1 and food insecure (Fi) ≤1		Total
			Fs	Fi	
		Transhumant:			
Communal	Livestock keeping	Below primary	11(31.4)*	16(45.7)	27(77.1)
		Above primary	3(8.6)	5(14.3)	8(22.9)
		Total	14(40.0)	21(60.0)	35(100.0)
Individual	Livestock and crop production	Agropastoral:			
		Below primary	28(80.0)	5(14.3)	7(20.0)
		Above primary	0(0.0)	2(5.7)	28(80.0)
		Total	28(80.0)	7(20.0)	35(100.0)

* Figures in brackets are percentages

This analysis shows that the level of education is still very low, and that there is no much difference in terms of education for both transhumant and agropastoral households. Also, land tenure showed no relationship with the level of education of both transhumant and agropastoral households.

4.3.4 Age

The age of household heads was grouped into two, young and old. The young household heads were those aged 30 years or less while the old household heads were those aged more than 30 years. The mean age of the transhumant household heads was about 43 years, with about 11 per cent of them being young and the remaining 89 per cent comprising the old. Table 5 shows age distribution based on land tenure, land use and food security.

In the transhumant system, age is inversely related to the total calories available. This could be attributed to the fact that young household heads tend to be flexible in their decision-making by looking for alternative sources of income such as casual work, petty trade and other forms of employment to improve on their household income. The older counterparts remain resistant to change due to their historical experiences and consequent strict adherence to traditional methods of production and enterprise management.

Table 5: Distribution of household head ages based on land tenure, land use and food security

Land tenure	Land use	Household	Food security, food secure (Fs) ≥1 and food insecure (Fi) ≤1		Total
			Fs	Fi	
		Transhumant:			
Communal	Livestock	Young	2(5.7)*	2(5.7)	4(11.4)
	Keeping	Old	12(34.3)	19(54.3)	31(88.6)
		Total	14(40.0)	21(60.0)	35(100.0)
Individual	Livestock	Agropastoral:			
	and crop	Young	1(2.9)	6(0.0)	7(20.0)
	production	Old	27(77.1)	1(2.9)	28(80.0)
		Total	28(80.0)	7(20.0)	35(100.0)

* Figures in brackets are percentages

Households headed by the old were more food secure than their younger counterparts in agropastoral households. The likely explanation is that the older household heads concentrate on and put extra efforts to farm production, and these coupled with accumulation of wisdom gained through many years of experience enable the households to produce enough crops to survive in a season. In transhumant households, the young household heads seek employment in town centres due to lack of alternative livelihood. In many cases, the jobs are not easy to come by; and if one is lucky the salaries earned are insufficient to sustain these households. Similar findings have also been reported in agricultural households by Asambu (1993) and Kigutha *et al.* (1996) in Machakos and Nakuru districts of Kenya.

4.3.5 Herd Sizes

To show the distribution of herd sizes in relation to land tenure, herd sizes were stratified into two. Households with 20 TLU or less were considered small and those with more than 20 TLU, large. In transhumant households, the mean herd size was 36.3 TLU. About 49 per cent of the households had small herd sizes. The mean herd size for agropastoralists was 26.5 TLU. Approximately 64 per cent of the households had small herd sizes. The survey results show that land tenure influences herd sizes kept by both transhumant and agropastoral households. Table 6 shows the distribution of herd sizes based on land tenure, land use and food security.

Table 6: Distribution of herd sizes based on land tenure, land use and food security

Land tenure	Land use	Herd sizes	Food security, Food secure (Fs) ≥1 and Food insecure (Fi) ≤1		Total
			Fs	Fi	
		Transhumant:			
		Small	4(11.4)*	13(37.1)	17(48.6)
Communal	Livestock	Large	10(28.6)	8(22.9)	18(51.4)
	Keeping	Total	14(40.0)	21(60.00)	35(100)
		Agropastoral:			
	Livestock	Small	18(51.4)	4(11.4)	22(62.9)
Individual	and crop	Large	10(28.6)	3(8.6)	13(37.1)
	production	Total	28(80.0)	7(20.0)	35(100.0)

* Figures in brackets are percentages

The transhumant pastoralists are motivated to keep large herd sizes to maximise use of common resources while agropastoral herd size is limited by the available land size. Also, herd size has an influence on household food security status; households with more animals tend to be more food secure than those with few animals, as the former can easily dispose of the animals to provide cash to purchase adequate foodstuffs that will provide the calories required to maintain active life.

4.3.6 Milk Yield

The influence of land tenure on milk yield was determined by grouping milk yield into low milk yields for households with 2 litres or less a day and high milk yields for households with more than 2 litres per day. Table 7 shows the distribution of milk yields based on land tenure, land use and food security.

Table 7: Distribution of milk yield based on land tenure, land use and food security

Land tenure	Land use	Milk yield	Food security, Food secure (Fs) ≥1 and Food insecure (Fi) ≤1		Total
			Fs	Fi	
		Transhumant:			
		Low	2(5.7)*	2(5.7)	4(11.4)
Communal	Livestock	High	12(34.3)	19(54.3)	31(88.6)
	keeping	Total	14(40.0)	21(60.0)	35(100.0)
		Agropastoral:			
	Livestock	Low	20(57.1)	6(17.1)	26(74.3)
Individual	and crop	High	8(22.9)	1(2.9)	9(25.7)
	production	Total	28(80.0)	7(20.0)	35(100.0)

* Figures in brackets are percentages

The mean milk yield in transhumant households was 8.2 litres per day while it was 3.5 litres per day for agropastoral households. The difference in milk yield could be attributed to flexibility in mobility by the transhumant herds to exploit pastures and water, which is favoured by the communal tenure. For the agropastoral system, individual tenure restricts mobility; hence there is continuous use of pasture, which reduces milk output per animal due to poor feed quality. The milk yield was higher in transhumant households than in agropastoral households, yet a greater number (60 per cent) were food insecure than their agropastoral counterparts (20 per cent). The likely explanation for high food insecurity in the transhumant system despite the high milk yield is that they lack the purchasing power during distress because they tend to purchase more cattle rather than keep cash money. During this period, animal prices are much lower leading to loss of income.

4.3.7 Income from Milk

Income from milk was grouped into two: households with an income of Kshs 5,000 or less from milk were considered low and those with more than Kshs 5,000 were considered high. Sale of milk is minimal in a transhumant system and is only possible when there is plenty, especially during the wet season. Table 8 shows the distribution of income from milk based on land tenure, land use and food security.

Table 8: Distribution of households by income from milk in relation to land tenure, land use and food security

Land tenure	Land use	Income from milk	Food security, Food secure (Fs) ≥1 and Food insecure (Fi) ≤1		Total
			Fs	Fi	
		Transhumant:			
		Low	2(5.7)*	2(5.7)	4(11.4)
Communal	Livestock	High	12(34.3)	19(54.3)	31(88.6)
	keeping	Total	14(40.0)	21(60.0)	35(100.0)
		Agropastoral:			
	Livestock	Low	20(57.1)	6(17.1)	26(74.3)
Individual	and crop	High	8(22.9)	1(2.9)	9(25.7)
	production	Total	28(80.0)	7(20.0)	35(100.0)

* Figures in brackets are percentages

The data show that about 14 per cent of the transhumant households sold milk while the rest was for home consumption. In the agropastoral system, income from milk formed an integral part of total household income, with about 87 per cent of them selling milk. Figures close to these have been reported by Thompson *et al.* (2000) among the Maasai of Narok District, Kenya. It can, therefore, be concluded that land tenure influences the amount of income from milk. In the agropastoral system, households with large herds obtain more income from milk, which improves the total income and food purchasing power. For transhumant households, the amount of income from milk seems not to have influence on the food security status likely because it is occasional.

4.3.8 Land Sizes

The analysis of land size is only applicable to agropastoral households, since in the transhumant system land is communal and size cannot be determined. Household land sizes were categorised into two: small and large. Households with small land sizes were those owning one-acre or less and households with large land sizes were those owning more than one acre. Table 9 shows the distribution of land size based on land tenure, land use and food security.

Table 9: Distribution of agropastoral household land sizes based on land tenure, land use and food security

Household land sizes	Food security, Food secure (Fs) ≥1 and Food insecure (Fi) ≤1		Total
	Fs	Fi	
Small	2(5.7)*	2(5.7)	4(11.4)
Large	26(74.3)	5(14.3)	31(88.6)
Total	28(80.0)	7(20.0)	35(100.0)

* Figures in brackets are percentages

The average land size for the agropastoral households was 2.5 acres. About 11 per cent owned small land sizes. Households with large land sizes tend to be more food secure than those with small sizes. This implies that an increase in land size leads to increased production or output per unit area. Similar findings have also been reported by Victoria *et al.* (1986) in Brazil, Kaseje *et al.* (1983), Kigutha *et al.* (1994) and Ntege *et al.* (1997) in Kenya. They stated that in countries where land is not

communally owned, land size is an important asset in determining the amount of food that can be produced for a household in terms of livestock and crops at any given time. Therefore, landlessness means lack of an important production resource and a sign of poverty, especially in rural areas. Melville (1988) further established that unequal distribution of land is the most widespread cause of poverty in most developing countries. As a result, some nutrition planners advocate for land redistribution as a means of ending malnutrition in these countries (Omawale and McLeod, 1984; Melville, 1988).

4.3.9 Remittance

The mean remittance received by the transhumant households was Kshs 980 compared to Kshs 319 for the agropastoral households. About 31 per cent of the households reported to have received money from friends and relatives in transhumant and agropastoral systems. Table 10 shows the distribution of remittance based on land tenure, land use and food security.

Table 10: Distribution of households with respect to remittance based on land tenure, land use and food security

Land tenure	Land use	Remittance	Food security, Food secure (Fs) ≥1 and Food insecure (Fi) ≤1		Total
			Fs	Fi	
		Transhumant:			
	Livestock	Remittance	13(37.1)	18(51.4)	31(88.6)
Communal	Keeping	No remittance	1(2.9)	3(8.6)	4(11.4)
		Total	14 (40.0)	21(60.0)	35 (100.0)
		Agropastoral:			
	Livestock	Remittance	4(11.4)	3(8.6)	7(20.0)
Individual	and crop	No remittance	24(68.6)	4(11.4)	28(80.0)
	production	Total	28(80.0)	7(20.0)	35(100.0)

* Figures in brackets are percentages

Remittance was more common in transhumant households than in the agropastoral households. This shows that more transhumant household members have migrated to towns and cities in search of alternative employment because transhumance can no longer sustain these households. The wages earned by these members formed part of remittance. Moreover, most agropastoral households did not receive remittance but a greater percentage (80 per cent) were more food secure than transhumant households

(40 per cent). This implies that remittance does not influence food security status of these households because it is rare and unpredictable.

4.3.10 Employment

Among the transhumant pastoralists, the mean employment income was Kshs 8,400. Only 25.7 per cent of the transhumant households reported to have been employed. For the agropastoralists, the mean employment income was Kshs 1,248 with only 9 per cent reporting to be employed. The survey shows that land tenure influences employment. Table 11 shows the distribution of employment income based on land tenure, land use and food security.

Table 11: Distribution of households employment based on land tenure, land use and food security

Land tenure	Land use	Employment	Food security, Food secure (Fs) ≥1 and Food insecure (Fi) ≤1		Total
			Fs	Fi	
		Transhumant:			
Communal	Livestock	Employed	4(11.4)*	5(14.3)	9(25.7)
	Keeping	Not employed	10(28.6)	16(45.7)	26(74.3)
		Total	14(40.0)	21(60.0)	35(100.0)
Individual	Livestock	Agropastoral:			
	and crop	Remittance	1(2.9)	2(5.7)	3(8.6)
	production	No remittance	27(77.1)	5(14.3)	32(91.4)
		Total	28(80.0)	7(20.0)	35(100.0)

* Figures in brackets are percentages

There are more people seeking employment elsewhere in the transhumant system to supplement livestock production than in the agropastoral system. When the ratio of the employed is compared in relation to food security, a greater percentage is food insecure. The likely reason is that the earnings from employment are low since most of these opportunities are season based.

4.3.11 Maize Relief

The mean maize relief received by transhumant households was 7.1 kgs. About 80 per cent of transhumant households received maize relief. In contrast, the agropastoral households did not received maize relief during the study period. Maize relief has no influence on food security status of transhumant households. Comparing transhumant

households and agropastoral households on the basis of maize relief, a greater percentage of transhumant households were food insecure than agropastoral households. The reason could be that the provision of relief food is occasional and unpredictable and could therefore not provide enough household calorie requirement. Table 12 shows the distribution of transhumant households by maize relief in relation to food security.

Table 12: Distribution of transhumant and agropastoral households by maize relief in relation to land tenure, land use and food security

Land tenure	Land use	Maize relief	Food security, Food secure (Fs) ≥1 and Food insecure (Fi) ≤1		Total
			Fs	Fi	
		Transhumant			
Communal		Relief	11(31.4)*	17(38.6)	28(80.0)
	Livestock	No relief	3(8.6)	4(11.4)	7(20.0)
	Keeping	Total	14(40.0)	21(60.0)	35(100.0)
Individual	Livestock	Agropastoral			
	and crop	No relief	28(80.0)	7(20.0)	35 (100.0)
	production	Total	28(80.0)	7(20.0)	35 (100.0)

* Figures in brackets are percentages

4.3.12 Cash Income

Sale of livestock was the main source of income for both transhumant and agropastoral households. Table 13 shows the contribution of different income sources to the total income.

Table 13: Contribution of different income sources to total household income (Kshs)

Household	Livestock	Labour	Remittance	Milk	Employment	Lease	Total
Transhumant	16,820.0	592.9	980.0	720.0	8,400.0	0.0	27,638.6
	(60.9)*	(2.2)	(3.6)	(2.6)	(30.5)	(0.0)	(100.0)
Agropastoral	14,081.1	743.4	38.9	5,786.9	1,248.0	371.4	22,269.7
	(63.2)	(3.3)	(0.2)	(26.0)	(5.6)	(1.7)	(100.0)

* Figures in brackets are percentages

The income sources were wages, remittances, employment, and lease of land. In transhumant households, the mean income for the six-month study period was Kshs 27,639 or 4,607 per month while that of the agropastoralists was Kshs 22,269 or 3,711

per month. The mean income was higher in the transhumant system than in the agropastoral system. The high income enabled the transhumant pastoralists to purchase food, which they do not produce. In contrast, agropastoralists produce some of the food crops themselves and therefore spend less of their income on food purchase. Land tenure system has influence on the total household income. Table 14 shows the distribution of households by total income based on land tenure, land use and food security.

Table 14: Distribution of households by total cash income based on land tenure, land use and food security

Land tenure	Land use	Total cash income	Food security, Food secure (Fs) ≥1 and Food insecure (Fi) ≤1		Total
			Fs	Fi	
		Transhumant:			
Communal		Less than 20,000	5 (14.2)*	12(34.3)	17(48.6)
	Livestock	More than 20,000	9(25.7)	9 (25.7)	18(51.4)
	Keeping	Total	14 (40.0)	21(60.0)	35 (100.0)
		Agropastoral:			
Individual	Livestock	Less than 20,000	13 (37.1)	3 (8.6)	16(45.7)
	and crop	More than 20,000	15 (42.9)	4 (11.4)	19(54.3)
	production	Total	28 (80.0)	7 (20.0)	35 (100.0)

* Figures in brackets are percentages

Agropastoral households tend to be more food secure with lower income levels than transhumant households because they produce most of their food to meet calorie requirement. This is because transhumant pastoralists do not keep cash but instead purchase more animals to increase their herd. As a result, they tend to be more food insecure because in times of distress the animal selling price is lower than the buying price, resulting in income loss.

4.3.13 Food Production

The main food crops produced by agropastoral households are maize, beans and occasionally vegetables to supplement their diet. Maize produced by households was categorised into two: low and high maize production. Households producing 1,000 kg or less were considered low maize producers while those producing more than 1,000 kg high maize producers. The mean weight of maize produced was 1,010 kg, with 63

per cent of agropastoral households obtaining low maize yields. The agropastoral households that obtained maize yields above 1,000 kg were food secure.

Land tenure influences food production because in an agropastoral system where tenure is individual a household can make decisions on the crops to grow. In the transhumant system, where land tenure is communal, households have no authority to make decisions on land use and only follow recommendations of the group ranch committee. The agropastoralists who produced maize and beans were more food secure (80 per cent) than the transhumant households (40 per cent) who relied on purchased food. When the total calories obtained from produced maize and beans were compared to the total calories from purchased foodstuff, such as sugar, oil, wheat and rice, the produced food contributed about 60 per cent of the total calories available to the agropastoral households. Table 15 shows the contribution (in percentages) of every foodstuff to the total calories available in transhumant and agropastoral households.

Table 15: Contribution of different foodstuff to the total calories available in transhumant and agropastoral households

Foodstuffs	Transhumant households	Agropastoral households
Maize	47.28	72.32
Beans	6.38	5.30
Sugar	5.41	3.98
Wheat	2.87	1.86
Rice	5.78	2.31
Milk	25.21	2.96
Oil and fats	6.53	1.27

4.3.14 Expenditure on Food

The average cash expenditure on food items by both transhumant and agropastoral households were varied. In transhumant households, the mean expenditure on food purchase within a six-month period was Kshs 15,461 or 2,577 per month. The agropastoralists had a mean expenditure of Kshs 12,178 or 2,030 per month. The proportion of money spent on various food items by both the transhumant and agropastoral households in decreasing order are maize, oil, sugar, rice, beans, and wheat. Table 16 shows the proportion of money spent on various food items.

Table 16: Proportion of money spent on various food items

Household type	Food items						Total
	Maize	Beans	Wheat	Sugar	Oil	Rice	
Transhumant	6,337.0 (40.9)*	1,470.9 (9.5)	909.7 (5.9)	2,017.9 (13.02)	2,990.3 (19.30)	1,762.3 (11.4)	5,490.0 100.0
Agropastoral	6,572.4 (54.1)	1,091.0 (9.0)	541.0 (4.5)	1,272.99 (10.5)	1,517.14 (12.5)	1,161.4 (9.6)	12,156.0 (100.0)

* Figures in brackets are percentages

Sunya (2003) has also reported a similar finding among the Rendille households in Marsabit District, Kenya. This outcome signifies that pastoral households prioritise the purchase of high-energy foods to enable them meet their calorie requirement.

4.3.15 Livestock Production

Livestock are the most preferred form of saving in pastoral households. Livestock provide food, traction, transport, income and social status for the transhumant and agropastoral households. These roles have also been discussed by several writers (Jahnke, 1982; Hecht, 1989; Legge, 1989; Nyariki, 1998; Sunya, 2003). The main livestock species kept in the transhumant and agropastoral households are sheep, goats and cattle. In addition to these, donkeys are also kept by a few agropastoral households to provide transport during harvesting and fetching of water in dry seasons.

The decision to sell a particular species of animal is influenced by the financial needs of the household and the number of animals owned. Household needs include food, school fees and medical services. The households interviewed reported that livestock were only sold to meet immediate cash requirements as dictated by different obligations. In most cases, agropastoral and transhumant households sold small stock (sheep and goats) while large stock (cattle) was sold to meet huge cash requirements such as school fees and medical bills. The decision to sell small stock was made by the household head while selling of a cow was done after consultation with all household members and only when there was no otherwise. Table 17 shows reasons for livestock sale by both transhumant and agropastoral households.

Table 17: Reasons for livestock sale by both transhumant and agropastoral households

Reason for sale	Transhumant households	Agropastoral households
Foodstuffs	60.5	52.2
School fees and medical bills	34.2	38.8
Build up stock	2.3	6.6
Drought	3.0	2.4
Total	100.0	100.0

4.4 OVERALL FOOD SECURITY AMONG TRANSHUMANT AND AGROPASTORAL HOUSEHOLDS

To analyse the factors affecting overall household food security situation among transhumant and agropastoral households, both descriptive and regression analyses were done. The minimum cash expenditure sufficient to meet the caloric requirement of one AAME was first established and then the daily cash available to each of the resident households was worked out. The assumption is that household members consume food according to their nutritional food requirements when food is in adequate supply. The minimum requirement was taken to be 2,250 kcal per AAME per day (Nyariki *et al.*, 2002).

For the calculation of food poverty incidence, the equation below was used:

$fp = q/n$

Where fp is the food poverty incidence, q is the number of households that fall below the food poverty line and n is the number of sampled households. The incidence of food poverty of households is the proportion of food poor households compared to the total number of households. To determine the food poverty incidence of households, the food poverty line was first determined. The food poor households are those that do not have access to food that can supply 2,250 kcal per AAME per day. Households whose members have access to food that provides 2,250 kcal per AAME per day and above are considered food secure.

The study was carried out in a 'normal' year when the environmental factors were considered average. The transhumant households had food poverty incidence (p_i) of

0.60 while the agropastoral households' p_i was 0.20. However, the food poverty incidence is expected to be higher than this in a year of drought because household food consumption behaviour changes during a dry season. Table 18 shows pastoral household food security based on land tenure.

Table 18: Distribution of transhumant and agropastoral households based on Household food security status

Household type	Food secure	Food insecure	Total
Transhumant	14 (40.0)*	21 (60.0)	35 (100.0)
Agropastoral	28 (80.0)	7 (20.0)	35 (100.0)

* Figures in brackets are percentages

The difference in food p_i could be attributed to the difference in land ownership between agropastoral and transhumant households. Individual ownership gives rights to households to use land based on their own decisions. This allows other land use practices such as crop production, which in turn increases agricultural output. Table 19 shows food poverty levels based on stratification of some variables. The crops, after harvest, provide forage for the livestock as crops provide an alternative source of feed.

Table 19: Food poverty incidences of transhumant and agropastoral households based on stratification of some variables

Variables	Transhumant households	Agropastoral households
Household size		
Small	0.4	0
Large	0.6	0.3
Herd size		
Small	0.8	0.2
Large	0.4	0.2
Milk yield		
Low	0.5	0.2
High	0.6	0.1
Land size		
Small	-	0.5
Large	-	0.2
Total income		
Low	0.7	0.2
High	0.5	0.2

Transhumant households had a higher p_i due to the type of tenure system that did not offer alternative land use options except livestock production. Also, there was no insurance against failure in livestock production, making them more susceptible to

food insecurity. At this time they depend solely on purchased foods, and at this particular time prices are even higher. As shown in Table 17, p_i was higher in transhumant households than in agropastoral households. The p_i in agropastoral households was the same for herd size and total income regardless of the stratification levels. The likely reason is that in a normal season, crop production provides adequate food supply and households neither purchase food nor sell livestock. Thus, herd sizes and income levels do not really matter.

The highest p_i was noted in transhumant households with small herd sizes. This implies that large herd sizes are essential in assuring access to food in transhumant households. The p_i based on income levels in transhumant households shows that households with low-income levels had a higher p_i than households with high-income levels. This was as expected. Households with high-income levels were able to purchase food items from the market to meet the calorie deficits. Among the agropastoralists, households with large land sizes had a lower p_i than households with small pieces of land, showing that total crop output increased with increasing land size.

The mean cash income required to satisfy daily calorie need was Kshs 24.20 (i.e., Kshs 726/AAME/month) and Kshs 13.70 (i.e., Kshs 408.80/AAME/month) for transhumant and agropastoral households respectively. The difference is attributed to the fact that transhumant households spend more money purchasing the foodstuff they do not produce but require. When these figures are compared to the 1997 estimated requirement of Kshs 927 per month per adult equivalent for rural Kenya and Kshs 1,254 per month per adult equivalent for urban areas (GOK, 2000a), the average monthly cash available for transhumant pastoralists and agropastoralists falls below the recommended government figure. However, the behaviour of pastoral households to allocate most of their income to high-energy foods such as sugar, fats and maize has made it possible for them to meet their calorie requirements with such low cash income per AAME.

The transhumant and agropastoral household food poverty incidences were within the ranges that have been reported from other parts of the country. In 1997 the food

poverty incidence ranged between 18 per cent and 70 per cent. Kiambu District had the lowest poverty incidence of 18 per cent, while Makueni District, which is agropastoral, had the highest poverty incidence of 70 per cent (GOK, 2000a). Sunya (2003) estimated the incidence of food poverty among the Rendille in Marsabit District, Kenya to be 0.61 during the wet season and 0.86 in the dry season. Also, Nyariki *et al.* (2002) estimated the annual food poverty among the agropastoralists in Kibwezi and Kilome Divisions of Machakos District, Kenya to be 46 per cent and 36 per cent respectively.

4.5 REGRESSIONS

The descriptive analyses showed the influence of land tenure systems on household size, herd size, level of education and age of the household head, total income, milk yield, number of malnourished children, and household food security. However, descriptive analyses do not show the contribution of each of these variables to the total calories available. Therefore, regression analyses were carried out to show the contribution of these variables.

As outlined in the previous chapter, two types of regression models were employed in the analysis of data. One of the statistical models, the multiple linear regression, was used to investigate the influence of the independent variables on the total calories available (the dependent variable) per household and the contribution of each independent variable with respect to the total explained variation in the total calories available. The second statistical model, the logistic regression (Logit) was used to compare with the results of the OLS regression.

Three OLS regressions were carried out. Two of the OLS regressions were for transhumant and agropastoral households independently, and a pooled OLS for both transhumant and agropastoral households. To determine the contribution of each variable to the total variation in the total calories available, the criterion for entry and removal of the variables was adopted to accommodate all the variables of interest using the enter method of model building. The regression analyses of the separate OLS for the transhumant and agropastoral households showed that, out of the nine

variables included in the analysis, two (household size and diversification) and three variables (household size, land size and diversification) were significant at 5 per cent level respectively. However, to try and improve the number of significant variables, the two samples were pooled together to obtain pooled OLS and Logit models. This was statistically acceptable because the F-test showed that the two samples were not significantly different. Ten independent variables were hypothesised to influence pastoral household food security.

Before running a regression analysis, correlations among the independent variables were tested. Correlation analysis shows the relationship between the independent variables. It also gives the guidelines on the variables to be included in the next stage of analysis. The correlation analysis of the variables is shown in Table 20. As shown in the table, household size and herd size have a correlation of 0.5; hence one has to be removed in the regression. To decide on which to remove, each was tried independently in the analysis. Household size gave a better fit, with a higher regression coefficient (R^2), hence the herd size was removed from the analysis. This implies that household size is becoming more important in assessing pastoral household food security as their herd sizes have been reduced due to frequent drought and inadequate grazing resources.

The nine independent variables included in the analysis of the models showed that five variables - household size, diversification, total income, sex of the household head and land tenure - turned out to be significant at 5 per cent level for OLS. The Logit had only two significant variables – sex of the household head and land tenure system at 5 per cent level. A summary of the regression analyses is provided in Table 21.

The outcome of the regression analyses shows that land tenure system is the major factor influencing both agropastoral and transhumant household food security status. Land tenure is inversely related to total calories available. This outcome supports findings by Mulaku (2000) and Robinson (1994) that individual land tenure improves household food security as landowners have full control over their land. Moreover, households are always striving to improve the quality of land to maximise their

returns from land. However, this finding contradicts those of Migot-Adholla *et al.* (1994) and Place *et al.* (1994), which indicate that land tenure has no influence on agricultural production.

Diversification influences household food security negatively. This implies that the more the involvement of households in the non-farm activities, the more they become food insecure. This outcome contradicts findings by Nyariki *et al.* (2002) and Vedeld (1990) and runs counter to the expectation that diversification improves household food security. The reason could be that there is inadequate labour to be involved in alternative activities, as pastoralists and agropastoralists have increasingly recognised the need to take their children to school with the introduction of free education. The outcome could also be attributed to lack of credit facilities and inadequate extension services to educate the transhumant pastoralists and agropastoralists on viable alternative livelihood sources compatible with pastoralism.

An increase in household size leads to increased food security for both agropastoral and transhumant households. This outcome is similar to the findings of Kigutha *et al.* (1994) and Kavishe and Mushi (1993) that large households with low dependency ratio favour resource contribution to the household because there is more food available for household consumption. Nyariki *et al.* (2002), however, found out that smaller household sizes lead to higher household food security because their households have less people to feed.

According to the results, sex of the household head is positively related to the total calories available. The likely reason is that households headed by men do not give priority to food purchase; instead they rebuild up animal herds since large herds indicate social status. This outcome supports the findings of Mencher (1985), Gulati

Table 20: Correlation coefficients

	Educationl level	Gender of household head	Land tenure system	Malnourished children	Remittance received	Herd sizes	Diversification	Household head age	Total income	Household size
Education level	1.00									
Gender of household head	.00	1.00								
Land tenure system	.18	-.05	1.00							
Children less 125mm	.11	-.100	-.13	1.00						
Remittance received	-.06	.154	-.21	-.06	1.00					
Herd sizes	.20	-.08	-.32	.06	.03	1.00				
Diversification	-.17	-.25	-.36	.00	-.14	.31	1.00			
Household head age	.14	-.02	.25	.13	-.16	-.03	.090	1.00		
Total income	-.42	.01	-.32	.04	.09	-.27	.113	-.19	1.00	
Household size	.12	-.10	.44	.05	-.01	-.51	-.42	-.19	-.171	1.00

Table 21: Results of regression analyses

Independent variable	OLS coefficients	t-values	Logistic coefficients	Wald values
Household size	0.29	3.24*	-	
Diversification	-0.39	-4.77*	-	
Education level of household head	-0.21	-0.58	-	
Children less 125mm	-0.14	-1.80	-0.19	0.05
Household head age	-0.04	-2.65	-0.21	0.12
Remittance	0.01	0.30	-0.89	1.56
Total income	0.23	2.62*	0.00	0.14
Gender of household head	0.14	2.32*	-2.62	5.12*
Land ownership	-0.44	-5.04*	-1.52	6.34*

* Significant at 95 per cent level of confidence; n = 70
OLS:
R^2 Adjusted = 0.66; F =15.87

Logit:
-2 Log likelihood = 74.66
Percentage correctly predicted = 72.9

(1980) and Muthoka (1996) that men spend more of their income on purchase of more animals and other non-food items rather than prioritising purchase of household food needs. Nyariki *et al.* (2002) noted a similar trend among agropastoral households of Kilome and Makueni Divisions of Machakos District, Kenya.

The total income has a positive and significant influence. This outcome supports the findings of Katabarwa (1994) and Islam (1989) that food security in developing countries can only be achieved by increasing household income and by giving income entitlements to the poor. They stress that without purchasing power, the world's hungry cannot hope to keep the 'wolf' (famine) from the door very long. Other studies (Katone, 1983; Leslie, 1985; Muthoka, 1996) have, however, shown that income available to the household does not imply better food availability for household consumption. It may only hold when the household income is controlled by women who prioritise food purchase unlike men household heads who prioritise purchase of non-food items.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 CONCLUSION

The objective of this study was to determine the effects of land tenure on land use and food security status among the Maasai in Loitokitok Division of Kajiado District, Kenya. Also, variables that influence household food security were assessed and the contribution of each variable to the total calories available was estimated. Land tenure was found to be an important parameter in assessing pastoral household food security status. It makes up an integral part of rural livelihoods by defining people's relationships to the nature and value of land as a resource. The land tenure systems in Loitokitok Division are communal and individual, practised by transhumant pastoralists and agropastoralists respectively. Land tenure system influences land use. For instance, in transhumant households where land tenure is communal, land use is restricted to livestock production. This type of tenure is characterised by mobility. Agropastoral households practise individual tenure on crop fields and communal tenure on grazing resources. The individual tenure is characterised by access options and rights to make decisions on the use of the crop fields allowing both crop and livestock production.

Variables that influence pastoral household food security are also influenced by the land tenure system. For instance, household sizes are larger in agropastoral households to provide labour for both crop and livestock production, while transhumant households have smaller household sizes providing labour only to livestock production. Also, herd sizes are larger in transhumant households due to the motivation of the transhumant pastoralists to increase livestock numbers to maximise the use of common resources; while agropastoralists herd sizes are limited by the available land sizes. Large herd sizes in transhumant households result in increased milk output. The high milk output is favoured by the ability to exploit a wide range of forage resources as opposed to agropastoral continuous grazing, leading to a reduction in milk output per animal.

The total income is derived from sale of livestock, employment, wages, remittance, sale of milk and lease of land. Income from livestock contributes the highest proportion of the total income while incomes from lease of land the least. In transhumant households, income sources include livestock, employment, remittances, milk, wages and land lease in a descending order. For agropastoral household's income sources include livestock, milk, employment, wages, lease of land and remittances in that order. Most household female income is remitted from relatives, most of which becomes part of the food budget. Transhumant households have higher income levels than the agropastoralists because they rely wholly on food purchase compared to the agropastoralists who grow crops to supplement animal protein.

In terms of household food security status, agropastoralists are more food secure with a low p_i of 0.2, in comparison to the transhumant pastoralists p_i of 0.6. The difference in food security status may be attributed to the difference in tenure systems. Apart from land tenure system, other variables that explain pastoral household food security are diversification, household size, total income and gender of the household head. These results cannot be generalised for all pastoral communities. There is need to increase the sample size and compare the findings.

5.2 RECOMMENDATIONS

From this study, the following recommendations are suggested to help reduce household food insecurity in transhumant and agropastoral households in Loitokitok Division, Kajiado District, Kenya:

- Educate and introduce the concept of individualisation of land rights among the pastoral households, since households practising individual tenure are more food secure.
- For most women, their income was from remittance and much of it became part of the food budget. Women should be encouraged to participate more in income generating activities in order to ensure more contribution of women towards access to food. This can be achieved by formation of women groups to provide a forum for sharing ideas and teamwork.

- There is need for the establishment of alternative livelihood sources that are compatible with transhumance and agropastoralism so as to improve cash incomes. They include activities such as establishment of micro industries for hides and skins, milk processing plants to provide ready markets and avoid exploitation by the middlemen.

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Appendix 1: Questionnaire

DOCUMENTATION OF THE EFFECTS OF LAND TENURE ON LAND USE AND FOOD SECURITY IN KAJIADO DISTRICT, KENYA

A. Location/ village/community_____

Questionnaire number:_____

Name of Enumerator:_____

Household number: _____

Date: _____ Tribe: _____

SECTION 1: RESPONDENT INFORMATION

Name: _____

1.1 Sex: 0. Male 1. Female.....

1.2 Age of the household head

0) Less than 30 years (young) 1) More than 30 years (old)

1.3 Level of formal education

0) Below Primary 1) above primary

1.4 How long have you lived in this area?

0) Less than 20 years 1) More than 20 years

1.5 What is your household's main source of livelihood?

0) Pastoral 1) Agropastoral 2) Agriculture

SECTION 2: ANIMAL PRODUCTION

2.1 What kind / type of animals do you keep?

1) Cattle 2) Sheep 3) Goats 4) Donkeys

2.2 How many animals were born in your household herd, in the last six months?

.....

1) Cattle 2) Sheep 3) Goats 4) Donkeys

2.3 How many animals died in your household herd in the last six months? (Specify cause of the death)

1) Cattle 2) Sheep 3) Goat s 4) Donkeys

2.4 Indicate the number of animal sold and the average price per animal, PPA)

a) Cattle... .....PPA..... b) Sheep... ...PPA....

c) Goats... .....PPA... d) Camels... .....PPA....

2.5 What period of the year do you normally sell your animals and why?

.....

2.6 Rank the possible reasons for selling your animals in order of importance?

a) Drought

b) School fees

c) Buy cereal food

d) Others (specify)

2.7 What are the problems you encounter in selling your animals?

.....

.....

2.8 Mention the total number of animals you currently own?

a) Cattle_____ b) Sheep_____

c) Goats_____ d) others specify_____

2.9 Milk production

2.9.1 How many cows were in milk in the last six months...

2.9.2 What was the average daily milk yield per cow per day... (In litres)

2.9.3 How much of the daily production was sold and consumed?

Consumed... litres

sold.....litres price per litre (PPL)...

3.0 Have you experienced change in number of livestock owned in the past one year?

Yes (why)

Why.....

.....

0) No .....

SECTION 3: AGRICULTURAL PRODUCTION

Has your household practiced any agricultural activity during the last six months?

If No, why? 1) Drought 2) seed unavailability 3) other reasons (specify)

3.2 Indicate main cereal crops cultivated

1) Maize 2) Others

3.3 Acreage under cultivation...

3.4 No of bags harvested.....

3.5 Indicate main legumes cultivated

1) Beans 2) others

3.6 Acreage under cultivation..... No of bags harvested.....

3.7 Indicate main fruit crops cultivated

3.8 For crops sold, mention the total amount sold during the last six months and the price per unit.

Crops Amount sold ..... (in Kg) Price per unit...

3.9 Have any pests / diseases affected any crops under cultivation or in storage during the last six months? 1) Yes 0) No

Details

.....

.....

SECTION 4: ANIMAL –LAND INTERACTIONS

4.1 Where do you graze your animals:

1) In the dry seasons..... 2) In the wet seasons

why?.....

..... Why?.....

....

4.2 How do you relate the grazing patterns of different animal/ class to forage and water availability?

.....

.....

4.3 What is your grazing / topology calendar showing grazing movements across the year?

.....

.....

5.0 LAND TENURE

5.0 What is the land tenure system practiced by your household?

0) Individual

1) Communal

2) Corporate / company

3) Others (specify)

5.1 What was the average land size for your household 20 years ago? (For household heads who are over 40 years)

.....

5.2 What is the current average land size for your household?

.....

In case of change in land size, what are likely causes of change in the land sizes?

.....

.....

5.3 How has change in land size affected the frequency of mobility of livestock?

.....

.....

5.4 How do you currently cope with changes in land size in managing livestock?..... .....

.....

Do you have any institutional linkages regulating the use of your land?

.....

5.6 If yes, what is the role of each institution?

.....

.....

6.0 OTHER ECONOMIC ACTIVITIES

6.1 Labour

6.1.1 Did any member of your family look for casual labour during the last six months? 1) Yes, how many? _____ 0) No _____

6.1.2 How many members of your family were actually engaged in casual labour in the last six months?

_____

6.1.3 What were the daily labour rates obtained? (in Kshs) _____

6.2 Charcoal

10.1Did your household engage in charcoal production during the last six months?

1) Yes 0) No

10.2 If yes, how many bags were sold and at what price per bag? (In Kshs) _____

6.3 Remittances

6.3.1 Did your household receive any p\ remittances or gifts from relatives, friends not currently living in the household?

1) Yes, what was its value in Kshs _____

0) No _____

SECTION 6: FOOD PURCHASES

7.1 Cereal/ legume purchases

7.2 Did your household buy cereals / legumes in the last six months? Yes / No

7.3 What were the quantity purchased and the price per kilogram (PPKG)?

Whole Maize:	1 Yes 0. No	Qty_____	PPKG
Posho (locally milled):	1 Yes 0. No	Qty_____	PPKG
Beans:	1 Yes 0. No	Qty_____	PPKG
Rice:	1 Yes 0. No	Qty_____	PPKG
Sugar	1 Yes 0. No	Qty_____	PPKG
Others (specify)	1 Yes 0. No	Qty_____	PPKG

7.4 Other significant income generating activities (specify)

7.4.1 Did your household get involved in any other income generating activities apart from livestock production in the last six months?

1) Yes 0) No

7.4.2 What are these other economic activities?

7.4.3 How do you spend income from these economic activities?

1) School fees 2) Food purchases 3) Health care 4) Banking

7.4.5 Have you ever obtained credit from any of the following institution in the last six months?

1) Government

2) Relatives and Friends

3) Non- governmental organisations

4) Others specify

7.4.6 What form was the credit? 1) Kind 2) Cash

7.4.7 Estimate the value of the credit in Kshs _____

8.0 DECISION-MAKING

8.1 Who participate in decision-making with regard to the use and management of land resources?

.....

9.0. WELFARE

9.1 Relief

9.2 Did your household receive any aid during the last six months? 1. Yes 0. No

(IF No go to questions17.0)

9.3 Mention the type of aid received in the last six months

(Relief food/ food for work/ cash for work/others)

9.4.Mention the quantity of food aid your house hold received in kilogram during the last six months

No. of Kgs relief food (cereals) per household: _____

No of Kgs from FFWs (cereals) per household _____

9.5 Did any of your children receive UNIMIX and / or Soya during the last six months? 1. Yes 0. No

9.6 Mention the number of kilograms of UNIMIX and / or Soya your children received during the last 6 months_____

9.7 Number of kilograms of UNIMIX and / or Soya received per child_____

10.0 NUTRITIONAL STATUS

10.1 Measure the Mid Upper Arm Circumference (MUAC) of the children older than one year but under five years of age (12-19months). Include qualifying children in the sample household as well as the children in the neighbouring household (s). Measure a minimum of five children.

Name of the child Age- in months -MUAC in millimetres (If impossible to get accurate age include children who are able to walk but shorter ten centimetres).

Name of the child	MUACS
1	
2	
3	
4	
5	

18.0 Food consumption

18.1 what amount of maize flour or posho does your household consume per meal? (in kilogram)_____ Kgs.