

HUMAN-WILDLIFE CONFLICTS AND RURAL LIVELIHOODS
IN LAIKIPIA DISTRICT

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Dedication

To the memory of SSP James Kiara Mworiah

Acknowledgements

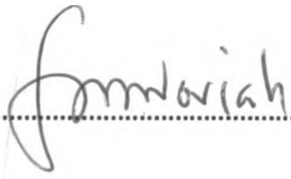
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Declaration

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


Signed  Date 9TH August 2006

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This thesis has been submitted for examination with our approval as University supervisors.

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Abstract

There are increasing cases of conflicts between human beings and wildlife over the use of natural resources manifested through such incidents as people being killed or injured by wild animals; loss of livestock through predation; competition for pasture and water; invasion of crop farms and food stores by wildlife; inadequate or lack of compensation for losses or injuries; encroachment on wildlife areas such as forests and protected areas, blocking of wildlife migration routes; and poaching of wildlife for food, ivory, horns, skins and other valuable products. The economic and emotional costs of these conflicts can be quite enormous.

Interventions directed at reducing human-wildlife conflicts are any activities designed to reduce the severity or frequency of encounters between people and wild animals or any activity that increases peoples' tolerance of wildlife. The effectiveness of interventions varies from region to region and also depends on the species involved. Barriers have been used as an intervention strategy for wildlife conservation and resolving human wildlife conflict and also to segregate the two users of resources. Electric fencing is the latest intervention in Kenya directed at alleviating conflicts between people and wildlife.

Until recently policy emphasis has been on the creation of barriers that kept wildlife from getting out of protected areas, the establishment of wildlife dispersal areas or keeping local people out of the wildlife areas. This study is an assessment of the effectiveness of these strategies by analyzing the effectiveness of different intervention measures on the livelihoods of smallholder farmers in Laikipia District in Kenya. The study was carried out in two areas: Endana and Rumuruti. The focus was on the effects of the strategies on the livelihoods of households in smallholder settlements in Laikipia and the livelihood strategies or coping mechanisms used in dealing with the conflict.

Elephants, baboons and bush pigs were the most problematic animals before the construction of barriers in the two areas. Other animals involved in the conflict were zebras, buffaloes, gazelles, hyenas and lions. The conflict was manifested through crop raiding, competition for resources, damage to crops and infrastructure, predation on livestock and threats to life. The farmers used a variety of strategies to deal with human-wildlife conflicts before the construction of the physical barriers. These strategies included creation of artificial and vegetation barriers,

burning fires to keep wildlife away, guarding of the farms, making noise and shining torches to scare wildlife off the farms and throwing of spears and stones.

In terms of effectiveness, the fencing strategy was more effective in reducing human wildlife conflicts compared to the strategy of constructing a ditch to keep wildlife at bay. The effects of the barriers on the livelihoods of the local farmers were increased crop yields, improved security and harmony, release of labour from dealing with the wildlife menace to other productive activities, reduced dependence on relatives and the government for food and the diversification of crops and other activities.

The study recommends that a review of Kenya's policy and legislative framework in regard to consumptive utilization be carried to facilitate the legal utilization of wildlife resources by communities living adjacent or within wildlife dispersal areas. It further recommends that people who suffer from losses to wildlife should benefit from the incomes derived from wildlife presence in their area. Structures should also be put in place to manage the payment of compensation to farmers who have suffered losses to wildlife. The wildlife authorities should also start paying compensation to farmers who have suffered crop losses and damage to infrastructure by wildlife.

CHAPTER 1 INTRODUCTION

1.0 Introduction

Competition between man and wildlife has been reported from time immemorial in various parts of the world. The nature and magnitude of the problem varies from country to country depending on human population growth rates, conservation methods and scarcity of critical natural resources, especially land and water (IPAR, 2005).

According to the World Parks Congress held in Durban, South Africa in 2003, (IUCN, 2003) human-wildlife conflict occurs when the needs and behaviour of wildlife impact negatively on the goals of humans or when the goals of humans negatively impact the needs of wildlife. These conflicts may result when wildlife damage crops, injure or kill domestic animals, threaten or kill people. As human activities continue to intensify in and around protected areas and wildlife threatens the economic security, livelihoods and even lives of people, human-wildlife conflict escalates. Consequently, if agencies charged with the responsibility of minimizing such conflicts fail to address them adequately, local support for conservation declines.

Kenya's high potential areas have continued to experience pressure due to an accelerated human population growth. This has contributed to the movement of population from the predominantly high potential areas to the relatively drier and ecologically more fragile marginal environments. There has also been a remarkable transition from semi-nomadism to sedentary semi-agricultural settlements, and the development of small-scale farming in areas that have historically been known to be prime wildlife habitats, wildlife migration corridors or natural wildlife buffer zones. In an endeavour to get enough food, water, shelter (habitat) and space, both people and wildlife have found themselves in competition for the aforementioned resources (Kagiri 2002).

Within Laikipia district, Huber and Opondo (1995), state that 55% of the land was at that time devoted to large scale ranching, 28% of the land was small scale farming in subdivided areas and about 8% was owned by Maasai under communal grazing while the remaining 9% was covered by gazetted forests, urban areas and

swamps. These researchers further state that due to pressure on available land in the high potential districts around Mt. Kenya, farmers in search of farmland have been moving to the marginal and low potential areas of Laikipia. At the same time annual population growth in Laikipia district was put at 7% between 1969 and 1979, 4.5%, 1979 - 1989, which was above the national average at 3.3%.

Laikipia district has an unusual diversity of land uses. The southern, eastern and western fringes have high rainfall and fertile soils with high agricultural potential. Towards the north rainfall drops off sharply and livestock husbandry and wildlife utilization are practiced (Thouless, Georgiadis, and Olwero, 2002). Before independence the bulk of Laikipia district was settled by European farmers and ranchers. When Kenya became a republic in 1963, the local people were encouraged to acquire and own land initially set-aside for the White Settlers. The creation of new legislation just before Kenya's independence removed racial barriers by laying down the principle of freedom of movement which allowed Kenyans the right to own land and live in any part of Kenya. Local people bought out the large-scale farms and ranches in Laikipia. The people subdivided the ranches into smaller-holder agricultural plots thus effectively converted the ranches into small-holder settlements practicing rain fed crop production (Kohler 1987).

1.1 Statement of the Research Problem

From a situation of coexistence with pastoralism and to a larger extent ranching, the migration of large numbers of people to land that was formerly ranches or government land in Laikipia district led to serious and devastating problems of human wildlife conflict as more people migrated into the area, encroaching on land that could be classified as having belonged to wildlife. In order to reduce conflict between wildlife and human beings intervention measures had to be put in place.

Interventions are any activity designed to reduce the severity or frequency of encounters between people and wild animals or any activity that increases tolerance of people for those conflicts. Examples of interventions aimed at reducing the frequency or severity of encounters include barriers, guards, deterrents, wildlife removals, and changes in the locations or types of human activities. Examples of interventions to raise the tolerance of people for remaining encounters include compensation programs, incentive schemes, environmental

education and regulated public harvests Interventions that address wildlife behaviour include barriers, deterrents, removal, etc. The effectiveness of these interventions varies dramatically (Treves et al.2005)

Electric fencing is considered as the most preferred deterrent for crop raiding by elephants and wildlife in general. Most such fences have been built or initiated under the auspices of Kenya Wildlife Service and donor agencies such as Biodiversity Conservation Programme (BCP) of the European Union, Laikipia Wildlife Forum and UNDP - COMPACT among others have also taken up to assisting communities to build fences in different areas of the country.

A question arises about how effective have wildlife barriers been in resolving human wildlife conflict in Laikipia and also whether the barriers have improved the livelihoods of local communities? This study aims to assess whether physical barriers have in fact improved the lives of adjacent rural communities through reduced incidence of human-wildlife conflict, increased crop yields, increase of investments for domestic economic development and better co-existence through the improvement of attitudes towards wildlife in general.

1.2 Study Objectives and Questions

The study has the following specific objectives:

1. To identify and compare management approaches applied at the study sites to address human-wildlife conflicts.
2. To determine the effectiveness of wildlife barriers as strategies in dealing with wildlife invasions in two different sites.
3. To identify the effects of the wildlife barriers on the rural livelihoods of communities adjacent to the physical barriers
4. To develop policy recommendations or proposals in regard to wildlife physical barriers and human wildlife conflict

The study was predicated on the need to generate answers to several questions about the strategy of physical barriers in reducing human wildlife conflicts in Laikipia district, namely:

1. What has been the role of local communities in the maintenance and management of barriers?
2. Have the wildlife barriers managed to significantly reduce human wildlife conflict?

3. Have livelihoods improved with the construction of the barriers?
4. How effective have physical barriers been in meeting its goals?

1.3 Justification

In spite of heavy investments of financial and human resources in the construction and maintenance of wildlife barriers, changes on affected rural communities are seldom monitored especially the effects the barriers have on their livelihoods. The focus has been on the effectiveness of the barriers in controlling wildlife and how wildlife adapts to the barrier or in some cases the design of the fences and materials used and not on how people are affected in terms of benefits or losses to their livelihoods and as such the study attempts to analyze the effects or impacts of the barriers on the locals.

Wildlife barriers have been used an intervention strategy in dealing with human wildlife conflict yet its not regulated or informed or governed by any legislation yet its It's perhaps especially fencing the only major factor having a substantial influence on ecosystems and animal populations in Africa. There are therefore lessons to be learnt or actually lie in planning for such interventions and their contribution to rural livelihoods and rural planning in general.

There are very few or no cost-benefit analyses studies for wildlife barriers in Kenya. Although this study will not focus on CBA, it will highlight key issues and indicators to measure for CBA studies related to electric fences.

1.4 Scope of the Study

The subject of human-wildlife conflict is very broad and can be looked at from different view points. From a protectionist view point human-wildlife conflict can be addressed through initiatives directed at keeping human activity out of wildlife habitats thus protecting wildlife from human encroachment. This study was limited to wildlife barriers as a strategy or intervention for dealing with human wildlife conflict and no attempt was made at an in-depth analysis of other strategies in use both in Laikipia district and the country in general.

The scope was also limited to the effects and impact of barriers on the livelihoods of the small holder communities living adjacent to the barriers and the associated benefits or losses it brings to the smallholder agricultural settlements, no attempt will be made to analyze its efficacy as a conservation strategy.

The study also limited its scope to understanding the livelihood strategies put in place or adopted by the smallholder settlements as household and community for dealing with human wildlife conflict.

1.5 Research Methodology and Design

This section provides a detailed description of research methods employed to accomplish the study. Various methods were employed in collecting, analyzing and presenting data for the study. It was necessary to make use of a multi-method approach in the research because of the variety of information required to address the research questions.

1.5.1 Research Design

Laikipia is interspersed with a number of fences both electric and non-electric and other types of physical barriers, which serve different purposes depending on the reasons for constructing them and the capacities of those putting them up. The barriers can be categorized as private and community responses for keeping wildlife out of private ranches and farms while other barriers keep and secure wildlife within designated areas. Data collected by the Ewaso Ngiro Elephant Conservation Project show that various places within the district undergo incidences of human elephant conflicts with varying intensities and different types of conflict ranging from crop raids to deaths in some cases. On the other hand, the concentration of smallholder settlement and agriculture has largely been on the southern part of Laikipia, taking a crescent shape due to rainfall patterns.

1.5.2 Population and Sample

The population consists of the smallholder farmers adjacent to the fences in the various settlements. The initial sampling procedure that was used to select sites for detailed studies was based on purposeful sampling that was premised on the need to select areas in different agro-ecological conditions and different settlement trends and periods. Through this process the Endana North electric fence and the Rumuruti ditch were selected.

The Endana fence is a six strand wire fence with four live strands (electric) on timber poles that were constructed in 2004. It's approximately 14km in length and is adjacent to Endana settlement scheme consisting of individual land holdings purchased from the Kenya government in the late 1980s and early 1990s. Formerly a single property, the settlement is currently adjacent to properties with high

wildlife densities. Its total area is 1942 hectares and is located in Central Division, Segera Location, Rugutu sub-location with a population of 1413 inhabitants and 379 households and a density of 11 persons per square kilometre. The sub-location has three dominant land uses namely large-scale farms, ranching and smallholder agriculture. A sample of 30 households was selected for the household survey.

The Rumuruti fence is a ditch approximately 1 meter wide and approximately 14km long. The ditch is supplemented with a two-strand electric fence on timber poles that straddles some parts of the ditch but most of it is in a state of disrepair even in the sections where it's still standing. It's on the boundary of the Rumuruti Forest Reserve, adjacent to four smallholder settlements; Marmanet A SFT (1643 hectares), Marmanet C SFT (2040 hectares), Ex-Canningham (627 hectares) and Ithima (213 hectares). The ditch (fence) cuts across two sub-locations namely ; Ol Jabet with a population of 3874 inhabitants, 933 households and a density of 209 persons per square kilometres and Siron with a population of 7393 inhabitants, 1664 households and a density of 176 persons per square kilometre. A sample of 55 households was selected in Siron sub-location through systematic sampling

1.5.3 Data Collection Tools

Different data collection procedures were utilized to collect data, both primary and secondary of relevance to the study. Some of the key parameters that were collected include land use patterns, production patterns, cropping trends, labour costs, settlements, socio -demographic characteristics of the study sites, human wildlife typologies, household strategies for dealing with HWC, etc. A household questionnaire was utilized to collect data relevant to the study.

1.5.3.1 Household Questionnaires

A household means the human group which shares the same hearth for cooking. A household survey was conducted through the use of questionnaires to collect data. The questionnaire was used to collect data on household characteristics, crop production and socio-demographic characteristics of the households, and the local people's perceptions of the physical barriers and the strategy of erecting wildlife barriers in reducing conflict between humans and wildlife. A total of 85 households were interviewed by four research assistants who were continuously provided with assistance whenever an issue needed to be clarified. The interviewers were provided with training on how to fill out the forms and how to approach the sensitive questions on income.

The household questionnaire was conducted in two sub-locations within which the barriers are located (Segera and Siron). A sample of 30 households was chosen in Endana and 55 households in Rumuruti. A semi - structured questionnaire was designed to give as much room as possible to accommodate respondents' views and responses.

There were, of course, many potential pitfalls related to controversial issues like income and wildlife but many people were confident and, were grateful for the opportunity to talk about the human-wildlife conflicts in their areas. To gain peoples confidence, households were informed of the presence of the research assistants by either the KWS community scout in Rumuruti (Siron sub-location) or by the chairman of the fence committee in Endana who explained to the households the purpose of the survey. The interviews took place in people's homes and, in order to get as good estimates as possible, only adults were interviewed within the households.

1.5.3.2 Pilot Survey

Due to the fact that the survey to be conducted was large and the results were important in determining livelihoods and household productivity a pilot survey was carried out prior to the actual survey in Endana to test whether the interviewers and respondents could understand the questions.

1.5.3.3 In-Depth Interviews with Key Informants

In order to assess the efficacy of different conservation strategies and management strategies for dealing with human wildlife conflicts especially fencing, the study also relied on the opinions and perceptions of the stakeholders in conservation. These included interviews with Save the Elephants, Kenya Wildlife Service, Laikipia Wildlife Forum, and the Biodiversity Support Programme. Interviews were conducted with other key informants who included the Chairman of Endana Electric Fence Self Help Group and the Vice-chairman of the Rumuruti Forest association. Unstructured interviews were also held with KWS community scout in Siron and also a former scout of the Ewaso Ngiro Elephant Research project who is a resident of Endana provided insights on the community and human wildlife conflicts in the area.

1.5.3.4 Observation

Observation of phenomenon by the researcher was utilized as a way of collecting data from the field. Some of the phenomenon that was observed included the state or condition of existing fences, incidences of conflict, destruction of crops by wildlife, wildlife presence in the study areas, among other aspects of the human-wildlife interface.

1.5.3.5 Secondary Data

Secondary data was collected from libraries, offices of non-governmental organizations, conservation agencies and government offices. The search involved reviewing published and unpublished materials, collection and analysis of existing data especially on human wildlife conflict in the region in order to avoid duplication and avoid unnecessary expenses and wastage of resources collecting information that already existed.

1.5.4 Data Analysis

The data was systematically analyzed to throw light on the research questions and objectives outlined above. Information collected through the household questionnaire survey was coded and input into a statistical software, SPSS for analysis.

For the purpose of this study descriptive statistics were of interest to the analysis. Results of the data analysis have been presented through cross tabulations or comparisons, frequencies (percentages) and regressions. The findings have been presented in charts, graphs, and tables. Content analysis was used to analyze qualitative information from the in-depth interviews and participant observation. Geographic data was analyzed, and presented in forms of maps prepared in a Geographic Information System using ArcGis 9.1 and ArcView 3.3 software.

1.6. Expected Output

The study resulted into a thesis report which produced the following outputs:

1. A description of the historical development of human wildlife conflict in Laikipia district and the different strategies that have been attempted or proposed so far to deal with the issue.
2. A description of the nature and type of conflict previously experienced or currently occurring in the study area, detailing the crops most susceptible to crop raiding and the animals involved.

3. An analysis of the strategy of wildlife physical barriers and the various types used as game barriers in conservation including the effects of the barriers in the study area on the livelihoods of the local communities living adjacent to the fences.
4. Policy recommendations or proposals for immediate action and long-term focus to deal with the issue of human wildlife conflict with regard to barriers especially fencing as a management strategy in Laikipia and Kenya in general.

CHAPTER 2 LITERATURE REVIEW

2.0 Wildlife Conservation and the Protected Area Network

Since the 1950s the protected area network, has expanded rapidly, particularly in the developing countries. In many developed countries, successful attempts to conserve wildlife have resulted in an increase in wildlife populations, particularly large mammals. The establishment of protected areas in developing countries has placed the heaviest burden on local communities, which has proven to be a gross disincentive to effective conservation. Any attempts geared towards wildlife conservation have come up against the harsh reality of rapidly increasing human population, who largely live in poverty and need to use natural resources to an even greater extent. In situations where wildlife conservation is at odds with the livelihoods of local communities the former is always at the losing end (Nepal and Weber, 1995a).

Most of Africa's protected areas were created by colonial administrators without taking into account the concerns of local communities, and in most cases people were displaced or deprived of the traditional use of resources, causing them to suffer economic hardship. Today crop damage and livestock depredation by wildlife are major sources of economic losses. Local communities have in turn threatened protected areas by poaching and by causing habitat loss through encroachment of farms into protected areas (Weladji and Tchamba, 2003).

The local communities complain bitterly that their interests and values are pushed aside giving virtually exclusive preference to wildlife protection instead. This perception has resulted in hostile attitudes towards wildlife, which has fuelled open and intense conflicts between local communities and conservation authorities. Several conflict resolution strategies have been proposed, which mainly focus on providing benefits to the local communities i.e. managing protected areas to support the overall fabric of social and economic development not as islands of anti-development, but as critical elements of regionally envisioned harmonious landscapes (Nepal and Weber, 1995b).

The arid and semi - arid areas of East Africa are known for their spectacular local diversity and abundance of large herbivores. Nomadic pastoralists also inhabit

these areas. These marginal areas are too dry for rain - fed agriculture, although extensive areas have recently been converted to cropland as a result of increased human pressure and the subsequent increased demand for land to grow food (Mwalyosi, 1995). Although measures have been taken to establish a network of national parks and protected areas in the region (East Africa), the future of these areas is threatened by the rapid increase in the human population and the concomitant increase in agricultural settlements. This increase in settlements is occurring mainly in marginal areas which have traditionally been used for wildlife and livestock grazing and which are not suitable for agricultural activities. This increase has also blocked important movement and migratory routes into dispersal areas for most wildlife. This blockage of important routes is a serious threat to the long - term survival of natural resources and protected areas (Melamari, 1994)

The conservation movement has embraced the idea that protected areas cannot exist as islands, but are a part of a larger, more complex landscape. It's argued that protected areas are just one type of specialized land use within a landscape mosaic. Protected areas alone are unlikely to be successful in conserving biodiversity if they are surrounded by degraded habitats that limit gene flow, alter nutrient and water cycles, and lead to regional and global climatic change. The integrity of surrounding landscapes needs to be maintained if the biological systems inside protected areas are to be preserved. It's thus critical to recognize rural communities directly dependent on these processes by incorporating them in the planning process and understanding their relationship with the landscape (Chambers and Ham, 1995).

Conservation strategies in Kenya have for a long time been in-situ or in essence setting aside land as national parks or reserves, with the core protected area network (i.e. national parks, game reserves, forest reserves and marine reserves) covering 8% of the total land area of Kenya (Melamari, 1994, Lusigi, 1992). However, a substantial amount of Kenya's wildlife persists outside of protected areas with approximately 73% of the current elephant population in Kenya living outside protected areas (Gadd, 2005).

New approaches and plans for biodiversity conservation have emerged over the last two decades. Instead of concentrating on in-situ and protectionist approaches, concerned agencies are focusing on motivating local land users to exploit existing

opportunities to support conservation activities. In this way, the local communities benefit in the process of conservation as well as appreciate the importance of conservation from the flowing gains. Previous approaches based on pure conservation moves have therefore had a key move in the way communities view these resources. Under this situation wildlife was perceived to be competing with human activities in form of existing land uses (Mathuva, 2002)

Conservationists now recognize the need to work beyond protected areas if they are to sustain viable populations of wildlife and large-scale ecological processes. Ambitious conservation maps extending wildlife corridors and buffer zones far beyond protected area boundaries often fail to consider the practical and political feasibility of promoting wildlife within rural landscapes. This creates conflict when wildlife forages on crops, attack livestock or otherwise threaten human security. Traditionally, humans respond to these conflicts by killing 'problem' wildlife and transforming wild habitats to prevent further losses. However, this traditional response is now illegal or socially unacceptable in many areas. Hence, environmental protections and non-utilitarian views of wildlife have changed a simple competitive relationship between people and wildlife into a political conflict between people and between institutions (Treves et al, 2005).

Wildlife conservation can therefore not be considered in isolation from local people's needs, and their often time honoured practices of natural resource utilization, by making them beneficiaries of conservation activities. While there are conditions where wildlife can barely coexist with dense human settlements, in some cases wildlife can be an asset in the development of local communities. Recent experiences in wildlife conservation have amply demonstrated that if properly managed, wildlife can bring considerable economic benefits (Nepal and Weber, 1995a).

2.1 Human-Wildlife Conflict

The World Conservation Union states that human-wildlife conflict occurs when the needs and behaviour of wildlife impact negatively on the goals of humans or when the goals of humans negatively impact the needs of wildlife (IUCN, 2003). The Kenya Wildlife Service (KWS) considers human-wildlife conflict to be all disagreements or contentions relating to destruction, loss of life or property, and interference with rights of individuals or groups that are attributable directly or

indirectly to wildlife. They further state that true human-wildlife conflicts include effects of a personal nature such as injuries and deaths as well as economic and psychological losses people suffer when wild animals destroy human life and property.

Muruthi, 2005, states that large numbers of big mammals, including several hundred thousand wild elephants and more than 20,000 lions, still roam freely, particularly in rangelands of Africa. The pastoralist people who live in these regions, and the agro-pastoralists and other settled small and large scale farmers and their families who live around their peripheries, all have to cope with the consequences: damage to and destruction of crops, livestock predation, competition for grazing and water, increased risk of some livestock diseases, various inconveniences - such as loss of sleep due to protecting crops at night - and even direct threats to human life. As human populations rapidly increase (the population in African came close to tripling in the four decades from 1960) and settled agriculture spreads to more marginal rangelands, conflict between wildlife and people inevitably increases.

The extremely high rate of human population growth in Africa leads to ever-increasing encroachment on wildlife habitats and an increase in human wildlife conflicts. Species that are unable to adapt to altered habitats are being forced into small, marginal habitat patches. Those species that, because of their behavioural flexibility, are able to adapt to a changing ecology and survive in agricultural systems often come into direct competition with humans and are persecuted as pests (Siex and Struhsaker, 1999).

There are increasing cases of conflicts between human beings and wildlife over the use of natural resources - mainly land, forests and water (Sitati, Walpole, Smith and Leader-Williams, 2003). These are manifested through such incidents as people being killed or injured by wild animals; loss of livestock through predation; competition for pasture and water; wildlife invasion of crop farms and food stores; inadequate or lack of compensation for losses or injuries; encroachment on wildlife areas such as forests and protected areas, blocking wildlife migration routes; and poaching of wildlife for food, ivory, horns, skins and other valuable products (Ngure, 1995). The economic and emotional costs of these conflicts can be quite

enormous, both at the national and household levels. Droughts often heighten the scope and severity of these conflicts (IPAR 2005).

Conflict arises from a range of direct and indirect negative interactions between humans and wildlife. These can culminate in potential harm to all involved, and lead to negative human attitudes, with a decrease in human appreciation of wildlife and potentially severe detrimental effects for conservation. Conflict generally arises from economic losses to agriculture, including loss of cattle through predation and destruction of crops. In arid areas it often occurs over access to water and competition for resources (Nelson, Bidwell, and Sillero-Zubiri, 2003).

Distefano 2005, states that human-wildlife conflicts also undermine human welfare, health and safety, and have economic and social costs. Nuisance, exposure to zoonotic diseases, physical injury or even death caused by large predators' attacks have high financial costs for individuals and society in the form of medical treatment to cure and prevent infections transmitted from animals. Individuals and society can be economically affected through destruction and damage to property and infrastructure (e.g. agricultural crops, orchards, grain stores, water installation, fencing, pipes), livestock depredation, transmission of domestic animal diseases, such as foot and mouth disease (Kiiru, 1995). Negative social impacts include missed school and work, additional labour costs, loss of sleep, fear, restriction of travel or loss of pets. A wide range of species are responsible for conflict, with the principal culprits being primates, rodents, ungulates (including antelope, bush pigs, elephant, hippo, buffalo and zebra), lions, leopards and hyenas (Hill, 2000; Naughton-Treves, 1998; Treves, O'Connell-Rodwell, Rodwell, Rice & Hart, 2000).

There are other socio-economic costs associated with human-wildlife conflict which can outweigh the direct costs of agricultural damage and be a major component of the conflict as perceived by local people. The extreme example of this is human death, but other examples include restrictions on movement, competition for water sources, the need to guard property (which may lead to loss of sleep), reduced school attendance (through loss of sleep, or fear of travel), poor employment opportunities, increased exposure to malaria, and psychological stress (Hoare, 2000; Naughton-Treves, 1998, Patterson et al, 2004)

In Africa, conflict with wildlife is increasing. The elephant, *Loxodonta africana*, is one of the most financially valuable species in terms of attracting tourists and trophy hunters, but it is also one of the most problematic to local human populations. With 84% of African elephant habitat outside of protected areas, elephants are particularly likely to come into contact with people (Osborn and Parker, 2002). In much of the continent, the local cost of tolerating elephants exceeds the benefits.

Farmers lose crops to various wildlife species and although elephant damage is infrequent compared to other pests, it is often the most severe or comes just before harvest when effort and resources have already been invested. Elephants are also dreaded crop-raiders because they are difficult to chase away and may kill people. To farmers, the cost of elephant damage is not only the direct loss of a source of nutrition and income, but also indirect losses of education for children who have to stay home to guard the crops or alter their schedules to avoid elephants, and psychological stress from anticipating nocturnal raiders (Gadd, 2005). However, it is their reliance on other animals for food that commonly brings carnivores into direct conflict with humans, especially in areas where native wildlife has been extirpated and replaced by domesticated stock. When carnivores attack humans and livestock, campaigns to eradicate them are inevitable (Patterson et al, 2004).

Studies on temporal patterns of elephant crop raiding in African savannahs indicate that most crop damage occurs at the end of the rainy season or at the beginning of the dry season when crops are mature and ready for harvest. Human-elephant conflict is a primary threat to elephant survival throughout Africa. Where elephants persist, contemporary physical conditions draw them into close contact with humans, and contemporary social conditions lower human tolerance of their presence (Naughton-Treves, Rose & Treves, 2000). Although elephants' regional economic impact on agriculture is negligible relative to other vertebrate and invertebrate pests, elephants pose a serious threat to farming communities living close to protected areas. Human- elephant conflict at some sites is a major obstacle to community support for conservation. A hostile vocal minority can undermine regional conservation initiatives (Chiyo P. I., Cochrane E P., Naughton L and Basuta G I. 2005).

As human-wildlife conflict intensifies, two major opposing interest groups emerge. First, local communities view wildlife as liabilities that should not continue occupying parcels of land (and other natural resources) that could otherwise be used for more beneficial activities. Second, conservationists, on the other hand, highly value wildlife, essentially due to their contribution to tourist attraction, employment creation and revenue, and would want to jealously conserve it.

Mill, (2002), states that crop raiding by wildlife is neither a new phenomenon nor a rare one, and in many parts of rural Africa and Asia is perceived to be an increasingly important issue by farmers, people working in resource management, conservation and development. Until relatively recently there has been little attention given to vertebrate species that damage crops, with the exception of elephants and rodents. Most notably, there has been little emphasis on the impact of wildlife on small-scale farmers. Instead, research and intervention programmes have concentrated on efforts to reduce the threat to wildlife from local communities, encouraging the view that wildlife are a valuable resource that can attract revenue through wildlife tourism, and thus should be protected. Something that is missing from many of these programmes is an understanding of the relevant issues from the farmers' perspective.

At several sites, local resentment over actual or perceived property losses occasioned by wildlife is so intense that this precludes discussion of other environmental concerns. Human-wildlife conflicts (HWC) can make affected communities hostile to wildlife conservation initiatives and aggressive toward staff of protected areas (Kangwana, 1995). HWC derives yet greater importance because the fate of many wildlife populations and species depends on their capacity to co-exist with humans. Thus HWC is now a major challenge for conservation, as reflected in the burgeoning literature and meetings on the topic (Osborn & Parker, 2002). In Kenya, human-wildlife conflicts challenge conservation, especially in areas where wildlife range outside parks and confront local communities. Local opinions can influence conservation efforts. Locals' opinions on wildlife and conservation are influenced by benefit systems, wildlife damage to property, danger to human life, and changes in land use patterns (Okello, 2005).

Wildlife is a direct symbol and image of the wildness in which many rural communities feel immersed, and the effect of this on the psyche and beliefs of

local residents should not be underestimated. Perceptions are shaped by costly or catastrophic events more than the frequent, small-scale losses to pests, notwithstanding cumulatively higher economic impacts. For example, economic losses to large vertebrates are usually insignificant at a regional scale when compared to other sources of agricultural losses such as diseases, weather, and insect pests. Yet the regional average masks the few individual households or communities that suffer devastating economic losses from wildlife. In the case of large or dangerous wildlife, tragic losses may occur when humans themselves fall prey. Successful interventions against the common, small-scale pests may not reduce complaints about human wildlife conflicts.

Wildlife populations in Kenya have been declining for the past 25 years. Wildlife managers increasingly recognize that the survival of remaining wildlife populations depends upon the willingness and ability of people living in and adjacent to areas inhabited by wildlife to support their presence. Since the early 1970s Kenya has implemented policies to increase economic incentives for communities to tolerate adjacent wildlife populations, but their success has been limited as human livelihood systems have continued to experience losses due to predation and crop damage by wildlife (Campbell D J et al, 2003). Considerable efforts have been made to identify the characteristics and causes of wildlife-society conflict, and to develop strategies for reducing it. Governments and NGOs in countries including Kenya, Zimbabwe, and South Africa have experimented with a variety of approaches to reduce tension between wildlife activities and adjacent communities

The report of the five-person review group (KWS, 1994) on human wildlife conflicts states that human wildlife conflict is acutely real in practically all districts in Kenya. The conflicts are most intense when agriculture is involved, particularly where cropland borders forested national parks and in pockets of agriculture surrounded by rangelands. The report further states that the enormous losses incurred, and fear wildlife causes by destroying property and killing people are the primary sources of this conflict. The loss of income from death is devastating to families and material losses often cause unbearable financial suffering, particularly when agricultural loans are involved.

HWC has escalated in recent years due to changes in land use, especially expansion and intensification of arable farming and sedentarization of pastoralists in

rangelands, inadequate wildlife control, the ban on hunting and capture of wildlife and the natural increase of animal numbers. These changes have contributed immensely to the hardships of landowners, who tend to invest and lose more as they try to cope with the wildlife challenge in their land use enterprises (KWS, 1994). As populations increase, habitats are lost, changes in land use are effected and conservation efforts increased human-wildlife conflicts will continue (Kagoro-Rugunda).

Many areas in Kenya with abundant wildlife, such as Samburu, Trans-Mara, Taita, Kwale and Laikipia districts, face intensified conflicts brought about by land use change especially the development of small-scale farming. In fact, state and trust ranches have been subdivided and sold as smallholdings and cultivated with small scale subsistence farming and commercial horticultural crops (Distefano, 2005). In other parts of the country, people who formerly practised pastoralism have been encouraged to turn to agriculture, thus creating conflict in places where wildlife and people formerly co-existed. Examples include the Maasai in Kajiado and Narok Districts, the Pokot and Turkana near Nasalot and South Turkana Reserves, the Samburu near Isiolo and Maralal towns, and the Rendille and Borana around the Marsabit Reserve (Kiiru, 1995).

In the light of population growth, increasing demand for natural resources and the growing pressure for access to land, it is clear that human-wildlife conflict will not be eradicated in the near future, however it needs to be managed urgently. Human-wildlife conflicts require comprehensive and innovative management approaches that promote the socio-economic welfare of affected communities

A wide range of management tools have been developed worldwide to address HWC, but most of these are strongly site and species/genera specific and are not widely or easily accessible (IUCN, 2003). The reasons as to why conflict occurs and where, and more importantly the long-term conservation implications of this conflict, are less clear and vary from country to country. Conflict with people and their livestock is a significant source of mortality for large carnivores and there is an urgent need to characterize and develop measures to reduce these conflicts (Nyhus and Tilson, 2004).

2.2 Wildlife Barriers and Rural People

Current views on conservation and rural development are polarized between the primary priorities being conservation biology, in which parks are established to protect wildlife at the exclusion of humans, or rather emphasizing social ecology, where resources are seen as one component in a natural system which incorporates human communities. A perspective from India is that social ecology is a science of biological conservation, where mature societies have evolved cultural and resource practices that lead to a sustainable use. The weakness of this view is that traditional sustainable use may reflect human population size more than representing an inherent tendency toward sustainability. The dynamic tension between the perspectives of conservation biology and those of social ecology plays out politically on the international scene, as well as locally where the conflicts occur. The specifics and history are unique for each particular circumstance and locale, yet discussions often address all Southern Africa or Eastern Africa or Asia, implying that a single solution could be found for each large region (O'Connell and Hart, 2000)

Changes in land tenure, with a trend towards privatization, erode traditional farming strategies based on joint properties and focus the impact of crop loss on individuals rather than communities. Similarly, at many sites farmers have abandoned communal hunting, planting and guarding activities that once reduced crop loss. Crop guarding has decreased with men moving to cities to seek employment, while children are increasingly involved in education. Politicians are paying more attention to local citizens who complain about crop-raiding, increasing the profile and awareness of conflict (Hoare, 1995; Kangwana, 1995).

Around the world and for millennia, humans have defended themselves, their livelihoods, and their property from wild animals. Wildlife can pose serious problems when their activities intersect with those of humans. In addition to property losses, the occasional threats to human safety compound the vulnerability of rural communities. The most sustainable solutions to human wildlife conflict must therefore protect or improve the welfare of rural communities, as well as the status of wildlife conservation (Treves et al 2005).

Recognition among conservationists that the cost of conserving large and sometimes dangerous animals is often borne disproportionately by farmers and

others living closest to wildlife has spawned strategies to reduce this imbalance. One popular response is to compensate rural residents for the costs of wildlife damage. By spreading the economic burden and moderating the financial risks to people who co-exist with wildlife, conservationists hope to reduce the negative consequences of human-wildlife conflict (Treves and Karanth, 2003).

One of the most effective ways of controlling human-wildlife conflict is the physical separation of wildlife areas from farmland using barriers like electric fences. Such fences have been either partially effective or too expensive to maintain, or both. With the rapid increase of human population and expansion of agricultural settlement, the destruction of crops by wildlife has markedly increased and the need to devise effective game proof barriers has now become greater than ever. Three types of game-proof fences have been used in Kenya i.e. moats, high tensile steel fences and electric fences (Jenkins & Hamilton 1982, Ngure 1994). The main purpose for erecting electric fences is to alleviate conflicts between people and wildlife, or to separate land uses for conservation purposes (Hoare 1992a).

Fences have been used in the control of the larger African mammals with four basic purposes i.e. to demarcate a boundary, contain or separate animals, to exclude domestic stock and to improve security. Fencing necessitated by the nuisance value of wildlife towards people has been for a number of possible reasons: control of diseases of livestock, raiding of crops, damage to water supplies, competition for grazing, predation on livestock and exclusion of potentially dangerous animals from human dwelling areas. In contrast wildlife needs protection from illegal hunting and the encroachment of human settlements and organized agriculture. Rural communities, whatever their orientation towards wildlife have often seen fencing as a solution to property damage by wildlife while the donors of financial aid encourage it because it represents tangible assistance and because fencing is believed to secure a future for protected areas. The main determinants for erecting fences have been political pressure and the availability of funds (Hoare 1992b).

However Kagwana (1995) warns that though barriers of various designs have been erected as an attempt to separate elephants and humans, experience has shown that elephants are capable of going through the most sophisticated barriers, including highly electrified fences. From all reports, it seems that an elephant will

roam where it will: it will go through a six-strand 7,000 volt fence, yet be kept out of another field by a non-electrified two-strand fence.

Ruhiu and Musyoki, (2000) in their assessment of the Mwea Elephant Fence emphasize the need to have a clear policy on the specific roles of the local community in relation to that of the Kenya Wildlife Service (KWS) in terms of fence management. They recommend that communities should be empowered through training while KWS retains the advisory and supervisory roles. The sustainability of the fence would then depend wholly on the way the community is integrated in fence management. They continue to state that with the fence in place, the farming community has stopped worrying about elephants and buffaloes destroying their property and causing injury. The confinement of elephants and buffaloes in the Mwea National Reserve assured the local community of both economic and social benefits. It saw a 100% change in disruptions by wildlife after the erection of the fence, which was attributed to 31% reduction in the number of animals responsible for crop damage. The area under cultivation increased by 16% with the construction of the fence and some of the farms that had been abandoned were reoccupied. This translated into enhanced incomes for farmers.

From the baseline survey of the Lower Imenti Forest, Mathuva (2002), observed that wildlife damage to property and loss of life was a major problem facing communities living adjacent to the forest, a problem that could be solved with the completion and proper management of a fence. The frustration and disillusionment by local people due to losses inevitably lead to negative attitudes towards the responsible authorities. When the fence is completed changes in attitudes are expected since the adjacent communities are convinced that the ongoing strategies will be effective in reducing human-wildlife conflict and are therefore providing support, though at low speed, to deal directly with the problem. Naughton, Rose and Treves, (1999), note that local intolerance of wildlife may also be amplified by institutional constraints on coping strategies. Farmers feel especially vulnerable to large animals, such as elephants and bush pigs, which inflict localized, infrequent and potentially catastrophic losses. The perceptions of farmers towards wildlife often reflect rare, extreme-damage events rather than persistent, small losses that cumulatively may be greater.

While wildlife crop raiding can pose a significant threat to field crops, and thus farmer's livelihoods, not all farms are equally vulnerable, and for some people the potential risks are not as great. Perceptions are shaped not only by the severity and frequency of losses but by numerous social and biophysical factors relating to individual vulnerability. Risk of exposure (common to everyone in the same locality) can be differentiated from vulnerability, defined as the individual or household capacity to cope with risk. To understand vulnerability, one must study how people cope with the risks they face (Treves et al, 2005).

2.3 Rural Livelihoods

Coping mechanisms of rural people range from individualized self-protection to collective insurance based on social reciprocity. The former depend heavily on individual access to land, labour and capital, which depend in turn on wealth, kin network size and political influence (e.g., field scattering, crop diversification, using guards, erecting barriers on individual property). By contrast, communal coping mechanisms depend on traditions of sharing, reciprocity, and joint land management (e.g., voluntarily sharing public spaces, reciprocal labour, and aiding less fortunate neighbours). In peasant agriculture, farm size is an index of wealth and may be the most important endowment for coping with risk. Wealth can also be measured in access to capital or labour. Capital permits smallholder farmers to hire guards or build barriers (Naughton, Rose and Treves, 1999).

The poorest households face compounding vulnerability. Without large landholdings they cannot buffer themselves from wildlife conflict, nor can they hire additional labour. Of course there is a continuum between individual and social coping mechanisms and affected communities may participate in both. Finally, some settings limit the use of social coping mechanisms, e.g., recent migration by new ethnic groups, political or economic incentives for individual land ownership, etc. Competition between people over land or resources increases vulnerability particularly among the politically marginalized (Treves et al 2005).

According to the Economic Commission for Africa, 2005, there are a variety of livelihood options for smallholders in Africa. The predominant livelihood activity is smallholder semi-subsistence farming, which is practiced by a variety of indigenous people. Most households rely on cash and subsistence incomes from a number of sources that include irrigated and rain fed cultivation, livestock production, tree

production, and other miscellaneous activities, such as honey production. Households also depend on a variety of non-farm livelihoods, such as woodland activities, fisheries, trading, value adding processing, wage incomes, and remittances. The agricultural activities are affected by unfavourable climatic conditions, poor markets and infrastructure services, and unfavourable physical conditions (poor soils, land degradation caused by cultivation on sloping land, deforestation).

Capabilities are both an end and means of livelihood: a livelihood provides the support for the enhancement and exercise of capabilities (an end) and capabilities (a means) enable a livelihood to be gained. Equity is both an end and a means: any minimum definition of equity must include adequate and decent livelihoods for all (an end) and equity in assets and access are preconditions (means) for gaining adequate and decent livelihoods. Sustainability too is both an end and a means: sustainable stewardship of resources is a value (or end) in itself and it provides conditions (a means) for livelihoods to be sustained for future generations.

Rural livelihood strategies are often heavily reliant on the natural resource base, at least to some extent. Natural resource base sustainability refers to the ability of a system to maintain productivity when subject to disturbing forces, whether a 'stress' (a small, regular, predictable disturbance with a cumulative effect) or a 'shock' - a large infrequent, unpredictable disturbance with immediate impact (Scoones, 1998, Chambers & Conway, 1991, DFID).

Within the sustainable livelihoods framework, three broad clusters of livelihood strategies are identified. These are: agricultural intensification/extensification, livelihood diversification and migration. Broadly, these are seen to cover the range of options open to rural people. Either you gain more of your livelihood from agriculture (including livestock rearing, aquaculture, forestry etc.) through processes of intensification (more output per unit area through capital investment or increases in labour inputs) or extensification (more land under cultivation), or you diversify to a range of off-farm income earning activities, or you move away and seek a livelihood, either temporarily or permanently, elsewhere. Or, more commonly, you pursue a combination of strategies together or in sequence (Scoones, 1998, Chambers and Conway 1991).

The livelihoods and survival of human individuals, households, groups and communities are vulnerable to shocks and stresses. Vulnerability has two aspects: external, the stresses and shocks to which they are subject and internal, the capacity to cope. Any definition of livelihood sustainability has to include the ability to avoid or more usually to withstand and recover from stresses and shocks (Chambers and Conway, 1991). Reducing vulnerability has two dimensions. The first is external through public action - to reduce external stress and shocks such as flood prevention, disaster preparedness, of season public works to provide employment prophylaxes against diseases, etc. the second is internal through private action in which a household adds to its portfolio of assets and repertoire of responses so that it can respond more efficiently and with less loss.

Out of the tangible and intangible assets people construct and contrive a living using physical labour, skills, knowledge and creativity. Skills and knowledge maybe acquired within the household, passed from generation to generation as indigenous technical knowledge, or through apprenticeship, or more formally through education or extension services, or through equipment and innovation. (Scoones, 1998, Chambers & Conway, 1991, DFID, 1999)

Sustainable livelihoods are those that can avoid or resist stresses and shocks and/or that are resilient and able to bounce back. Households' portfolio of tangible (stores and resources) and intangible (claims and access) assets can be understood as partly chosen by design to reduce vulnerability and to enable the household to survive stresses and shocks with minimum risk of threat to the future livelihood. Similarly the repertoire of activities of household members can be interpreted partly as designed to spread risk.

The extent to which people tolerate wildlife damage may be influenced by various socio-economic factors, including relative wealth, levels of education, the extent to which people derive monetary or other benefit from wildlife, and the magnitude of wildlife-associated costs. However, personal values also have an important influence on attitudes towards conservation (Naughton-Treves *et al.*, 2003). Therefore, understanding which factors influence attitudes and tolerance in different situations is key to choosing and targeting the most appropriate solutions, whether mitigation to reduce losses, education to improve awareness, or benefit

generation to provide incentives (Zimmermann, Walpole, and Leader-Williams, 2005).

The ability of the local communities to pursue different livelihood strategies is dependent on their basic material and social, tangible and intangible assets. Therefore the resources at their disposal will determine how their livelihoods adapt to stress or shock. Scoones, (1998) states that those who are unable to cope are inevitably vulnerable and unlikely to achieve sustainable livelihoods. The ability to cope is dependent on historical experiences of responses to various shocks and stresses. The resilience and the ability to positively adapt or successfully cope requires on the hand depends on the different responses, including avoidance, repartitioning, resistance or tolerance mechanisms applied by as livelihood strategies.

2.4 Conceptual Framework

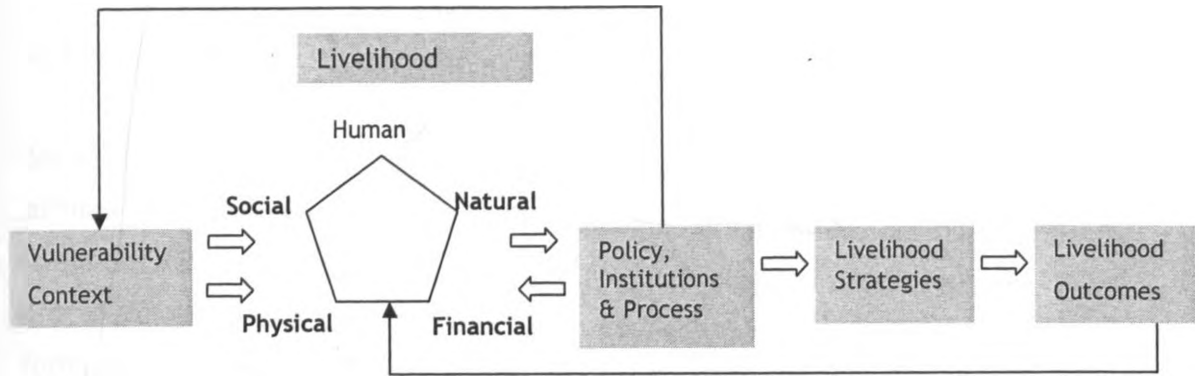
This section presents a conceptual framework that seeks to capture the main components of rural livelihoods and the strategies applied in coping or dealing with stress and shock on the livelihoods of rural people. The conceptual is by no means exhaustive. Any framework is an oversimplification of a complex reality and merely provides a way of viewing the world.

The concept of 'sustainable rural livelihoods' is increasingly central to the debate about rural development, poverty reduction and environmental management. A livelihood comprises the capabilities, assets (including both material and social resources) and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks, maintain or enhance its capabilities and assets, while not undermining the natural resource base (Chambers and Conway, 1991). The Sustainable Livelihoods Framework has a number of basic elements.

The framework provides an analytical structure, highlighting key components of livelihoods against which project impacts can be assessed, and making the complexity of livelihoods more manageable. The assumption is that people pursue a range of *livelihood outcomes* (for example better health, increased income, and reduced vulnerability) by drawing on a range of *assets* to undertake a variety of *activities*. The activities they adopt and the way in which they reinvest in assets is

driven in part by their own *preferences* and priorities. However, it is also strongly influenced by the *context* (e.g. climate, population and the effects of changes in these) and by external *policies and institutions*. These policies and institutions have a critical influence on people's access to assets and livelihood opportunities.

Figure 1 Sustainable Livelihoods Framework



Source: DFID, 1999

The ability to pursue different livelihood strategies is dependent on the basic material and social, tangible and intangible assets that people have in their possession. Such livelihood resources may be seen as the ‘capital’ base from which different productive streams are derived from which livelihoods are constructed.

Natural Capital - the natural resource stocks (soil, water, air, genetic resources etc.) and environmental services (hydrological cycle, pollution sinks etc) from which resource flows and services useful for livelihoods are derived.

Physical Capital comprises the basic infrastructure and producer goods needed to support livelihoods. Producer goods are the tools and equipment that people use to function more productively. Infrastructure consists of changes to the physical environment that help people to meet their basic needs and to be more productive.

Financial Capital denotes the financial resources that people use to achieve their livelihood objectives. There are two main sources of financial capital: available stocks, which can be held in several forms such as cash, bank deposits, liquid assets such as livestock and jewellery, or resources obtained through credit-

providing institutions; and regular inflows of money, including earned income, pensions, other transfers from the state, and remittances.

Human Capital consists of the skills, knowledge, ability to labour and good health and physical capability important for the successful pursuit of different livelihood strategies and achievement of livelihood objectives. At a household level human capital is a factor of the amount and quality of labour available; this varies according to household size, skill levels, leadership potential, health status, etc.

Social Capital - the social resources (networks, social claims, social relations, affiliations, associations) upon which people draw when pursuing different livelihood strategies and livelihood objectives requiring coordinated actions. These are developed through: networks and connectedness, membership of more formalised groups, and relationships of trust, reciprocity and exchanges that facilitate co-operation, reduce transaction costs and may provide the basis for informal safety nets amongst the poor.

Livelihood Strategies are the range and combination of activities and choices that people make/undertake in order to achieve their livelihood goals. This is a dynamic process in which people combine activities to meet their various needs at different times (Ashley and Karim 2000). In the context of human-wildlife conflicts, these are the strategies used by people experiencing conflict to deal with the wildlife menace and generally involve avoidance of conflict, diversification of livelihoods and in extreme cases migration.

Livelihood Outcomes are the achievements or outputs of livelihood strategies. In the context of human-wildlife conflicts these are the various outputs of the strategies put in place to reduce or minimize the conflict. The strategies result into outcomes that may or may not have effects on the livelihoods of rural people. It should not be assumed that people are entirely dedicated to maximising their income. It is hard to weigh up the relative value of increased well-being as opposed to increased income, but this is the type of decision that people must make every day when deciding which strategies to adopt. There may also be conflict between livelihood outcomes (DFID, 199).

The vulnerability Context may include population trends, resource trends, (including conflict), national/international economic trends, trends in governance (including politics), technological trends, human health shocks, natural shocks, economic shocks, conflict, crop/livestock and health shocks (Ashley, 2000). Human wildlife conflict in the two study areas is therefore the vulnerability context within which the livelihoods of the small holder farmers are affected.

Policy, Institutions and Processes are the institutions, organisations, policies and legislation that shape livelihoods. They operate at all levels, from the household to the international arena, and in all spheres, from the most private to the most public (DFID, 1999). They represent the framework or context within which human-wildlife conflicts occur and the institution responsible for the management of such conflicts and the interaction between the affected people and these institutions.

The ability of a livelihood to be able to cope with and recover from stresses and shocks is central to the definition of sustainable livelihoods. Such resilience in the face of stresses and shocks is key to both livelihood adaptation and coping. Those who are unable to cope (temporary adjustments in the face of change) or adapt (longer term shifts in livelihood strategies) are inevitably vulnerable and unlikely to achieve sustainable livelihoods. Assessing resilience and the ability to positively adapt or successfully cope requires an analysis of a range of factors, including an evaluation of historical experiences of responses to various shocks and stresses. Different types of shock or stress, in turn, may result in different responses, including avoidance, repartitioning, resistance or tolerance mechanisms (Scoones, 1998).

2.5 Statement of Research Hypothesis

Null Hypothesis (H_0): There is no significant relationship between the construction of wildlife barriers and the reduction of human wildlife conflict.

Alternative Hypothesis (H_1): - There is a significant relationship between the construction of wildlife barriers and the reduction of human wildlife conflict

CHAPTER 3 THE STUDY AREA

3.0 Introduction

This chapter presents the setting within which human wildlife conflicts occurs in Laikipia. It begins by giving the physical setting, size and location of Laikipia. It also outlines the land use system of the district and the changes that have occurred in the last century, from the colonial period, through the colonial period, post independent and the current land use typologies. The second section of the chapter provides a synopsis of human-wildlife conflicts in the district and the strategies used in dealing with the menace at a regional level.

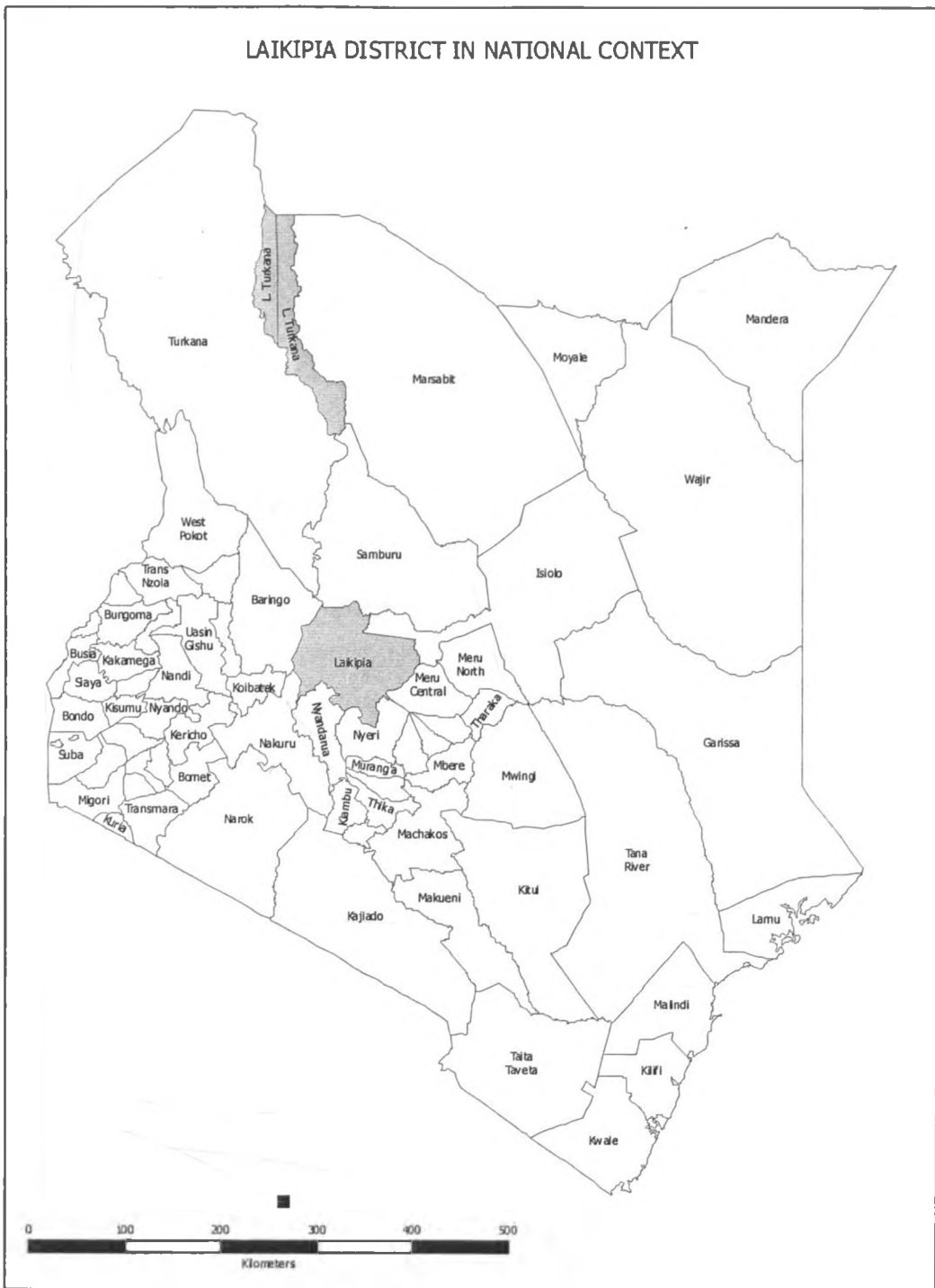
3.1 Physical Setting, Location and Size of Laikipia

In pre-colonial times most of Laikipia formed part of the territory of the Maasai. Under colonial rule the Maasai were forced to abandon the area due to an agreement that had been reached between their leaders and the colonial administration in 1912. Laikipia then became part of what was referred to as the “scheduled Areas” or “White Highlands”, developing into an area for large scale ranching.

Laikipia district was created after the enactment of the two Maasai agreements between 1904 and 1911 and is approximately 9,700km² in size and is located between 1,600 and 2,300 meters above sea level on a semi arid high plateau northwest of Mt. Kenya. Laikipia district is one of the districts in Rift Valley province, the largest administrative unit in the country. It's bounded by Samburu district to the north, Nyeri and Nyandarua to the south, Isiolo, Meru Central and Meru North to the east and Baringo and Nakuru districts to the west.

The district is divided into seven administrative divisions consisting of Nyahururu, Central, Lamuria, Mukogodo, Olmorani, Rumuruti, and Ngarua divisions. It's further divided into 36 locations and 64 sub-locations. There are three local authorities namely Nanyuki and Nyahururu Municipal councils and the Laikipia County Council and the district has two constituencies - Laikipia East and West.

Figure 2 Laikipia District in the National Context



3.1.2 Population

The population of Laikipia increased from around 30,000 in the early 1960s to 65,506 in 1969 and had grown to 134,524 by 1979 representing an intercensal growth rate of 7.3 % per annum between 1969 and 1979; between 1979 and 1989 it experienced annual population growth of 5.0% reaching a figure of 220,000 in 1989. According to the population census of 1999, (CBS) the population of Laikipia was 322,187. The two main urban centres of Nyahururu and Nanyuki have the highest densities with Majengo sub-location in Nanyuki with a density of 2560 persons per kilometre squared and Ndunyu in Nyahururu with a density of 2,245 persons per kilometre squared. Sieku sub-location in Mukogodo Division has the lowest density in the district, 1 person per kilometre squared¹.

Distribution of Population in the district is highly determined by the land use with the highest concentration of population in the urban centres and the smallholder agricultural settlements in the southern parts of the district where sub division of former settler ranches and farms has occurred. The population density is much lower in Mukogodo division which is under pastoralism and the sub-locations/areas within which ranching and/or large scale commercial agriculture are the dominant land use activities.

3.1.3 Rainfall

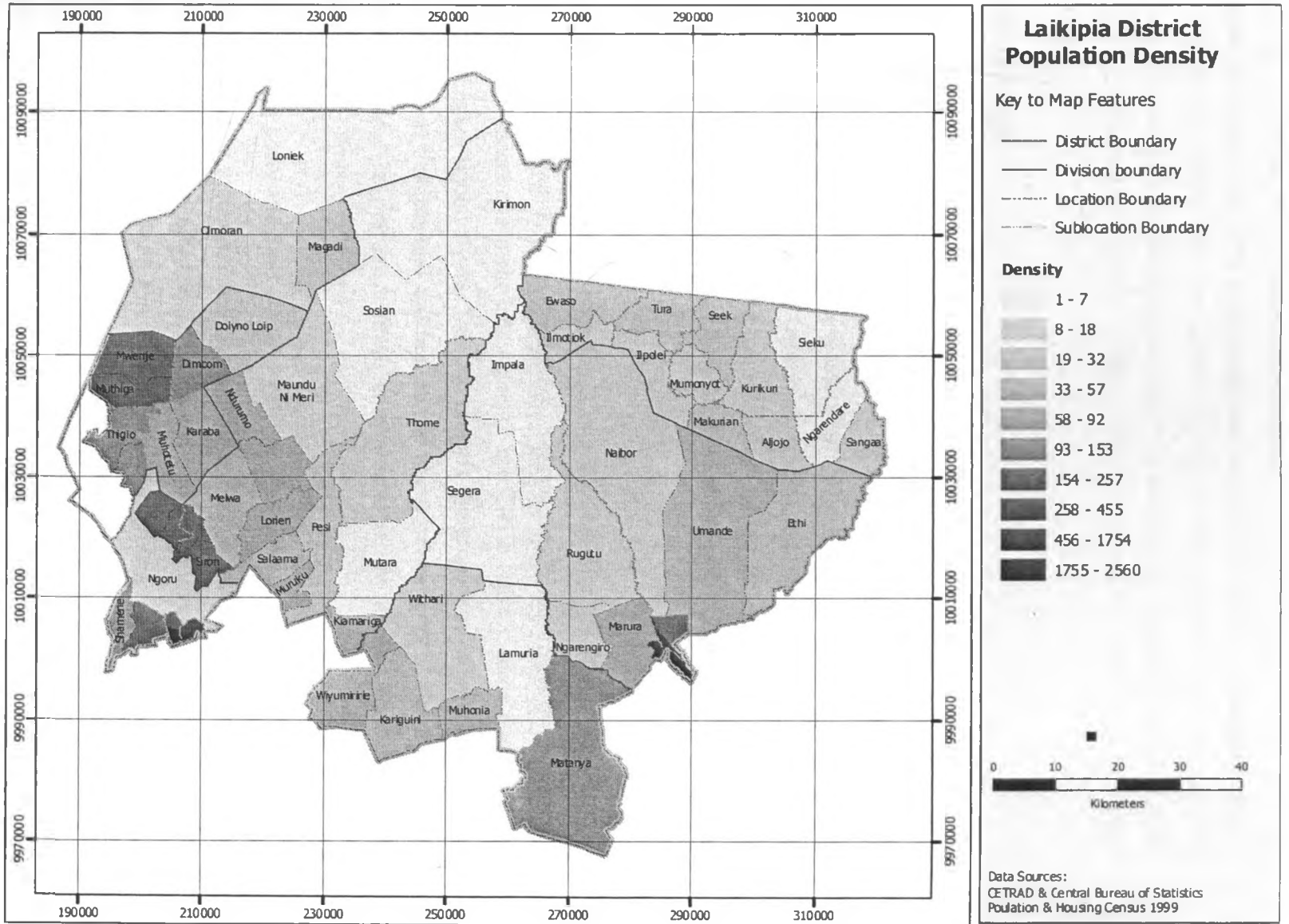
Laikipia lies on the equator, but is comparatively dry due to its leeward position in regard to Mt. Kenya. Precipitation in this area is mainly bimodal; April-June and October-December a result of the influence of the Northeast and South trade winds and the inter-tropical convergence zone, while the rest of the months are usually dry.

The spatial distribution and temporal variance of the rainfall are greatly influenced by the Mt. Kenya massif (5199 ASL) and the Aberdares range (3999 ASL), the latter lying south west of the plateau. Mean annual rainfall falls along a steep gradient, from 800 - 900 at the foot of both massifs to less than 500mm in the northern parts of the district. A small section of the western side of the district receives more rainfall, the annual amount ranging between 800 and 1000mm. This rainfall is characterized by spatial and temporal variances (Kiteme et al, 1998, Kohler, 1987).

¹ Population figures from the Population and Housing Census 1999 (CBS)

Figure 3

Population and Administrative Boundaries



The rainfall patterns in the district differ but typically average between 400 and 750mm per annum. North Marmanet experiences the heaviest rainfalls of up to 900mm per annum but with average annual rainfalls of 706 mm. Mukogodo forest also has similar annual average rainfall figures. At the plateau where the ranches are situated the annual rainfall is estimated to be 500mm. Mukogodo and Rumuruti divisions experience the lowest rainfall with average annual rainfall of less than 400mm.

3.1.4 Drainage

Together with the slopes of Mt. Kenya and the Aberdares Range, Laikipia forms the upper catchments of the Ewaso Ngiro River, which is of crucial importance to the livelihoods of the people in the semi-arid and arid lowlands in the northeast whose predominant livelihood system is pastoralism. The tributaries of the Ewaso Ngiro which flow through Laikipia are perennial streams fed from the Aberdares and Mt. Kenya during the dry season. The forest belts of the two massifs are both important in this process. The upper forest belts are the areas with the highest contribution to surface runoff and ground water recharge.

Several rivers flow from Mt. Kenya into Laikipia to feed into the Ewaso Ngiro River. These include Burguret, Naro Moru, Likii, Sirimon and Timau rivers among others. From the Aberdares the main tributaries of the Ewaso Ngiro include Ewaso Narok, Pesi, and Engare Ngobit rivers. The two massifs therefore play an important role in the drainage of Laikipia and are in-fact the upper catchments of the Ewaso Ngiro drainage basin. The plateau is however characterised by limited water resources and especially limited potential for rain-fed agriculture.

3.1.5 Topography and Soils

The district is located on a semi arid high plateau northwest of Mt. Kenya at an altitude of between 1,600 and 2,300 meters above sea level. It borders the Great Rift Valley to the West and the Aberdares and Mt Kenya massifs to the South. To the Northwest, this plateau descends to the floor of the Rift valley, while in the North and East it merges with areas that extend to the northern parts of Kenya. Within the plateau are the hills of the Loldaiga - Mukogodo area (1700-2200m A.S.L). Other notable topographic features are scarps and isolated hills which dot the plains.

The predominant soils are characteristically deep, have a high water retention capacity and are highly erodible. The soils consist of luvisols in the west of the district, regosols and phaezoms and luvisols in the north, phaezoms in the east and south east and nitisols in the forest complex near Nyahururu and surrounding areas.

Figure 4 Laikipia Agro-Ecological Zones

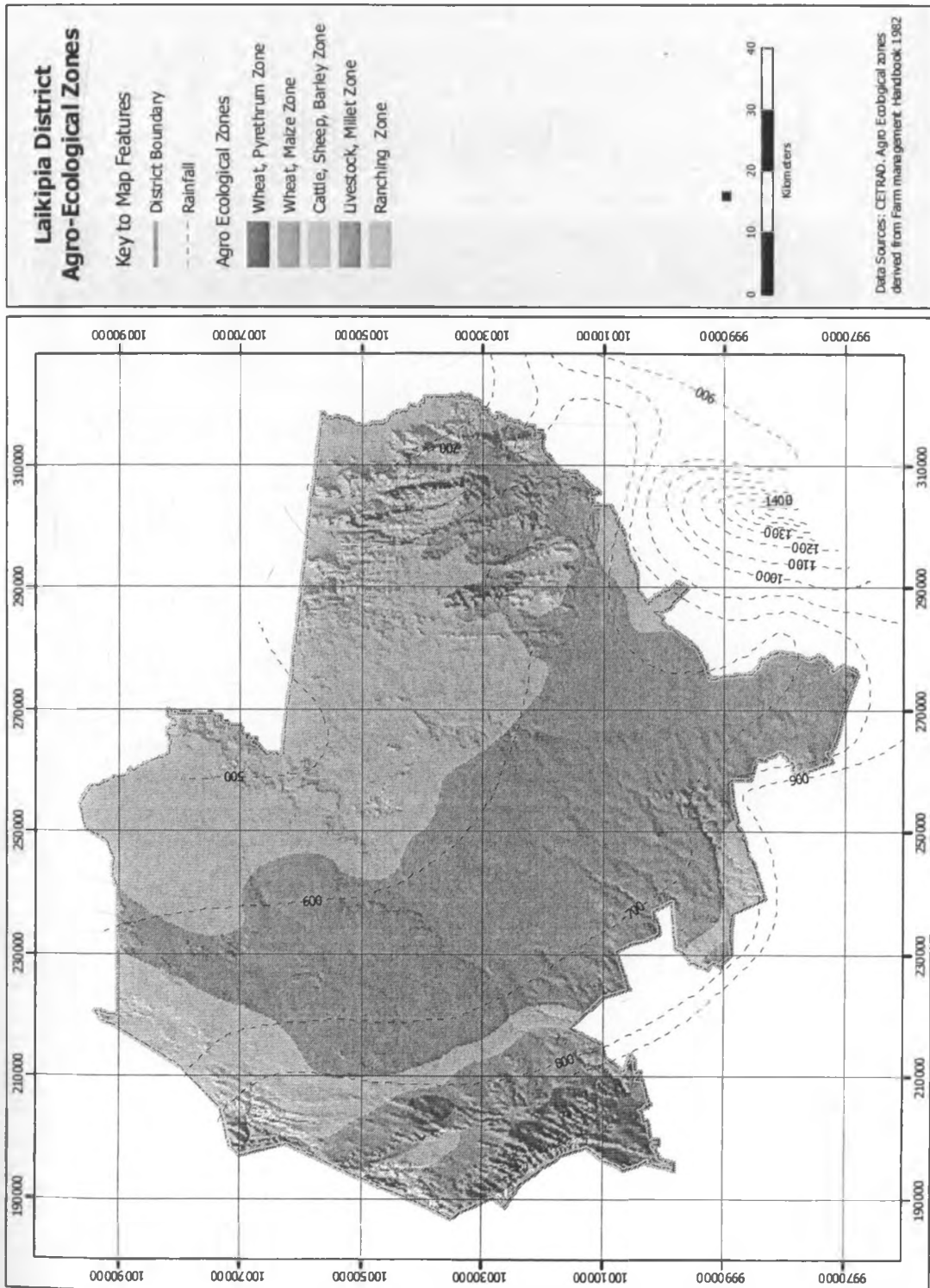
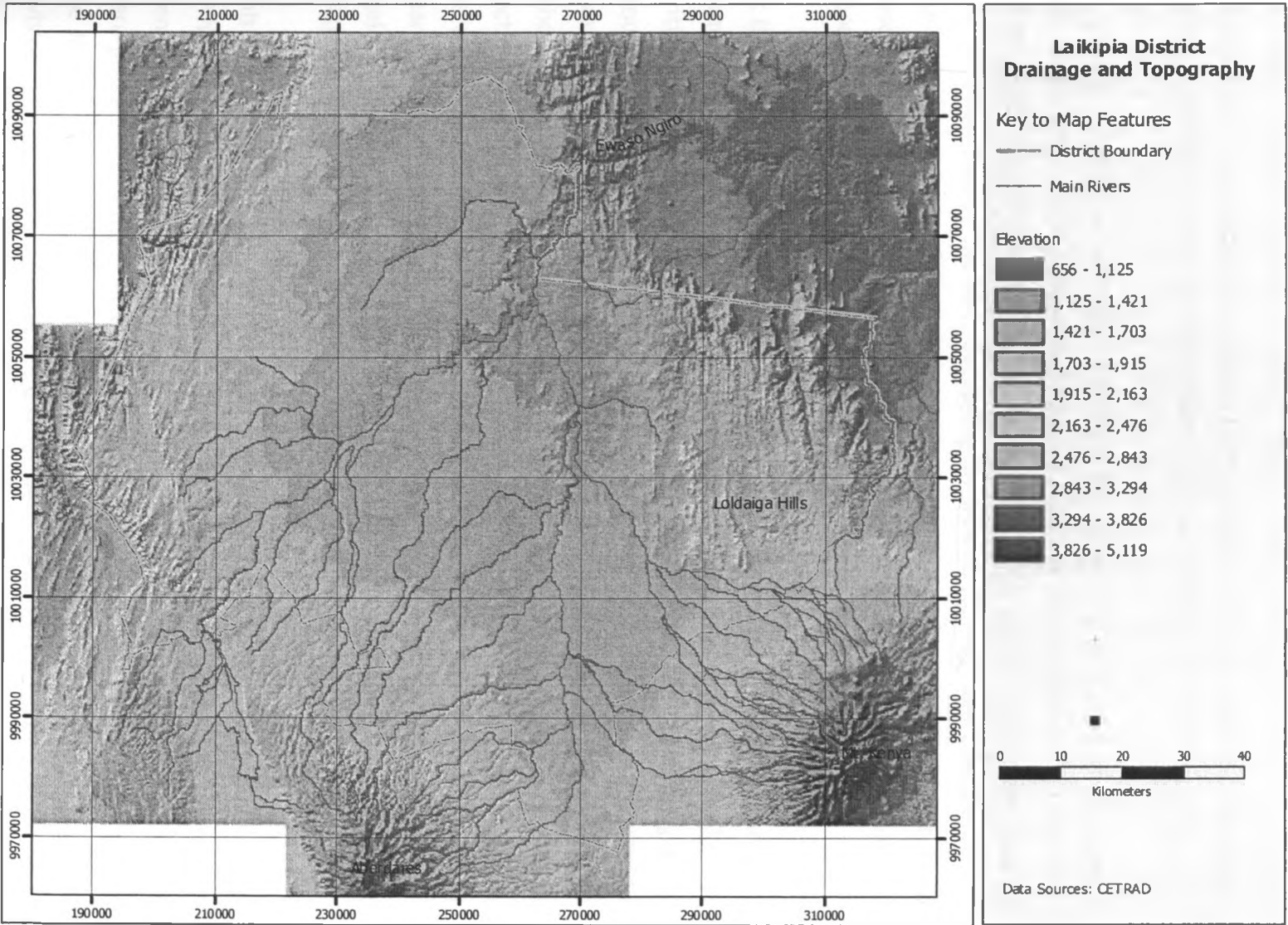


Figure 5 Topography and Drainage



3.2 Land Use and Ownership Patterns

Laikipia district has undergone dramatic changes in land use and ownership as witnessed within the last century. Three distinct periods can be clearly distinguished in analyzing the changes to the patterns of land use: the pre-colonial period, colonial and the post independence period (Kohler, 1987, Mkutu, 2001).

In the pre-colonial period most of Laikipia fell under the territories of the Maasai who practised nomadic pastoralism and the land was under community ownership. By the early nineteenth century, at the height of their power, the Maasai lived in and on either side of the Rift, occupying an area stretching from Lake Baringo in the north to central Tanzania in the south. This former territory has been described as lying at latitude of between one degree north of the equator and about six degrees south, and more than 200 km wide in some places.

At the start of the 20th century the coming of the Europeans and colonisation of Kenya was to mark the point at which the Maasai lost their land. In 1904-05, the British forcibly moved certain sections of the Maasai out of their favorite grazing grounds in the central Rift Valley (Naivasha-Nakuru) into two reserves in order to make way for white settlement. One reserve was on Laikipia in the north, the other in the south on the border with German East Africa where other Maasai sections already lived. Under a 1904 Maasai Agreement or treaty, these territories were promised to the people for 'so long as the Maasai as a race shall exist'. Seven years later, the British went back on their word and moved the 'northern' Maasai again, at gunpoint, from Laikipia to an extended Southern Maasai Reserve. White settlement of the highlands was the primary reason for the expulsion.

This process of colonization saw the country divided into two major blocks: the "White Highlands" or "Scheduled Areas" and the "Native Reserves". As earlier mentioned the Laikipia Maasai were among the victims of this balkanization and were pushed out to the Southern reserve. Those that remained were restricted to the Mukogodo Native Reserve to the north which is the present day Mukogodo division. The remaining areas of the district were then sub-divided into large tracts of land for the exclusive occupation and ownership by European settlers with Africans allowed into these areas only if they found employment in the settler farms. Ranching, mixed farms with dairy and crop production and game ranching

were introduced into land that was formally under pastoralism putting into place different land and resource management systems.

One of the main reasons for discontent, social and political unrest and agitation for independence by Africans in colonial times was the question of African land rights. The reclamation of alienated lands (white highlands) was a key issue and one of the most important claims of African political activity (Kohler, 1987). By the time of Kenya's independence the colonial administration had resulted into the cultivation of 7.5 million acres in the high potential areas by Europeans that accounted for 78% gross marketed agricultural output, over 80% of agricultural exports and 40% of the total reported employment (Mbithi, 1977).

In 1963, Kenya achieved independence and with it a new constitution that guaranteed freedom of movement and the right to own property in any part of the country. The "Scheduled Areas" were thus abolished and the white highlands opened up for settlement by whosoever desired. Laikipia therefore became a frontier for African migration and settlement with some of the white settlers opting to migrate from the ranches allowing for their acquisition by either the Government or by Land buying co-operatives and companies, or individuals. A big number of the white settlers however remained in Laikipia and Kenya in general and continued with their activities. The Maasai community remained confined to the former native reserve, an area they have continued to occupy up to date.

Laikipia currently is a mosaic of different land use activities. These activities include: large scale farming, ranching, game ranching, small scale agriculture, forestry and pastoralism. The district therefore has specific areas that are wildlife tolerant or intolerant depending on the land use of a specific area.

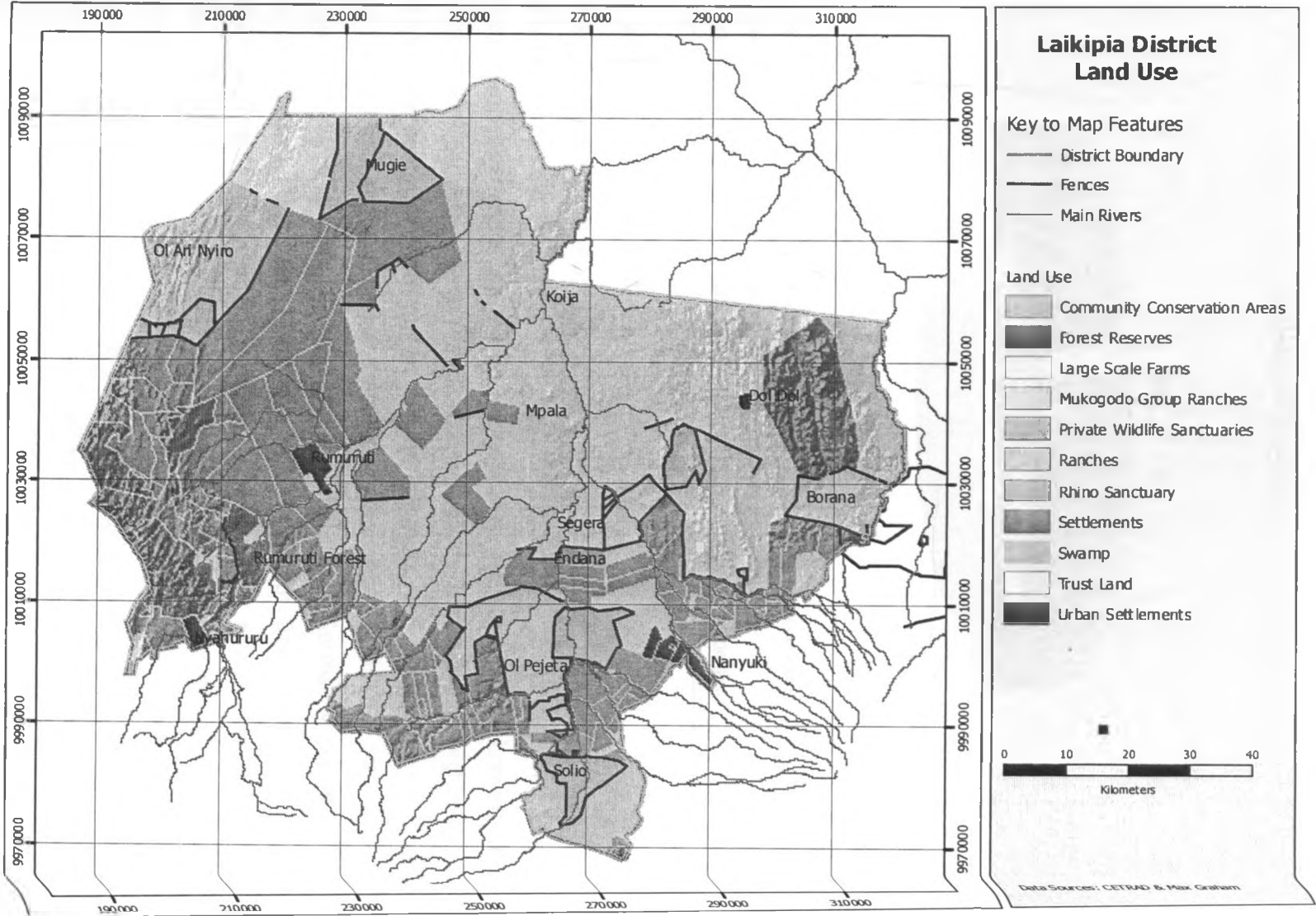
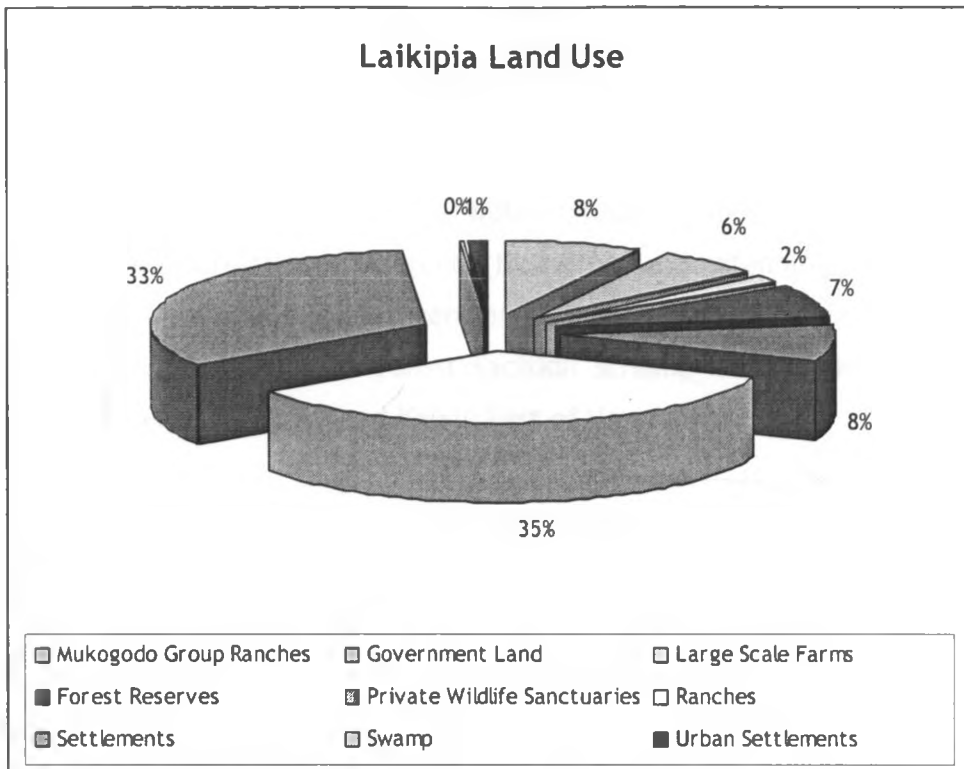


Figure 6

Laikipia District land use

Chart 1 Land Use in Laikipia



3.2.1 Small Scale Agriculture

The purchase, subdivision and settlement by indigenous Kenyans of large scale settler farms and ranches were undertaken through the initiation of several settlement programmes by the government. The first and widely known was the Million-Acre Scheme where 1 million acres mainly in the white highlands were bought and subdivided into small-scale farming plots. This programme was a legacy of the colonial era started just before independence in 1961/62 and came to a close in the 1970s. Funding was from the British and German governments with further financial assistance from the Commonwealth Development Bank. Apart from supporting the official settlement policy of the government the creditors were also interested in preventing the land market and agriculture production from collapsing as had been witnessed after the Lancaster House Conference in 1960 when land prices in the highlands fell to as low as one tenth of their previous prices (Kohler 1987). At the end of 1970, about 1,062,575 acres were apportioned to 34,000 African households, 7,500 trading centres were created and 160 primary and 4 secondary schools established all at a total cost of 25 million pounds or about \$19 per acre (Mbithi, 1977).

In Laikipia the government settlement schemes are of comparatively little significance compared to other parts that were in the white highlands, covering only 3% of the district due to the ecological conditions under the Million acre scheme an area had to fulfil in order to qualify for small scale settlement. Rainfall was therefore a limiting factor and the few settlement schemes existing in the district are to be found in the wetter, higher potential westernmost section adjoining the forest reserves around Nyahururu and extending northwards towards Ol Arabel². The other government settlement schemes in the area include the *Haraka* scheme (Marmanet Forest Excision Scheme north of Nyahururu) and the *Shirika* Scheme (Ndindika and Kalalu East of Nanyuki).

As the settlements continued it became evident that the government schemes were not enough to accommodate the needs of all who wanted land. By the mid 1960s the option of small-scale settlement was quickly becoming too expensive for the government as a solution for the landless and land hunger that was present. In the Sessional Paper No. 10 of 1965 on African Socialism and its Application to Planning in Kenya, the Government went as far as to state that.

“The settlement process was inherited from the British and was designed more to aid those Europeans who wanted to leave than the Africans who received the land.However, there have been reasons for settlement. Many European farmers wished to leave and the United Kingdom Government was willing to give grants and loans to Kenya to enable them to go. Neither of these reasons takes into consideration the present need for development in Kenya. It is unlikely that Kenya, in accepting the debt burden, has obtained economic benefits of anywhere near the amount of the debt incurred.” (GOK, 1965)

Apart from this, the donors were also reluctant to put more funds into the settlement programme.

The only alternative therefore available was for the country to rely on its own resources for the solution of the land problem simply by adopting the concept of self-help. This was necessary since the pattern of land ownership in the white highlands was predominantly large scale and from the beginning, transfer of land if

² Marmanet settlement scheme in Siron sub-location was among settlement schemes initiated by government in the early sixties

not intact was by large tracts whose cost was way beyond the financial capability of the common man. To acquire the land they had to come together as land buying companies and cooperatives to raise enough capital to purchase the land, normally through sale of shares to the member. Public funds were also used through land-purchase loans to the companies or cooperatives. After purchase, land was subdivided with each member getting land proportionate to his contribution.

Land buying co-operatives and companies were active all over the white highlands. Kohler (1987) estimates that by 1970 they had already acquired about 20% of the area, or as much as the government settlement schemes. He further states that small scale farming initiated through self help is by far the most important category of African ownership. It covers approximately a quarter of the district's surface, forming a crescent from the east to the extreme northwest, touching the lower slopes of Mt. Kenya and the Aberdares. Due to low rainfall most of this area is less suitable for farming than where the government or public schemes were initiated³. The area under small scale agriculture or settlement in Laikipia is approximately 33% of the districts land surface.

3.2.2 Ranching

Large scale ranching covers 35% of Laikipia district with a large proportion of large scale ranching being under non-African ownership. The ranching sector falls within the driest parts of the district with land holding varying between 3,000 to 100,000 acres (Laikipia Ranching). Most of the ranches are wildlife tolerant as their activities are in not affected by wildlife and generally cases of human wildlife conflict are not high. However several ranches for example Mogwooni are completely fenced off and are intolerant of wildlife in the ranch as it's exclusively for livestock. The proportion of land under ranching has reduced over the years. Huber and Opondo, 1996 and Kohler, 1987 had documented it at more than half of the districts surface. This is however explained by a shift of some ranches from ranching into purely wildlife conservation activities by converting into Private Wildlife Sanctuaries. Private wildlife sanctuaries currently cover over 8% of the district with some being sanctuaries for endangered species of wildlife. Examples of this type of land use include: Mugie, Solio, Sweetwaters, Ol Jogi and Ol Ari Nyiro that are all rhino sanctuaries.

³ The Endana settlement was purchased and subdivided under this category of settlement schemes and falls in area with ecological conditions unsuitable for agriculture.

3.2.3 Large scale Farms

This category covers 2% of the districts land surface under the ownership of indigenous Kenyans, Europeans or companies engaged in large scale crop production either under irrigation or rain fed production. They are generally located adjacent to main rivers or in parts of the district with adequate rainfall for their activities. Most of their production is horticultural crops for export.

3.2.4 Government Land

This is land owned by the government or under ownership of state corporations and covers around 6% of the districts surface. They are in the hands of two organizations: the Agricultural Development Corporation (ADC) set up in 1965 with the aim of breeding quality livestock (ADC Mutara). The other category is the Ministry of Livestock and Fisheries which is supposed to manage the government properties in the northern boundary of the district. The land was meant for use as livestock holding grounds, for the purpose of vaccination, quarantine and fattening of livestock which the Livestock Marketing Division (LMD) used to buy mainly from the pastoralist communities living in districts neighbouring Laikipia. This service is no longer offered by the government and the land is currently occupied by squatters and neighbouring pastoralist.

3.2.5 Mukogodo Group Ranches

The Mukogodo Native Reserve is the area that the Maasai were restricted to during the colonial era when Africans were placed in native reserves and currently constitutes the area under communal land ownership and use. It covers an area of 8% of the land surface of the district. Ownership of land in this category is communal under the Land (Group Representative) Act which provides an innovative legislative framework within which communities can relate to land without fundamentally altering their customary land arrangements. The area is divided into 7 distinct group ranches with the main activity being pastoralism. This is however one of the driest part of the district, with harsh climatic conditions and few water resources. The Mukogodo area has also experienced some form of private ownership with parcels being hived off the group ranches to create private ranches. Wildlife utilization schemes have also led to the creation of Community Conservation Areas (CCA) in Mukogodo in an attempt to derive benefits through utilization of the wildlife present in their land. This has seen the creation of several conservation areas in the different group ranches e.g. Ilngewzi.

3.2.6 Forest Reserves

This category covers 7% of the land in the district and is based on the areas gazetted as forests. Excisions by government for settlement of “landless” people, encroachment by locals and destruction of the forest by loggers and charcoal burners has led to serious depletion of the forest cover in Laikipia district. Lariak, Ol Arabel, Marmanet, Ewaso Narok and Rumuruti forests have been heavily depleted. Mukogodo forest in the Northern part of the district (within Mukogodo division) is largely intact.

3.2.7 Urban Settlements and Swamps

The remaining part of the district is land under urban settlements and swamps with the urban area covering 1% and the swamps less than 1% of the surface of the district. The main urban areas include Nanyuki, Rumuruti, Nyahururu and Dol Dol in the north. The swamps include Pesi and Ewaso Narok though they have undergone extensive drainage and small scale farming in small plots currently going on. The swamps have also been used as grazing land by pastoralists.

3.3 Study Sites

A cross sectional study was carried out focusing on two physical barriers (fence and a ditch) i.e. Endana and Rumuruti. The two were selected first because they represent different types of settlement and have different agro-ecological conditions. The selection is also based on the influence of the two massifs neighbouring the district namely the Aberdares and Mt. Kenya. The Rumuruti fence is on the migratory path of wildlife from the Aberdare ranges while the Endana fence is a barrier for wildlife from Mt. Kenya forest and national park. Selection was further influenced by the type of settlements based on trends and the year of initial settlement, the method of construction of the fence and the donor or organization bearing the cost of construction and the areas vulnerability to crop raiding by wildlife.

3.3.1 Endana

The idea of a solar fence was initiated in 1999 when the Endana Electric Fence Self Help Group was established and registered at the ministry of social services. According to Mr. Wachira (Chairman of the group) this was necessitated by the suffering the farmers were experiencing in Endana from wildlife menace making life very difficult. There were high levels of human wildlife conflict, death, threat to life, predation, crop raiding, insecurity brought about by fear to move around

and general insecurity due to the situation in Endana. The project was initiated because the community was *“Tired of running around in the night with torches chasing wildlife which still came back”* *“We were planting and getting nothing”*. There was death from elephants and predation on livestock.

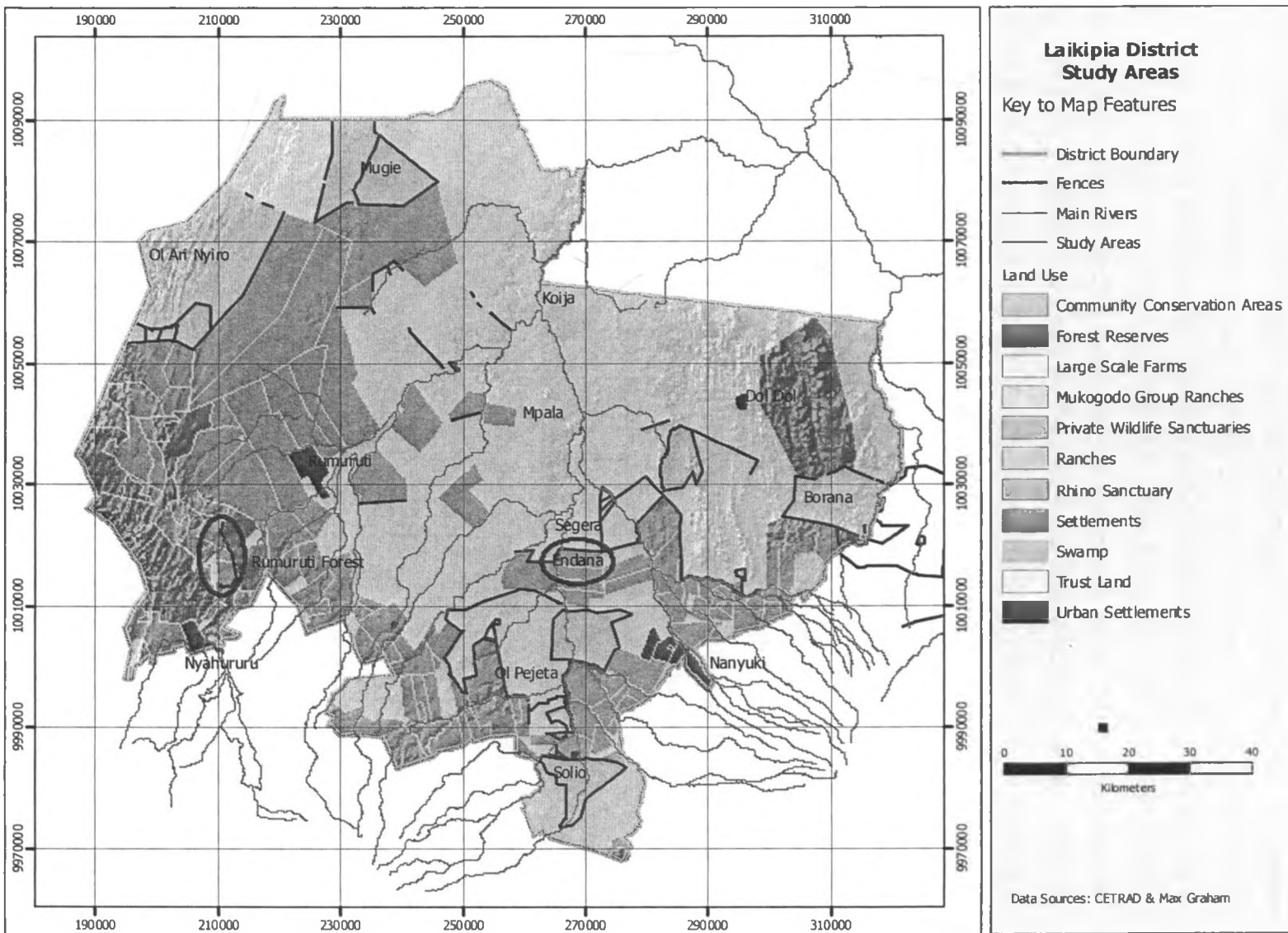
The community began by clearing bush for the fence-line even before they had identified a donor. They however received a lot of help from the owner of El Karama ranch, Guy Grant, who introduced them to Laikipia Wildlife Forum who initiated contact with the Biodiversity Conservation Programme of the joint funded Government of Kenya/European Union Community Development Trust Fund. He also made them aware that KWS was responsible for wildlife and they could get assistance with dealing with the wildlife menace from them. This saw the entry of KWS who provided them with rangers and thunder flashes to chase away wildlife.

After making contact with KWS and LWF, BCP was identified by the two organizations as a potential donor and they initiated contact between BCP and the locals. BCP provided funds for purchasing materials - wires, posts, insulators, batteries, solar panels, etc and the community provided labour throughout the duration of construction *“Every hole was dug by the community, every pole put up by the community”*. The KWS assisted with technicians who also trained locals on how to install and manage an electric fence with the KWS technicians doing 6km and the two trained technicians the rest. El Karama & Segera ranch also undertook the cost of putting up 2 strands (fence was initially supposed to be 4 strands). The construction of the fence was completed in 2004 and handed over to community on February 15th 2006. The total cost of the project was Ksh. 2,224,900. The contribution from EU-CDTF (BCP) was Kshs 1,684,200 and added 70,000 later on in the course of the project.

The fence is 12km in length (was initially 10.4km but realigned so as not to interfere with access to water by wildlife). The posts are 10ft in height, 3ft depth into the ground and 7ft high. It's a 6 strand fence with 4 being live. The fence is joined to the Mogwooni fence, through El Karama all the way to link with the segera fence

Figure 7

Study Areas



3.3.2 Rumuruti

The Rumuruti Forest Block is situated in Laikipia District and covers around 6,337 hectares. The forest used to be a part of the Marmanet Forest Reserve, to which nowadays it is connected through a small corridor. Rumuruti is a gazetted forest under the central government. It is the second largest forest in the district and habitat of resident and migrating elephant populations, as well as other wildlife. The sub-locations surrounding the forest are Lorian and Salama on the Salama side and Gatundia, Makenzi and Siron on the Marmanet side. Human-wildlife conflict is prevalent in the area and in 1992; the Kenya Wildlife Service (KWS) started a community partnership programme to address these problems.

The Rumuruti fence is a ditch approximately 1 meter wide and approximately 14km long. A two-strand fence with sections being electric on timber poles straddles some parts of the ditch but most of it is in a state of disrepair even in the sections where it's still standing. The ditch was dug in 2005 through a community effort in combination with their local leaders under the auspices of the Rumuruti Forest Association and involved a food for work project for community members who participated. The KWS has appointed community scouts to deal with human wildlife through the use of thunder flashes. A proposal to construct a solar fence on the Marmanet side of the forest was presented to the Biodiversity Conservation Programme of EU in 2002 but the project never took off after BCP pulled out due to political interferences in the project.

3.3 Human - Wildlife Conflict in Laikipia

The settlement schemes initiated in Laikipia after independence especially by land buying companies and co-operatives were in areas too dry to support rain-fed agriculture in most years and as a result many plots were not occupied, and others have been abandoned (Huber and Opondo, 1995). This led to a patchwork of struggling farms surrounded by natural habitat - perfect conditions for conflict with wildlife. This has been exacerbated by the fact that Laikipia has been one of the few districts in Kenya where wildlife populations have increased substantially over the last twenty years.

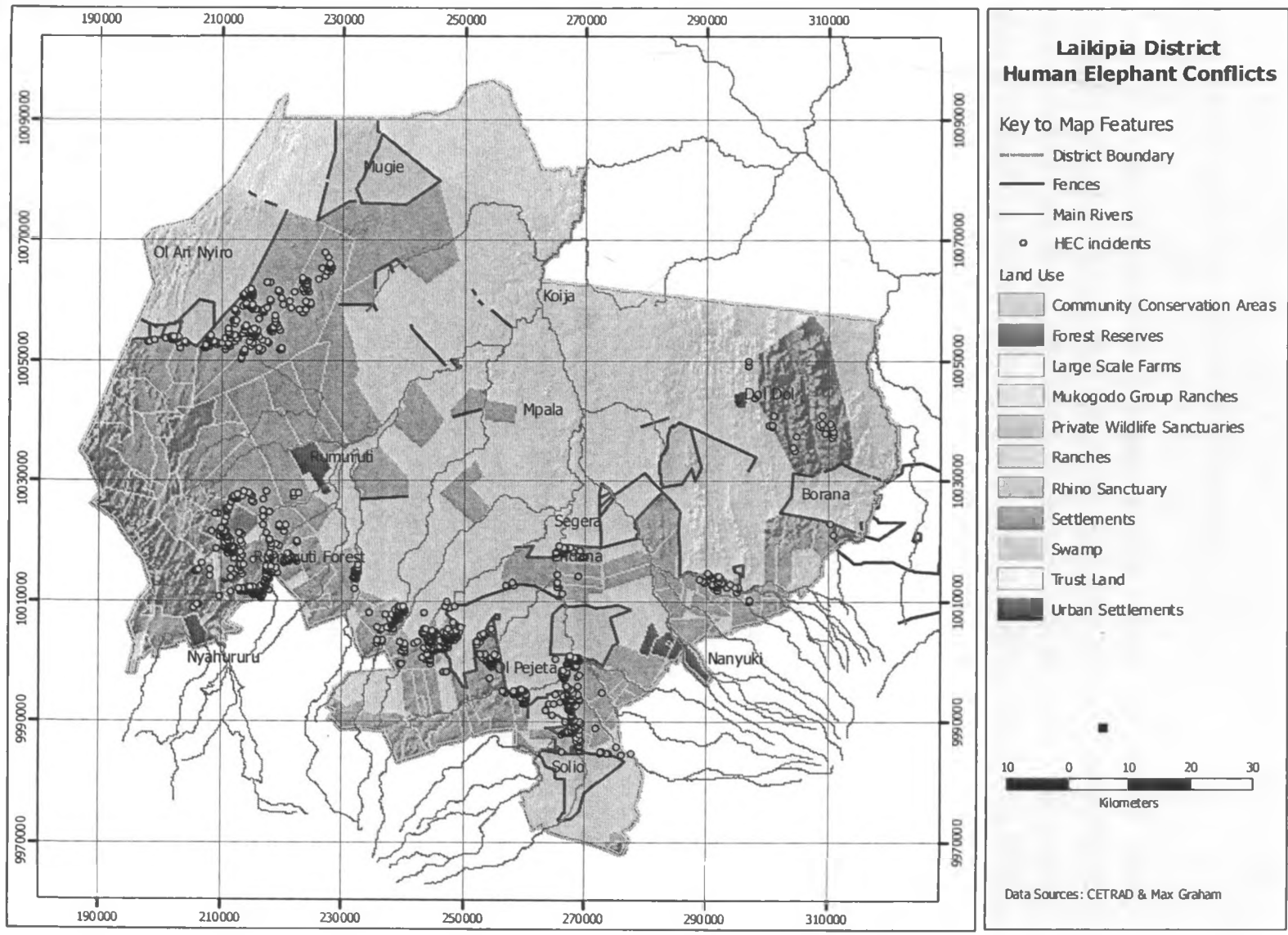
Human-wildlife conflict has become a major political issue in the district⁴ (*African Indaba e-Newsletter Vol. 3 No. 1, January 2005*). Elephants are a big problem due to the amount of damage they do to crops, their responsibility for human deaths, and the difficulty for an individual farmer of controlling them, but zebra, eland and buffalo are also a problem in farming areas, and lion, leopard and hyena cause conflict in ranching and pastoral areas (Thouless, Georgiadis, and Olwero, 2002).

The districts of Laikipia, Samburu and Isiolo host Kenya's largest population of elephants outside of protected areas (Thouless & Sakwa 1995). In 1999, the population was estimated at 3400 individuals (Kahumbu et al. 1999), and believed to have increased since. Only a small fraction of the population, estimated at 250 individuals, is inside the refuges of Samburu-Buffalo Springs and Shaba Game Reserves at any given time. Apart from elephants other northern plains game inhabit the Laikipia Plateau. Resident predators include lions (*Panthera leo Linnaeus*), leopards (*Panthera pardus Linnaeus*), cheetahs (*Acinonyx jubatus Schreber*), wild dogs (*Lycaon pictus Temminck*), jackals (*Canis mesomelas Schreber*) and caracals (*Felis caracal Schreber*).

Within Laikipia District, some elephant range is within privately owned ranches who are pleased to host wildlife, but much of it falls within land that belongs to people who struggle to maintain their own families. These subdivided ranches are often surrounded by ranches with wildlife and suffer frequent wildlife incursions (Gadd, 2005). The new settlers include farming people from the wetter, more densely settled parts of the country, who having practiced highland agriculture or inherited the practices from preceding generations who transfer the same practices to Laikipia with disastrous results as many are unfamiliar with either wildlife or dry-land farming. Farmers are rarely satisfied with their yields on these semi-arid lands and are distressed by any losses occasioned by crop-raiding wildlife as this impact negatively on their livelihoods which are dependent on agriculture.

⁴ Laikipia West Member Of Parliament G.G Kariuki in 2003 gave notice in parliament of his intention to introduce a Private Members Bill to amend the Wildlife Act. The Bill's objective was two-pronged: to seek better service from KWS and to set up a workable system of compensation for those who suffered loss to wildlife. On New Year's Day, The Daily Nation reported that President Mwai Kibaki had refused to give his assent to the Bill and had sent it back to Parliament on grounds "that it would have reintroduced hunting in Kenya's game parks."

Figure 8 Incidences of Human-Elephant Conflict in Laikipia



The district has become a complex mosaic of wildlife-friendly and wildlife-intolerant places. Elephants moving long distances have little alternative but to traverse cattle grazing areas and agricultural crops. The elephants come into conflict with humans by raiding crops, and by threatening, and occasionally killing, people and livestock (Thouless & Sakwa 1995, Gadd, 2005)

As early as 1982, the problem of human wildlife conflict had already been identified in Laikipia district. The reasons or causes for this was attributed to heavy poaching of the early 1970's which forced elephants that were traditionally residents of Samburu district in the north to move into Laikipia where they found reasonable protection and plenty of food and water (Jenkins & Hamilton 1982). Laikipia and Samburu districts combined hosts the second largest elephant population in Kenya after the Tsavos (Thouless, 1995). By 1978 the situation had become sufficiently serious that the Game Department began attempts to move the elephants back to the north. Over 400 elephants were pushed into the Aberdares and connecting South Laikipia forests using aircraft, helicopters, vehicles and lines of men. Later in the year 300-500 were pushed north from Solio/Tharua towards El Karama, and 400 were driven from Kieni to Ol Maisor.

During the 1990s, human-wildlife conflict became a major political issue in the District, as the effects of droughts and insecurity were exacerbated by wildlife damage to crops and human deaths. Although conflict in some areas was reduced by the use of fencing, it was little changed in central Laikipia and around Rumuruti. Changes in KWS's funding and approach to problem animals may have also had an effect on the level of conflict. In 1995 there was a peak of 48 elephants killed on control; this figure had reduced to between 10 and 15 elephants annually from 1997-9.

With the failure of the attempts at driving, and increasing use of electric fencing in controlling wild animals, a new approach to the problem was sought, and a proposal was made to construct a fence across Laikipia (Jenkins & Hamilton 1982). The plan was to use the fence in combination with a series of drives to exclude elephants from the southern part of the district. However, this was never put into operation due to lack of funds and difficulty in achieving a consensus on the alignment of the fence. Nevertheless, a number of different types of wildlife barrier have been employed in Laikipia. During the last fifteen years an increasing

number of wildlife fences have been built in Laikipia with the exact circumstances and the wildlife species to be controlled determining the appropriate fence typology.

3.4 Regional Approaches to Managing Human-Wildlife Conflicts

Approaches to managing human wildlife conflicts can be classified into two basic classes: prevention and mitigation. Although management strategies have similar goals, they are embedded in different ecological, social, cultural and economic realities and they are also targeted towards different taxonomic groups. Mitigative strategies attempt to reduce the level of impact and lessen the problem; while preventative strategies endeavour to prevent the conflict occurring in the first place and take action towards addressing its root causes. Some are efficient in the short-term while others show results only in the long-term; others are more effective within defined geographic regions or specific taxonomic groups.

Several approaches have been used over time in Laikipia district with varying levels of success and some are currently being practiced while others have been abandoned or banned by the government or wildlife authorities. This section will discuss the regional approaches used either by wildlife authorities or by communities at the community level or regional scale. These approaches include: compensation, wildlife utilization schemes, physical barriers, etc.

3.4.1 Mitigative Measures

3.4.1.1 Compensation

Conservationists recognize that the cost of conserving large and sometimes dangerous animals is often borne disproportionately by farmers and others living closest to wildlife (Nyhus, Fisher, Madden & Osofsky, 2003). Compensation of rural communities for their losses is a popular response to this burden of wildlife damage (Muruthi, 2005). By spreading the economic burden and moderating the financial risks to people who co-exist with wildlife, it's hoped that the negative consequences of HWC will be reduced. If carried out effectively, compensation can shift economic responsibility for conservation away from farmers towards supporters of conservation (Nyhus and Tilson, 2004).

HWC carries significant economic costs to humans and compensation is a measure which aims to alleviate conflict by reimbursing people for their losses (Distefano,

2005). In their most common form, compensation schemes reimburse individuals or their families who have experienced wildlife damage to crops, livestock, property, or who have been injured, killed, or physically threatened by wildlife. A farmer who experiences wildlife damage may receive compensation in the form of cash or in-kind assistance. Compensation can range from more than fair market value to just a fraction of the value of the lost crops or livestock (Muruthi, 2005, Nyhus, et al, 2003).

A major benefit attributed to compensation programs is that they may increase tolerance of wildlife and promote more positive attitudes and support for conservation among people who live closest to endangered and dangerous animals. When carried out effectively, compensation programs raise awareness about community concerns and shift economic responsibility to a broader public (Nyhus et al, 2003).

In Kenya there was a national policy of paying compensation for wildlife damage until 1989 when the scheme was suspended because of widespread cheating on claims, high administration costs and lack of disburseable funds. The Government of Kenya has not provided for any compensation for crop and livestock losses since then (1989) and it does not replace or repair any installations that are destroyed by wildlife. However compensation for loss of human life still exists. Payment of compensation in Kenya is from the Treasury and not by KWS, a fact nor known by most rural communities. There are complaints of the slow processing of claims and the process is said to be cumbersome.

Compensation schemes in Kenya have been documented as being very problematic. The Five Person Committee on HWC in Kenya, (1994) reports that compensation for people killed and property destroyed by wildlife is an issue that upsets people most in terms of HWC. They report that the compensation of Ksh. 30,000 that people receive for loss of human life is insufficient to help bereaved families cope with the loss. Distefano, (2005) states that the compensation received for loss of human life or injury is not sufficient to cover funeral expenses or hospital bills. It also does not take into consideration the impact of such incidents on dependent children who are often taken out of school because of the lack of funds to pay their fees. The report further states that most people want the compensation for loss of human life to be increased to 1 Million shillings.

The chronic frustration engendered by cumbersome and ineffectual government procedures required for claiming compensation when people are killed compounds the conflict. In particular people perceive the government's failure to pay compensation on grounds of management problems as a denial of their rights (KWS, 1994). This frustration is the same all over the country in districts where wildlife is present including Laikipia. Another aspect is that compensation is almost always accompanied by demands to kill culprit wildlife thus defeating the purpose for which the schemes are meant for.

Compensation schemes, almost without fail, have been unsuccessful. A major flaw from the outset (unlike most other conflict management strategies), is that they attempt to address the effects, rather than the causes of the conflict (Hoare, 1995). Compensation programs are routinely criticized for being inadequate, fraudulent, or cumbersome (Naughton-Treves, Grossberg and Treves, 2003). They are typically dogged by the same problems:

- failure to decrease the level of the problem (by not tackling the root cause);
- an immediate increase in claims, suggesting either corruption (through bogus or inflated claims) or a decrease in crop-guarding, or both (the lack of motivation for self-defence might in fact aggravate the problem);
- complaints of unreasonably low payments and/or the inability to cover all claims (usually driven by an overall shortage of central funding);
- unequal disbursement (e.g. only to some people), creating social disputes and resentment;
- bureaucracy through cumbersome, expensive and slow administration
- the inability to quantifiable some socioeconomic and opportunity costs for people affected by the threat of wildlife;
- the schemes have absolutely no effect on the relationship between local communities and the wildlife authorities.

3.4.1.2 Translocation

This consists of moving a certain number of animals from a problematic zone to a new site. It has been used to remove individual animals responsible for depredations and also, in some cases, to reduce populations in specific areas by removing relatively large numbers of animals. Translocation can be an appealing method to the general public, especially those who are particularly concerned

about animal welfare, as they perceive that it gives the affected animal a second chance at a new site (Muruthi, 2005).

In theory translocations seem to provide the perfect solution: removal of the 'problem' animal to an area where there will be reduced contact with people and their crops. It saves wildlife from being shot, restocks reserves that have been affected by poaching, and provides concrete action for both the affected communities and donors (Nelson, Bidwell & Sillero-Zubiri, 2003).

Translocation may be a practical and acceptable approach in some cases and especially where an alternative site is available with a suitable habitat for the animal involved (Treves and Karanth, 2003). Unfortunately the reality is often not so positive and translocation can be a controversial means of resolving human-wildlife conflicts, associated with a number of problems. Translocation is also a risky procedure and it is normal for a proportion of translocated animals to die either due to the stress of capture, or soon after release in the Mwea-Tsavo translocation in Kenya, five out of 26 animals died from drug-related stress.

In Laikipia several elephants were translocated from the Sweetwaters Game Sanctuary in 2002 to the Meru National Park more than 100KMs away following increased levels of conflict with neighbouring farmers. 504 Burchell's zebra and 411 impala and 50 reticulated giraffe from Laikipia were also moved into the Park in June 2003. While the conflicts were presumably reduced, the translocated elephants did not do well at first and, unfortunately, monitoring was terminated after only one year for lack of resources and so the ultimate fate of the animals is unknown. Translocations are also very expensive affairs and their cost effectiveness is normally questioned even where the animals are of high conservation values. For example the cost of the vehicle alone in translocation of elephants in the Mwea-Tsavo Kenyan operation cost US\$140 000 (Nelson, Bidwell & Sillero-Zubiri, 2003 quoting from. Njumbi *et al*, 1996). It however contributes towards the success of a re-introduction programme (the translocation was part of a programme to restock Meru National Park), or if public concerns outweigh other consideration as was the case in Laikipia at the time of the translocation.

3.4.1.3 Wildlife Utilization Schemes

Currently there is a ban in Kenya on hunting and capture of wildlife in Legal Notice No. 120 of 20th May 1977 and the subsequent prohibition of trade in wildlife and wildlife products contained in Act No.5 of 1978 and Legal Notice No. 181 of 21st August 1979. However game cropping had been allowed in Laikipia on a trial basis under the direction of the Laikipia Wildlife Forum and the Kenya Wildlife Service (KWS). It involved assigning of quotas to individual landowners and communities to crop specific wildlife species - mainly plains herbivores, based on their numbers and density in a given area. This form of consumptive utilization was meant to give landowners and communities direct benefits from the wildlife existing on their lands.

Community involvement in conservation, or simply community conservation, incorporates a broad diversity of projects. This generally involves initiatives from national park management referred to as 'protected area outreach activities'. It also includes collaborative projects between states and local communities (and sometimes the private sector), while at the other end of the continuum are community based natural resource management (CBNRM) initiatives. CBNRM projects characteristically aim to achieve rural development through the use of wildlife or other biological resources in places or ways unconnected with protected areas.

CBNRM initiatives have been instigated in many areas of the world (e.g. Central and South America, Asia and Africa), and are often not only based on the 'big animal' definition of wildlife, but include wild plants, smaller animals and habitats in general. They are also not always 'resource-based, revenue generation strategies and are often motivated by cultural factors (e.g. the conservation of sacred spaces), or ecological functions (e.g. forests as water catchments). These initiatives typically involve devolution of some responsibility for wildlife management from central government to local government or community level (Nelson et al, 2003).

An example from Kenya is the Community Wildlife Service initiative of KWS which was a pilot extension scheme to establish modalities for community partnership and management of wildlife. It encouraged landowners in selected conservation units to allow wildlife to inhabit their lands and in return the landowners would

receive certain wildlife-related revenue sharing and consumptive utilization rights assistance with non-consumptive utilization benefits.

Laikipia has several CBNRM initiatives mainly in the Northern part of the district in Mukogodo area where the land is under communal tenure - group ranches. These initiatives include the construction of eco-lodges through donor funds from USAID's COBRA and CORE projects. Some of the lodges (Ilngwezi) are already complete and the group ranch members deriving benefits from tourism. These benefits include employment at the lodge and cultural tourism. Profits from the lodge are also shared with the group ranch with the money going to construction of schools, health centres, provision of bursaries, etc. The African Wildlife Foundation (AWF) in collaboration with the Laikipia Wildlife Forum (LWF) is also involved in assisting the Maasai community whose livelihood system is dependent on pastoralism to demarcate areas for wildlife conservation or Community Conservation Areas as they are commonly referred to.

Other non-consumptive wildlife utilization schemes in the district include the conversion of previous ranches into wildlife sanctuaries and the subsequent benefits derived from tourism activities. This has been a response to the changing trends in agricultural production with ranching becoming more and more uneconomical to ranchers due to the prevailing economic situation and the poor state of the livestock sector in the country.

3.4.1.4 Problem Animal Control

Problem Animal Control (PAC) in Kenya is undertaken by the national wildlife authority - KWS. The 'problem animal' can either be killed or captured for translocation. In the lethal control or killing of problem animal it's always desirable for the wildlife authority to focus on those individuals actually causing the problem (the culprits) or at least to target the group of animals whose home range includes the site where the problem is occurring. However, the problem animal is likely not to be identified and any individual is killed to satisfy the demand for action and revenge by the aggrieved community - especially in the case of loss of human life or the killing of livestock. In such a situation the action by the wildlife authority rangers may have public relations value but in all probability the culprit will survive and continue to inflict damage.

The Kenya Wildlife Service reports that between 1989 and June 1994 wildlife had killed 230 people and injured 218. On the other hand, damage of crops by wildlife is the most common and debilitating HWC. Kenya Wildlife Service (KWS) records show that 119 elephants were killed in PAC programs from 1990-1993, with total numbers increasing each year (Kiiru, 1995).

The killing of problem elephants has been, and still is, widely used as a quick-fix solution to human elephant (wildlife) conflict (Ngure, 1995). It's a relatively cheap method which is employed with the aim of providing instant relief to locals affected by HWC. It allows the local or wildlife authorities to demonstrate a show of force to appease the affected communities, while the communities generally believe it will provide a lasting solution, as well as being an obvious act of retribution, coupled with the bonus of free meat (Hoare, 1995). Authorities are quick to carry out PAC and "problem" animals are often shot on sight in damaged fields. Elephants are usually shot on control as a result of a human death or following persistent crop-raiding. In all cases, the people experiencing the elephant damage are required to report the incident to their local wildlife authority. The wildlife authority then arranges to have an elephant shot. Shooting thus takes place long after the event and, for the most part, becomes a public relations exercise with no opportunity to condition the elephants (Kagwana, 1995).

Another form of PAC that is commonly used is disturbance shooting (firing shots over raiding wildlife species) but this becomes ineffective as the wildlife habituate to the noise or threat caused by the shots. All these forms have been practiced in Laikipia with varying levels of success.

Historically, 20 - 30 elephants were shot every year in efforts to control elephants in western Laikipia that were coming into farmland on the lower slopes of Mt. Kenya and the Aberdares and moving along the forested hills on the edge of the rift valley. They were considered to be a threat to the newly established farms. The problem became severe in August of 1932 when elephants in numbers never seen before widely dispersed through the area. A full time control officer was then appointed and he shot 80 elephants in 1934 and further 35 in 1935, closing this movement route. In the preceding year the control officer was himself killed by an elephant.

3.4.2 Preventative Measures

3.4.2.0 Physical Barriers

The physical exclusion of wildlife through the use of barriers can, in many situations, be an effective method of reducing human-wildlife conflicts. Proper design, construction and maintenance of fences are key to them being completely effective in preventing HWC (Muruthi, 2005). Barriers have the function of preventing spatial overlapping among wild animals and local communities. They are usually man-made, but natural barriers such as rivers, coasts or mountain ranges may occur along a nature reserve boundary. Spatial separation has been proved to be especially successful when physical barriers enclose a large reserve (Distefano, 2005).

Another option is the construction of physical barriers in human settlements to protect crop fields and livestock, while defining properties and gathering farm animals. Fencing homestead areas instead of an entire reserve boundary is not only less expensive, but allows greater wildlife dispersal. They can be walls made from different materials such as stone, mud, brushwood, or high rubble, barbed wire or mesh-wire fences. The type of fence depends on locally available materials, as the farmers generally use local products

Physical barriers, although an expensive option, are seen by many people as potentially a permanent solution to an elephant problem. Several types of barriers have been tried against elephants; most commonly electrified wire fences, ditches and moats and stone walls (Hoare, 2003).

3.4.2.1 Ditches and moats

Ditches and moats have been also been used in the control of wildlife in Laikipia. Moats were constructed in Laikipia and along the boundaries of the Aberdares and Mt. Kenya. They were also constructed in Meru National Park, Tsavo National Park and the Maralal Forest Reserve. Simple ditches along the Aberdares failed because elephants learnt how to break down the walls of the moat and climb through and other animals could jump across. In Laikipia a ditch was dug in 1980 across Ol Ari Nyiro but it was plagued by corruption and incompetence from within the Wildlife Conservation Management Department (WCMD). In some places it was dug to a depth of less than 1meter nowhere was it deep and large enough to be effective. Other ditches failed due to lack of maintenance (Thouless & Sakwa, 1995).

The problem with ditches or trenches is the massive investment required both to construct them and maintain them, the latter because of their extreme vulnerability to soil erosion. Elephants learn to kick in the sides of trenches and cross them and are also undeterred by narrow stretches of water. Ditches alone are unable to contain elephants but suitably dug ditches in combination with a fence on the outside appear to have been effective. Thouless and Sakwa (1995) further state that it is difficult to assess the potential for ditches, because all of the game-proof ditches built in Kenya have failed due to lack of maintenance.

3.4.2.2 Stone walls

Stone walls, although expensive to build, have been quite effective as an elephant barrier in parts of Kenya particularly if used as a strong base for a simple electric fence. Unfortunately the application of stone walls to many other areas is limited by insufficient quantities of useable stone. Stone walls also suffer from relatively expensive construction costs and in most areas a lack of usable stones for construction. Stone walls have been used in Laikipia District, Kenya, with varied success (Thouless & Sakwa, 1995). Stone walls by themselves do not form satisfactory barriers against elephants which are able to break stone walls by pushing them with their chests, and in a 3 month period one wall was breached 101 times. On Kifuko they have been used as a moderately effective elephant barrier, but this has been backed up by a vigorous reaction to animals that have broken through the wall. Another wall constructed by a ranch in the same area was moderately effective, but this has been attributed to the forceful action taken against animals that breached it.

Thouless & Sakwa (1995) suggest that stone walls with a concreted top, or an electrified wire running along the top of them might be viable alternatives. The advantages of stone walls are their minimal environmental impact, and their relatively low material costs if the stones are readily available and tractors do not have to be used. The stone wall in Laikipia cost US\$3 500 per km. The advantages of stone walls are that maintenance costs can be low, construction costs can be largely of local labour (although this depends on nearby availability of stone), and temporary failure of maintenance will not result in loss of much of investment.

3.4.2.3 Wildlife fences

Hoare (1992a) states that wildlife fences have been used in the control of the larger African mammals. The major factor limiting the wider use of wildlife fences is their cost. This will vary depending on many factors among them topography, type of fence and the species it is designed to contain; the 3.3 metre-tall, electrified fence currently being constructed around Aberdare National Park in Kenya costs on average US\$20 per metre. Fences to exclude elephants and other wildlife from human settlements, cultivated areas and livestock areas are in use in Laikipia.

After the consistent increase in the numbers of elephants coming from the north in the 1960s and by the 1970s in response to poaching in Samburu over 1000 elephants had become resident (Jenkins & Hamilton, 1982). The elephants were responsible for damage to ranch and farm infrastructure and threatening the lives of herdsmen and cattle in the bush. A study conducted by the WCMD in 1982 on the Laikipia elephant problem recommended the construction of an electric fence across the district separating the areas that welcome were not welcome and the wildlife tolerant areas. The fence was however not built mainly due to lack of finances and disagreements on the route to be taken by the fence. Since then ranchers have either come to accept wildlife on their properties or fenced them off.

In the smallholder settlements wildlife continue to be a menace but fences have been constructed in several areas to either prevent wildlife from getting out of ranches and wildlife sanctuaries (Solio, Sweetwaters, Ol Jogi) or to keep the wildlife away from the settlements (Endana, Ngare Ndare forest). Many of the early fences in Laikipia incorporated a single electrified wire running along the top of standard five strand stock fences. In recent years a number of electrified fences have been put up with the objective of restricting game movements and control of grazing. They are more than 2m high with several electrified strands with voltages exceeding 6kV.

CHAPTER 4: LOCALISED MANAGEMENT APPROACHES TO HUMAN-WILDLIFE CONFLICTS

4.0 Introduction

This section deals with the management strategies applied at the local or community level by rural communities undergoing human wildlife conflict. The strategies highlighted here are those that were applied prior to the creation of barriers in the two study sites of Endana and Rumuruti. They are derived from informal interviews of residents of the two areas and information generated from data collected through household questionnaire surveys in the Endana and Rumuruti areas of Laikipia district.

The first part of this chapter is a breakdown of the socio-demographic characteristics of the study sites. The field work was carried out in the last week of April 2005. It's on this basis that the strategies utilized in the past or currently being used to deal with wildlife menace can be clearly contextualized. The second part looks at the actual management strategies used to deal with human wildlife conflicts

4.1 Socio - Demographic Characteristics

The household survey sought information on household socio-demographic characteristics such as household size, age-group of respondent, overall monthly household income, gender of respondent, level of education, the size of household land holdings, proportion of the land under crop or livestock production, the distance of the homestead from the wildlife zone, the method of acquiring the land and the origin of the household. The household survey revealed into a gender composition of 58.8% female and 41.1% males.

Table 1 Gender Composition of Respondents

Age group of respondent	Male	Female	Total
Below 25 years	3.5%	2.4%	5.9%
25-34 years	8.2%	14.1%	22.4%
35-44 years	8.2%	15.3%	23.5%
45-64 years	11.8%	18.8%	30.6%
Above 64 years	9.4%	8.2%	17.6%
Total	41.2%	58.8%	100.0%

In terms of the age of the respondents, a small proportion 5.9% of the total sample was below 25 years old with 3.5 % of the respondents under 25 years in Endana and the remaining 2.4% in Rumuruti. The age group with the highest percentage of respondents was 45-64 years representing 30.6%. The category of 35-44 years was next with 23.5% of the respondents.

Table 2 Distribution of the Different Age Groups in the Household Survey

		Endana	Rumuruti	Total
Age group of respondent	Below 25 years	3 3.5%	2 2.4%	5 5.9%
	25-34 years	5 5.9%	14 16.5%	19 22.4%
	35-44 years	7 8.2%	13 15.3%	20 23.5%
	45-64 years	10 11.8%	16 18.8%	26 30.6%
	Above 64 years	5 5.9%	10 11.8%	15 17.6%
Total		30 35.3%	55 64.7%	85 100.0%

As seen in Table 3, around 24.7% of the households had 1-4 people within the household, than 62.4% of the total sample had 5-9 members. In Endana 53.3% of the households have 5-9 members while in Rumuruti 67.3% of the respondents in the household survey have 5-9 members.

Table 3 Household Numbers

HH Numbers of Respondents	Endana	Rumuruti	Total
1-4	26.7%	23.6%	24.7%
5-9	53.3%	67.3%	62.4%
10-14	13.3%	5.5%	8.2%
15-19	3.3%	3.6%	3.5%
More than 20	3.3%		1.2%
Total			100.0%

The households varied also in terms of the level of education of the respondents. In Endana 23.3% of respondents had no formal education (Table 4). In general, the education level was low and usually limited to primary school education at 66.7% of the respondents. Only 10% had secondary level education in Endana with none with post secondary education.

Table 4 Level of Education of Respondents in Endana

Endana	
Education level	
No formal education	23.3%
Primary level	66.7%
Secondary level	10.0%
Total	100.0%

However, in Rumuruti (Table 5) the education levels were much higher with a large proportion of the respondents having secondary school education, 43.6%. 40% of the respondents had primary school education with the remaining 14.5% and 1.18% with no formal education and with post secondary education respectively.

In terms of responses from the two study sites (Table 6), 31.8% of the total sample of 85 respondents has secondary school level education. 17.6 % of the total sample has no formal education and 49.4% of total sample had primary school level of education.

Table 5 Level of Education of Respondents in Rumuruti

Rumuruti	
Education level	
No formal education	14.5%
Primary level	40.0%
Secondary level	24 43.6%
Post-secondary	1 1.8%
Total	100.0%

Table 6 Level of Education (Total Sample) In Household Survey

Education level	Endana	Rumuruti	Total
No formal education	8.2%	9.4%	17.6%
Primary level	23.5%	25.9%	49.4%
Secondary level	3.5%	28.2%	31.8%
Post-secondary		1.2%	1.2%
Total	35.3%	64.7%	100.0%

However, the fraction of the respondents with some level of education varied between different age groups as shown in Table 7. In Endana 20% of the respondents in the age 45-64 years had at least primary school education, while 16.7% in the 35-44 age-group had the same level of education. The largest proportion of respondents without formal education was in the 45-64 years age group. None of the respondents below 35 years had secondary school level education. None of the respondents within Endana had any post secondary school education.

In Rumuruti 43.6% of the respondents had at least secondary school education with the 45-64 years age group with the highest proportion of respondents at 16.4% of the sample. There was also one respondent with post secondary school education within the same age group. In both study sites, all the other age groups apart from the below 25 years category had a proportion without formal education with Endana having 23.3% of the respondents without any formal education compared to 14.5% in Rumuruti. From the statistics it can be deduced that Rumuruti has higher levels of education compared to Endana with Endana having a majority of its sample with only primary school education. Endana also has a bigger proportion of the respondents without formal education.

Table 7 Education Level per Age Group

			Below 25 years	25-34 years	35-44 years	45-64 years	Above 64 years	Total
Endana	Education level	No formal education		3.3%	3.3%	10.0%	6.7%	23.3%
		Primary level	10.0%	13.3%	16.7%	20.0%	6.7%	66.7%
		Secondary level			3.3%	3.3%	3.3%	10.0%
		Total	10.0%	16.7%	23.3%	33.3%	16.7%	100.0%
Rumuruti	Education level	No formal education		1.8%	1.8%	3.6%	7.3%	14.5%
		Primary level	1.8%	10.9%	10.9%	7.3%	9.1%	40.0%
		Secondary level	1.8%	12.7%	10.9%	16.4%	1.8%	43.6%
		Post secondary				1.8%		1.8%
		Total	3.6%	25.5%	23.6%	29.1%	18.2%	100.0%

In terms of monthly income, none of the households surveyed had a monthly income over Ksh. 30,000 (Table 8). 56.7% of the respondents in Endana had an income of less than 5,000 shillings compared to 45.5% in Rumuruti. More than 90% of the respondents had an income of 10, 000 shillings and lower.

Table 8 Monthly Incomes of Respondents in Household Survey

Monthly Income		Locality of respondent		Total
		Endana	Rumuruti	
Below 5000	% within Locality of respondent	56.7%	45.5%	49.4%
	% of Total	20.0%	29.4%	
5000 - 10000	% within Locality of respondent	36.7%	45.5%	42.4%
	% of Total	12.9%	29.4%	
10001 - 20000	% within Locality of respondent	6.7%	5.5%	5.9%
	% of Total	2.4%	3.5%	
20001 - 30000	% within Locality of respondent		3.6%	2.4%
	% of Total		2.4%	
Total	% of Total	35.3%	64.7%	100.0%

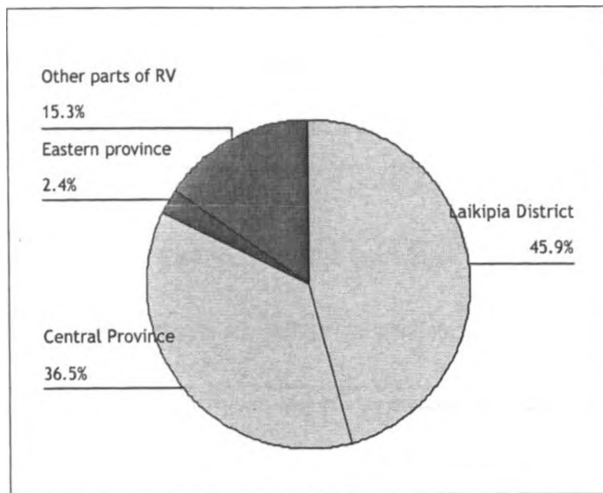
In Endana 20% of the respondents had land holdings of less than 1 acre representing 7.1% of the total sample while 56.7% had land sizes between 2 and 2.9 acres (Table 9). A majority of the respondents in Endana have land holdings of less than 3 acres (76.7%), another 20% with land parcels of 3-5 acres and the remaining percentage, have 5-9.9 acres. In Rumuruti 47.3% have 5-10 acres and 20% with 3-5 acres. 12.7% of the respondents have land sizes of above 10 acres. The respondents in Rumuruti have larger land holdings compared to their counterparts in Endana.

Table 9 Household Land sizes

Size of Farm		Locality of respondent	
		Endana	Rumuruti
Less than 1 Acre	% within Locality of respondent	20.0%	7.3%
	% of Total	7.1%	4.7%
1 - 1.9 Acres	% within Locality of respondent		1.8%
	% of Total		1.2%
2 - 2.9 Acres	% within Locality of respondent	56.7%	10.9%
	% of Total	20.0%	7.1%
3 - 4.9 Acres	% within Locality of respondent	20.0%	20.0%
	% of Total	7.1%	12.9%
5 - 9.9 Acres	% within Locality of respondent	3.3%	47.3%
	% of Total	1.2%	30.6%
Above 10 Acres	% within Locality of respondent		12.7%
	% of Total		8.2%
Total	% of Total	35.3%	64.7%

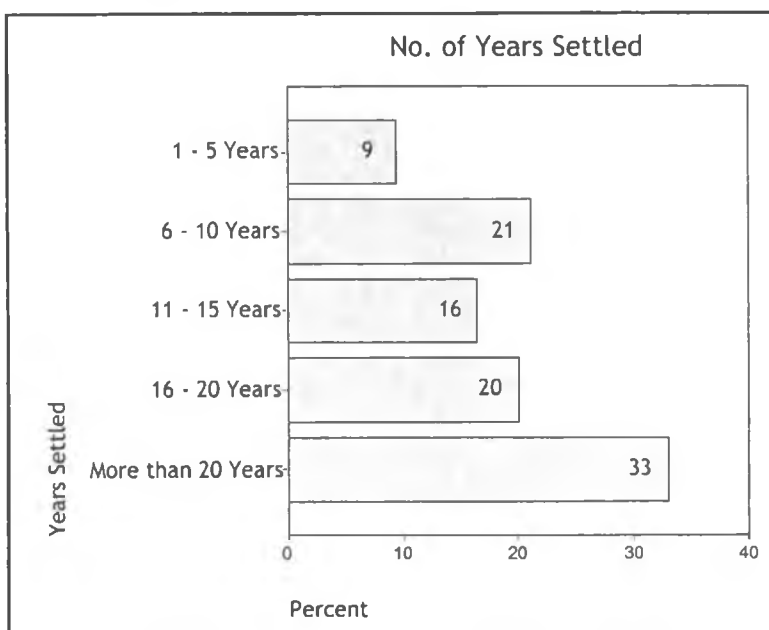
In terms of migration, 45.9% of respondents migrated from other parts of Laikipia to their current settlements and 36.5% from Central province. The rest are from Eastern province 2.4% and other parts of Rift Valley 15.3% as observed in chart 2.

Chart 2 Original Home of Respondents



Thirty three per cent of the total sample has lived in their respective areas for more than 20 years and 20% between 16-20 years. 21% of the respondents have been living in either Rumuruti or Endana for a period of 6 -10 years. Only 9% of the respondents have less than 5 years in their current land holdings.

Chart 3 Years Settled in Current Farm



The main method of acquiring land in Endana and Rumuruti was through purchase 70% and 40% respectively (Table 10). In Rumuruti a substantial proportion (29.1%) had inherited their current land parcels. This is a reflection of the years that the area has been under settlement with land being transferred to second generation

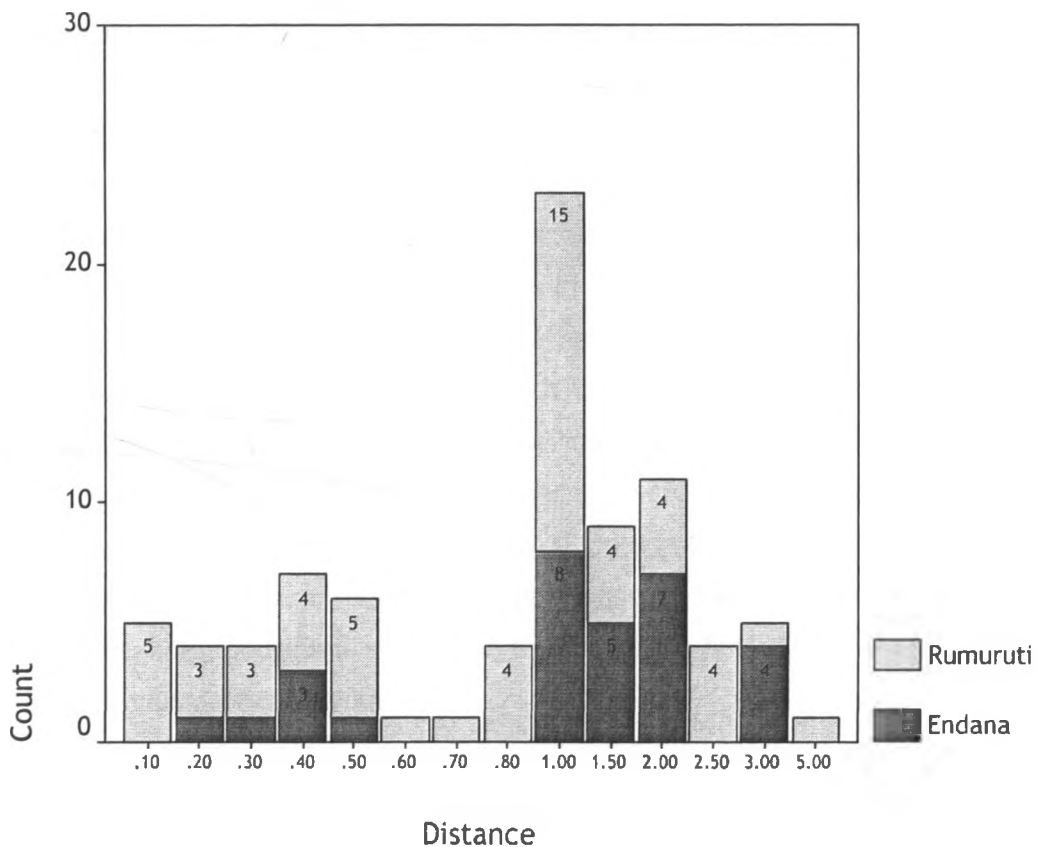
settlers. However both study sites had an average of 23.5% of the respondents having acquired the land through shares in land buying companies (1st generation settlers).

Table 10 Acquisition of Land by Respondents

Acquisition of current land		Endana	Rumuruti	Total
Inheritance	% within Locality of respondent	3.3%	29.1%	20.0%
	% of Total	1.2%	18.8%	20.0%
Direct purchase	% within Locality of respondent	70.0%	40.0%	50.6%
	% of Total	24.7%	25.9%	50.6%
Shares in land buying company	% within Locality of respondent	23.3%	23.6%	23.5%
	% of Total	8.2%	15.3%	23.5%
Others	% within Locality of respondent	3.3%	7.3%	5.9%
	% of Total	1.2%	4.7%	5.9%
Total	% of Total	35.3%	64.7%	100.0%

The furthest distance from the barrier in the household survey (Rumuruti) was 5 Km and the least was 100 meters from the barrier (Endana). More than 50% of the households were in a range of 1-2Km from the barrier.

Chart 4 Distances from Barrier



4.2 Livelihood Systems

Rural livelihoods are generally dependent on the natural resource base - agriculture, either based on crop production or on livestock production or a combination of both. The most sustainable system is that which is able to recover from stress or shock. Naughton, Rose and Treves, (1999) note that farm size is considered an index of wealth in peasant agriculture. It may be the most important endowment for coping with risk. The wealth can also be measured in terms of access to capital or labor.

As earlier noted by the Economic commission for Africa, the predominant livelihood activity for smallholders in Africa is semi-subsistence farming. Most households rely on cash and subsistence incomes from a number of sources that include irrigated and rain fed cultivation, livestock production, tree production, and other miscellaneous activities, such as honey production.

From the household survey, it was established that the livelihood systems were reliant on crop production or livestock production or a combination of both. The farm sizes ranged from less than 1 acre to more than 20 acres. Generally land sizes are bigger in Rumuruti than in Endana. A quarter (26%) of the respondents derives their income from non-formal engagements. Only 2.4% of the respondents rely on remittances from relatives living in the urban areas (Chart 5).

Crop production is generally the most important activity in rural households in the two areas. It contributes to the livelihoods of more than 90% of households in the survey. Crop production for sale is an important source of cash income to households so is livestock production (both for own use and sale) important to livelihoods and livestock sales also provide important contributions to household cash income. Given the households' reliance on crop and livestock production, reduced yields have negative impacts on livelihoods and households' ability to cope with shocks such as drought and HWC. This reliance - particularly on cropping - to provide household food supplies leads to hunger within households when crops fail, with children hit particularly hard.

Chart 5 Source of Income

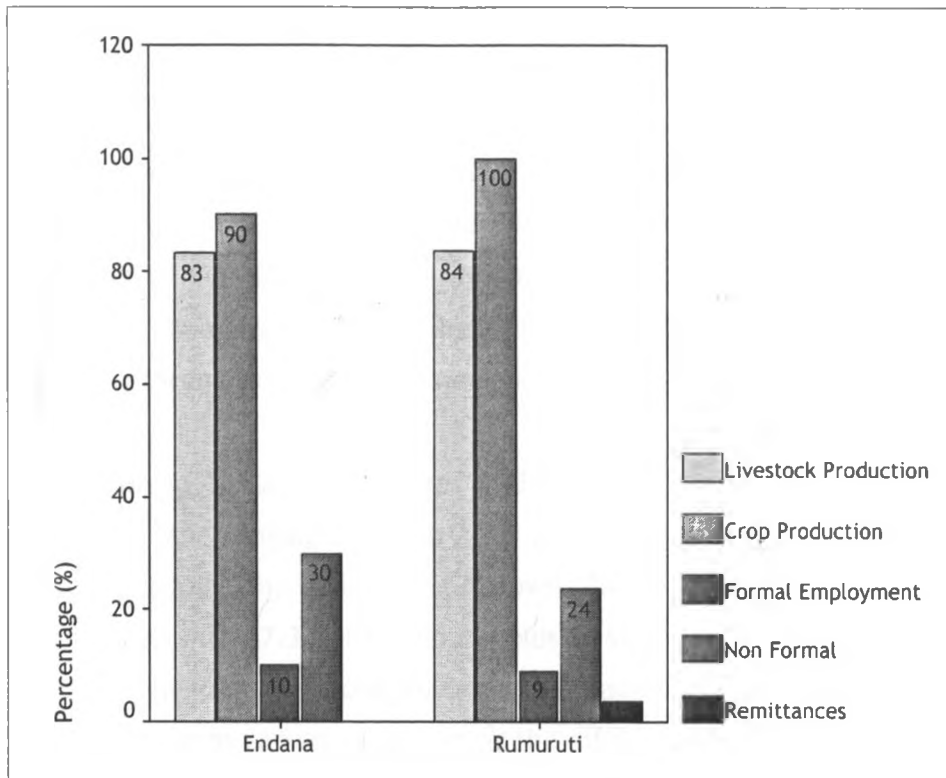
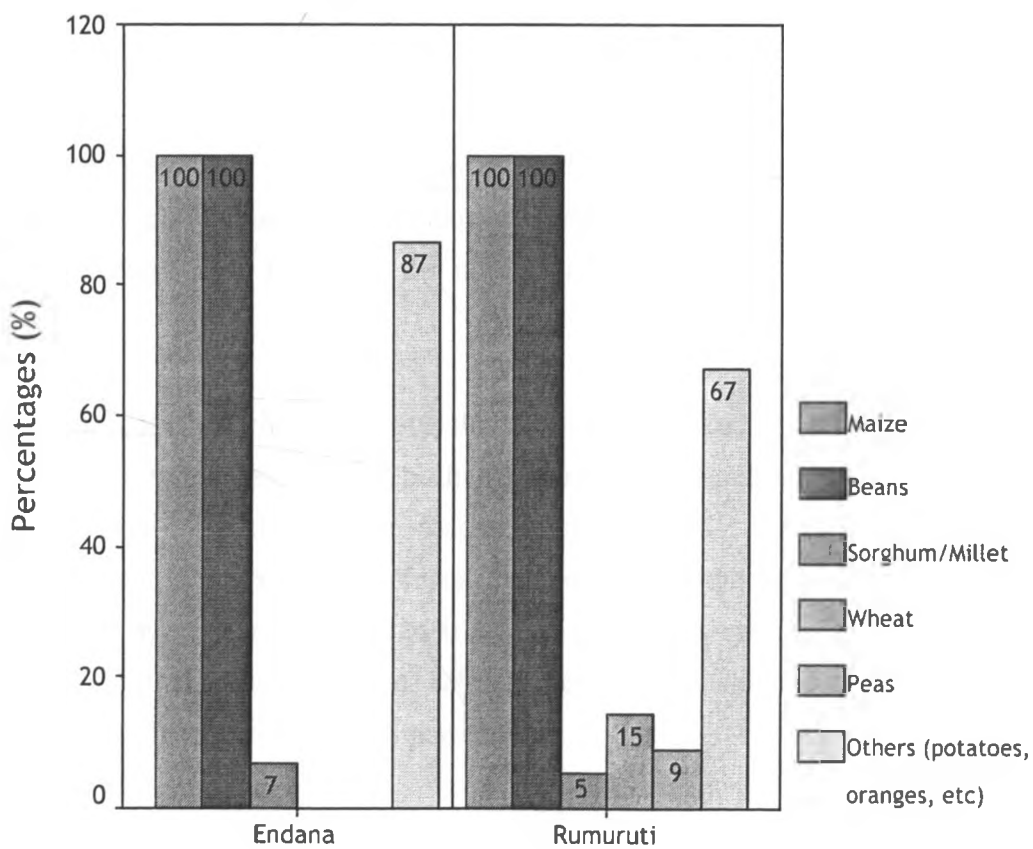


Chart 6 Crops Grown By the Respondents



4.2.1 Crop production

The main livelihood system in the two areas is based on crop production - 96.5% of the respondents. Of the crops grown, all the respondents planted maize and beans in both localities. 6.7% of the respondents in Endana and 5.5% in Rumuruti are involved in the production of sorghum/millet. 14.5% of the respondents in Rumuruti are engaged in wheat production representing 9.4% of the total sample. At the same time 9.1% of Rumuruti respondents grow peas (Chart 6). In Endana 74.1% of the total sample is engaged in the production of other crops which include oranges, avocados, pyrethrum, potatoes and sweet potatoes.

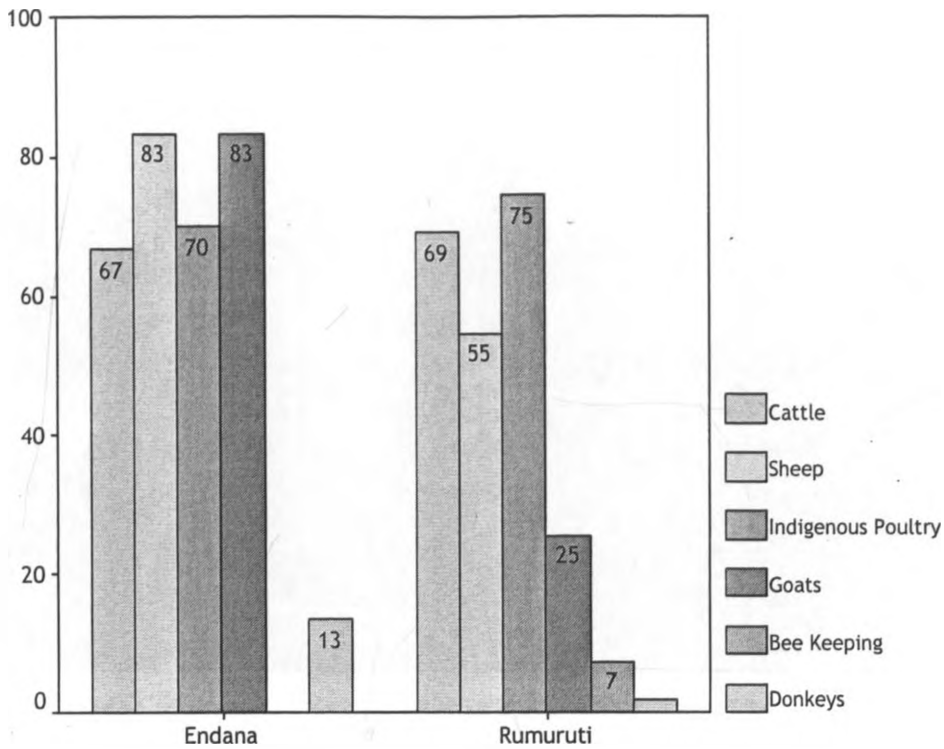
As earlier shown in Table 9, land sizes in Endana are quite small. (56.7% of the respondents had land ranging between 2-2.9 acres) and their production system is based on intercropping the various crops grown. The land sizes are on average larger in Rumuruti with 47.3% of the households surveyed with land holdings of 5-10 acres. 12.7% of the Rumuruti households had acreage of more than 10 acres. The difference in land sizes can be explained by the different method of acquiring land. The area under Rumuruti fell under the government settlement scheme which allocated large parcels of land to the migrants and took into consideration the ecological conditions of an area before determining the size of land to be allocated to each household.

Interviews with key informants and residents revealed that on the other hand, Endana was purchased by a land buying company, Endana Farmers Co-Operative, which allocated land based on the number of shares an individual had (1 share = 1 acre).

The agro-ecological conditions are also a determining factor in terms of the crops grown in the two areas. Though both areas grow maize and beans simply due to the fact they are crops that have a readily available market and also due to cultural factors, Rumuruti has a more diverse nature of crop typology. The cultivation of wheat and pyrethrum in the area is due to the ecological conditions of the area. The area also experienced higher rainfall than Endana which is in a semi arid area with rainfall of less than 400mm per annum.

4.2.2 Livestock Production

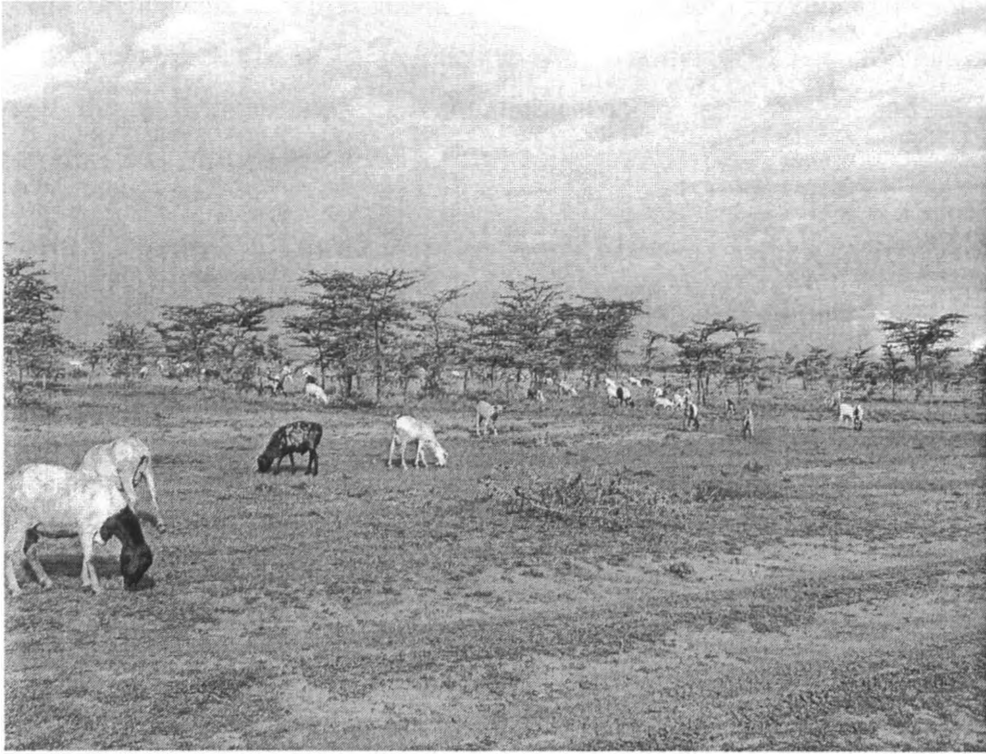
Chart 7 Livestock Typologies



The livelihoods of the respondents are also dependent on livestock production in the two localities. The main livestock typologies are cattle, sheep, goats and indigenous poultry. 83% of the respondents in Endana keep sheep and goats while 67% have cattle. In terms of responses, the households in Endana are reliant more on livestock production. 69% of the households in Rumuruti have cattle, 55% sheep and only 25% goats. Bee keeping was reported in Rumuruti but is not the case in Endana as seen in chart 7.

The differences in the livestock can be explained by two main factors: in Endana the people rely on grazing their livestock in unsettled or abandoned plots in the settlement as the farms are surrounded by natural habitat. The settlement adjacent to Endana (Ileri) is also not settled and there is a huge presence of pastoralists using it as grazing land. This could explain the high incidence of respondents keeping sheep and/or goats. The presence of abandoned or unsettled plots in Endana is crucial to the livelihoods of the locals as it provides them with a coping mechanism against their small land holdings. It enables them to practice livestock production at levels beyond the capacities of the individual farms. However it has also provided habitat for wildlife that roam in the area, making it easier for their crops to be raided.

Picture 1 Sheep and Goats grazing in Endana



The varying land sizes between the two areas also account for the differences in livestock production and typology. In Rumuruti, the locals are more dependent on crop farming as compared to those in Endana. From the informal interviews in Endana it was established that the area is faced with recurrent “drought”. Rainfall is rarely adequate for rain fed agriculture thus the importance of livestock as a livelihood coping strategy. Livestock is used as a way of diversifying their livelihood approaches or as a coping mechanism in times of crop failure. Crop failure is however not as common in Rumuruti hence more reliance on crop production. It was further noted that in Rumuruti cattle are a source of extra income through milk sales to Brookside Dairies and the Kenya Co-operative Creameries.

From the data collected from the household survey it is emerging that the locals in Endana are worse off than those in Rumuruti. The land holdings are smaller in Endana with 76.7% of the respondents with less than 3 acres while in Rumuruti 78.2% of the respondents have more than 3 acres. The monthly incomes in Endana are also lower: 56.7% have a monthly income below 5,000 and 36.7% with a monthly income of 5,000 - 10,000 shillings. In Rumuruti the proportion with a monthly income below 5,000 shillings is 45.5%, and another 45.5% with an income of 5,000-10,000 per month. The poorest households in a community thus face

compounding vulnerability in terms of human wildlife conflict. Without large landholdings they cannot buffer themselves from the wildlife conflict, nor can they hire additional labour to assist in dealing with the menace. A continuum exists between the individual and the community coping mechanisms and affected communities may participate in both.

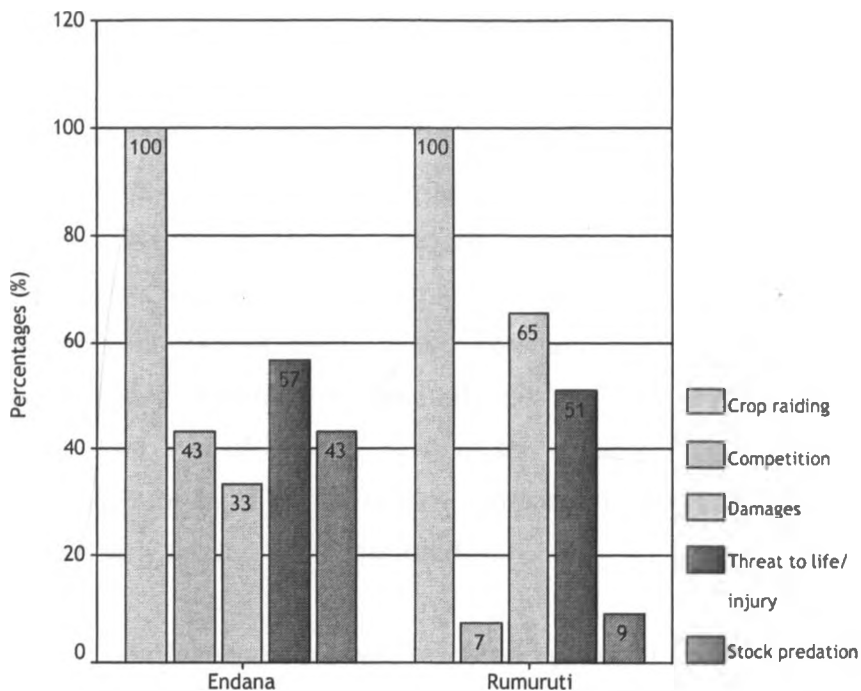
4.3 Human Wildlife Conflict in the Study Areas

As it was noted in chapter two, conflict arises from a range of direct and indirect negative interactions between humans and wildlife. These can culminate in potential harm to all involved, and lead to negative human attitudes, with a decrease in human appreciation of wildlife (Nyhus *et al.*, 2000). Conflict generally arises from economic losses to agriculture, including loss of cattle through predation and destruction of crops.

There are other socio-economic costs associated with human-wildlife conflict which can outweigh the direct costs of agricultural damage and be a major component of the conflict as perceived by local people. Human death is an extreme example of this is but other examples include restrictions on movement, competition for water sources, the need to guard property (which may lead to loss of sleep), reduced school attendance (through loss of sleep, or fear of travel), poor employment opportunities, increased exposure to malaria, and psychological stress

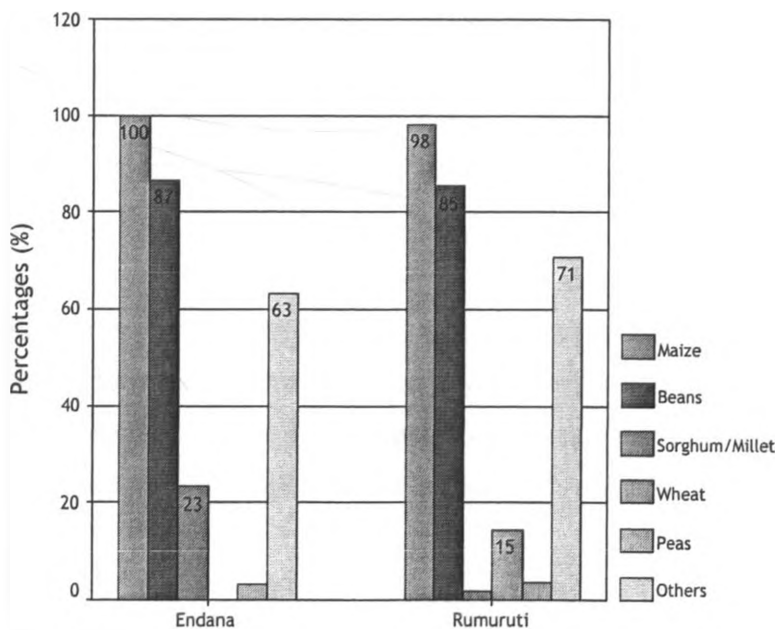
Before the establishment of the physical barriers in the study areas various forms of conflict were experienced. These include: crop raiding, competition for resources, damages to infrastructure, threat to life and in some cases death, and livestock predation.

Chart 8 Conflict Experienced In The Study Areas.



Crop raiding is the prevalent form of human wildlife conflict prevalent in the two areas with all respondents reporting they have experienced crop losses to wildlife. It was observed that in both locations the farmers were very emotional when it came to damage of crops by wildlife in their respective areas. Maize and beans were the crops most affected by crop raiding in the two areas 100% and 87% respectively in Endana and 98% and 85% in Rumuruti. Sorghum/millet was also affected 23% in Endana while wheat (15%) was also affected in Rumuruti.

Chart 9 Crops Affected By Crop Raiding



Another critical source of human-wildlife conflicts is the damage to property, particularly fences, structures and buildings by wildlife. Elephants often break down food granaries and destroy tonnes of stored maize and wheat. Obviously, this results in heavy post-harvest losses and exacerbates the pain of chronic poverty and food insecurity for many farmers and their families. In Endana 33% of the respondents reported that they had experienced damaged to infrastructure which includes damage to fences, granaries/stores, pipes, etc. In Rumuruti 65% of the respondents experience the same type of conflict with damage to fences and granaries or fences being quiet common among the respondents. The high percentage in Rumuruti is generally due to their level of development which is higher than that of Endana. Most of the respondents in Rumuruti had fences and other types of farm infrastructure compared to Endana where fences were mainly erected only around the homestead.

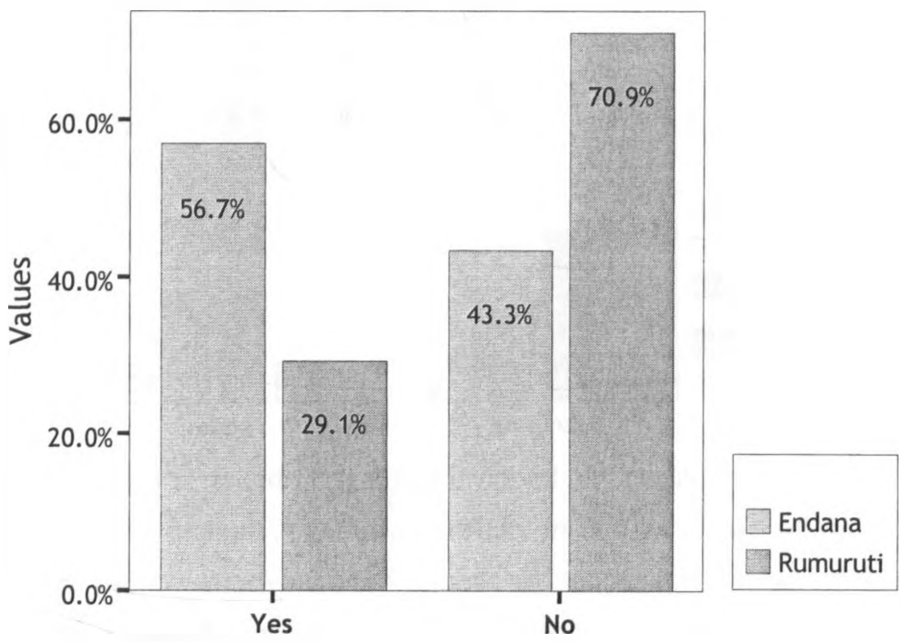
Competition for resources was reported by 43% of the respondents in Endana. This was generally competition for fodder or grazing and competition for water during the dry season between plains game and livestock in the settlement and neighbouring settlements. Endana is an area with a mosaic of crop farms surrounded by unoccupied or abandoned plots thus wildlife live also within these areas. In Rumuruti only 7% experienced competition for resources. This is explained by the fact that most of the wildlife only come out of Rumuruti Forest at night into the settlements thus the possibility of such form of conflict occurring regularly are slim.

Threat to life or injury resulting from the presence of wildlife was reported by respondents in both areas. In Rumuruti 51% reported having had their lives threatened or at risk of injury either while chasing the wildlife from their farms or when running away from wildlife. 57% of the respondents in Endana experienced these forms of conflict especially fear of predators in the area. A man was reportedly killed in the area by a lion 2 or 3 years ago. Cases of death through elephants were reported to have occurred in both areas. The husband to one of the respondents in Endana was killed by an elephant on his way home from Ngare Ngiro which is 4Km away. The threat to a sustainable livelihood is quiet high in such cases as the person affected is in most cases the bread winner or household head.

In Endana 43% of the respondents reported having experienced predation on their livestock by wildlife in the area. This is quiet high compared to Rumuruti where only 9% reported cases of stock predation. As earlier indicated this could be a reflection of the type of land use in the area and also the difference in wildlife species and population numbers in the two study areas. The presence of herbivores (plains game) in Endana and neighbouring areas could also be a magnet to predators to the area resulting in predation on domestic animals.

A question was posed to respondents as to whether wildlife had any impact on livestock typologies and production in the area. 56.7% Endana and 29.1% in Rumuruti responded that wildlife had affected livestock in the area while 70.9% in Rumuruti and 43.3% in Endana did not think the typologies had been affected in any way by wildlife (HWC).

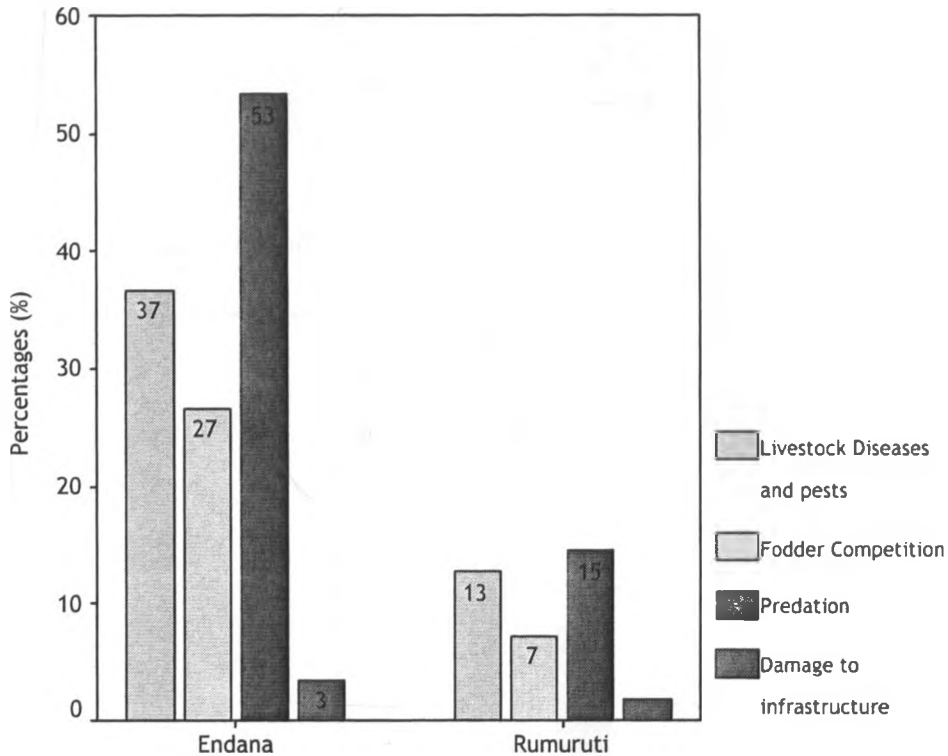
Chart 10 Effect of Wildlife on Livestock Typologies



Wildlife is reported to have affected the livestock typologies in four major ways: livestock disease and pests, competition for fodder, predation and damage to infrastructure. Predation on domestic animals by wildlife was experienced by 53% of the respondents in Endana and 15% in Rumuruti. Predation was considered to have the largest impact on livestock typologies by the households that felt that wildlife had an effect on livestock.

In Endana livestock diseases and pests as an impact was reported by 37% and in Rumuruti 13%. Competition for fodder was also higher in Endana (27%) compared to Rumuruti (7%). Damages to infrastructure mainly fences and enclosures were quiet low at 3% in Endana and lower in Rumuruti. From chart 11 below it can be observed that the impact of wildlife on livestock typologies and subsequently production was felt or perceived more in Endana reflecting also their dependence on a livelihood system based more on livestock than on crop production.

Chart 11 Effect of Wildlife on Livestock



Households were also asked if they had dropped any crops previously cultivated or grown as a result of human-wildlife conflict. In Endana 53.3% of the households responded in the affirmative while in Rumuruti 50.9% reported having shunned the growing of a number of crops. A majority of the respondents had dropped crops which included oranges, bananas, avocados, potatoes and sweet potatoes - 40% in Endana and 24% in Rumuruti. Other crops dropped included maize and wheat (29%) in Rumuruti and sorghum/millet (20%) and peas (13%) in Endana. The main reason given for dropping the crops was destruction by wildlife and poor rains.

Chart 12 Respondents who have dropped crops

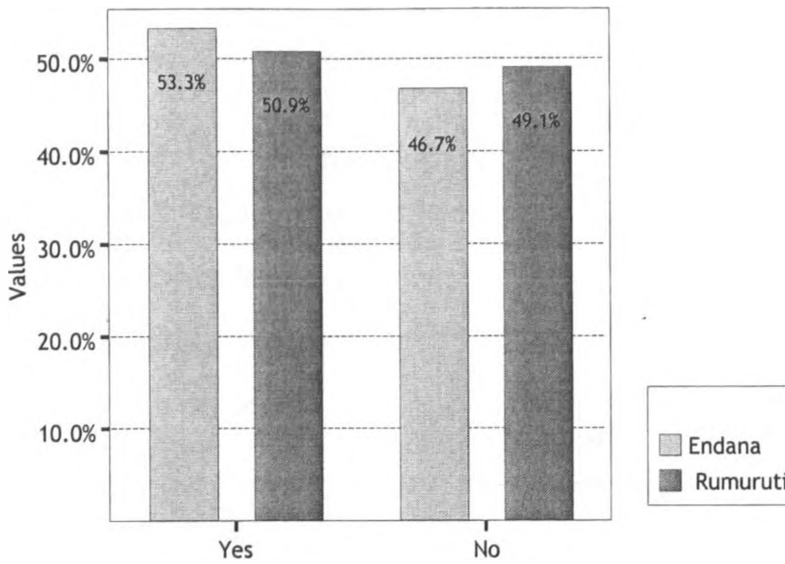
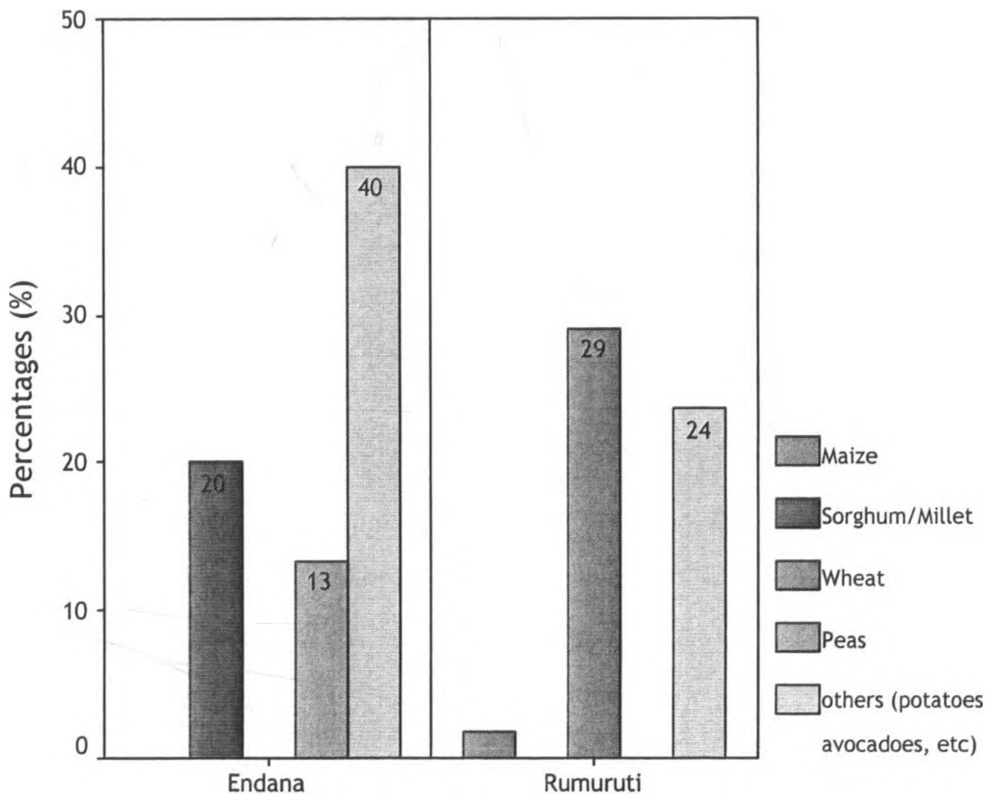


Chart 13 Crops dropped



Human-wildlife conflict also had an impact on education in the two study areas. 66.7% of the households in Endana and 80% in Rumuruti responded that education in their areas had been affected by the conflict (chart 14). Insecurity, child labour, inability to pay school fees, reduced concentration and death as a result of HWC were cited as having had an effect on standards of education in the two areas (chart 15). 57% and 80% of the respondents in Endana and Rumuruti respectively

considered insecurity brought about by the conflict as affecting education while 10% in Endana and 20% in Rumuruti said that concentration in class was affected as children were tired from chasing wildlife out of farms at night with child labour. 10% in Endana and 16% in Rumuruti also cited as a reason. A small percentage (below 5%) responded that death especially that of the household head or breadwinner also had an impact on education

Chart 14 Effect of Wildlife on education

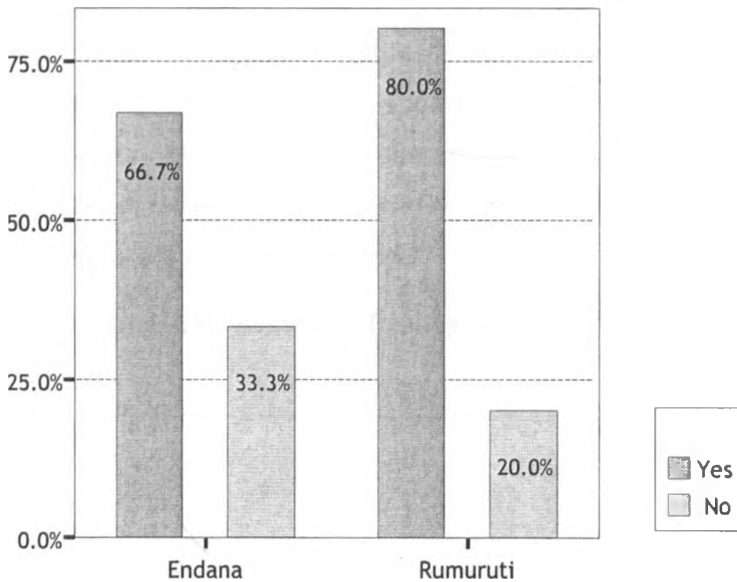
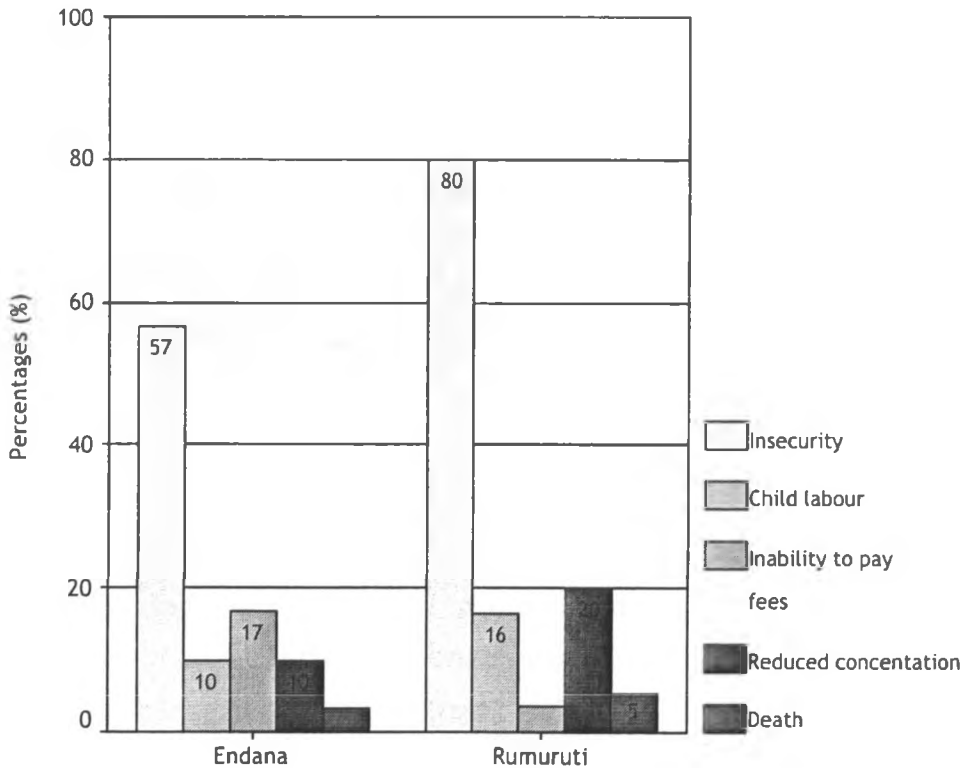


Chart 15 Impacts on Education

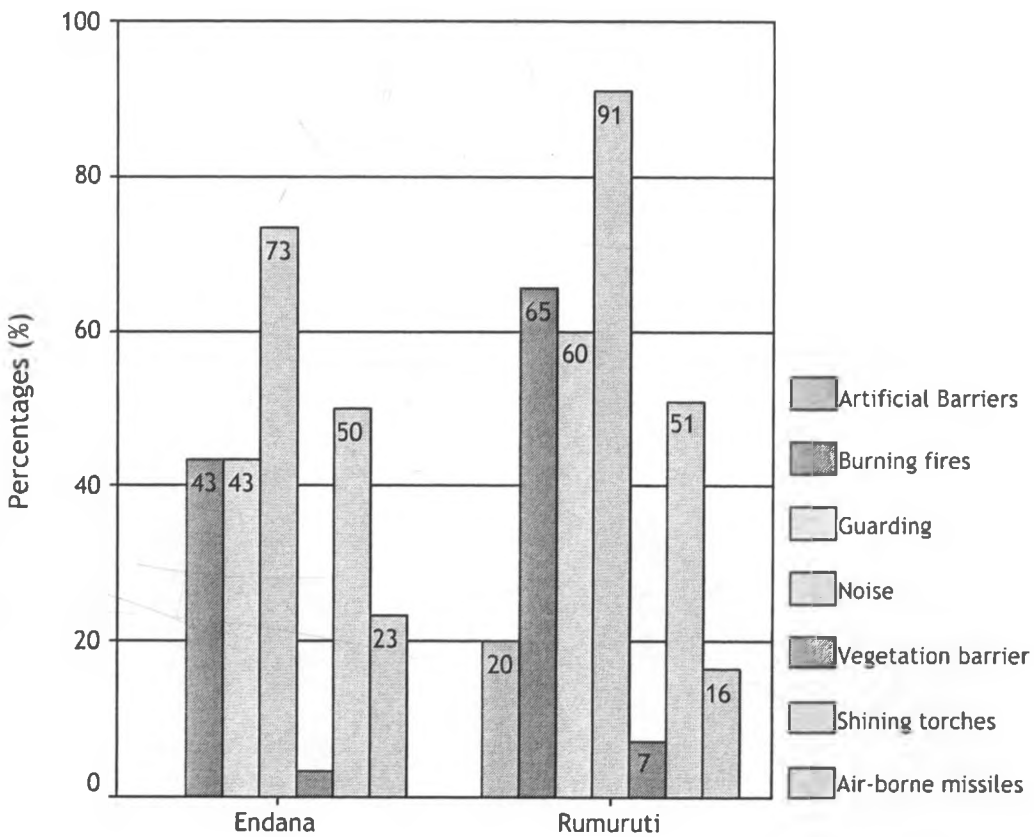


4.4 Household Strategies for Dealing with HWC

It has already been established that the livelihoods of the communities in the two areas are dependent on agriculture. Any form of shock or stress would affect agricultural production thereby making the locals vulnerable to risk.

Several strategies were utilized by the respondents before the physical barrier to deal with the problem of human-wildlife conflict were introduced. The respondents had used methods that encompassed all self-defence measures taken by local farmers to protect their crops from wildlife damage. Many of these strategies have been used for centuries, and the term loosely encompasses local methods used before local authority involvement in human-wildlife conflict management and before the evolution of what are considered modern techniques. Those used in the study areas are indicated in chart 16 below.

Chart 16 Management Strategies for Dealing with HWC



The strategy used and the intensity of use varied in the two areas. They ranged from erection of artificial barriers (fences, enclosures, etc), burning fires, guarding the farms to stoning of the crop raiding animal.

4.4.1 Guarding

Although not strictly a deterrence method, crop guards sleeping on watchtowers with some means of alerting the community and other household members about crop-raiding wildlife (e.g. whistles) are an important part of any traditional deterrence system. Human effigies (scarecrows) are used in some places, but wildlife quickly becomes habituated. Watchtowers that provide good vantage points, built around fields of crops, increase the farmers' chances of being alerted to the presence of potentially harmful wildlife before damage has occurred. Simple alarm systems, using string and cowbells or tins, can also be effective and avoid the farmer having to be alert all night long. Dogs can be effective in protecting homesteads and livestock from attack by predators.

43% of the respondents in Endana guard their farms against incursions by wildlife or crop raiding. In Rumuruti 60% utilize the strategy of guarding their farms. This is however a very tiring procedure severely affecting the capabilities of the household to engage in other activities. Cases of child labour were reported in both areas and children not being able to concentrate in class due to fatigue from guarding crops the previous night were reported.

Picture 2 Scarecrow on a Farm Adjacent to Rumuruti Forest



4.4.2 Artificial Barriers

Another traditional wildlife deterrence observed in the study areas was the erection of “fences” around fields. These fences consist of a string mounted around the cultivated area with various objects such as cans; discarded plastic bags, etc. are suspended from the string (Picture 3). The perception being that the motion of the objects frightens wildlife from the farm. Some of the objects such as tin lids make noise when moved by the wind which is also thought to deter elephants. Whether this is an effective means of deterring elephants from fields is doubtful.

Other barrier types include the construction of enclosures using sticks to protect the farm from invasions by smaller game e.g. gazelles. These enclosures usually surround the small holdings but the homestead in some cases. They are however not effective with elephants as they are able to easily break through. 20% of the respondents in Rumuruti utilize this management strategy. This could also explain the high incidences (60%) of damage of infrastructure reported in Rumuruti. No case of artificial barriers was reported in Endana though they were noticed to be in use through field observations.

Picture 3 Artificial Barriers in Rumuruti



Picture 4 Artificial barrier in Endana



4.4.3 Noise

Beating on drums or making a noise of any kind is one of the most common strategies. The respondents use noise made by drumming on tins and pots and by hitting the roofs (iron-sheets) to scare or frighten off elephants and other wildlife. Whip-cracking to imitate gunfire is also used, making noise and screaming to alert the community of the presence of wildlife in the neighborhood and to scare off the animals is also used. More than two thirds of the respondent used noise as a strategy, 73% in Endana and 91% in Rumuruti. Another type of noise included the revving of tractor engines for those who possess tractors.

4.4.4 Fire

Most wild animals avoid fire, hence the use of fire as a strategy. Fires at field boundaries, or at the entry points of wildlife to fields, serve as short-term deterrents to crop raiding wildlife. This is usually unsustainable for any length of time without large tracts of forest being cut down. Other materials can be burnt to increase the deterrent effect of fire. In Rumuruti, the locals burn rags immersed in used motor oil at strategic points in their farms to keep elephants out or at points they believe are used by elephants and other wildlife to cross over to the

settlement from the forest. They claim the noxious smoke is to a certain extent successful in repelling wildlife. 43% of the respondents in Endana used fire as a strategy for dealing with HWC while 65% of the respondents in Rumuruti used the same strategy.

4.4.5 Shining Torches

The communities in the two study areas also used powerful flashlights or torches to deter wildlife especially elephants in combination with noise and fire. The respondents however complained of the high costs associated with this strategy as it involves purchase of alkaline batteries to run the torches. Around 50% of the respondents use lights as a strategy, 50% in Endana and 51% in Rumuruti.

4.4.6 Air Borne Missiles

A small percentage of the respondents, 23% in Endana and 16% Rumuruti, throw air borne missiles at the animals to chase them away from their farms. These range from stones and sticks, to glowing tinder and spears. This often results in fatal incidents on both sides as the nature of the interaction is extremely aggressive. Wounded wildlife generally become far more aggressive and are prone to attacks on humans. The animals often die from infected wounds months later.

4.4.7 Pre Conflict Strategies

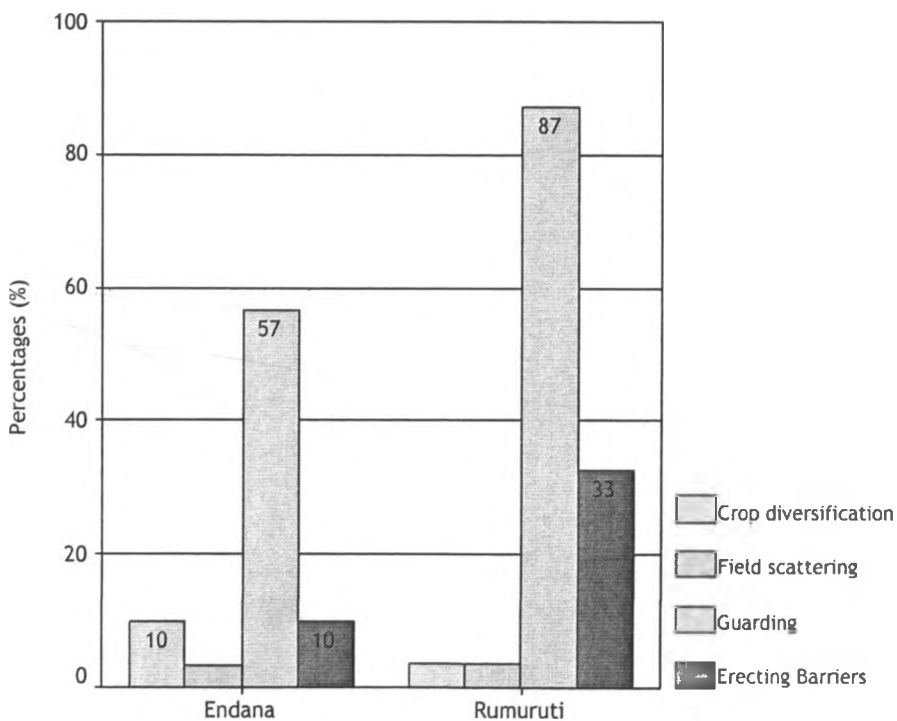
Within the context of sustainable livelihoods three broad clusters of livelihood strategies are identified. These are: agricultural intensification/extensification, livelihood diversification and migration. Broadly, these are seen to cover the range of options open to rural people. They either gain more from agriculture (including livestock rearing, aquaculture, forestry etc.) through processes of intensification (more output per unit area through capital investment or increases in labour inputs) or extensification (more land under cultivation), or they diversify to a range of off-farm income earning activities, or they move away and seek a livelihood, either temporarily or permanently, elsewhere. Or, more commonly, rural communities pursue a combination of strategies together or in sequence (Scoones, 1998).

Different types of shock or stress may result in different responses, including avoidance, repartitioning, and resistance or tolerance mechanisms. The local people in the two study areas are faced with a threat to their livelihoods, namely human wildlife conflict. What strategies therefore do they put in place to avoid the

conflict, spread the risks or to substitute the mode of production with one that will not be vulnerable to the conflict? These are strategies applied with the hindsight that conflicts will occur at one point or another of the production process. In essence these are the strategies put in place to deal with wildlife when and if they invade their farms or to totally avoid such a situation from happening. The strategies put in place to avoid conflict include: guarding, crop diversification, field scattering and erection of barriers to keep off wildlife.

In Endana 57% of respondents and 87% in Rumuruti applied guarding as a strategy to avoid losses incurred from crop raiding or damage. Guarding is considered a livelihood strategy when it's planned for in advance and a combination of resources and action applied towards actualizing the strategy. The erection of barriers was used by 10% of respondents and 33% in Rumuruti. Crop diversification was applied by 10% in Endana and below 5% in Rumuruti while a small percentage in both areas had a strategy of scattering their fields. This was premised on the need to spread the risks and reduce the household's vulnerability in case of wildlife invasions and subsequent losses experienced because of the conflict. In Rumuruti the households using field scattering as a strategy were hiring farms in areas further away from the forest where there was no conflict or experienced minimal human wildlife conflict.

Chart 17 Livelihood Strategies for Dealing with HWC

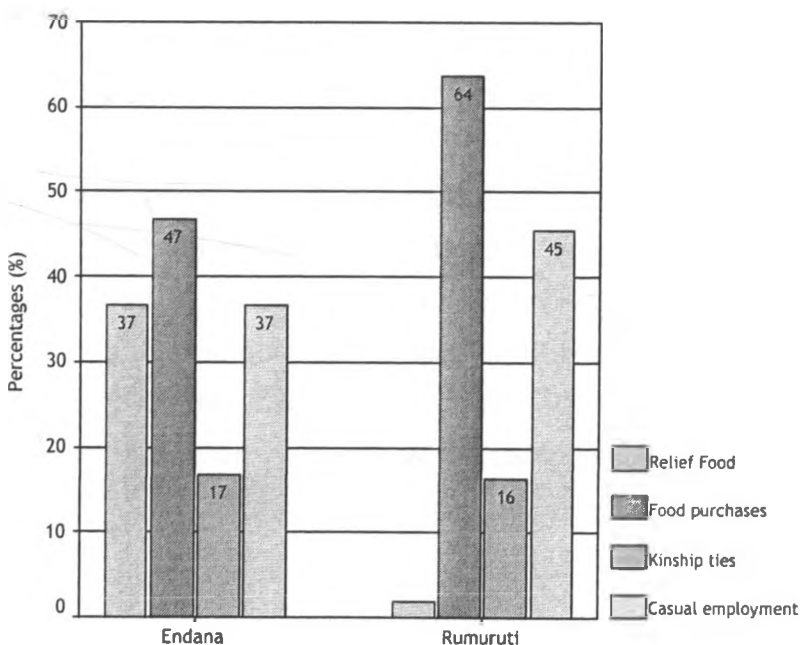


4.5 Coping Strategies

After crop raiding and damage of crops and other forms of conflict have occurred, the local people in the study areas applied various coping mechanisms with variations depending on locality. They are put in place once their livelihood capabilities are affected and they are no longer able to derive a livelihood. The strategies included: reliance on government for relief food, purchase of food using other household resources, engagement in casual labour and the reliance on kinship ties to support them through the period of food shortages.

In Rumuruti 64% of the respondents and 47% in Endana relied on other household resources to purchase food supplies to cover the deficit created by losses to wildlife. In most cases this was the sale of livestock with the proceeds used to purchase food and to pay for services. 37% of the respondents in Endana relied on government relief food supplies with only a small percentage doing so in Rumuruti. Approximately 16% of the respondents relied on kinship ties with relatives from the areas they had migrated from to support them with food and other resources in times of need. Engaging in casual labour was utilized by 37% of the households in Endana and 45% in Rumuruti which involved working in the farms of locals who were able to cope with HWC. An area might experience the same shock or their livelihoods may be at risk but the levels of vulnerability are different depending on one's socio-economic status, farm size and access to capital and labour.

Chart 18 Household Coping Mechanisms against Losses to HWC



CHAPTER 5: EFFECTIVENESS AND EFFECTS OF WILDLIFE BARRIERS

5.0 Introduction

This chapter analyses the effectiveness of the physical barriers in reducing human wildlife conflicts in the study areas of Rumuruti and Endana and the effects on their livelihoods. The analysis is area specific due to the different nature or type of physical barrier being used. Effectiveness has been measured by several variables that include: reduction of human-wildlife conflicts, reduced losses to wildlife and respondents perceptions to wildlife.

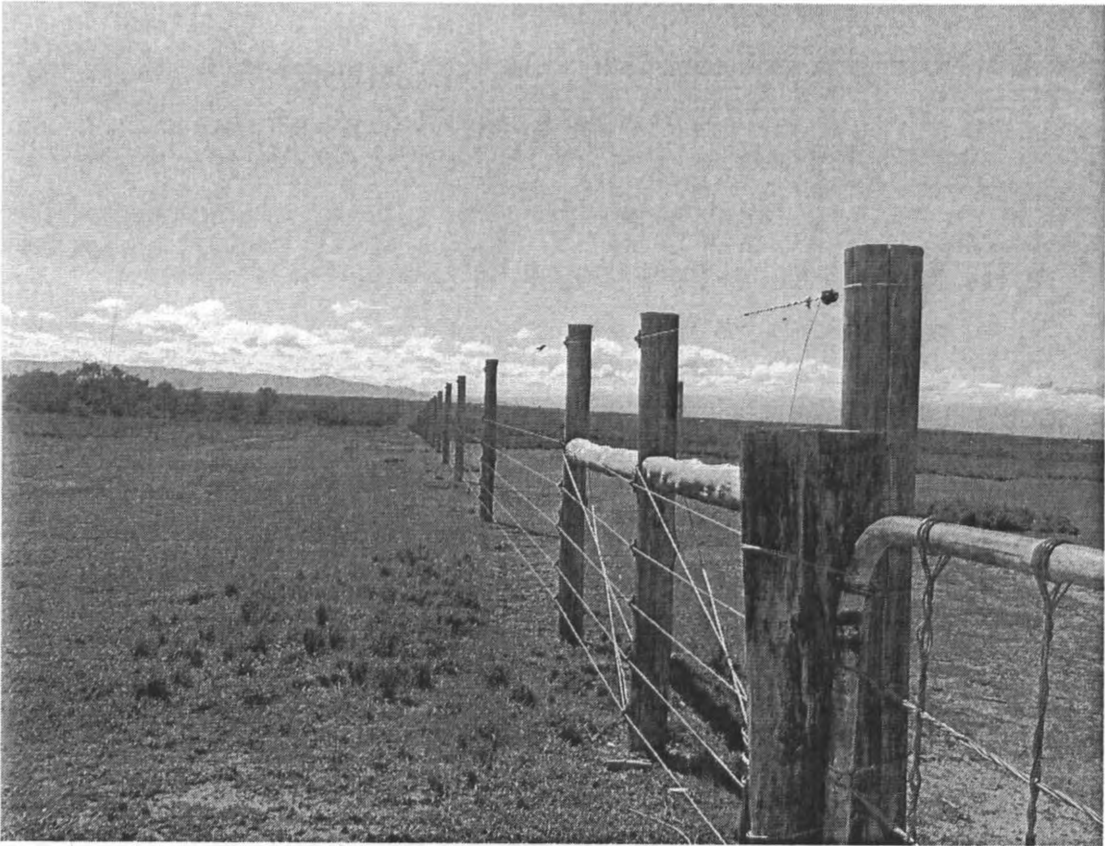
The second section of the chapter looks at the effects of the barriers on the rural livelihoods of the locals. As earlier defined, livelihood comprises the capabilities, assets (including both material and social resources) and activities required for a means of living. The effects will therefore be analyzed in the context it has been experienced in the capabilities assets and activities of the rural communities.

5.1 Effectiveness of the Barriers in Reducing HWC

Several variables were used to measure the effectiveness including asking the respondents their perceptions on the effectiveness of the barrier in their locality. The continuation of HWC and its intensity was also used to gauge if the barrier had been successful in reducing or dealing with HWC. Breakages of the barriers were also used as a way of measuring effectiveness.

The barrier in Endana is a six strand fence with four live wires on 10ft posts with 3ft deep into the ground and extending 7ft above ground in height. It's joined to the Mogwooni ranch fence, through El Karama ranch all the way to link with the Segera ranch fence. The fence is 12 kilometres in length. Initially it was meant to be 10.4km but was realigned so as not to interfere with access to water (Ngare Ngiro River) by wildlife and domestic animals. In Rumuruti the barrier is a ditch along the boundary of the Rumuruti forest reserve in Siron and Salama sub-locations extending more than 10Km dug by the community through a food for work programme. Some parts of the barrier have an electrified two strand fence standing on posts.

Picture 5 Endana North Electric Fence



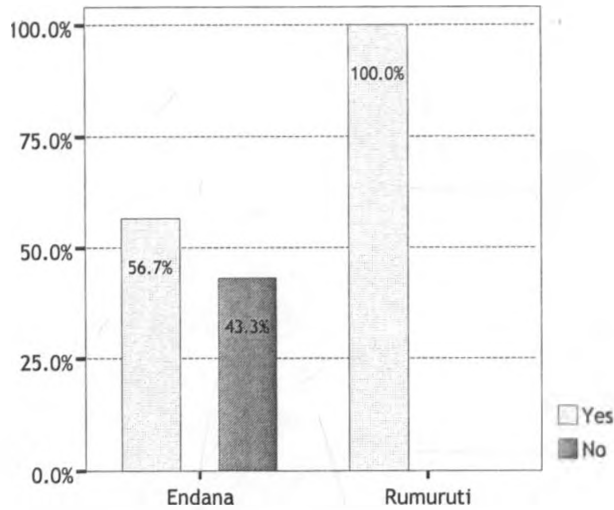
Picture 6 Rumuruti Ditch



5.1.1 Human Wildlife Conflict after Erection of Barriers

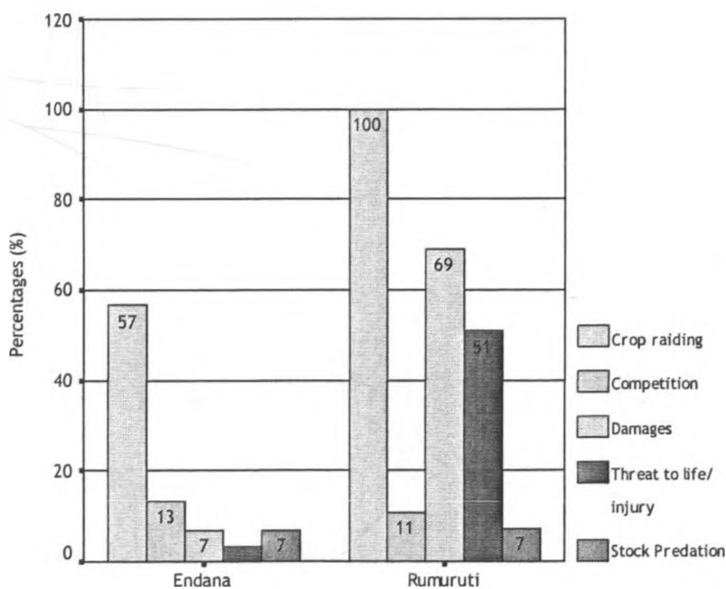
100% of the households surveyed in Rumuruti continued to experience human wildlife conflicts in whatever form after the ditch was dug. In Endana the proportion still experiencing conflict had dropped to 56.7% (chart i9).

Chart 19 Presence of HWC



In Rumuruti all the respondents reported that crop raiding was still present, 69% further reported that they experienced damage to property, 11% competition for resources, 51% threat to life or injury and 7% predation on livestock. 57% in Endana reported experiencing crop raiding after the fence was constructed. A further 13% reported competition for resources, damage to property (7%) and stock predation (7%) while threat to life is very minimal (below 5%) in Endana.

Chart 20 HWC Existing After Barriers



Picture 7 Bananas Destroyed by an Elephant in Rumuruti

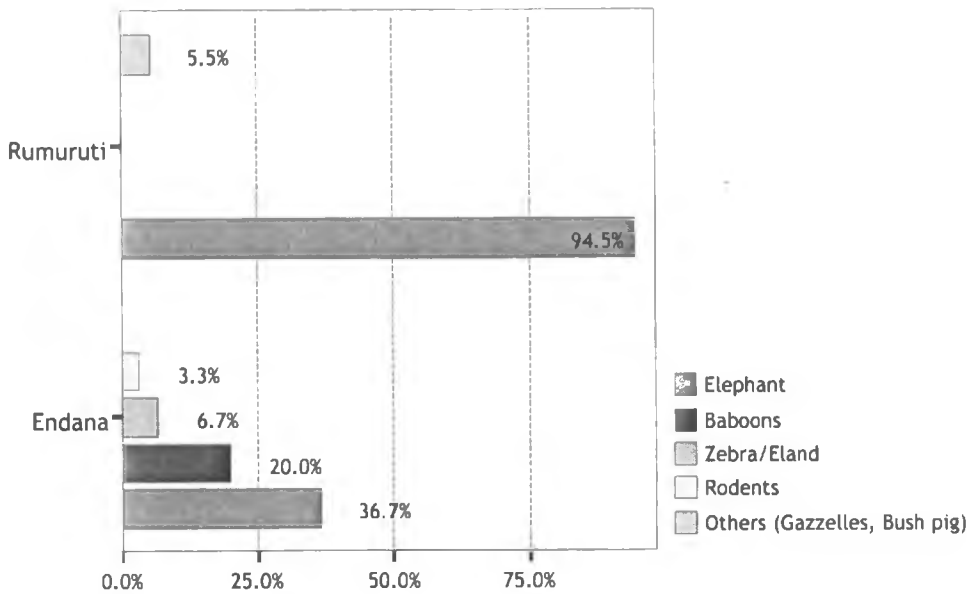


Picture 8 Elephant Droppings in a Farm in Rumuruti



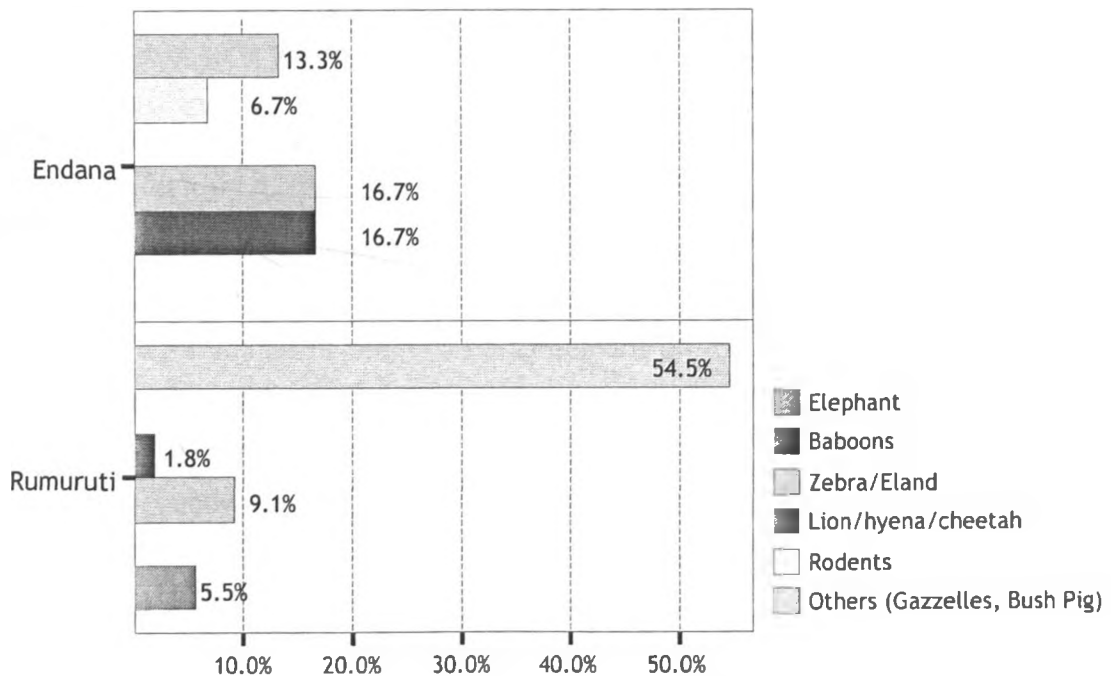
The respondents were asked to rank animals that were most problematic in order to determine which animals were responsible for the continuing conflict.

Chart 21 Most Problematic Animals



A majority of the respondents in Rumuruti, 94.5% considered elephants to be the most problematic animal and as the animal mostly responsible for the ongoing conflict in the area. 5.5% ranked bush pigs as being most problematic. Elephants were ranked as most problematic by 36.7% of the respondents in Endana. Other animals given high ranking were baboons (20%), zebras (6.7%) and rodents (3.3%).

Chart 22 2nd Most Problematic Animals



The second most problematic animals in Endana were considered to be gazelles and bush pigs (13.3%), zebras and baboons (16.7%) and rodents (6.7%). The household respondents considered bush pigs (54.5%), zebra (9.1%), elephants (5.5%) and predators (1.8%) as second most problematic animals (chart 22).

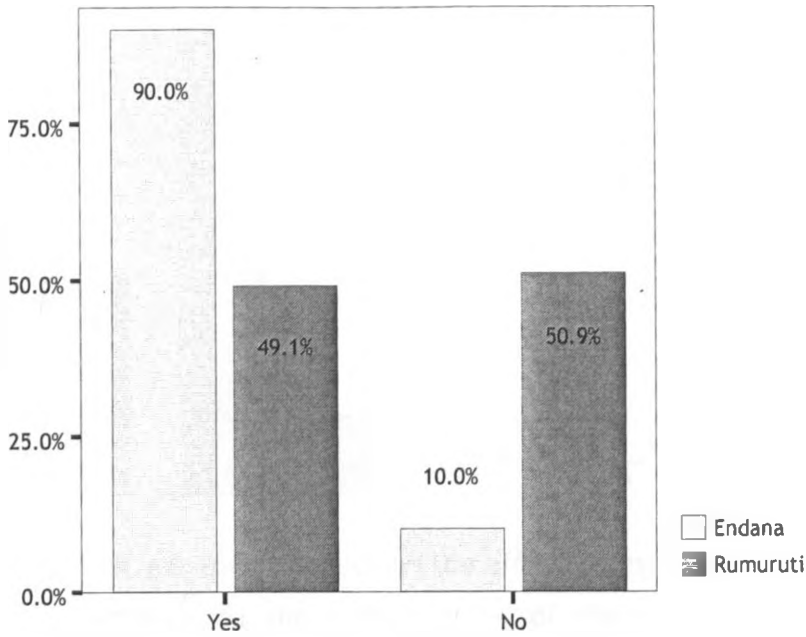
The rankings above reflect the differing levels of effectiveness of the two barriers in the study areas. In Rumuruti the ditch is not able to stop bush pigs from getting through from the forests to damage crops in the settlement. As a barrier ditches are more efficient on the bigger animals and not small game like bush pigs which can also burrow. Elephants were also ranked highly because of their ability to get over the ditch. One of the main reasons given for this by a key informant (KWS Community scout) was the poor maintenance of the ditch and the width of the ditch which was not wide or deep enough in some areas to keep off elephants. In some areas the locals were unable to deepen or widen the ditch as it was too rocky and they didn't have the right equipment to dig in such areas.

In Endana the ranking of problem animal was lower compared to Rumuruti. Baboons and rodents were considered problematic and this generally because of the fence typology. Primates have been known to get over any barriers and this does not reflect on the efficiency of that particular fence. It's also important to note that there is wildlife in the settlements adjacent to Endana thus the presence of certain levels of conflict. However from the ranking of animals before the erection of the fence it can be seen that the ranking of elephants as a menace has tremendously gone down in Endana, from 100% to slightly over 35% after the fence was constructed.

5.1.2 Reduction of HWC

From the rankings it's emerging that conflict levels in Endana are considered to have reduced by a substantial number of respondents. In comparison the respondents in Rumuruti seem to be agreement on the problematic animals in the area. It is however, not possible to make an informed judgment on the efficiency of the two barriers or to attempt a comparison of the two different barriers based only on the above rankings. The respondents were also asked if they thought HWC had reduced in their respective areas after the construction of the barriers. 90% of the respondents in Endana reported that levels had reduced and 49.1% in Rumuruti had experienced a reduction in human wildlife conflict (Chart 23).

Chart 23 HWC Reduction in Households Surveyed



The reasons advanced by the respondents for the reduction of conflict included improved security (27% and 5%), wildlife kept out of the settlements (67% and 9%), reduced frequency of HWC in the area (7% and 36%), and the lack of competition for resources between wildlife and the households in Endana and Rumuruti respectively. From these results, it can be seen that a trend has begun to emerge whereby the households in Endana perceive the barrier (fence) to be effective. 67% of the respondents felt that wildlife had been kept off the settlement

Chart 24 Reasons for Reduced HWC

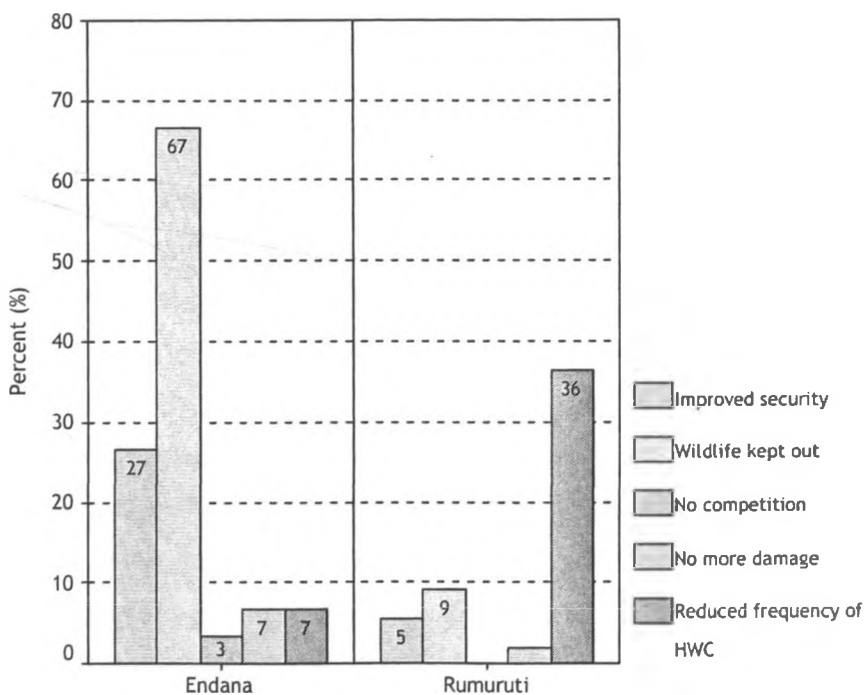
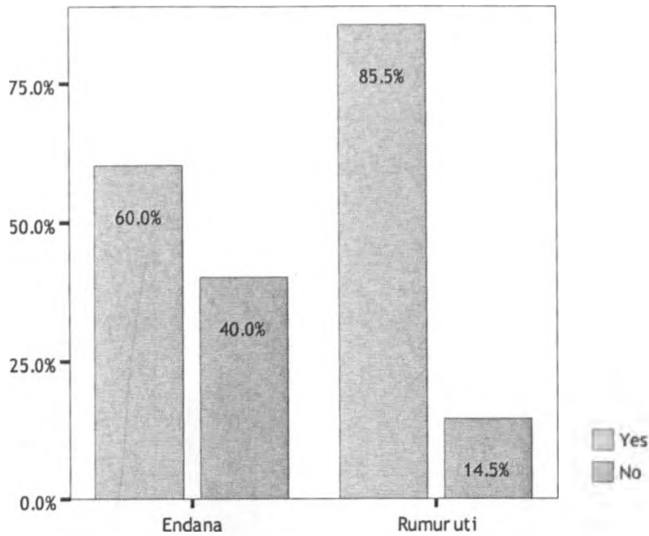


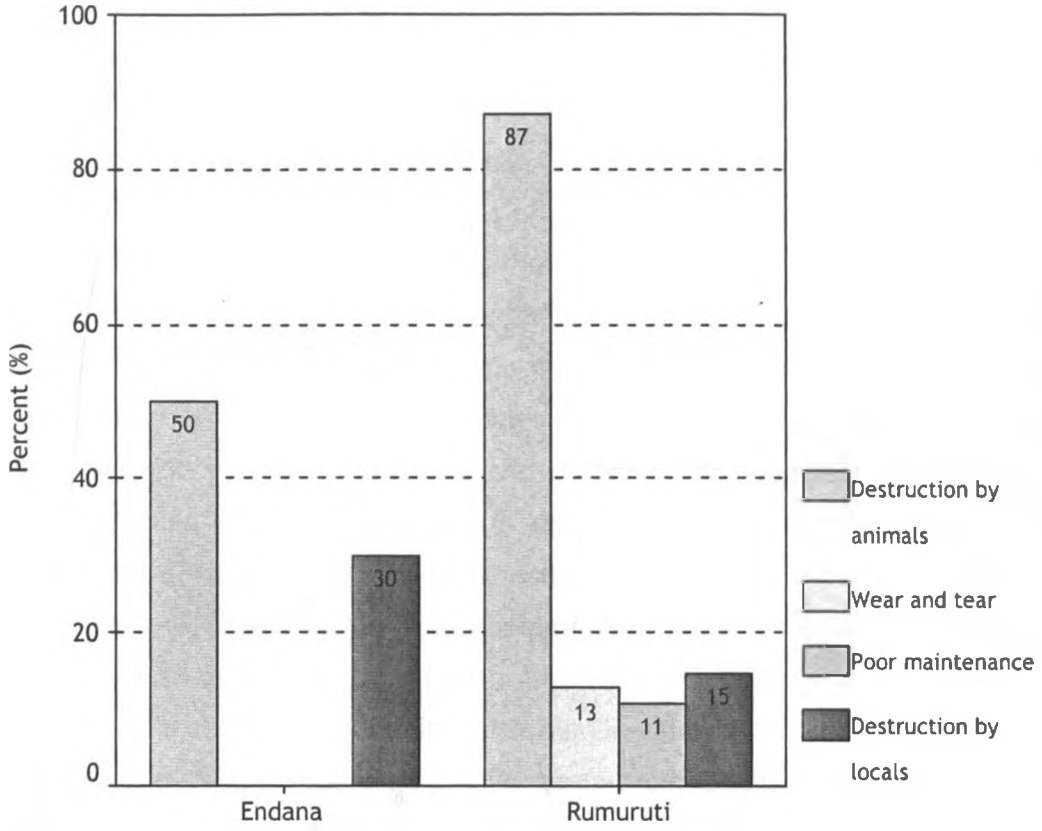
Chart 25 Barrier Breakages



Another variable that was used to check on the effectiveness of the barrier was the occurrence of breakages on the barriers. 60% of the respondents in Endana reported breakages on the fence while 85.5% of the respondents in Rumuruti reported breaks on the ditch. The percentage was higher in Endana (40%) for those who were of the opinion that no breaks have occurred on the barriers. It was observed that 50% of the household respondents in Endana considered destruction by animals to be the cause of breaks on the barriers. 87% of households surveyed in Rumuruti reported that destruction of the ditch was by animals. 30% of the respondents linked fence breakages in Endana to destruction by locals and pastoralists through cutting of the wires. In Rumuruti 15% reported that locals were responsible for the breaks on the ditch while 24% stated that poor maintenance and wear and tear was responsible for the breaks on the ditch.

The responses from the two areas indicate that the barrier is less effective in terms of preventing wildlife from breaking through in Rumuruti than in Endana. More than 80% of the respondents in Rumuruti reported destruction by wildlife as the main cause of breaks on the ditch. It was observed that lack of repair or maintenance of the ditch was a major reason why the animals were able to get over the ditch. Filling in of the ditch by domestic animals while crossing and by rainfall made it possible for wildlife to cross over by reducing the depth of the ditch and also by eroding the edges making it easier to pass. The wildlife also used these filled up areas to cross back into the forest on their way back from the crop fields. The respondents reported experiencing a decline in crop raids when the ditch had just been dug but this changed as the state of the ditch worsened over time.

Chart 26 Causes of Breaks on the Barriers



Picture 9 Destruction of the Ditch by an Elephant



It's clear from the data analysis above that the ditch in Rumuruti has not been effective in reducing human wildlife conflict or dealing with the wildlife menace in the area. Elephants and bush pigs are able to cross over with impunity and continue raiding and damaging farms in the settlement. Interviews held in the area with farmers revealed that the ditch had only worked efficiently when it was still fresh. They complained that there was no way of ensuring the ditch was properly maintained and as the work of digging the trench had come to a halt, wildlife was still able to pass in sections where the ditch had not been dug. Some sections were also quiet rocky thus the trench was poorly dug. As the field work (questionnaire survey) was done when there were crops in the farm it was observed that crop raiding was still present in the area and though some households experienced a decline, nothing much had changed in regard to HWC with the digging of the barrier. Interviews with the KWS community scout revealed that though the ditch had been dug elephants were still a problem necessitating him to use thunder flush (noise) to chase them away from farms. All these bring into question the efficiency of ditches as a strategy for dealing with human-wildlife conflicts. As noted in an earlier section of the report all of the game-proof ditches built in Kenya have failed due to lack of maintenance which is slowly being manifest in Rumuruti.

Picture 10 **Maize damaged by Elephants in Rumuruti**

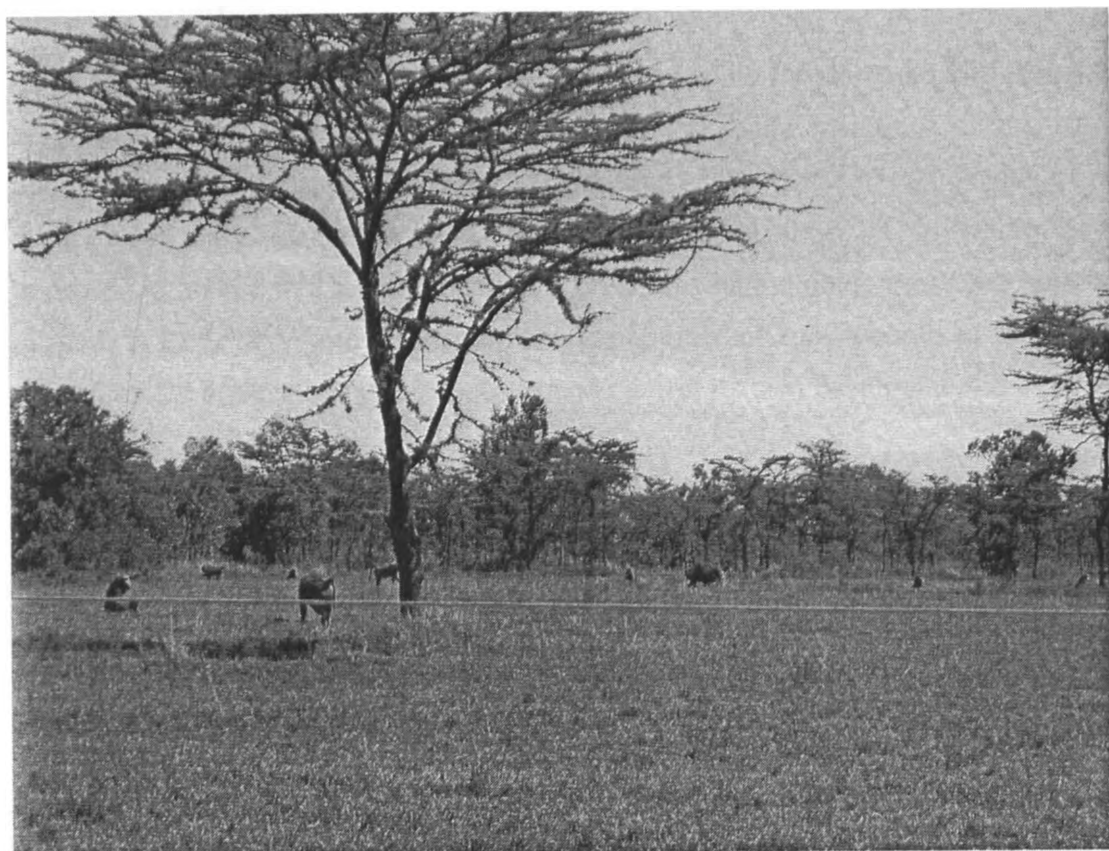


The respondents from Endana reported that reduced levels of human wildlife were mainly due to the electric fence keeping wildlife out or off the settlement. 90% of the respondents indicate that there has been a reduction of human wildlife conflict in the area since the construction of the fence. It can be deduced that the reduction is based on the ability of the fence to prevent wildlife from getting into the settlement. The fence has also reduced the perception of respondents of elephants as the most problematic animal (100%) before the construction of the fence to approximately 35% currently. This has also brought to the forefront other animal typologies as crop raiders, animals that the locals did not perceive as a threat before the barrier was put in place. Baboons, zebras, gazelles and rodents now take precedence in the minds of the respondents as problem animals.

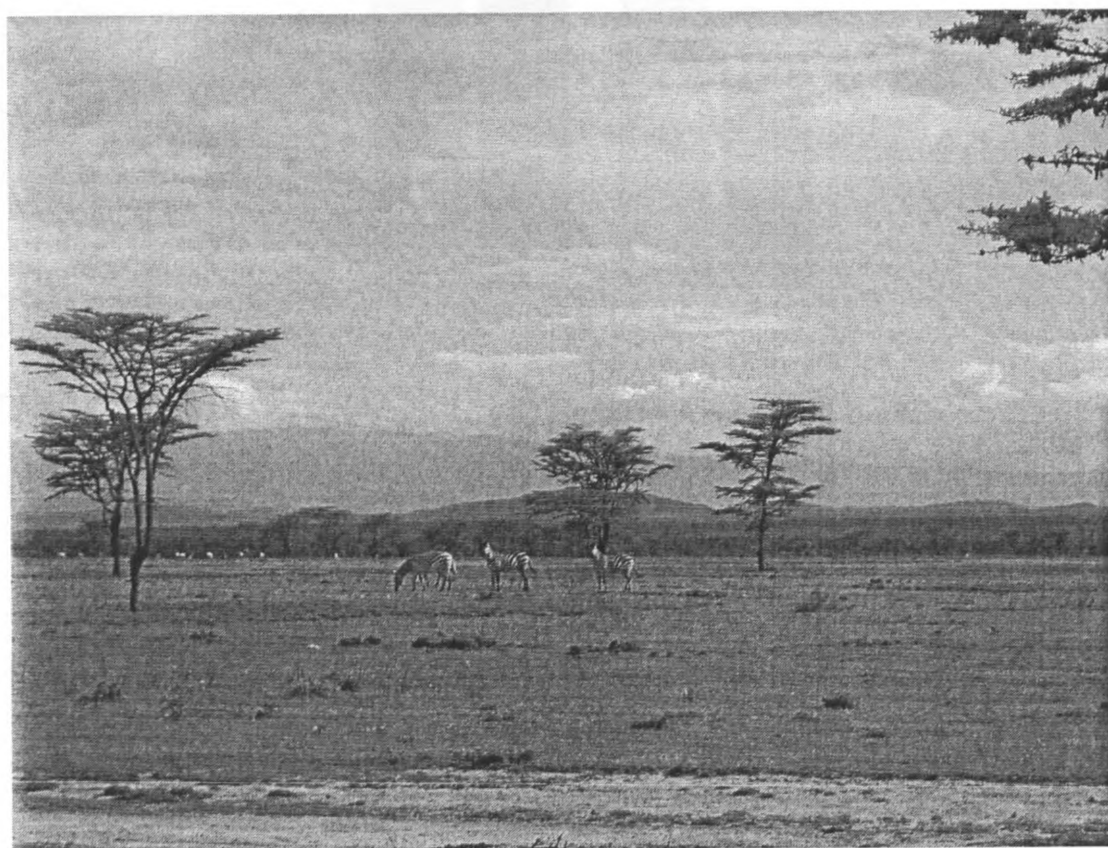
However Endana is a settlement adjacent to areas that are not occupied by their owners. Pastoralists utilize these areas and are tolerant to wildlife. The interaction with wildlife occurring in Endana is mostly from wildlife that frequents the farms adjacent that were never occupied. Interviews with the respondents indicated that most of the problem animals were coming from Ireri (adjacent settlement). However the fence is not effective in stopping baboons from crossing over from the ranch though there is hardly any barrier that so far stops them.

Endana provides an interesting scenario in terms of the effectiveness of the fence due to its unique position. The settlement neighbours a ranch which is wildlife tolerant and on the other it's bounded by a scheme that was never settled, utilized by pastoralists and wildlife without interference from anyone. The fence was erected on the side of the ranch as the community felt that was the source of all their problems in regard to human wildlife conflicts and depredation brought by wildlife. The fence has so far been effective in keeping off wildlife as has been clearly illustrated by responses by the respondents. Fence breakages are dealt with to ensure the proper functioning of the fence. Although there have been cases of wire cutting by pastoralists, this happened during a period of devastating drought as the pastoralists attempted to invade the ranch in such of pasture the situation has already been solved and such incidents were no longer expected. The wildlife on the other side remains, reflecting the landscape within which small holders exist in Laikipia, surrounded on all sides by wildlife and habitats tolerant to wildlife.

Picture 11 Baboons across the Fence from Endana



Picture 12 Zebras in a Settlement Adjacent to Endana

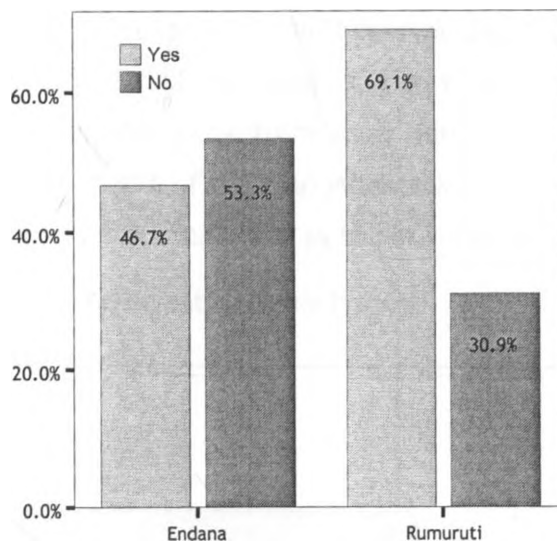


5.1.3 Community Participation in Management of Barriers

Participation can be viewed either as a means to an end or/and as an end itself, for achieving effective results. Participation when taken as a means to an end is a way of harnessing the existing physical, economic and social resources of the rural people to achieve the previously established objectives of a development programme more efficiently and effectively. The strategy is to reform and improve. As an end in itself it is seen as a process, which unfolds over time, and its purpose is to develop and strengthen the capabilities of rural people to intervene more directly in development initiatives and control their own developments.

Participation of the community in the management of the fence was reported by 46.7% of the respondents in Endana while 69.1% in Rumuruti said that the community is involved in the management of the ditch.

Chart 27 Community Participation in the Management of Barriers



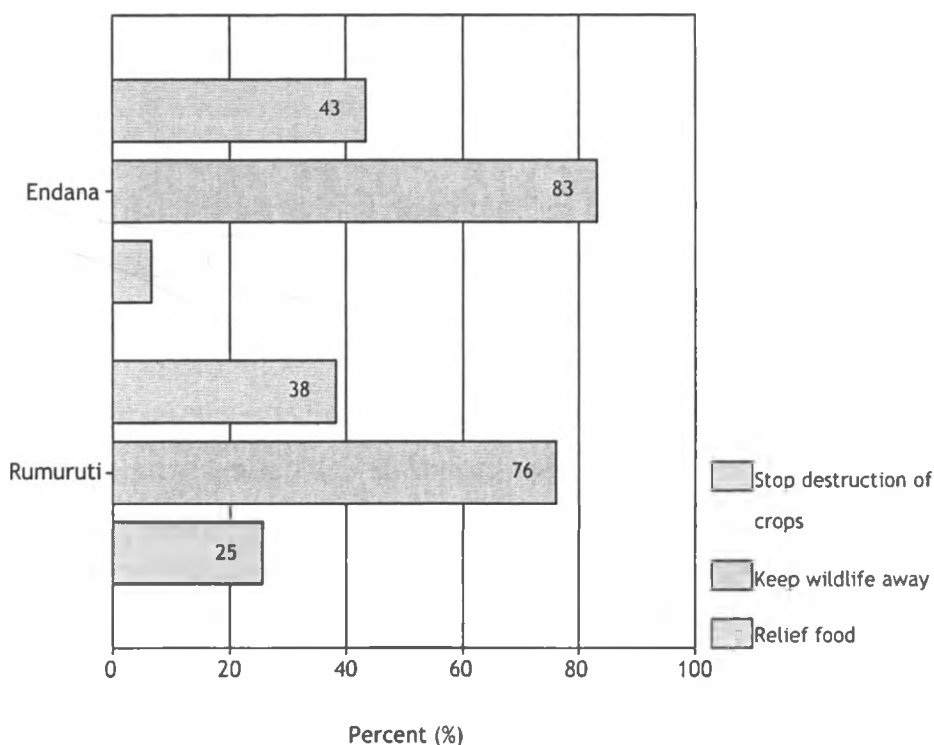
A fence committee exists in Endana although more than 50% of the respondents said that the community is not involved in the management of the fence. According to the Chairman of the Endana Electric Fence Self Help Group, the management of the fence was handed over to a committee of 14 consisting of people living adjacent or close to the fence who were selected by the community. The committee is responsible for maintenance of the fence and repairs when necessary with help from members of the community who are called upon to assist when the need arises. The fence also remains intact and operational due to the participation of the management of El Karama in the construction and maintenance of the fence. The fence line is on the border of the ranch which demolished its stock

fence to allow for the construction of the solar fence. It's in the interests of the ranch to have the fence in place and efficient as it secures its livestock and also prevents or keeps of livestock from getting into the ranch. Some material remained from the construction of the fence which is used for repairs and general maintenance of the fence. The chairman of the group attributes the success of the project to community participation and personal contribution of members through provision of labour.

“It’s purely a community project, initiated by the community and implemented by the community.....we kept the politicians and the local administration away from our fence” “Otherwise they were going to mismanage the money!!!”

From the household survey it emerged that both the two communities were involved in the construction of the barriers. The communities provided labour by clearing vegetation from the fence line, digging of holes for the posts, putting up the posts and the wires in Endana while in Rumuruti they dug the ditch on a food for work basis. 83% and 76% of the respondents said they participated in the projects to keep the wildlife away from their farms in Endana and Rumuruti respectively. An average of 40% of the respondents wanted to stop the destruction of their crops while others participated so as to get relief food (25% in Rumuruti).

Chart 28 **Reasons for Participating in the Project**



5.2 Effects of the Barriers on Livelihoods

A livelihood comprises people, their capabilities and their means of living including food income and assets. Tangible assets are resources and stores, and intangible assets are claims and access. A livelihood is environmentally sustainable when it maintains or enhances the local and global assets on which livelihoods depend, and has net beneficial effects on other livelihoods. A livelihood is socially sustainable which can cope and recover from stress and shocks, and provide for future generations.

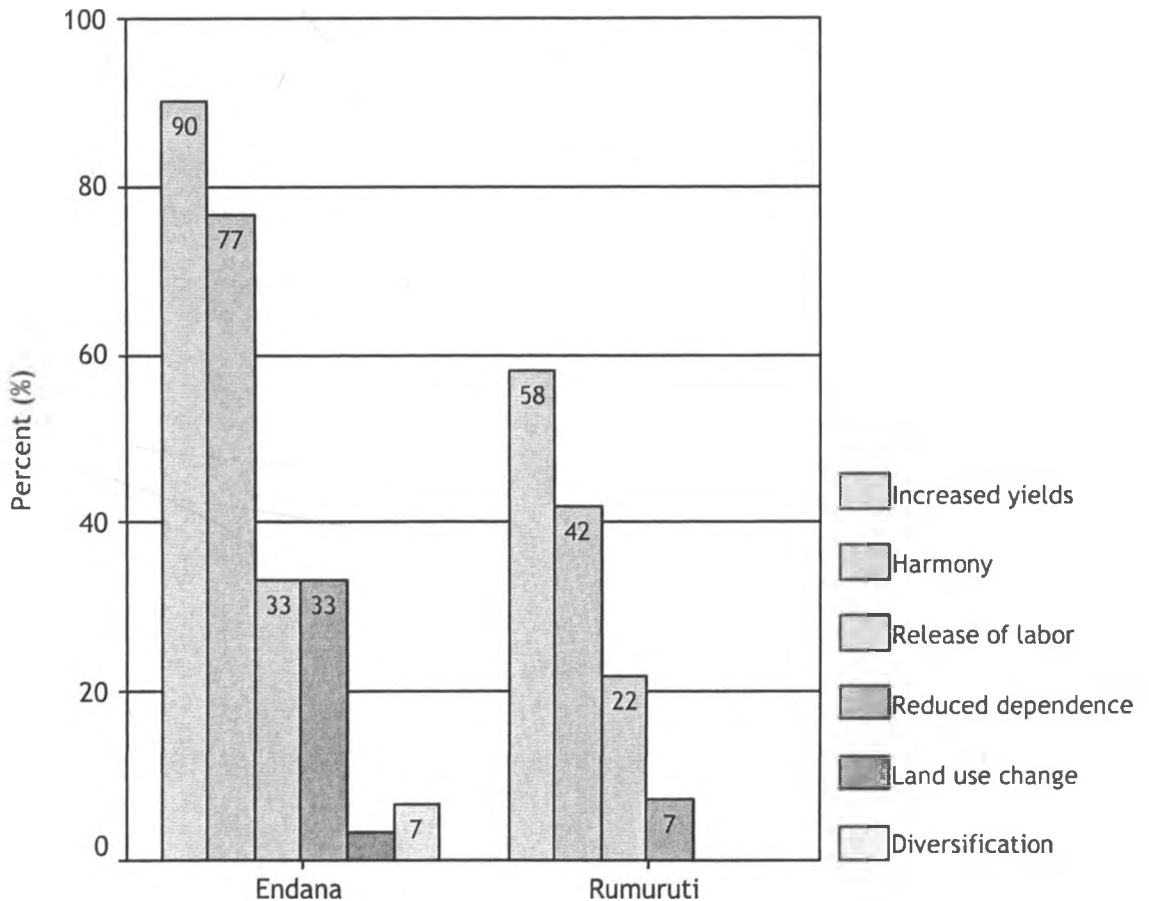
Rural livelihoods comprise one or more often several activities. These can include cultivation herding, hunting, gathering, reciprocal or wage labour, trading and hawking, artisanal work such as weaving and carving, providing services in transport, fetching and carrying and the like, begging and theft. These activities variously provide food, cash and other goods to satisfy a wide variety of human needs. Some of these benefits are consumed immediately, and others go into short or long term stores, to be consumed later or to be invested in other assets.

In rural areas people seek to put together a living through multifarious activities. Many livelihoods are also less singular or predetermined. Some people improvise livelihoods with degrees of desperation, what they do being largely determined by the social, economic and ecological environment in which they find themselves. A person or household may also choose a livelihood especially through education and migration. Those who are better off usually have a wider choice than those who are worse off, and a wider choice is usually generated by economic growth.

Any analysis of the effects of an intervention on rural livelihoods has to take into consideration improvements on capabilities, the tangible and intangible assets and the means of living of the people concerned. For the intervention to have an impact it has to enhance the capabilities of the rural households or people to deal with stresses or shocks or increase their capabilities to derive an income from the activities they are involved in. Livelihoods are also influenced by perceptions. Individuals will undertake specific livelihood strategies if they are perceived as being able to contribute to the advancement of their livelihoods. Perceptions of reduced risk or vulnerability will lead to adaptation of strategies that bring about benefits which can be utilized or consumed by the household immediately or stored for future use.

From the household survey, the respondents reported that the benefits derived from the construction of the barriers included: increased crop production or yields, harmony between the farmers and wildlife in the area, the release of labour from dealing with the wildlife menace to production, reduced dependence on relatives and government relief food, land use changes and diversification of crop and livestock typologies. In Endana 90% the respondents and 58% in Rumuruti experienced an increase in crop yields, while 77% in Endana and 42% in Rumuruti stated that harmony was experienced in their areas. Release of labour and reduced dependence was experienced by 33% of the households in Endana while 7% diversified their production as a result of the fence. The list of benefits was smaller in Rumuruti and generally experienced by less households. Only 22% experienced release of labour from keeping wildlife at bay to such activities as schooling and farming while 7% had reduced dependence as a benefit or effect of the ditch.

Chart 29 Impacts of Barriers in the Different Localities

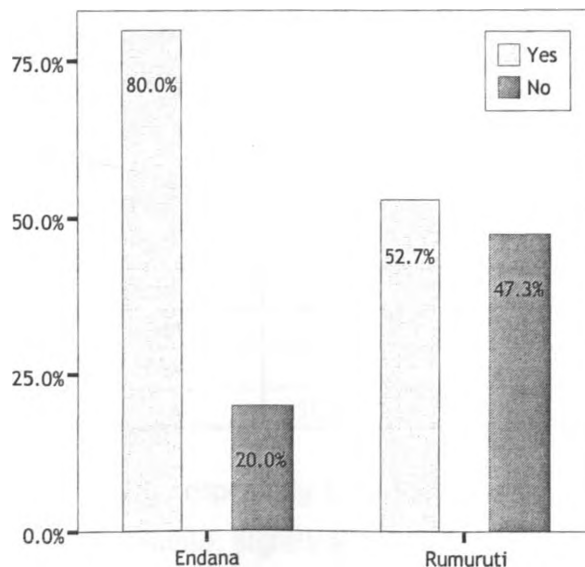


5.2.1 Increased Yields

It has already been established from the household survey that majority of the respondents rely on crop production as a source of income. Approximately 96% of the households are reliant on crop production for their livelihoods. Private or public interventions that results into an increase in output from crop production will have an impact on their livelihoods. In a rural area where agriculture (crop production) is the mainstay economic activity any shock or stress that affects productivity will adversely affect the sustainability of the livelihoods in that particular area. Most of the respondents claim that crop raiding by wildlife was by far the biggest threat to their livelihoods. 90% and 58% of the respondents in Endana and Rumuruti respectively stated that they experienced an increase in their crop yields after the barriers were put in place.

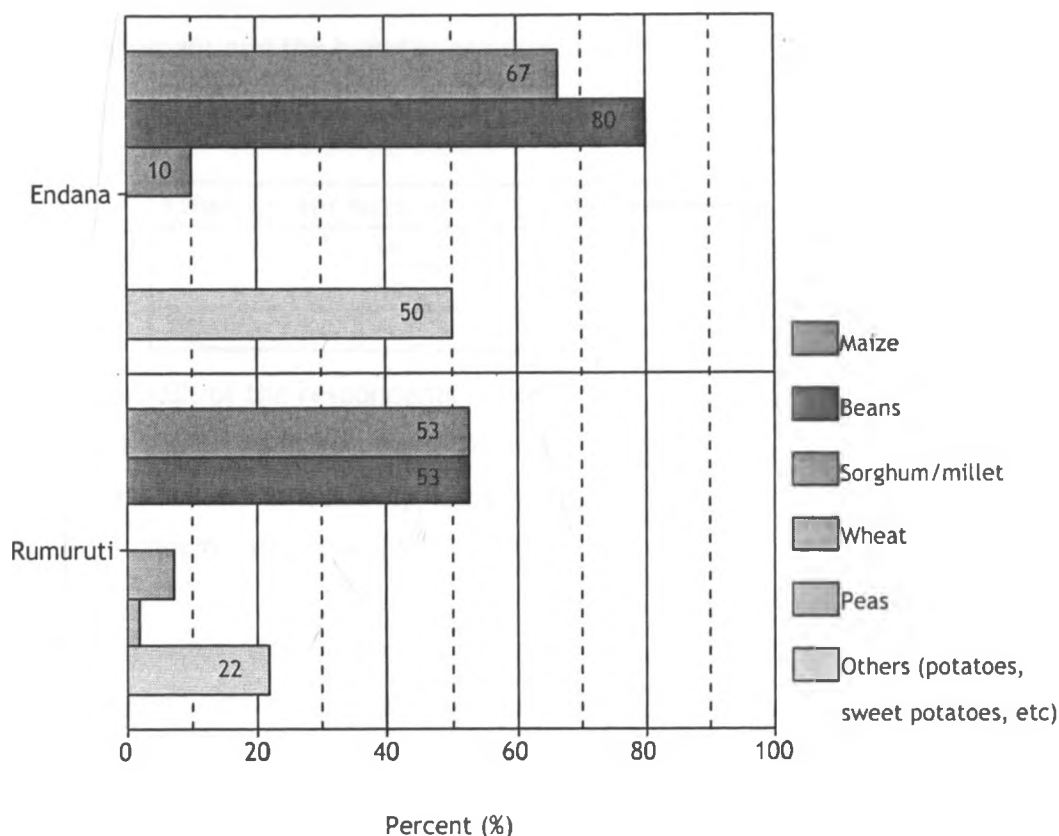
This increase has to be viewed in the context of increased income to the household from the sale of agricultural produce. A higher yield means a bigger surplus produce that can be sold to provide for cash to meet other needs within the household. In this respect the increase in yields in the two areas can be seen as a positive impact of the barriers on the livelihoods of the people living there. The respondents were also asked if they had experienced an increase in crop production in general related to the barriers. 80% of the respondents in Endana claimed they had experienced an increase in crop production while 52.7% in Rumuruti experienced increased production.

Chart 30 Increased Production



Crops that were reported to have experienced an increase in yield after the barriers were constructed included: maize (67% and 53%), beans (80% and 53%), a combination of potatoes, sweet potatoes, avocados, etc (50% and 22%) in Endana and Rumuruti respectively. These crops especially maize had been adversely affected by wildlife before the fence was erected.

Chart 31 Crops with Increased Yields



Respondents were also asked if they had experienced an increase in livestock numbers in the households. 70% of the households in Endana had an increase in livestock while 92.7% in Rumuruti did not have experience any increase in livestock numbers.

Table 11 Increase in Livestock Numbers

Increase in livestock	Endana	Rumuruti	Total
Yes	70.0%	7.3%	29.4%
No	30.0%	92.7%	70.6%
Total	100.0%	100.0%	100.0%

Although an increase in yields, especially crop yields were reported by household respondents from the total sample, significant differences emerge on the level and intensity of increases experienced in the two study areas. A big proportion of the

respondents in Endana experienced increases in crop production and an increase of livestock numbers after the fence was put up. In contrast the increase in crop yields was not as widespread (52.7%) in Rumuruti. In terms of livestock numbers only a small percentage (7.3%) experienced a change in their households. This is a reflection of the varying efficiency of the two barriers in dealing with HWC. The fence is more efficient and the benefits derived from this efficiency higher than those from the ditch. There is also a clear link between post project maintenance and management and the benefits brought about by the barrier.

Table 12 Effect of Barrier on Income

Effect on HH income	Endana	Rumuruti	Total
Yes	73.3%	45.5%	55.3%
No	26.7%	54.5%	44.7%
Total	100.0%	100.0%	100.0%

In Endana 73.3% of the respondents reported that the barrier (electric fence) had a positive effect on their income with most reporting increased incomes after the development of the fence. Only 45.5% of the respondents in Rumuruti reported an increase in income after the ditch was dug.

Investments within the framework of livelihoods occur when production leads to a surplus beyond immediate consumption needs or requirements. Investments are made in enhancing or acquiring resources, in establishing claims, in gaining access and in improving capabilities. Resources may be enhanced through investing labour as in terracing to improve the stock of soil, or through investing money in a cart to take produce to the market. Capabilities may be enhanced through investment in useful education and training and in apprenticeship. The results of successful investments are an added variety or quality of assets and /or capabilities which can be used for further production or in responding to future contingencies and threats to survival.

5.2.2 Release of Labour

In Endana 33% of the respondents and 22% in Rumuruti reported that they had experienced release of labour after the barriers were developed. A lot of resources are utilized in dealing with human wildlife conflict with a large proportion of these contributed by household labour. The effect is that when the household is engaged in activities or strategies for dealing with wildlife invasions other activities face a shortage of labour or are simply abandoned.

A lot of time and effort is expended through guarding of farms to keep wildlife away, making noise and chasing crop raiding animals out of the farms. All these are labour intensive activities that require co-ordinated and concerted efforts from household members. In most cases school going children are not spared either as every person in the household is called upon when there is a threat to the livelihood of the household. Child labour has far reaching consequences on the individual and the household. Education is seen as a way of enhancing an individual's or the household's capabilities to cope with stress and shocks in the future and being able to find and make use of a wider range of livelihood opportunities. Such capabilities include gaining access to services and information, exercising foresight, experimenting and innovating competing and collaborating with others.

By releasing labour to other activities other than protecting the household's livelihood, individuals are able to reduce the vulnerability of the household to stresses and shocks by engaging in other productive activities. As noted earlier rural livelihoods consist of more than reliance on agriculture and can include off farm activities, casual labour, etc. These activities are aimed at providing the household with cash and other goods to satisfy household needs. Diversification of economic activities is one way of coping in situations of threats to livelihood security and spreading of risks in case of shocks or stresses to livelihoods.

Guarding of farms at night may lead to sleep deprivation leading to lack of concentration in class by children involved in guarding or reduced school attendance, increased exposure to diseases, reduced employment opportunities and psychological stress. It's also important to note that labour is an important capital in rural livelihoods. Smallholder households rely heavily on internal labour in production of goods (crops) and any labour that is released from other activities and redirected towards production activities adds to the economic and social wealth of a household.

5.2.3 Reduced Dependence

From the household survey it was established that the respondents relied on government relief food and remittances from relatives either in monetary form or food as a way of coping with losses incurred from human wildlife conflicts. These forms of coping mechanisms characterized the livelihoods of the respondents. After

the development of the barriers, 33% of the respondents in Endana and 7% in Rumuruti claim that there is reduced dependence on government or relatives.

Chambers and Conway (1991) state that claims and access are intangible assets of a household. Claims are demands and appeals which can be made for material, moral or other practical support or access. This support may take the form of food, implements, loans, gifts or work. Claims are often made in times of shock or when other contingencies arise. Claims may be made on individuals or agencies, on neighbours, patrons, chiefs, social groups or communities, or on NGOs, governments or on the international community, including programmes for drought relief, or poverty alleviation. They are based on a combination of right, precedence, social convention, moral obligation and power. Access is the opportunity in practice to use a resource, store or service or to obtain information, material technology, employment, food or income. Services include transport, education, health, shops and markets. Employment and other income generating activities include rights to common property resources (CPR) such as fuel wood or grazing on state or communal lands.

Reliance on relief food from the government by the respondents was 37% and below 5% in Endana and Rumuruti respectively while reliance on kinship ties for support was 17% in Endana and 16% in Rumuruti. By keeping the wildlife off the farms subsequently increasing the amount harvested due to reduced crop damage and raiding the barriers were able to reduce dependence of the households.

Stores and resources are tangible assets commanded by a household. Stores include food stocks, stores of value such as jewellery and woven textiles, and cash savings in banks or co-operative societies and credit schemes. Resources include land, water, trees, and livestock, farm equipment, tools and domestic utensils. Assets are often both stores and resources. With reduced dependence it means the households are able to stock the resources and stores available to it enhancing livelihood security. Households are also able to invest in claims and access with reduced dependence by not calling on or utilizing its existing stock of claims and access either to the provincial administration or to relatives in other parts of the country.

In addition to direct and physical benefits, adequate and decent livelihoods can and often do have other good effects. They can improve capabilities in the broader sense of the term by providing conditions and opportunities for widening choices, diminishing powerlessness, promoting self respect, reinforcing cultural and moral values, and in other ways improving the quality of living and experience.

5.2.4 Security

In the assessment of effects on livelihoods, the outcomes of different livelihood strategies do not necessary need to have a direct impact on the livelihoods of an area. The conditions within which strategies are applied by households to spread risks or reduce vulnerability determine the outcomes of the various livelihood strategies. Not all impacts of a project on livelihoods will be direct (resulting into an increase in the natural capital or financial capital). A range of other impacts important to people's lives, not just on cash or physical outputs are also generated.

In Endana 77% of the respondents and 42% in Rumuruti indicated that harmony or a sense of well being brought about by increased security was a benefit derived from the barriers. In as much as there were no direct physical benefits brought about by security, the respondents were of the opinion that their lives were much better as they were not scared anymore. In Endana the respondents claimed that general insecurity in the area had been brought about by human wildlife conflict and this had gone down tremendously after the construction of the fence.

Respondents were asked if there was increased freedom and security for people and school going children after the barriers were developed. 90% and 36.4% of the respondents in Endana and Rumuruti respectively, said that there was increased freedom of movement and security in their respective localities (Table 13). The perception of increased security was quiet high in Endana and this could be related to the effectiveness of the fence in keeping out animals considered dangerous. It was also established from informal interviews that the general security in Endana had greatly improved after the construction of fence. There had only been one case of attempted livestock theft after the fence was put up in Endana as compared to the period before where cases of cattle rustling were quiet high. Although the electric fence was intended to keep wildlife away, it has now become a deterrent to cattle rustlers.

Chart 32 Perceptions on Security and Increased Movements

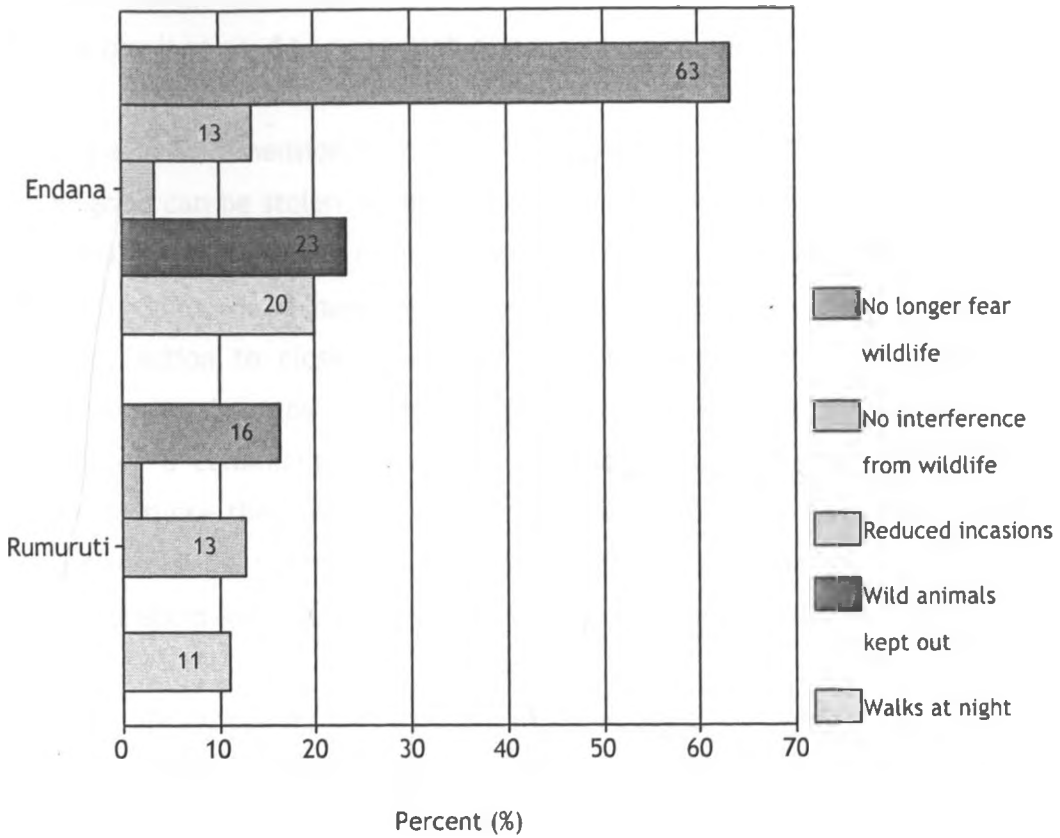


Table 13 Increase in Freedom of Movement and Security

Locality of respondent	Yes	No
Endana	90.0%	10.0%
Rumuruti	36.4%	63.6%
Total	55.3%	44.7%

After the fence was put up 63% of the respondents in Endana are no longer scared of wildlife while 13% feel that there is no longer interference from wildlife. Increased freedom of movement and security was linked by 23% of the respondents to wildlife being kept out of the settlement and 20% said they are now able to walk at night without fear (Chart 32). From the statistics above and earlier sections, a trend has emerged that clearly reflects the effectiveness of the fence in Endana in reducing human wildlife conflicts compared to the ditch in Rumuruti. The fence has had a bigger impact on the livelihoods of the people of Endana and the people seem to be content that the strategy has met the goals or needs for which it was established. On the other hand, the respondents in Rumuruti perceived the ditch as having been a short term measure (with hindsight) and more needs to be done. Evidence from literature has indicated that no ditch dug to deal with the wildlife

menace has worked in Kenya and Rumuruti seems not to be a case away from the norm. The findings from this study indicate that the failure of the ditches to keep wildlife at bay is related to poor ditch design and maintenance.

Security is a basic dimension in livelihood sustainability. Assets can be vulnerable. Stores of grain can be stolen, or destroyed by floods, fire or pests. Households can be deprived of their resource rights. Claims may be lost, as with death of a relative on whom a claim would have been made. Even access may disappear, as with government action to close a school or health centre. A feeling of enhanced security brought about by an intervention is therefore a positive impact on the livelihoods of a community. This is an impact felt at the community level as compared to those that are felt at household level. However the knowledge that household resources, stores and assets are safe is an addition to the capabilities within a household as it encourages participation in a range of diverse activities.

“We were always calling for help.....from the Police & Administration Police to chase after cattle rustlers and from KWS to chase away wildlife”

“This area has become safe again. Now I can go visit my friends at night or stay at the centre till late. We are not scared anymore of wildlife or bandits. Before the fence we had to run home and lock ourselves inside the moment it struck 6 o'clock. Even the police at the police post have nothing to do because we have no problem of insecurity.....before the fence gunshots used to rule the night as bandits attacked and robbed us. The Anti Stock Theft Unit (Kenya Police) even knew us!!!” “We have released resources spent on us by government to other areas” (Mr. Wachira, Chairman, Endana Self Help Group)

The two statements above from Mr. Wachira the chairman of the Endana Self Help Group and also the committee selected to manage and maintain the fence reflects the impact the fence has had on the security situation in Endana. Apart from just keeping wildlife out of the settlement, it seems that the general security situation in the area has improved. At the time of the field surveys criminal activity had declined in the area.

5.2.4 Testing of Hypothesis

The study also embarked to test if there was an association between the construction of physical barriers and the reduction of human-wildlife conflict in the two study sites. A chi-square test was applied to test the null hypothesis as stipulated below.

Null Hypothesis (H_0): There is no significant relationship between the construction of wildlife barriers and the reduction of human wildlife conflict.

Alternative Hypothesis (H_1): There is a significant relationship between the construction of wildlife barriers and the reduction of human wildlife conflict.

Benefits of the fence		Endana	Rumuruti	Total
Increased crop yields	Count	27	32	59
	Expected Count	20.8	38.2	59.0
No response	Count	3	23	26
	Expected Count	9.2	16.8	26.0
Total	Count	30	55	85
	Expected Count	30.0	55.0	85.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	9.256 ^b	1	.002		
Continuity Correction ^a	7.818	1	.005		
Likelihood Ratio	10.408	1	.001		
Fisher's Exact Test				.003	.002
Linear-by-Linear Association	9.147	1	.002		
N of Valid Cases	85				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 9.18.

Symmetric Measures

		Value	Asymp. Std. Error ^a	Approx. T ^b	Approx. Sig.
Interval by Interval	Pearson's R	.330	.086	3.185	.002 ^c
Ordinal by Ordinal	Spearman Correlation	.330	.086	3.185	.002 ^c
N of Valid Cases		85			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Based on normal approximation.

Benefits of the fence		Endana	Rumuruti	Total
Release of labour	Count	10	12	22
	Expected Count	7.8	14.2	22.0
No response	Count	20	43	63
	Expected Count	22.2	40.8	63.0
Total	Count	30	55	85
	Expected Count	30.0	55.0	85.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.342 ^b	1	.247		
Continuity Correction ^a	.809	1	.369		
Likelihood Ratio	1.313	1	.252		
Fisher's Exact Test				.303	.184
Linear-by-Linear Association	1.326	1	.250		
N of Valid Cases	85				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 7.76.

Symmetric Measures

	Value	Asymp. Std. Error ^a	Approx. T ^b	Approx. Sig.
Interval by Interval Pearson's R	.126	.111	1.154	.252 ^c
Ordinal by Ordinal Spearman Correlation	.126	.111	1.154	.252 ^c
N of Valid Cases	85			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Based on normal approximation.

According to the statistics above, the Null Hypothesis is thus rejected and concludes that there is a significant relationship between the construction of physical barriers and the reduction of human-wildlife conflicts⁵.

⁵ Further tests of the hypothesis are in the appendices at the end of the report.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

6.0 Introduction

This chapter brings together lessons drawn from the analysis of human-wildlife conflict of Laikipia district. The effect of human-wildlife conflict on the livelihoods of the households in the two study sites has already been established from the preceding chapters. The strategies put in place to deal with the conflict and the effects they have on the livelihoods of the locals have also been outlined. This chapter concludes by providing recommendations on the way forward in terms of resolving human wildlife conflicts and suggests interventions or strategies for doing so. The first part of the chapter highlights the emerging issues from the study; the second part of the chapter presents the conclusions while the final part of the chapter highlights the recommendations and areas for further research.

6.1 Emerging Issues

Several issues have emerged from the preceding chapters which can be categorized into: the types of conflict and problem animals, efficiency of the barriers, their impacts on rural livelihoods and their management in the respective areas. A trend has also emerged that demonstrates the variations from management to perceptions on the level of conflicts between the two study sites. The people of Endana seem to be satisfied with the results of their fencing project compared to the respondents in Rumuruti who perceive the ditch as not having been effective in dealing with human-wildlife conflicts. Below is an assessment of the emerging issues.

6.1.1 Wildlife Fences versus Ditches

From the analysis in chapter 4, it has emerged that the fence is more effective than the ditch in reducing human-wildlife conflicts. All of the respondents in Rumuruti stated that human wildlife conflicts in whatever form continued to be experienced after the ditch was dug compared to 56.7% in Endana. The respondents in Rumuruti also reported that a high level of crop raiding was still present. Observations from the field confirmed this situation as several fields were raided by elephants and bush pigs at the time the household survey was carried out. Existence of HWC was much lower in Endana compared to Rumuruti. The most problematic animal remained the elephant in Rumuruti while this changed in Endana after the fence was constructed.

Several authors have indicated that projects that used ditches as a management strategy for dealing with human-wildlife in Kenya have all failed. It has emerged that in this respect Rumuruti is no different. Observations from the field bore evidence to this as elephants and bush pigs were able to cross over the ditch to raid crops in the settlements. In some sections the ditch had begun filling up due to damage from livestock and people passing and also soil erosion during the rainy season. As much as the ditch was able to reduce conflicts in Rumuruti when it was constructed, this was short-lived as the animals especially elephants became habituated to it. Most of the respondents indicated a drop in the frequency of attacks and an increase in production within the first wet season after the ditch was dug but the situation went back to “normal” soon after the first harvest.

On the other hand the response from the households in Endana was more positive in regard to the effectiveness of the solar fence in reducing human-wildlife conflicts. 90% of the household reported increased levels of security and movement had been experienced in the area after the erection of the fence. The fence is clearly in good condition and the construction materials were of good quality. Interviews indicated that the fence had on several occasions repulsed elephants from getting into the settlement from the side of the ranch.

Mburu (2003) states that the desire to fence is greatly supported by savings in guarding costs and losses from crops and livestock that landowners receive from the fences installed in areas experiencing human wildlife conflicts. The interests of the landowners are therefore to derive full benefits out of the fencing initiative through the enhancement of farming activities. This is clearly evident in Endana where 90% of the respondents have experienced an increase in crop yields compared to 58% in Rumuruti after the fence was erected. In Endana 77% of the respondents experienced harmony with wildlife compared to 42% in Rumuruti, while 33% in Endana perceived there was reduced dependence compared to 7% in Rumuruti.

The two study areas experienced varying intensities and variations in the types of impacts brought about by the different physical barriers. From the analysis of data it was clear that the impacts were felt more in Endana after the fence was erected unlike in Rumuruti where the residents were dissatisfied with the ditch that was dug to deal with human-wildlife conflict.

6.1.2 Livelihoods

Rural livelihoods are generally dependent on the natural resource base, relying mostly on land for productive purposes. Land size is therefore an important component in determining the livelihood strategies applied by a household in pursuit of different livelihood outcomes and also in spreading risks associated with reliance on the natural resource base. Vulnerability to shocks and household stresses can therefore be significant in situations of small land holdings or sizes especially coupled with no other sources of income.

One of the emerging issues is that the respondents in Endana were more vulnerable to risks and shocks associated with losses from human wildlife conflicts. With land sizes averaging not more than 2 acres in a fragile marginal environment, the households in Endana are more susceptible to unsustainable livelihoods due to their reliance on crop production. That is why the fence had a bigger impact on the livelihoods as they were more at risk of losing their entire crops compared to Rumuruti. The livelihood strategies in Endana are based on diversification and reliance on claims to the central government. The respondents in Endana rely on a combination of crop and livestock production with livestock acting as a store to be utilized in times of drought or crop loss. It also emerged that in times of drought the only option available to most of the households in Endana was to rely on relief food from the government.

In Rumuruti the livelihoods are more reliant on crop production. As much as a combination of crop and livestock production is also undertaken in Rumuruti, the importance attached to livestock in the livelihoods is not as high compared to Endana. The land holdings in Rumuruti are larger and in an area more suitable for agriculture compared to Endana with some having holdings of more than 20 acres. Losses to crop raids would therefore have fewer impacts in Rumuruti compared to Endana. The larger land sizes in Rumuruti also allows for diversification of crop typology, scattering of fields, etc which is not the case in Endana

When asked what else could be done to improve livelihood security, the respondents in Endana said that they should be provided with water to enable them to carry out irrigation. Due to the vulnerability of their livelihoods to human wildlife conflicts the residents in Endana had more reasons to pursue an intervention that would bring the conflicts to an end or at least reduce them to

levels less threatening to their livelihoods. Although both areas were (or still are) at risk of human-wildlife conflicts and the subsequent losses, livelihoods in Endana are more vulnerable. The coping mechanism and livelihood strategies available to Endana remain little even after the erection to of the fence due to the nature of their natural resource base: poor ecological conditions for rain-fed agriculture and small land sizes.

Even when crop raiding was at its highest points both areas continued to grow maize and beans and in some cases potatoes yet according to them, these were the crops most raided by wildlife. This can be associated to the importance attached to maize and beans by the respondents and their livelihoods. It is often the assumption that peasant or small scale agriculture is not market oriented but the emphasis on maize and beans in the face of destruction from wildlife can only be explained by the relative ease of getting a market for maize and beans when the need arises. The respondents are able to easily sell produce to pay for other services and are therefore reluctant to change the crop typology due to availability of a market for their produce.

6.1.3 Management of Barriers

Although both areas claim to have committees or associations responsible for the management of the barriers, the ditch in Rumuruti is not well maintained. There are several places where the ditch has been filled up by wildlife or livestock or people crossing over to the forest. What emerges is the lack of a feeling of ownership of the ditch by most respondents compared to those in Endana. In fact the project was not completed as the digging came to an end when the relief food assigned to the food for work programme came to an end. Some of the residents said they were still owed food for the work they did.

In Endana, the construction of the fence was completed and eventually handed over to the community to maintain and manage by the donor. So far the breaks on the fence have been attended to as soon as they occurred due to the desire of the community to have the fence in place. According to the chairman of the group they had suffered for too long to let the fence collapse and fall into ruins. *"We do not want to go the way of other fencing projects"*. He attributes the success of the project to community participation and personal contribution of members through provision of labour.

Though there is no empirical evidence to prove that the project succeeded due to the lack of political interference from politicians or any form of participation from the provincial administration, it was the feeling among the residents that the project would not have succeeded if politicians had been involved. The truth of this claim emerges clearly when one looks at the situation in Rumuruti. The same donor who funded the construction of the Endana fence pulled out of a project that had been proposed to fence the Rumuruti Forest because of political interference and vested interests in the project. At the time of the household survey two camps existed in Rumuruti - the local councillor against the Member of Parliament with both sides having divergent views on what strategy to put in place to deal with the wildlife menace. One side is proposing for the wildlife to be relocated from the Rumuruti forest while the other is for the erection of the fence to separate the wildlife area and the settlements. It's this infighting amongst the community and their leaders that made the donor decline to fund the fencing project.

The participation of the community in Endana in initiating the fencing project and the contribution in terms of labour has greatly contributed to its success as there is a sense of ownership of the barrier and the community believes it is for their own good. While the community participated in the digging of the ditch in Rumuruti it appears that there were no institutional structures put in place to continue managing the ditch effectively and the community had not agreed on the type of barrier to develop.

6.1.4 Perceptions on Wildlife

In Endana 50% of the respondents and 42% in Rumuruti perceive wildlife to be a source of income for the country while 33% and 31% in Endana and Rumuruti respectively consider wildlife to be of no benefit (chart 33). In Endana 13% of the respondents and 33% of the respondents in Rumuruti consider wildlife to be destructive while 55% of the respondents think that wildlife should be kept away. 17% perceive wildlife to be benefiting only the white man (rancher) in Endana.

On the other hand 95% of the respondents in Rumuruti think that the erection of an electric fence would effectively deal with human-wildlife conflicts. In Endana half the respondents (50%) feel that their livelihoods are now secure with the fence in

place and nothing else can be done in regard to wildlife to improve livelihood security in the settlement.

Chart 33 Perceptions of Respondents towards Wildlife

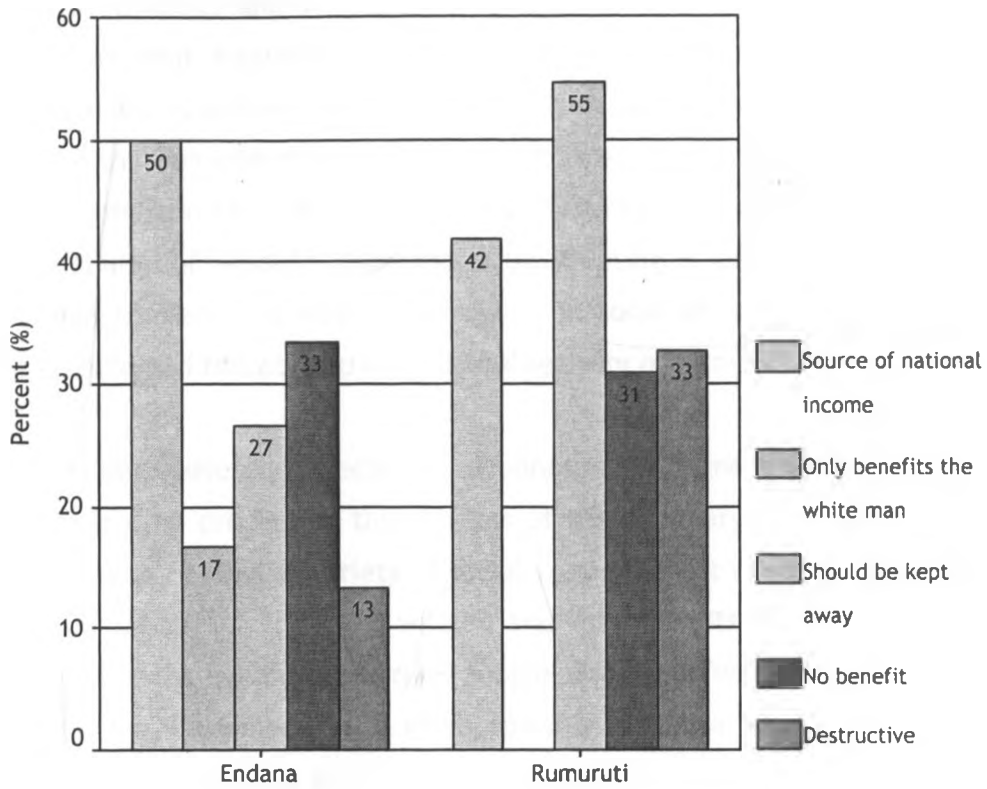
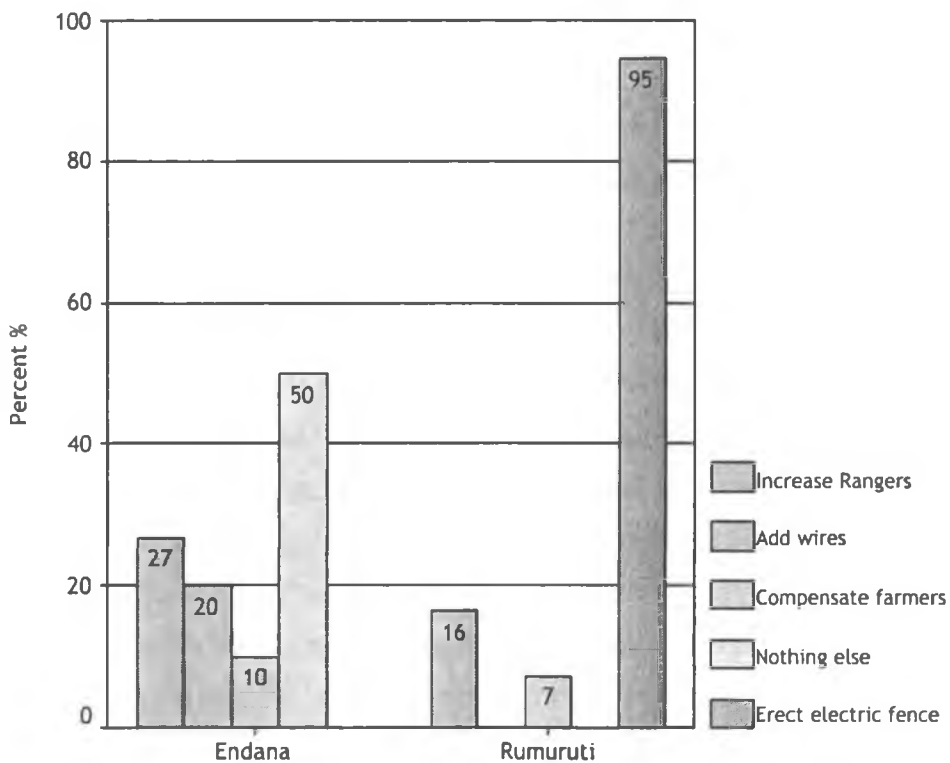


Chart 34 Perceptions on Improving Livelihood Security



6.2 Conclusions

Human-wildlife conflict is a major concern for rural development and wildlife management initiatives across Africa. This conflict typically involves damage of crops by wildlife, and solutions are generally set within a policy and legislative framework that attempts to address both wildlife management issues and rural development objectives. Many initiatives have been designed to address crop loss because this can undermine the success of other programmes related to agriculture or wild land conservation (Hoare, 1995). Human-wildlife conflict can also threaten the viability of wildlife populations by creating a confrontational atmosphere between farmers and wildlife managers. In some areas the problem is chronic, predictable and threatens the livelihood security of farmers living near wildlife.

Crop raiding severely affects the livelihoods of farmers whose main source of income is crop production through loss of their primary food and cash resources, and indirectly through a variety of social costs. In most cases the interventions put in place are meant to secure wildlife and the interests of conservationists rather than secure the livelihoods of rural people who are affected by the wildlife in their vicinity. Rural development and improvements of the livelihoods is generally an outcome of these initiatives with the main aim of the intervention being conservation of wildlife. The interventions or strategies are considered to have been successful if they lead to conservation of wildlife with no regard given to their effect on livelihoods of people living with or adjacent to wildlife.

In a study of fencing in Lake Nakuru National Park and Maasai Mara Game Reserve (Kassily, 2002) it was revealed that fencing effectively ameliorates the wildlife menace situation at the human-wildlife interface surrounding conservation areas. The author associated reduced wildlife invasions within the Lake Nakuru National Park interface with the presence of the fence concluding that people separated from wildlife by a fence are better protected than those in an area without it. The study further states that fencing of wildlife areas remains controversial among Kenyan conservationists on the grounds that it creates unviable 'islands of biodiversity'. Such areas are island ecosystems due to sharp differences in land use patterns within and without their boundaries, and not necessarily because of their being fenced in. Because it perceptibly reduces wildlife invasions of private land bordering conservation areas, fencing should, where feasible, form part of the

overall problem animal management strategy in Kenya. Effective policy responses should also incorporate livelihood needs of surrounding communities.

Stones or branches built by farmers are usually ineffective against elephants and wildlife in general. Strong non-electrified fences have worked around Kruger National Park (Osborne and Parker, 2003) but require regular maintenance. Electric fences have proven to be technically effective at limiting the movement of large mammals but the materials; installation and maintenance costs make this method impractical for large-scale applications in poorer developing countries. Thouless and Sakwa (1995) concluded that elephants do overcome modifications to fences. The effectiveness of the fence is not necessarily determined by its design, construction and voltage.

As much as we have seen the active involvement of the community in the construction and maintenance of the fence in Endana, most interventions aimed at reducing crop-loss come from organizations outside of the affected community, which include government wildlife departments and external development organizations. Farmers expect the conflict to be resolved, and when it is not, often turn against the responsible agencies. In the case of Endana the funding of the fence came from a donor and over time the maintenance costs might become more than the community is able to incur. Looking at their livelihoods and livelihood strategies, maintaining a 14km of electric fence would not be easy without intervention from outside the community. As it already stands the neighbouring ranch is actively participating in the maintenance of the fence and this shall remain the only hope for the fence if the co-operation between the ranch and the community continues.

In many cases the erection of a fence cannot be justified economically because of the low return from the crops protected and the reoccurring investment needed from a donor. Rarely is a cost-benefit analysis undertaken, and if it is, the value of the lost crops is not found to justify the cost of the fence. Farmers see it as an outside intervention that they have no responsibility for, even if financed by money generated from wildlife in their area (Osborn and Parker, 2003). Every field site has specific characteristics and it is unlikely that any single method will work in all situations. The factors that contribute to human-wildlife conflict range from or include geographical, social, cultural, historical, political and economic factors.

Most policy responses fail to take into account issues of tangible benefits to farmers who live with the wildlife menace, or farmers are told that some abstract benefit will be forthcoming.

The analysis of data collected from the household survey has revealed the socio-demographic characteristics of the respondents to be vulnerable to the threat of human-wildlife conflicts. In Endana the fence was able to change this by significantly reducing the levels of conflict and enhancing livelihood security. On the hand the ditch in Rumuruti has not been effective, having only reduced human-wildlife conflicts for a few months before the animals became habituated to it and finally getting ways of crossing over and damaging crops and infrastructure in the settlements adjacent to the fence.

A large proportion of the respondents appreciate the importance of wildlife to the economy of the country but they are the ones who live with the wildlife without any benefits accruing from wildlife. Unresolved human-wildlife conflicts in the long run affect their perceptions and participation in any conservation efforts. The local people also have little faith in the Kenya Wildlife Service and its staff because they feel let down by the institution for not controlling their wildlife. It was noted that 17% of the respondents in Endana perceived wildlife as benefiting the rancher. This feeling has come about because the ranch is able to co-exist with wildlife and also the changing scenario in Laikipia in which more and more ranches are taking up wildlife utilization schemes through game ranching and establishment of lodges in the ranches. This is possible for the ranchers because unlike the people in Endana they do not rely on a subsistence economy comprising of small scale production of food crops. The perception of wildlife as destructive by 33% of the respondents in Rumuruti is a reflection of the frustration they under go as their livelihoods are put at risk by wildlife. It is no wonder that 55% of small scale farmers want wildlife kept away from them.

Without regular maintenance, physical barriers are unlikely to be effective in reducing human-wildlife conflicts in Laikipia. Regular maintenance requires labour and other resources which the affected communities are unlikely to afford because currently their primary concerns are directed at providing the needs of their families. These are noted above calls for interventions and support by agencies outside the affected areas. No other agency has a larger mandate and resources for

the welfare of the people and the wildlife in the country than the government. This implies the need for the development of partnerships between the government, conservationists and the affected communities.

6.3 Recommendations

From the review of literature it's clear that fencing is seen as an effective barrier for dealing with human-wildlife conflicts from the perspective of keeping wildlife out of human settlements and also for protecting wildlife from human interference or poaching. There is however a disclaimer to this. The effectiveness of a fence is determined by various factors and not necessarily by the design, construction or voltage. Fences also require constant maintenance for them to be effective and in some situations a combination of fencing and other strategies are required to deal with human-wildlife conflicts and its effects on the livelihoods of people living with wildlife or adjacent to protected areas. There is however no doubt on the practicability of wildlife fences in dealing with human-wildlife conflicts as they are in use in several African countries: Kenya, Zimbabwe, South Africa, etc with varying degrees of success.

Several authors (Hoare, 2003, Muruthi 2005, Nelson et al, Thoules and Sakwa, 1995) state that ditches have not worked in Kenya due to a number of reasons, simple ditches along the Aberdares failed because elephants learnt how to break down the walls of the moat and climb through and other animals could jump across. The ditch dug in 1980 across Ol Ari Nyiro was plagued by corruption and incompetence from within the Wildlife Conservation Management Department (WCMD). In some places it was dug to a depth of less than 1meter nowhere was it deep and large enough to be effective. Other ditches in the country failed due to lack of maintenance. They further state that the problem with ditches is the massive investment required both to construct them and maintain them, the latter because of their extreme vulnerability to soil erosion. Wildlife and elephants in particular quickly learn to kick in the sides of trenches and cross them and are also undeterred by narrow stretches of water.

With this in mind several recommendations can be made in regard to wildlife barriers and human wildlife conflicts and its effect on rural livelihoods. It's important for the people who suffer losses from wildlife to benefit from the income derived from wildlife presence in their area. Over 70% of wildlife in Kenya

is outside the protected area network. In most parts of the country, Laikipia included, communities whose land tenure system is communal and practising pastoralism have benefited from wildlife mainly through tourism. In this rangeland or pastoral regions, including group and individual ranches the land owners can potentially absorb the impacts of HWC through wildlife utilization. Urgent measures need to be put in place to ensure that communities practising crop production also acquire some benefits for wildlife living amongst them or in an adjacent protected area or they are protected from incurring losses to wildlife.

The policy and legislative framework as it currently stands in Kenya does not allow for consumptive utilization of wildlife. Kenya banned the hunting and capture of wildlife in Legal Notice No. 120 of 20th May 1977 and also has a prohibition of trade in wildlife and wildlife products contained in Act No.5 of 1978 and Legal Notice No. 181 of 21st August 1979. A review of the policy and legislative framework is required so as to allow legal utilization of wildlife by communities in Laikipia and the country in general. Human-wildlife conflict management strategies are also not integrated within the policy and legal framework and this also needs to be done. Although fencing has been used in the country for a while no policy framework exists in KWS on how to carry out fencing or even the management and maintenance of the fences by either by KWS, the communities or donors who fund such projects. Modalities of cropping, game ranching and game farming procedures and processing and marketing of wildlife products also need careful evaluation.

KWS is not responsible for the payment of compensation to victims of wildlife damage or losses. Compensation is a quick way of offering relief to people who have suffered losses by spreading the economic burden and moderating the financial risks to people who co-exist with wildlife by reducing the negative consequences of HWC. The treasury should transfer the responsibility of paying compensation to KWS. A review of the amounts paid to victims should also be undertaken to reflect the current economic situation. Compensation should also be paid for damages to crops and predation of livestock by carnivores not only for loss of life. It's up to the wildlife authorities to come up with ways of verifying damages and losses and also with solutions to abuse of the compensation scheme through adequate controls and checks.

Areas recommended for further research include

- The efficiency of fences in reducing human-wildlife conflicts through an analysis of the design, construction and voltage of various fences in different locations,
- Land use planning and how it can be used to ameliorate human-wildlife conflicts in Laikipia and other parts of the country,
- The policy, legislative and institutional framework within which management strategies for dealing with HWC are implemented,
- A cost benefit analysis of fencing involving a comparison of the benefits derived by farmers from the fencing with the costs of fencing and maintaining the fence in the long term and
- The effects of physical barriers on the biodiversity and the implications of the creation of the “islands” by the barriers.

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Appendix

Hypothesis Tests

Benefits of the fence		Endana	Rumuruti	Total
Increased crop yields	Count	27	32	59
	Expected Count	20.8	38.2	59.0
No response	Count	3	23	26
	Expected Count	9.2	16.8	26.0
Total	Count	30	55	85
	Expected Count	30.0	55.0	85.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	9.256 ^b	1	.002		
Continuity Correction ^a	7.818	1	.005		
Likelihood Ratio	10.408	1	.001		
Fisher's Exact Test				.003	.002
Linear-by-Linear Association	9.147	1	.002		
N of Valid Cases	85				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 9.18.

Symmetric Measures

		Value	Asymp. Std. Error ^a	Approx. T ^b	Approx. Sig.
Interval by Interval	Pearson's R	.330	.086	3.185	.002 ^c
Ordinal by Ordinal	Spearman Correlation	.330	.086	3.185	.002 ^c
N of Valid Cases		85			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Based on normal approximation.

Crosstab

Benefits of the fence		Endana	Rumuruti	Total
Harmony	Count	23	23	46
	Expected Count	16.2	29.8	46.0
No response	Count	7	32	39
	Expected Count	13.8	25.2	39.0
Total	Count	30	55	85
	Expected Count	30.0	55.0	85.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	9.494 ^b	1	.002		
Continuity Correction ^a	8.142	1	.004		
Likelihood Ratio	9.895	1	.002		
Fisher's Exact Test				.003	.002
Linear-by-Linear Association	9.382	1	.002		
N of Valid Cases	85				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 13.76.

Symmetric Measures

		Value	Asymp. Std. Error ^a	Approx. T ^b	Approx. Sig.
Interval by Interval	Pearson's R	.334	.098	3.231	.002 ^c
Ordinal by Ordinal	Spearman Correlation	.334	.098	3.231	.002 ^c
N of Valid Cases		85			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Based on normal approximation.

Benefits of the fence		Endana	Rumuruti	Total
Reduced dependence	Count	10	4	14
	Expected Count	4.9	9.1	14.0
No response	Count	20	51	71
	Expected Count	25.1	45.9	71.0
Total	Count	30	55	85
	Expected Count	30.0	55.0	85.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	9.583 ^b	1	.002		
Continuity Correction ^a	7.782	1	.005		
Likelihood Ratio	9.196	1	.002		
Fisher's Exact Test				.004	.003
Linear-by-Linear Association	9.470	1	.002		
N of Valid Cases	85				

a. Computed only for a 2x2 table

b. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 4.94.

Symmetric Measures

	Value	Asymp. Std. Error ^a	Approx. T ^b	Approx. Sig.
Interval by Interval Pearson's R	.336	.107	3.247	.002 ^c
Ordinal by Ordinal Spearman Correlation	.336	.107	3.247	.002 ^c
N of Valid Cases	85			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Based on normal approximation.

Household Questionnaire

Basic Information

Name of the respondent (optional) _____

Date of interview _____ Interviewer _____

Socio-demographic

1. Gender: 1. Male 2. Female

2. Age group:

1. Below 25 years 4. 45 - 64 years
2. 25 - 34 years 5. Above 64 years
3. 35 - 44 years

3. Locality: 1. Endana 2. Rumuruti

4. Education level of the respondent:

1. No formal education 4. Post-secondary level
2. Primary level 5. Tertiary level
3. Secondary level

5. Main source of income for the household (*possibilities to more than a single response*)

1. Livestock keeping 4. Non-formal engagements
2. Crop farming 5. Others (specify _____)
3. Formal employment (specify _____)

6. Overall monthly household income estimation (Kshs.)

1. Below 5000 4. 20,001 - 30,000
2. 5000 - 10,000 5. Above 30,000
3. 10,001 - 20,000

7. Stable household number / those depending on the farm _____

8. Overall farm size of the household _____

9. Proportion of farm under crop production _____

10. Proportion of farm under livestock production (pasture) _____

11. Distance of the household from the fence line /wildlife area ___(Km or meters)

OBSERVATION SCHEDULE

12. Physical condition (tick where appropriate - one answer)

#	Narrative /issues	1-Excellent	2- Good	3-Satisfactory	4-Bad	5 NA
12a	Condition of main house					
12b	State of fencing					
12c	Status of crop production					
12d	Condition of livestock					
12e	Condition of water facilities					

Settlement History and Dynamics

13. For how many years have you been settled in the current farm? _____

14. Which part of the country is your original home?

1. Laikipia District [] 4. Other parts of Rift Valley []
2. Central Province [] 5. Other parts of Kenya []
3. Meru /Eastern Region []

15. How did the household acquire the current land? (*Possibilities to more than a single response*)

1. Inheritance [] 3. Shares in land buying comp. []
2. Direct purchase [] 4. Others []

Land Production Issues

16. What types of crops do you normally grow? (*Possibilities to more than a single response*)

1. Maize [] 4. Wheat []
2. Beans [] 5. Peas []
3. Sorghum /Millet [] 6. Others [] (Specify _____)

17. Are there some crops that the household used to grow but has since dropped?

1. Yes [] 2. No []

18. If Yes to Q17, above, which ones? (Possibilities to more than a single response)

- | | | | |
|--------------------|-----|-----------|---------------------|
| 1. Maize | [] | 4. Wheat | [] |
| 2. Beans | [] | 5. Peas | [] |
| 3. Sorghum /Millet | [] | 6. Others | [] (Specify _____) |

19. For how long has the household shunned the growing of these crops? ____ (years)

20. What pushed the household from this production system?

21. What are the household's core livestock types? (*Possibilities to more than a single response*)

- | | | | |
|-----------------------|-----|----------------|---------------------|
| 1. Cattle | [] | 4. Goats | [] |
| 2. Sheep | [] | 5. Bee keeping | [] |
| 3. Indigenous poultry | [] | 6. Others | [] (Specify _____) |

22. Has livestock numbers been affected in any way by wildlife in the neighborhood?

1. Yes [] 2. No []

23. If Yes to Q22, above, how has wildlife affected livestock production? (*Possibilities to more than a single response*)

- | | | | |
|------------------------------|-----|--------------|---------------------|
| 1. Livestock diseases /pests | [] | 3. Predation | [] |
| 2. Fodder competition | [] | 4. Others | [] (Specify _____) |

Conservation and Human-Wildlife Conflicts

24. Was the household in any way involved in the fencing project?

1. Yes [] 2. No []

25. If Yes to Q24, above, specify the role of the household in the implementation of the project.

26. What prompted the household to get involved in this project?

27. Provide a crop production comparison for the household before and after the erection of the fence;

Crop typology	Bags Before	Bags After	Comment on variance
Maize			
Beans			
Potatoes			
Sorghum /Millet			
Peas			

Pre-Fencing Approaches

28. What form of wildlife conflict did you experience before the fence? *(Possibilities to more than a single response)*

- | | |
|----------------------------------|------------------------------|
| 1. Crop raiding [] | 4. Threat to life/injury [] |
| 2. Competition for resources [] | 5. Stock predation [] |
| 3. Damage to infrastructure [] | 6. Others [] (Specify |

29. Which were the problem animals? Rank by order of most problematic.

Problem animal	Rank	Problem animal	Rank
Elephant		Lion/Hyena/Cheetah	
Buffalo		Rodents	
Baboons/Monkeys		Others (specify _____)	
Zebra/Eland			

30. How did you deal with the animal menace? *(Possibilities for more than a single response)*

- | | |
|----------------------------|---------------------------|
| 1. Artificial barriers [] | 5. Vegetation barrier [] |
| 2. Burning fires [] | 6. Shining torches [] |
| 3. Guarding [] | 7. Others [] (Specify |
| 4. Noise [] | |

31. What strategies did you apply to reduce invasions? *(Possibilities for more than a single response)*

- | | |
|-----------------------------|--------------------------|
| 1. Crop diversification [] | 4. Erecting barriers [] |
| 2. Field scattering [] | 5. Others [] (Specify |
| 3. Guarding [] | |

32. What household resources were utilized in dealing with the wildlife menace?

33. Did the conflict have an impact on education in the area?

1. Yes [] 2. No []

34. If yes to Q33, indicate how? (Possibilities for more than a single response)

1. Insecurity [] 4. Reduced concentration []
2. Child labour [] 5. Death []
3. Inability to pay fees [] 6. Others [] (Specify _____)

35. What were the crops most affected by human wildlife conflict? (*Possibilities for more than a single response*)

1. Maize [] 4. Wheat []
2. Beans [] 5. Peas []
3. Sorghum /Millet [] 6. Others [] (Specify _____)

36. Did you adjust the crop typology as a result of the raiding/damage?

1. Yes [] 2. No []

37. How did that affect your household income?

38. If the fence was not in place, how is this situation likely to affect?

Farm yields: _____

Livestock production: _____

The settled plot: _____

39. What strategies do you use to cope with the losses from human wildlife conflict?

Effectiveness of the Fence

40. Is human wildlife conflict still present after the erection of the fence?

1. Yes [] 2. No []

41. If Yes to Q40, what forms of conflict is still present? (*Possibilities to more than a single response*)

1. Crop raiding [] 4. Threat to life/injury []
 2. Competition for resources [] 5. Stock predation []
 3. Damage to infrastructure [] 6. Others [] (Specify

42. Which are the problem animals? Rank by order of most problematic.

Problem animal	Rank	Problem animal	Rank
Elephant		Lion/Hyena/Cheetah	
Buffalo		Rodents	
Baboons/Monkeys		Others (specify _____)	
Zebra/Eland			

43. Is there a reduction in the levels of human wildlife conflict after the fence was put up?

1. Yes [] 2. No []

44. If Yes to Q43, above, please explain:

45. Are there any fence breakages?

1. Yes [] 2. No []

46. If Yes to Q45, what is behind this state? (*Possibilities to more than a single response*)

1. Destruction by animals [] 4. Wire cutting by locals []
 2. Wear and tear [] 5. Fence weakness []
 3. Poor maintenance [] 6. Others [] (Specify

47. How best can these breakages be dealt with?

48. Is the community involved in the operations and maintenance of the fence?

1. Yes [] 2. No []

49. If Yes to Q48, specify the level of involvement in;

Operations _____

Maintenance _____

50. If No, how can the community be incorporated in the fence management?

Impacts of the Fencing Strategy

51. What have been the benefits of the fence?

1. Increased crop yields [] 5. Land use changes []
2. Harmony [] 6. Diversification []
3. Release of labour [] 7. Others [] (Specify
4. Reduced dependence []

52. Have you changed your land use as a result of the fencing initiative?

1. Yes [] 2. No []

53. If Yes to Q52, explain why

54. What has been the effect of fencing on physical infrastructure (fences, granaries, etc)?

55. Has there been an increase in crop production in general related to the fencing?

1. Yes [] 2. No []

56. If Yes to Q55, identify the relevant crops (*Possibilities for more than a single response*)

- | | | | |
|--------------------|-----|-----------|---------------------|
| 1. Maize | [] | 4. Wheat | [] |
| 2. Beans | [] | 5. Peas | [] |
| 3. Sorghum /Millet | [] | 6. Others | [] (Specify _____) |

57. Has there been an increase in livestock numbers in your household in particular?

1. Yes [] 2. No []

58. If Yes to Q57, quantify the increase?

Livestock typology	# before the fence	Current #
Indigenous poultry		
Cattle - local		
Cattle - dairy		
Sheep		
Goats		

59. What explains this increase? (*Possibilities to more than a single response*)

- | | | | |
|-----------------------------|-----|--------------------------------|--------------|
| 1. Reduction of competition | [] | 4. Diversification of typology | [] |
| 2. Disease reduction | [] | 5. Others | [] (Specify |
| 3. Increased security | [] | | |

60. Has there been an effect on household income due to the erection of the fence?

1. Yes [] 2. No []

61. If Yes to Q60, explain how the fence has affected household income.

62. Compared to the period before the fence, are you now able to pay school fees and services?

1. Yes [] 2. No []

63. If No to Q62, explain why this is the case?

64. Is there increased freedom of movement and security for people and school-going children?

1. Yes 2. No

65. If Yes to Q64, explain how?

66. Has your household experienced any losses due to the erection of the fence?

1. Yes 2. No

67. If Yes to Q66, account for the losses (*Possibilities to more than a single response*)

- | | | | |
|--------------------------------|--------------------------|------------------------------------|--------------------------|
| 1. Reduced access to fodder | <input type="checkbox"/> | 5. Grazing land | <input type="checkbox"/> |
| 2. Limited access to firewood | <input type="checkbox"/> | 6. Crop land | <input type="checkbox"/> |
| 3. Income loss (charcoal, etc) | <input type="checkbox"/> | 7. Building material | <input type="checkbox"/> |
| 4. Herbs/medicine | <input type="checkbox"/> | 8. Others <input type="checkbox"/> | (Specify |

68. With the fence in place, what is your perception on wildlife?

69. What else should be done to increase livelihood security in this area as related to wildlife?

70. Any other relevant comment to the subject under study:

Work Plan

	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	May	Jun	July
Research proposal												
Literature review												
Preparation of research instruments												
Data collection												
Data coding, preparation and input												
Data analysis												
Report writing												
Report submission												

Budget

Item	Description	Cost
Research assistants	5 RAs @ 500 Ksh. Per day for 10 days	25,000
DSA Researcher	1500 Ksh. For 10 days	15,000
Transport	1000km @ 32Ksh/km	32,000
Stationery	Notebooks, pencils, photocopying, etc	10,000
Research materials	Books, journals, internet, etc	5,000
Miscellaneous		5,000
	Total	92,000

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