LUCID's Land Use Change Analysis as an Approach for Investigating Biodiversity Loss and Land Degradation Project

The Dynamics of Land Use Changes and their Impacts on the Wildlife Corridor between Mt. Kilimanjaro and Amboseli National Park, Tanzania

LUCID Working Paper Number: 31

By

Christine Noe

Department of Geography
University of Dar es Salaam
P.O. Box 35049
Dar es Salaam, Tanzania

March 2003

Address Correspondence to:
LUCID Project
International Livestock Research Institute
P.O. Box 30709
Nairobi, Kenya
E-mail: lucid@cgiar.org
Tel. +254-20-630743
Fax. +254-20-631481/ 631499

The Dynamics of Land Use Changes and their Impacts on the Wildlife Corridor between Mt. Kilimanjaro and Amboseli National Park, Tanzania

LUCID Working Paper Number: 31

By

Christine Noe

Department of Geography
University of Dar es Salaam
P.O. Box 35049
Dar es Salaam, Tanzania

March 2003

Address Correspondence to:
LUCID Project
International Livestock Research Institute
P.O. Box 30709
Nairobi, Kenya
E-mail: lucid@cgiar.org
Tel. +254-20-630743
Fax. +254-20-631481/ 631499

Cite working paper as follows: Author. Year. Title. Land Use Change Impacts and Dynamics (LUCID) Project Working Paper #. Nairobi, Kenya: International Livestock Research Institute.

Working papers are available on www.lucideastafrica.org or by emailing lucid@cgiar.org.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF MAPS

BOX

ABSTRACT

This paper examines the dynamics of land use changes in Kitendeni wildlife corridor and their impacts on biodiversity. Data on land use/cover changes were obtained through interpretation of aerial photographs for 1952 and 1982 and satellite imagery for 2000. The field survey was conducted on the Tanzanian side of the corridor in Lerangw'a, Kitendeni, Irkaswa and Kamwanga villages, which border the corridor. The survey involved observations, interviews and discussions with indigenous people, previous researchers and Kilimanjaro National Park officials.

The study established that there has been expansion of agriculture and settlements into the wildlife grazing and dispersal areas. These changes have led to reduction of the size of the corridor from approximately 21 km^2 in 1952 to approximately 5 km^2 in 2001, changes in migration routes, animal numbers and distribution in the corridor. In addition, human-wildlife conflicts have increased due to land use incompatibility. The changes are mostly a result of changes in livelihood strategies, encroachment of agriculture, and breakdown of traditional management systems. However, the drivers of the process of change are among others demographic factors, government policies, economic factors, and changes in natural resources management responsibilities, traditions and attitudes of the people towards the corridor.

1.0. INTRODUCTION[1]

Mount Kilimanjaro is part of a large ecosystem encompassing Amboseli and Tsavo West National Parks in Kenya and Kilimanjaro National Park in Tanzania. The Kilimanjaro-Amboseli wildlife corridor is also known as Kitendeni corridor (Map 1.1), which links Kilimanjaro National Park in Tanzania and Amboseli National Park in Kenya. In Tanzania the corridor is in Monduli District in Arusha Region, with the southern part being in Rombo District in Kilimanjaro Region. In the Northern part the corridor cuts across the Kenya/Tanzania international border through Kajiado District to Amboseli basin. The wildlife corridor is within the West Kilimanjaro ecosystem, which has relatively high mammal species diversity and several uncommon species, including the lesser kudu (*Tragelaphus imberbis*), cheetah *(Acinonyx jubatus*), striped hyena (*Hyaena hyaena*) and patas monkey *(Erythrocebus patas*) (Poole and Reuling, 1997).

Kitendeni is the only remaining corridor that links Kilimanjaro and other ecosystems after the blockage of the former corridors to Tsavo West National Park, Arusha National Park, Meru forest and Mkomazi Game Reserve. The corridor is, however, under threat following the expansion of human activities in the area and the changing land uses over the years.
This paper examines the extent and magnitude of land use changes over the past 50 years and their impacts on wildlife in the Kitendeni wildlife corridor. Understanding the factors that have accelerated land use changes and their impacts on the wildlife corridor in terms of its size, the diversity of habitat and animal species should, therefore, assist in proposing short-term and long-term management strategies for the corridor.

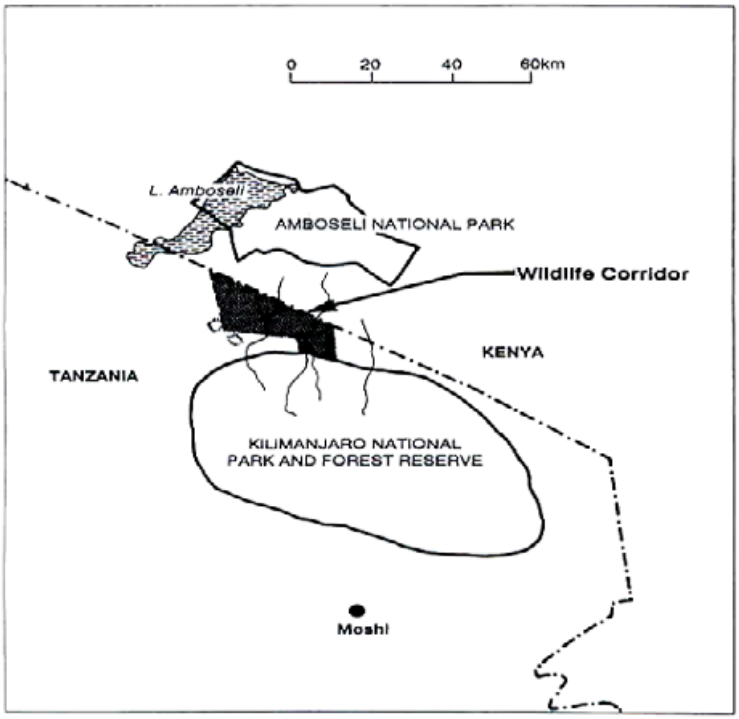
1.2 Objectives of the study

The main objective of the study was to assess the extent and magnitude of land use changes between 1952 and 2001 and their impacts on biodiversity in the Kitendeni wildlife corridor. Specifically, the study sought to:

- Assess the nature and magnitude of land use changes in the wildlife corridor over the last fifty years (1952-2001);

[1] This paper is derived from a M.A. thesis by the author from the University of Dar es Salaam Department of Geography.

Map 1.1: The location of the Kilimanjaro-Amboseli wildlife corridor on the northwestern side of Mount Kilimanjaro



Source: Newmark *et al*., 1991

- Establish the causes of such land use changes;
- Assess the impacts of land use changes on the wildlife corridor in terms of its size, the diversity of habitat and animal species.

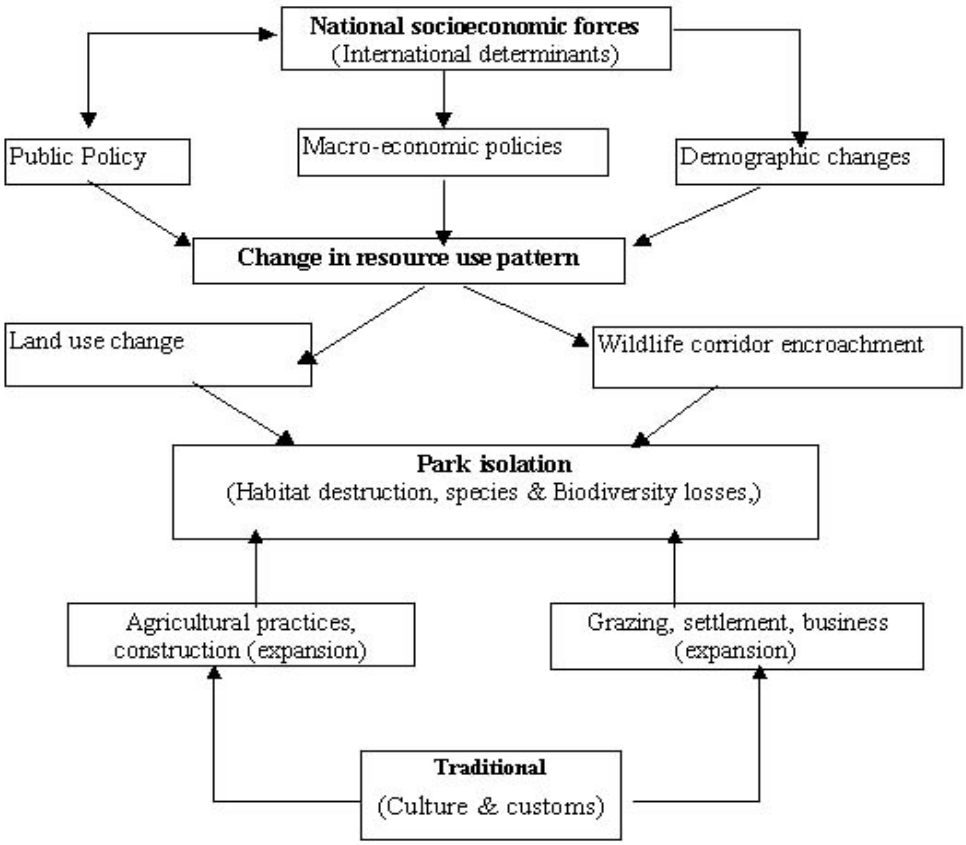
1.3 Research Hypotheses

1. There are land use changes in the wildlife corridor between 1952 and 2001.
2. Changes in land use have negatively impacted on the size of the corridor.

1.4 Conceptual and Theoretical Framework

This paper adopts the framework that was developed by Wood *et al*. (1999), in analysing the root and direct causes of biodiversity loss in Vietnam. According to them, forest degradation and loss were the most important contributors to the loss of biodiversity in Vietnam. According to them, the rapid loss of biodiversity and habitats around the world is occurring at local levels as a result of farmers clearing new fields, settlements and timber companies opening new forests for logging. The explanation for these activities, however, is often found in socio-economic forces that arise at national and international levels, which shape the decisions made at local level on the resource use patterns. The socio-economic forces referred to here include macro-economic policies, demographic changes, development biases, public policies, poverty and inequality. The changes in the resource use patterns resulting from the above mentioned forces are also associated with infrastructure construction, forest overexploitation, in-migration, pollution and land use changes. These activities, together with traditional practices cause habitat destruction and ultimately biodiversity loss. The focus of this study is on wildlife. So the framework is modified to fit the situation (Figure 1.1).

Figure 1.1. Root causes of land use change and loss of biodiversity



Source: Modified from Wood *et al.*, 1999.

The study focused mostly on demographic changes, traditional aspects (culture and customs), public and macro-economic policies as well as institutional factors, which seem to be the important factors for land use changes around most of the wildlife migration routes in Tanzania. These factors are closely interlinked and the inter-relationships among them are complex and they tend to reinforce each other. These factors lead to change in resource use patterns, which in turn lead to land use and cover changes in the wildlife corridor. The result of all these will be blockage of the wildlife corridor and habitat destruction thereby causing park isolation and loss of biodiversity.

2.0 RESEARCH METHODOLOGY

The field survey was done in four villages, namely Kamwanga, Irkaswa, Kitendeni and Lerangw'a. The selection of the sample villages depended on the number of villages bordering the corridor. The interest of the researcher was to study those villages that lie along the wildlife corridor on the Tanzanian side. Only two villages border the corridor now, these are Kitendeni and Irkaswa but these villages split recently from Lerang'wa and Kamwanga, respectively. The assumption was that these newly established villages were a result of encroachment on the wildlife migratory route. Ideally, the sample population was to be 15% of the total number of people in each village. As a result 30 people were interviewed in each of the three villages, namely Lerangw'a, Kitendeni and Kamwanga while only ten were interviewed in Irkaswa village (Table 1.1).

Table 1.1: Number of households interviewed in the study villages

Village	Number of households	Number of interviews	Percentage
Kitendeni	78	30	38.5
Lerangw'a	477	30	6.3
Kamwanga	582	30	5.2
Irkaswa	501	10	1.9

Source: Field data

There was a conflict between the Irkaswa village council, KINAPA and Monduli District Council following the encroachment on the wildlife corridor by the villagers who wished to settle and cultivate in the area of the corridor. Consequently, villagers were not willing to talk about the corridor and therefore only ten were interviewed.

2.1 Types and sources of data

The study used two major categories of data, namely, primary and secondary data. Primary data covered information about human activities in relation to wildlife ecosystem, population dynamics and land use changes in the study area. These data were obtained from villagers, park authority and NGOs that have undertaken research in the study area including African Wildlife Foundation (AWF) and a Maasai pastoralist's development organization (Inyuat E-Maa) as well as from interpretation of aerial photographs and satellite imagery. Interviews and discussions were made with villagers, KINAPA Chief Park Warden and Community Conservation Services officer, AWF's researcher and Inyuat E-Maa public relation officer.

Secondary data included other research findings and experience from different case studies and focused on the land use changes and their impacts on wildlife in terms of their habitats, number, movements and species diversity. Most of secondary data were obtained from libraries, for example the University of Dar es salaam library, TANAPA, College of Wildlife management-Mweka library, AWF library, TAWIRI, Conservation Information Centre (CIC) and Wildlife Division libraries. A land use map for 2001, which was obtained from the Monduli District Land Survey Unit, was also used to generate information on land use.

2.2 Data collection techniques

The following data collection techniques were employed; Formal (structured) and informal interviews, non-participatory observation, transect walk, group discussions, diagrams, documentary reviews as well as interpretation of aerial photographs, satellite imagery and land use maps.

2.2.1 Group discussions

The discussion focused on older people who could provide information about land use changes and their impacts on wildlife migration and species diversity over the past 50 years. Other discussions were held individually with National Park officials, including Kilimanjaro National Park Chief Park Warden, Ecologist, Community Conservation Service Officer and AWF researchers.

2.2.2 Informal interviews

Interviews were conducted on individual basis. Specifically, this technique was used to derive information about changes in land use in the study area, vegetation, animal movements, numbers, types, routes, relationship between people and wildlife for the previous 50 years and existing situation.

2.2.3 Questionnaire interviews

The questionnaire was directed to counterchecking the information gathered through informal interviews and covered information about socio-economic activities of the people, land use

practices and changes in the study area and the way these changes have affected wildlife migration and people.

2.2.4 Participatory observation and transect walk

For the transect walk, the researcher joined groups of village game scouts who patrol at the edge of the corridor where there are farms, to scare away wild animals that raid crops. The walk started at the Kilimanjaro Forest Reserve boundary to the International border. This facilitated the observation of wild animals to determine their types, the distance of farms from the corridor, crop damages, different techniques used in the farms to scare animals and changes in vegetation cover as one goes towards Amboseli National Park. Observations were also made when crossing the corridor to and from Kamwanga and Irkaswa villages.

2.2.5 Use of diagrams and pictures

Diagrams and pictures for different wild animals were used to identify animal species where the interviewer could not understand what species the respondents mentioned. The problem of misunderstanding was common where respondents used local names of animals.

2.2.6 Interpretation of aerial photographs and satellite imageries

In order to capture information about land use changes aerial photographs for 1952 and 1982, and satellite imagery for 2000 were visually interpreted to generate land use maps for the time periods.[2] The 2001 land use map, which was obtained from the Monduli District Land Survey Unit, was used for comparison to determine land use changes. Because of the different levels of resolution and quality in the air photos, satellite imagery and existing map, it was not possible to compare land uses across years with great certainty (especially to distinguish grassland, bushland and cultivation); nevertheless the data provide a general sense of land use in the various years.

2.3 Data analysis and presentation

Data collected from different sources were summarized and presented using frequency tables, charts, abundance indices, photographs and maps. The SPSS computer technique was used in the analysis of questionnaire data. With this technique, frequencies, percentages and other statistical measures were computed and then used for analysis. Descriptive analysis was also used to analyse information collected from informal interviews and information captured through observation and discussion.

Extraction of information from maps about land use changes involved technical procedures of integration using the GIS computer technique. The 1952 and 1982 were overlaid using ArcView computer program, the product of the integration being the map showing changes in land use in the study area between 1952 and 1982. Qualitative comparisons were made to derive changes in land use between 1982, 2000 and 2001 following the fact that these two maps were generated from different sources.

The land use maps were used to test the study hypotheses. Comparison of land use patterns for 1952, 1982, 2000 and 2001, tested the first hypothesis, which assumed there were land use changes in the wildlife corridor. The changes between 1952 and 1982 were virtually and mathematically derived from the integrated land use map for the two years while those for 1982, 2000 and 2001 were qualitatively derived. The second hypothesis was tested by comparing the width of the corridor in 1982 and 2001. The hypothesis assumed changes in land use have had impacts on the size of the corridor**.** Other variables like number of registered villages in the area of the corridor in 1982, 2000 and that of 2001were used to derive changes in land use. Information derived from questionnaires, interviews and observations supplemented information obtained from land use maps.

[2] Bilal Butt of LUCID-ILRI prepared the 1952, 1982 and 2000 maps using the author's data.

3.0 LAND USE/COVER PATTERNS AND CHANGES

3.1 Land use/cover patterns and change 1952-1982

Map 1.2 and 1.3 presents the major land use/cover patterns in the corridor in 1952 and 1982 respectively while table 1.2 presents the areal extent of each cover category in both years. The area of bush and scattered trees between Kitendeni and Irkaswa villages used to serve as grazing area for both livestock and wildlife. This study assumed that the area of bush and scattered trees as shown in yellow were wildlife grazing and migratory routes. It will be noted that in 1952, the major land use/cover categories were closed forest, bush and scattered trees and cultivation. Others include settlements, which were found in Kamwanga (see Map 1.2), grassland and fallow land.

Map 1.2. The 1952 land use/cover types in the Kitendeni and adjacent areas

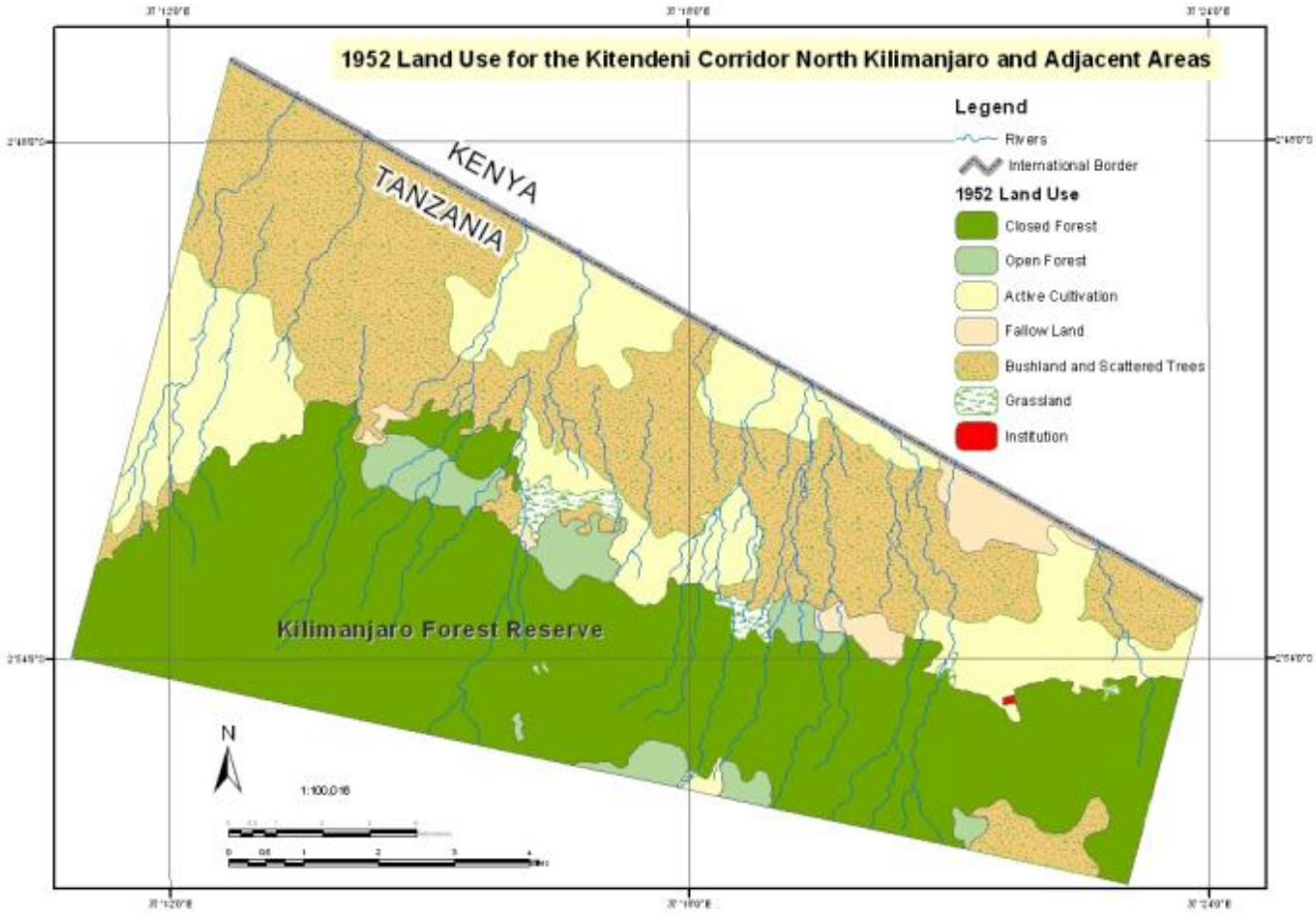


Table 1.2: Areal extent of land use/cover categories (in ha) in 1952

Land Use 1952	Hectares	Percent
Active Cultivation	4343	19
Bushland and Scattered Trees	7200	32
Closed Forest	9396	42
Fallow Land	507	2
Grassland	215	1
Open Forest	845	4
Institution	4	0
Total	22510	100

The area of closed forest was 9396 ha while the area of open forest was 845 ha. Bush and scattered trees occupied 7200 ha or 32% of the total area. This is the area that was being used by the Maasai pastoralists and wild animals for grazing, migration and dispersal. Cultivation was active in Kamwanga area, Lerangw'a along the road that joins these two areas and in few areas on the northern side towards the international boundary. About 4343 ha, that is 19% of the total area, were under cultivation. Agricultural activities were concentrated around settlements in Kamwanga area although in Lerangw'a and along the road there were no signs of settlements. This cultivation pattern suggests that people were moving from Kamwanga village to cultivate along the road and go back to the village. On the other side of the corridor, people were moving from Ol Molog village to cultivate in Lerangwá and back to Ol Molog.

Some areas seemed to have been used as farms and settlements but later were abandoned possibly as a result of the nomadic nature of the pastoral societies. This suggests that the Maasai were cultivating around their settlements while looking for good pasture in some other places. When pastures were finished they abandoned the farms and bomas and moved to other places and probably came back again after grass regeneration. Consequently, 257 ha remained as fallow land. Meindertsma and Kessler (1997) also observed the same system of rotational grazing during their study on the agricultural potentials in Monduli District. The areas under grassland occupied 214 ha. These areas are mostly found adjacent to farms and settlements and these might be the areas mostly used for livestock grazing.

The land use pattern in 1952 favoured a range of wild animals that were passing through the corridor from the forest through the areas of bush to Amboseli and back to the forest. According to responses from the key informants, the animal flows were very high from the forest reserve to Amboseli. This is also described in Child (1965), Millard (1954) and Lasan (1971). Areas between Kamwanga and Lerangw'a were used as common grazing areas for all pastoralists in the area. Farms that the Maasai referred to as gardens and areas for grazing small and sick animals surrounded the traditional Maasai bomas.

By 1982, the distribution and density of residence and farms had changed from being low and scattered to high density and nucleated (Map 1.3). In 1952 settlements were only found in Kamwanga but by 1982 there was a high concentration of settlements and farms in both Kamwanga and Lerangw'a (See Maps 1.2 and 1.3).

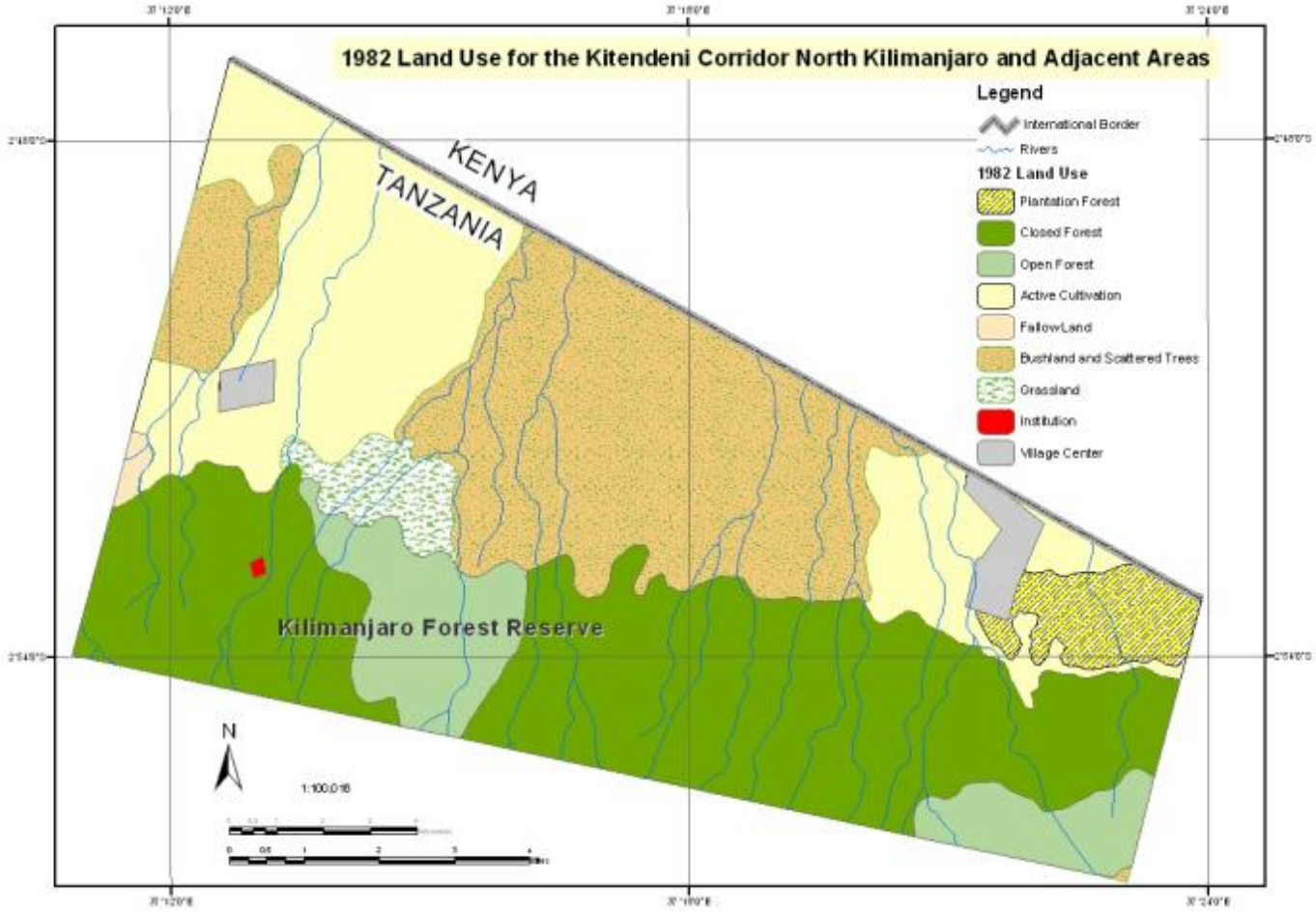
Areas of cultivation and settlement covered 4937 ha, that is, 22% of the total area (Table 1.3). The distribution of settlement and farms in 1982 could be a result of the villagization programme of 1975 that aimed to increase agricultural production and centralize socio-economic services by persuading communities scattered in small settlements to move to Ujamaa villages (Kikula, 1999). During the same period, Lerangw'a and Kamwanga villages were officially registered. The two village centres can be seen on Map 1.3.

Bush and scattered trees occupied the area between the two village centres and it covered 6120 ha, which is 27% of the total area compared to 32% in 1952. There was a decline in the area covered by bush and scattered trees and this could be a result of expansion of farms and settlements on either side of the corridor after the villagization programme of 1975. In 1952, there were scattered farms and settlements in the area towards the international boundary but by 1982 all farms and settlements had become concentrated in the village centres. In addition, some closed and open forest areas became farmlands as a result of encroachment. Other cover types include plantation (740 ha), grassland (555 ha) and fallow land (73 ha).

Table 1.3. Areal extent of land use/cover types in 1982

Land Use 1982	Hectares	Percent
Active Cultivation	4937	22
Bushland and Scattered Trees	6120	27
Closed Forest	7702	34
Fallow Land	73	0
Grassland	555	2
Open Forest	2008	9
Plantation Forest	740	3
Village Center	383	2
Institution	11	0
Total	22517	100

Map 1.3. The 1982 land use/cover types in the Kitendeni corridor and adjacent areas



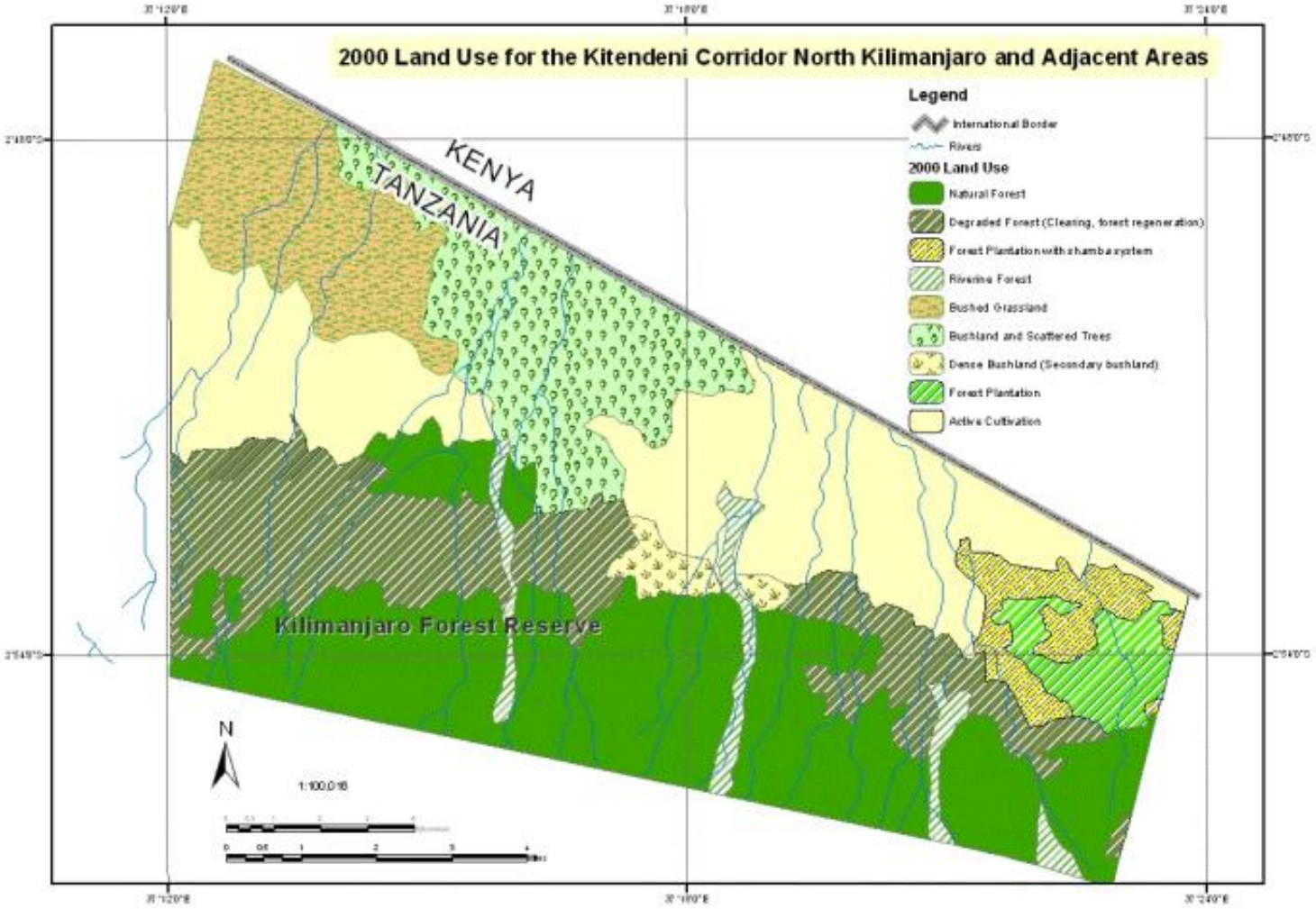
3.2 Land use/cover patterns and change in 1982-2001

The land use/cover patterns and extent of coverage of the different use/cover categories for 2000 are presented in Map 1.4 and Table 1.4, respectively. Map 1.5 presents the land use patterns for 2001. Natural forest covered 6189 ha (29%) of the study area in 2000. Some parts of the forest, however, seem to have been degraded as evidenced by the category of degraded forest, which covers 3485 ha (16%). However, this cover type could be the former open forest, which has emerged and dominated the area around the natural forest, which suggests that there are more forest clearings and regeneration in the year 2000 compared to 1982. Other cover categories include cultivation, which covered 4997 ha (23%) of the area in 2000, bush with scattered trees (2631 ha or 12%), grassland (1980 ha or 9%) and forest plantation (604 ha or 3%).

Table 1.4: Areal extent of land use/cover types in 2000

Land Use 2000	Hectares	Percent
Active Cultivation	4997	23
Bushland and Scattered Trees	2631	12
Bushed Grassland	1980	9
Degraded Forest (Clearing, forest regeneration)	3485	16
Dense Bushland (Secondary bushland)	289	1
Forest Plantation	604	3
Forest Plantation with shamba system	675	3
Natural Forest	6189	29
Riverine Forest	557	3
Total	21406	100

Map 1.4: The 2000 land use/cover types in Kitendeni wildlife corridor and adjacent areas



Compared to 1982 (Table 1.3), there seems to be a declining trend in the area under forest and bush and scattered trees in 2000 while the area under cultivation seems to have increased. New cover classes also seem to have emerged, including dense bush land (1%), riverine forest (3%) and forest plantation with shamba system (3%) (Table 1.4). The shamba system is the system whereby farmers are allowed to inter-crop annual crops with tree seedlings in the forest plantation until the third year of tree growth. By the third year, the young trees canopy casts shade, which hinders the normal growth of agricultural crops. At this point farmers move out and are allocated

other plots, if available. The absence of other land use categories on the previous maps (particularly Riverine forest) could be an interpretation error.

In 2001, cultivation and settlement seem to dominate in the area. Whereas in 2000 there were three registered villages in the area of the corridor, which were Lerangw'a, Irkaswa and Kamwanga, in 2001 there were four villages. These are Lerangw'a, Kitendeni, Irkaswa and Kamwanga villages. These villages border the international boundary in the north and Kilimanjaro Forest Reserve in the South. In Kamwanga village, 100% of the total village area was under cultivation and settlements while in Irkaswa only 48.6% was under cultivation and settlements. In Kitendeni village, 44.7% of the village area was under cultivation and settlements while in Lerangw'a 25.2% of the area was under cultivation (Map 1.5).

At present the area of the wildlife corridor occupies 2474 ha. Out of these, 88.5% is in Irkaswa village while 11.5% is in Kitendeni village. The area is basically a wildlife migration route from the mountain to the lowlands for feeding and dispersal but also it is a common grazing land for all pastoralists in the study villages.

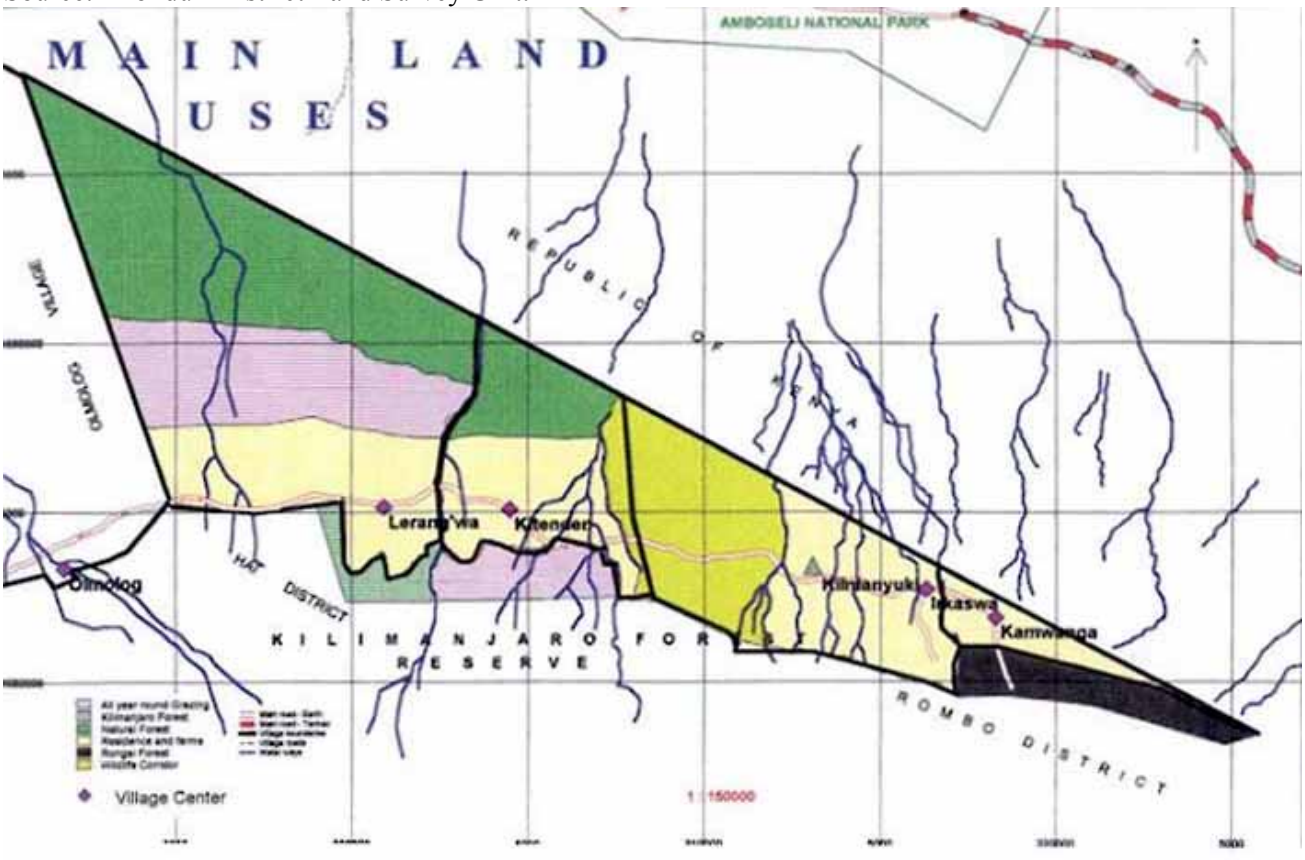
From the above, it is evident that the major land use changes that occurred in the study area during this time period are related to the conversion of traditional grazing areas to farms and settlements. As observed in previous sections, back in the 1950s the study area was basically a traditional livestock grazing area for Maasai pastoralists and pasture was traditionally managed. Wild animals used the same area for dispersal, feeding and migration to the forest and back to the savannah in Amboseli.

The study area is within the Longido Game Controlled Area (GCAs). These are the areas of rich wildlife biodiversity put aside for the conservation of wildlife. Although in the GCAs human activities like livestock grazing, farming and settlements were allowed, pastoral activities became second to game (wildlife conservation) activities, and so were the traditional roles of managing pasture. The wildlife corridor and livestock grazing area has also been transformed from one dominated economically and culturally by Maasai herding to settlement and agriculture. Whereas in 1952 the area was dominated by closed forest and bush with scattered trees, the area covered by closed forest and bush with scattered trees had decreased by 8.9% and 3.3% of the total area, respectively, between 1952 and 1982. The area covered by cultivation increased by 2.2% while the area of open forest increased by 4.2%. While other land use/cover categories increased insignificantly, plantation forest, village centres and institutions emerged as new land use/covers.

In Kamwanga village centre, agriculture and settlements expanded into the former bush land and scattered trees that were used for grazing both livestock and wild animals. Also, the area of the bush land in Lerangw'a was transformed into farms and settlements.

In all, about 2978 ha (40%) of the area covered by bush and scattered trees in 1952 remained in 1982 while 3318 ha (45%) was changed to cultivation (Figure 1.2). The remaining 8% was changed to plantation forest, 4% to open forest and 3% to closed forest. In addition, some areas covered by grassland (97 ha) were changed to closed forest while 117 ha (58%) changed to bush and scattered trees (Figure 1.2). It will also be noted that 3318 ha of bush land representing 15.2% of the total area in 1952 were converted to cultivation by 1982.

Map 1.5: The 2001 land use/cover types in the Kitendeni wildlife corridor and adjacent areas. Source: Monduli District Land Survey Unit.



The area of closed forest that was changed to cultivation between the two time periods was only 4% of the total area. Much of the forest area (approximately 68%) remained unchanged in 1982 while 12%, 9%, 6%, and 1% changed to fallow land, bush and scattered trees, grassland, and plantation forest, respectively. In the open forest, only 5% of the 1952 area remained unchanged in 1982 while 25%, 39%, 29%, 1.5% and 0.5% changed to closed forest, bush and scattered trees, grassland, cultivation and plantation forest, respectively.

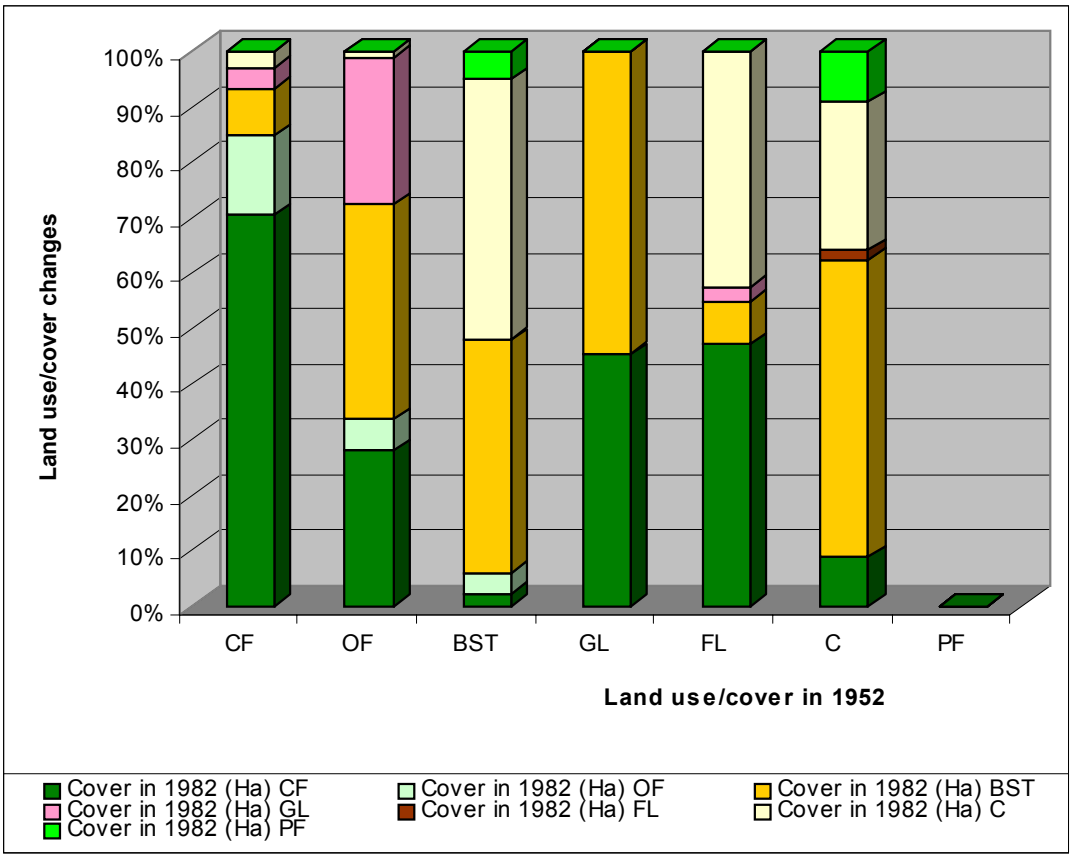
The areas covered by fallow land in 1952 were all changed to other land cover forms. While 43% was changed to closed forest, 42% was changed to cultivation. The remaining 7% was changed to bush and scattered trees while 3% changed to grassland. The other 22%, 6% and 1% were changed to plantation forest, closed forest and fallow land, respectively.

Although land use and cover changes occurred in the area between 1952 and 1982, the major land use changes seem to have occurred after 1982. This is the period when there was a transformation of the society from pastoralism to agro-pastoralism, high population growth and changes in the management of the wildlife corridor. These changes resulted in the designation of the areas formerly used for livestock grazing to the wildlife corridor, expansion of grazing activities in Kilimanjaro Forest Reserve and expansion of settlements and agricultural activities following the establishment of new villages in the corridor. By the year 2001 four villages had been established in the area of the corridor (See map 1.5). Consequently, the areas available for grazing both livestock and wild animals decreased and areas of settlement and agriculture increased.

While the average number of herders who engaged in farming activities was only 27.8% of the population in 1970s, the number engaged in farming increased to about 88.2% by the year 2001. Only 11.8% were not engaged in farming activities (Figures 1.3). Consequently, the areas

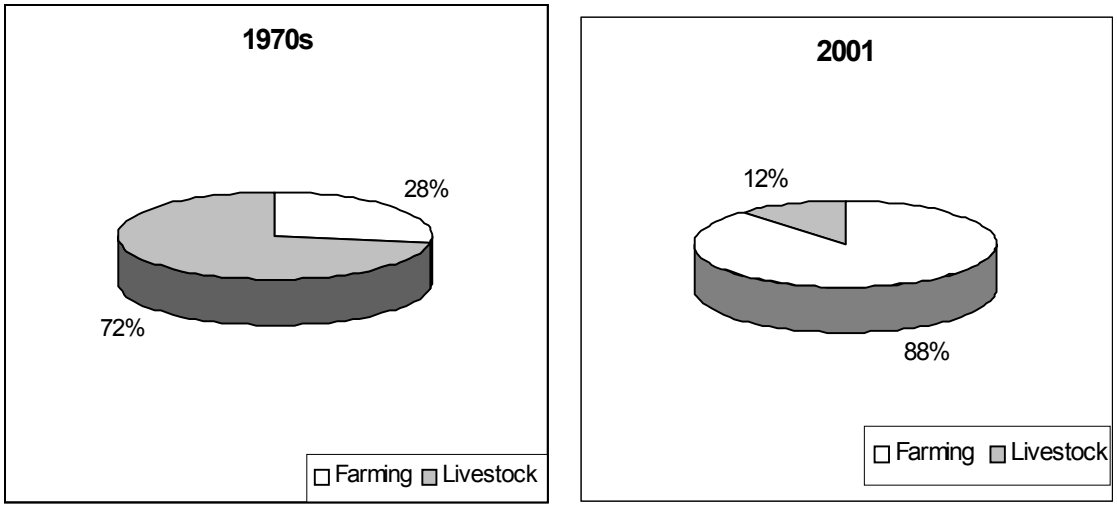
available for grazing both livestock and wild animals decreased and areas of settlement and agriculture increased.

Figure 1.2: Land use/cover changes from 1952 (horizontal) to 1982 (vertical and colour). The values are approximate.



CF = Closed Forest, OF = Open Forest, PF = Plantation Forest, BST = Bush and scattered trees, FL = Fallow land, GL = Grassland, C = Cultivation

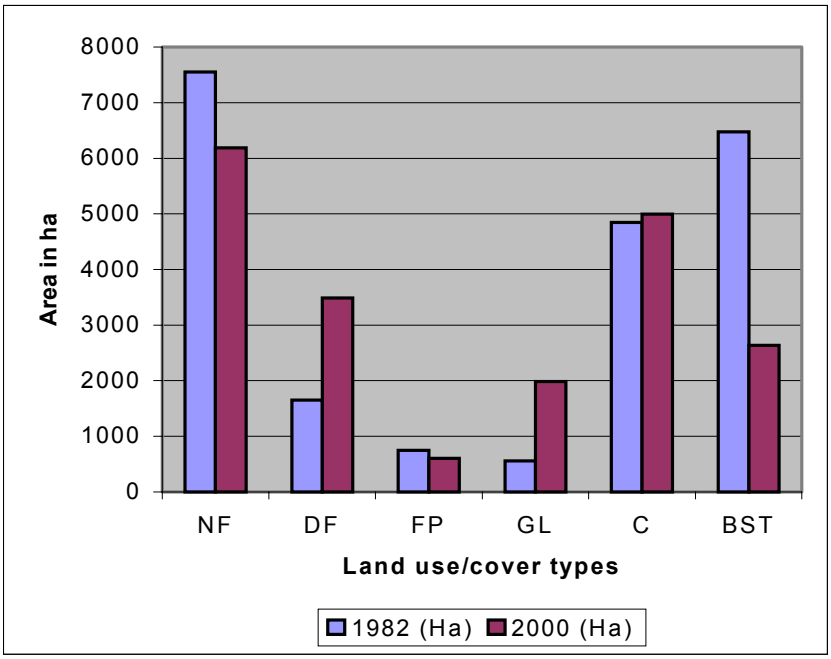
Figure 1.3. Percent of population engaged in livestock keeping and farming in 1970s and 2001



Following these land use changes, major land cover changes also occurred in the area. Closed forest changed into open and in some cases degraded forest, dense bush land and cultivation while much of the fallow land was turned to cultivation. The area covered by natural forest decreased

from 7553 ha (33.9%) in 1982 to 6190 ha or 28.9% of the total area. The area of degraded forest that could be the same as the area referred to as open forest in 1982 dominates around the natural forest, which could be a sign of encroachment into the forest. Degraded forest covered 1648 ha (7.4%) in 1982 while in 2000 it covered 3485 ha or 16.2% of the total area. Forest plantation that covered 743 ha (3.3%) in 1982 decreased to 604 ha (2.8%) most probably due to the forest shamba system, which was not there in 1982 and which covered 676 ha (3.1%) in 2000 (Fig. 1.4).

Figure 1.4. Bar chart of land use/cover in 1982 and 2000.



NF = Natural Forest, DF = Degraded Forest, FP = Forest Plantation, C = Cultivation
GL= Grassland, BST = Bush and Scattered Trees

3.3 Changes between 1952 and 2000

A comparison of land use/cover patterns between 1952 and 2000 shows an overall significant decrease of natural habitats and an increase of cultivation and settlements over the two time periods (Table 1.8 and Figure 1.5).

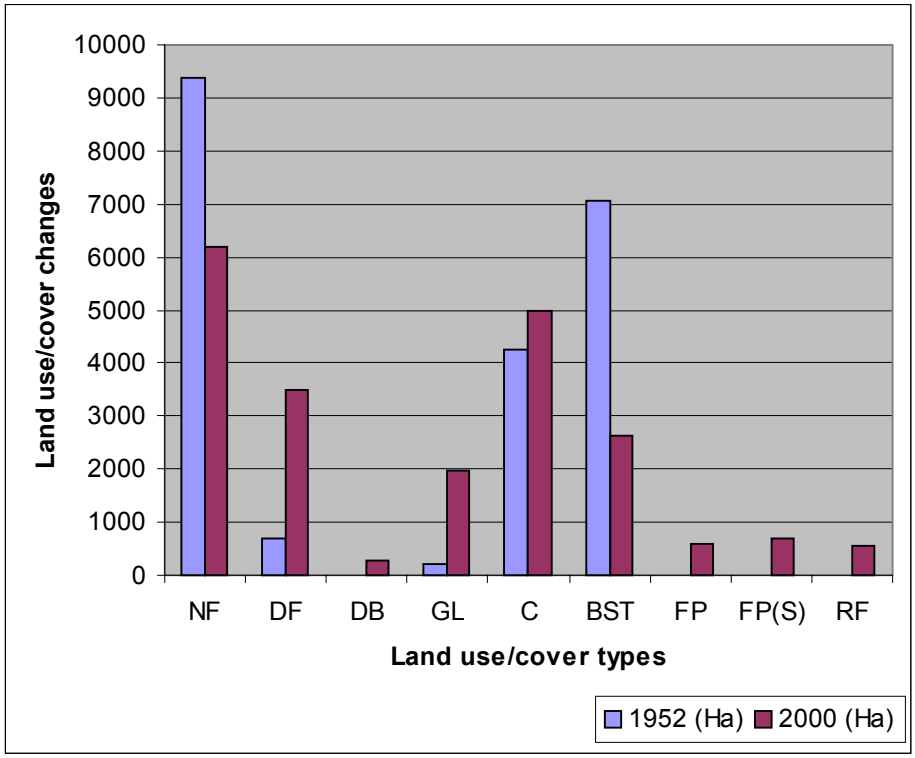
Cultivation increased from 4263 ha in 1952 to 4996 ha in 2000, which is 4.8% increase of the total land area. Bush and scattered trees, the natural habitat for wildlife in the corridor decreased from 7067 ha in 1952 to 2631 ha in 2000, which is 29.5% decrease. The area of grassland increased from 214 ha in 1952 to 1980 ha in 2000, which is 11.7% increase while the area of degraded/open forest increased from 707 ha in 1952 to 3484 ha in 2000.

The number of villages increased from one in 1952 to four in 2001, which had significant impacts on the size of the corridor, animal movements and distribution. It has also increased human-wildlife conflicts. As far as this study was concerned, the change of other land use and cover types to closed forest, bush and scattered trees were considered as positive for wildlife. Other forms of changes for instance from closed forest, bush and scattered trees to open forest and cultivation are regarded as negative changes as they caused a decline in the natural habitat and, therefore, reduced the size of wildlife corridor. It is evident from the findings that most of the land use/cover changes that occurred in the study area were negative and these had significant effects on wildlife as they caused reduction of the areas available for wild animal grazing and dispersal.

Table 1.8: A comparison of areal coverage of land use/cover types 1952 and 2000

Land Use	1952 %	2000%	Change %
Cultivation	19	23	4
Grassland & fallow land	3	9	6
Bush and Scattered Trees	32	12	-20
Dense bush	0	1	1
Plantation forest	0	3	3
Plantation forest with shamba syste	0	3	3
Degraded/ open forest	4	16	13
Natural forest	42	29	-13
Riverine forest	0	3	3
Total	100	100	

Figure 1.5 Bar chart of land use/cover in 1952 and 2000



NF = Natural Forest,
FP = Forest Plantation,
GL= Grassland,
FP (S) = Forest Plantation with Shamba System
DF = Degraded Forest,
C = Cultivation
BST = Bush and Scattered Trees
RF = Riverine Forest
DB = Degraded Bush land

Based on the land use/cover maps and statistics derived from the 1952, 1982 and 2000 maps, the research hypothesis, which states that there were land use changes in the wildlife corridor between 1952-2001 is accepted. Farms and settlements have been expanding at the expense of grazing areas for both livestock and wildlife. Three more agropastoral villages have been established in the wildlife corridor since 1952. These villages are Lerangw'a, Irkaswa and Kitendeni villages. These changes in land use were also supported by the 97.8% of respondents who said that there has been an increase of settlements and farms in the areas previously used for wildlife and livestock grazing, which have led to the reduction of the areas available for grazing and dispersal.

4.0 CAUSES OF LAND USE CHANGES

This section analyses the causes of land use changes and their associated impacts. The causes are categorized as immediate and root causes. The immediate causes are those which directly causes land use change, while the root causes are those which drive the process of change. The

immediate causes include changes in Maasai livelihood strategies, expansion of agriculture and settlements, encroachments and availability of markets for agricultural products in the study area. The root causes include changes in resource management responsibilities, demographic factors, government policies, economic, environmental and institutional factors.

4.1 Immediate causes of land use changes

4.1.1 Changes in Maasai livelihood strategies

The Maasai pastoralists depended for many years on livestock production, a type of land use that co-existed with wildlife. Milk and meat were the common food while cattle skins were used as clothes and for shoes. They did not believe that they could use plants directly to get food, rather, plants could provide food for their cattle. The dependence of Maasai on livestock only co-existed with existence of wild animals. The decline of livestock production resulting from long periods of drought, limited pasture and the outbreak of cattle disease in 1970s, however, forced them to diversify their livelihood strategies. The immediate solution was to copy from the in-migrants and produce food from their fields. As a result Maasai livelihood strategies changed from depending on livestock only to cultivation. This led to land use change from livestock grazing to agriculture. Campbell (1999) and Campbell *et al. (*2000) also noted more or less the same kind of changes in Kajiado District in Kenya.

4.1.2 Expansion of settlements and agriculture

As outlined in previous sections, until 1952 only few Maasai bomas were established in Kamwanga. Lerangw'a village started in 1975. These two villages bordered the wildlife corridor on either side. In 1992 a new village called Irkaswa split from Kamwanga village in the eastern side of the corridor. Later in 2001 another village called Kitendeni split from Lerangw'a village in the western side of the corridor. It should be noted that the expansion of villages was towards the corridor at a time when the Maasai had already changed their livelihood strategies from depending on livestock only to cultivation. Therefore, two agro-pastoral villages whose main activity was agriculture, Irkaswa and Kitendeni, were established inside the wildlife corridor.

4.1.3 Encroachments

Despite the 1991 designation of the area as a corridor and the restrictions imposed by KINAPA, Monduli District Council and Maasai leaders on settlements, people encroached on the area of the corridor for settlements and agriculture. Seven bomas and one primary school moved in after the 1991 agreement. The government, however, has recently relocated the people and the primary school from the corridor. Wild animals now use the former primary school water wells as watering points and there is a high concentration of animals in that place compared to the time when there was a school. This is also considered a land use change, which had an effect on the wild animals in terms of their distribution

Furthermore, there has been a lot of encroachment in the corridor from the people in Irkaswa village. In early 2001, the village council changed the boundary of the corridor in the Irkaswa village from Kilimanyuki area to the gully called Gari Bovu. The area between Kilimanyuki and Gari Bovu was allocated to the landless villagers, mostly youths and widows, each getting four hectares for agriculture and settlements. During this study, this area was under cultivation and settlement. Currently the corridor boundaries are between Loormotiak gully in Kitendeni village and Gari Bovu in Irkaswa village. Gradually, the area of bush land was transformed to farms and settlements. By 1982, 29% of bush and 8.9% of forest had been converted to cultivation. Other land use changes included conversion of fallow land and grassland in to cultivation and settlements.

4.2 Root causes of land use/cover changes

Root causes of land use/cover changes are the drivers of the process of change. These include demographic factors, government policies, economic, environmental and institutional factors (Figure 1.6). These factors have operated in different time scales in the study area. For the sake of this study, only factors that operated after 1950 have been included in the timeframe.

4.2.1 Demographic factors

The Maasai pastoralists inhabited the area in Kamwanga village way back in 1950s before the official registration of the villages. At that time, human population was very low and that allowed people to have many cattle because there was plenty of pasture. For a long time polygamy was practiced hand in hand with the number of cattle owned because children were needed to take care of the cattle. At the same time, cattle were needed for children to inherit.

Growth in Maasai population and in-migration contributed to land use changes that ensued in the area since the 1950s. Net migration, for example, contributed to 9.5% of the total population in Arusha region in 1967 and 11.1% in 2001 (URT, 1998). In the study area in-migrants came mainly from densely populated fertile highlands of Arusha and Kilimanjaro Regions. The Waarusha, the sedentary agricultural group of the Maasai originating from Mt Meru area were among the first groups to settle in the former Maasai area in Kamwanga village. Later, the Wachaga, who are an agro-pastoral and business group from the slopes of Mt Kilimanjaro, also joined in the early 1960s.

The increase in human population went hand in hand with the need for more areas for cultivation and settlements. As a result agriculture developed fast in the study area. The same pattern was observed on the Kenyan side of the Mt Kilimanjaro ecosystem where non-Maasai farmers and many former Maasai herders diversified into cultivation (Campbell *et al.*, 2000). These developments had problems, as the requirements for agricultural lands and settlements involved clearing of the areas previously used as grazing lands and wildlife migratory routes. Thus the growth in Maasai population and continued in-migration of farmers significantly reduced the availability of land for grazing as more land was being turned to cultivation and settlements. As a result, the average livestock herd size declined forcing many herders to seek alternative sources of income from agriculture.

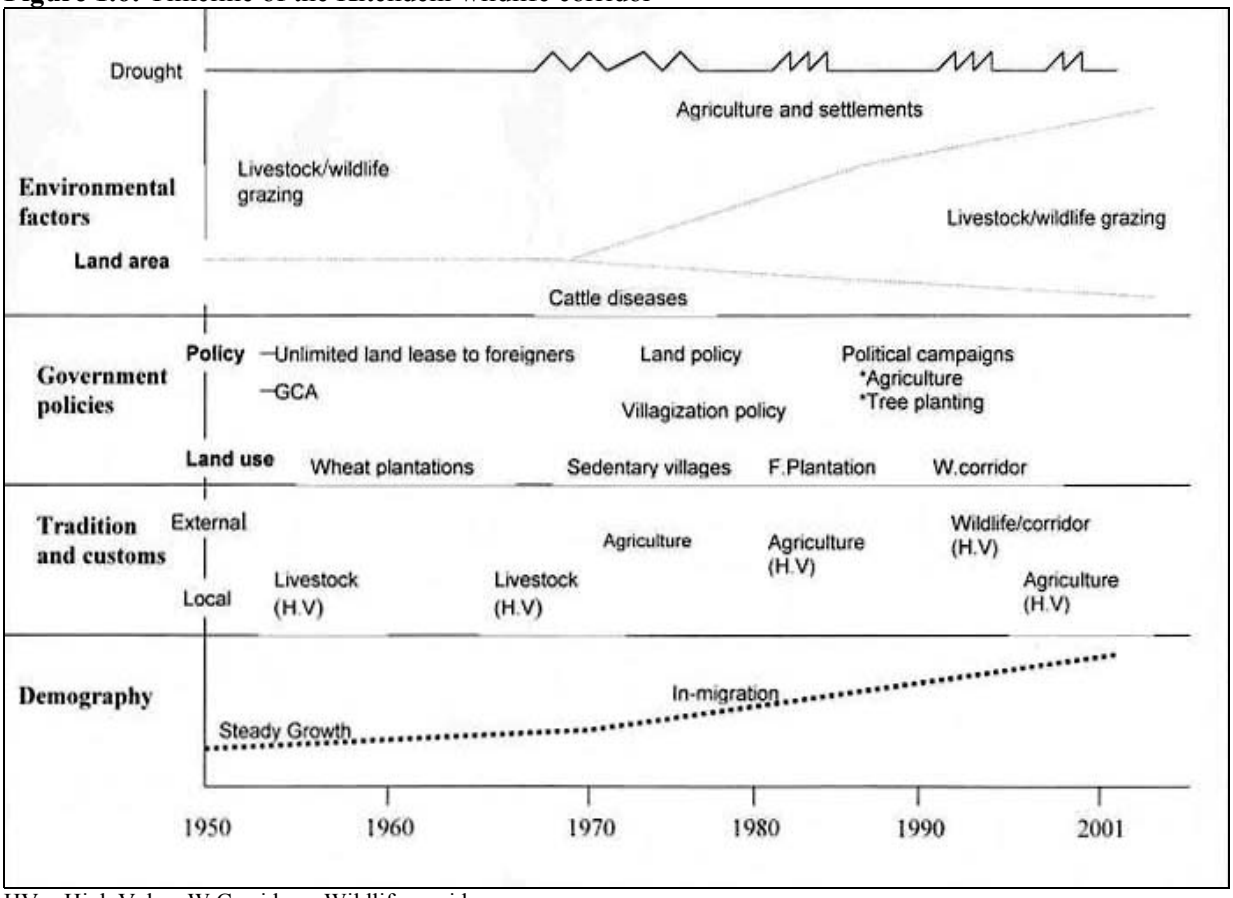
4.2.2 Government policies and legislation

The land use changes in the wildlife corridor are to a great extent associated with government policies and legislation that governed natural resources during colonial periods and after independence. The Maasai traditional land use planning became centralized and governed by colonial policies. The post independence policies inherited much of the colonial policy features in an attempt to promote the social and economic development using the available resource base. Land use planning was again done in a centralized fashion, which jeopardized the right of the Maasai to plan for their land as they used to. Consequently, this led to the changes in the way land was being used and managed by the indigenous people.

Before 1895, individuals, families or clans owned land in Tanganyika under the customary law (Nahonyo, 2001). Traditional chiefs had powers over the land and natural resources in areas under their jurisdiction. In 1895, however, the Germans confiscated all the land and declared it as public property. In that context, the German government then owned all the land and the law did not allow the transfer or lease of land by natives without approval of the government (Nahonyo, 2001). This was, however, not followed and foreigners took most of the native lands. This affected natives because most of their lands (in this case pastoral lands) were taken for large-scale agriculture. In the study area most of the land were taken and converted into wheat plantations and dairy farms.

The British introduced the Land Act No. 3 of 1923 where all the land became public land and foreigners were given unlimited land lease (Nahonyo, 2001). Again, this gave the foreigners power to take most of the native's pastoral lands for agriculture. Natives, therefore, had to occupy the land in semi-arid areas where the agricultural potentials were low (Lissu, 2000). Changes in land ownership during colonial period caused changes in land use in the former pastoral lands and occupation of the semi-arid areas, formerly wildlife grazing areas, for livestock grazing.

Figure 1.6: Timeline of the Kitendeni wildlife corridor



HV = High Value, W.Corridor = Wildlife corridor
F.Plantation = Forest Plantation, GCA = Game Controlled Area

The privatisation of the common grazing lands and establishment of wheat plantations in West Kilimanjaro in early 1950s, done under the 1923 land Act (Child, 1965) further influenced the rate and pace at which land use changed in the study area. They denied local Maasai pastoralists access to the traditional grazing lands and watering points. Much of the area was changed to plantation agriculture. Likewise the wheat farms blocked the elephant migration route from the mountain through Londorosi and Ol molog village west of the main Kitendeni corridor (Grimshaw and Forley, 1990). With time, livestock grazing areas became limited to the extent that pastoralists had to move to Ol molog area and later to Lerangw'a village (towards the wild animal migration routes) to avoid conflicts with farmers due to crop damage that could be caused by cattle. This move is considered to have reduced the area of the corridor because with time, the society changed the land use patterns from grazing to cultivation that involved clearing of pasturelands for agriculture and settlements.

The gazettement of the common grazing area into a Game Controlled Area in 1960 also contributed to land use changes in the study area. This gazettement was done under the 1896 German ordinance to protect rare species and to control hunting (Nahonyo, 2001). Although inside the Game Controlled Areas people were allowed to live, keep livestock and practice agriculture, the major land use became game activities and, therefore, livestock grazing was made a subsidiary land use. The legislation governing Game Controlled Areas, however, was too weak to protect and make wildlife conservation compete with other forms of land use. This led to encroachments into the wildlife corridor.

The post independence policies that had a bearing on land use changes in the study area include land policy, villagization policy, wildlife policy and agricultural and forestry campaigns. After independence in 1961, for example, few amendments were made to the colonial Land Act and the

changes focused only on the issues of long-term land lease until 1963. The native land including Maasai land was held under the customary law under which the status of land was vaguely defined as deemed right of occupancy. Consequently, the process of occupation of pastoral lands by agriculturists continued. Agriculture continued to be practiced on the key resources for pastoralists the dry season grazing lands for both livestock and wild animals, a phenomenon that has continued till today by the Waarusha and Wachaga.

The new Land Policy of 1995 proposes that the security of tenure for pastoralists in pastoral land areas should include measures like gazetting areas to protect grazing land from encroachments (Lissu, 2000). However, the common grazing area in the study villages was already gazetted as a wildlife corridor since 1991 (under the Monduli District by-law, Government Notice 132) to protect it from further encroachments. Although livestock grazing is allowed in the wildlife corridor, the gazettement has changed its use from being common livestock grazing area to a wildlife corridor.

Furthermore, in 1975 Tanzania adopted the villagization programme that aimed at mobilizing scattered homesteads into villages in order to incorporate them into the government hierarchy. Implementation of the programme led to the establishment of sedentary villages that were associated with establishment of farms and permanent settlements. Before 1975, there were no registered villages in the area of the corridor but there were scattered Maasai homesteads, which were surrounded by grazing areas. The concentration of settlements was only in Kamwanga Juu and Olmolog area, which were used as common social service centres.

The villagization programme led to the establishment of Kamwanga Chini and Lerangw'a villages that involved relocation of people from their scattered homesteads to clustered settlements in Lerangw'a and Kamwanga village centres. Lerangw'a is noted to have been an elephant migratory route well before the establishment of the village and that the establishment of permanent houses affected elephant migrations (Grimshaw and Forley, 1990). Irkaswa village was established in 1992 and Kitendeni in 2001. These two villages were established inside the area of the corridor, which involved clearing of natural vegetation and establishment of settlements and farms that caused reduction of the size of the corridor.

It is important also to note that agriculture is the backbone of the Tanzanian economy and that national campaigns have often involved promoting rural agricultural activities to improve national and per capital incomes and, therefore, improve standards of living. It is possible that the rapid spread of agriculture in the animal migratory route was due to the implementation of the agricultural policies and campaigns. Agriculture has been expanding at the expense of key resources for wild animal dispersal, migration and grazing.

In addition, Tanzania had no wildlife policy until 1998. Previously, protection and utilization of wildlife was dealt with by the use of guidelines, regulations and laws, which were implemented by the Wildlife Department and other institutions entrusted with the responsibility of conserving the wildlife. The relevant pieces of legislation, which governed wildlife conservation and management in Tanzania after independence were the Wildlife Conservation Act No 12 of 1974, the National Park Ordinance Cap 412 of 1959 and Ngorongoro Conservation Area Authority Ordinance Cap 413 of 1959 and amendments. These regulations and laws, however, were not effective enough to correct the overuse of biological resources and habitat degradation outside protected areas (MNRT, 1998). None of these pieces of legislation for example covered the existence of wildlife corridors nor provided legal protection to the migratory routes and dispersal areas. The absence of legal protection of migratory corridors against human abuse has made conservation attention accorded to them not viable. This was cited as a major constraint confronting the wildlife sector as wildlife corridors became more vulnerable to human activities, particularly agriculture and settlements.

4.2.3 Environmental factors

The study area experiences long periods of drought, which are associated with lack of pasture and increase of cattle diseases. A major drought occurred in the period between 1970s and 1980s (see Figure 1.6) and caused reduction of livestock numbers due to deaths. In addition, the poor pasture during dry season and long periods of drought caused livestock to be in a poor condition and become more susceptible to diseases. Apart from drought, the interaction of cattle with wildebeest during calving season caused outbreak of diseases like Malignant Catarrhal Fever (MCF) in the late 1970s (Poole and Reuling, 1997). Other cattle diseases mentioned by the respondents were trypanosomiasis, tick borne diseases, black quarter, anthrax, foot and mouth diseases, brucellosis, dermatitis and heartwater. These must have been responsible for the abrupt decline in cattle numbers in the area.

Data on livestock obtained from key informants indicated that the average number of cattle per person in 1970s was 100-1000 cattle but currently it is only 5-20 cattle per person. Some do not even have any. The Maasai's traditional responses to stress have been to draw on their flexibility to diversify their livelihood systems. The contemporary strategy has been to diversify to cultivation. Many herders have thus chosen to seek alternative ways to sustain their life and alternative sources of income from agriculture, often alongside a continued commitment to livestock production. This has contributed to land use changes experienced in the area.

4.2.4 Economic factors

Although global economic forces might have minor influence on the local economic operations, globalisation is considered to be one of the factors for land use changes. Like most other third world countries, Tanzania adopted Structural Adjustment Programme (SAP) in the early 1980s. The elements of SAP are removal of subsidies, privatisation and other reforms in macro economic policies, such as price exchange rates, trade and market liberalization. Among the elements that were to be implemented in the programme that might have influenced land use changes in the study area are commercialisation and market liberalization.

Before market liberalization in Tanzania, the government played a central role in controlling market prices through rural co-operative societies. After market liberalization in early 1990s, individual farmers had free market access and the market forces influenced prices. At present, the market for agricultural products like wheat, maize, beans and potatoes in the study villages is reliable and available in the farms at good prices because there is competition between buyers. Likewise, farmers are free to sell their crops in Kenya where prices are even higher.

4.2.5 Availability of markets for agricultural products

In Tanzania, businessmen come from the nearby towns like Sanya Juu, Londorosi, Boma and Moshi to buy crops during harvest periods and transport them to big towns like Dar es Salaam, Tanga and Arusha. In addition, farmers have access to the markets in Kenya where prices are even higher. Compared to Tanzania where a bag of maize (approximately 90kg) was being sold at 6,000 Tshs during this study, the price for the same bag in Kenya was 900 Kshs, which is equivalent to 9000 Tshs. This has, therefore, greatly stimulated expansion of agricultural activities in the area of the corridor. Also it has attracted the attention of land speculators who buy small plots from the indigenous people at higher prices, leaving the indigenous people with small plots, which are not enough for production of family food and other needs.

According to the discussion with leaders in Irkaswa village, indigenous people have sold most of their land to the in-migrants due to the higher prices for the pieces of land. This has resulted in encroachment on the wildlife corridor by the indigenous people in order to acquire more land for selling and others for agriculture and settlements.

Commercialisation of resources, which were free resources for local communities, has also influenced land use changes in the study area. Wildlife resources became commercialised when the area was designated as a Game Controlled Area. Prior to that they had no economic value and

the local Maasai were using and managing the area on the basis of society needs and priorities, which were basically livestock keeping. The commercialisation of wildlife resources has led to game activities being accorded highest priority as opposed to pastoral activities. So wildlife has essentially become a more important land use type than livestock grazing in the corridor.

4.2.6 Institutional factors

4.2.6.1 Changes in resource management responsibilities

Historically, the wildlife of West Kilimanjaro and Amboseli were accorded considerable protection and the presence of Maasai was said to keep the slave and ivory traders out of the area (Berntsen, 1979). The Maasai have for several hundred years co-existed with wildlife and protected animal populations within the ecosystem from hunting. Their long experience and traditional knowledge of their environments also allowed them to manage their environmental resources. To them land was the basic resource that was managed communally for pasture at all times of the year. Land use plans and allocations were done by traditional leaders and got blessings from traditional elders.

The area of the wildlife corridor was managed under the Maasai traditions and grazing and watering schedules were organized in such a way that no rangeland degradation occurred due to overgrazing. This maintained the ecological balance in the ecosystem. Their traditional pasture management based on the climatic factors made it possible for the pasture to be available throughout the year not only for livestock but also for wild animals. The government interference in the management of wildlife resources since 1960s, however, led to the breakdown of these traditional natural resources management systems.

In 1960, for example, the government through the Wildlife Department designated the traditional grazing area to be a Game Controlled Area for the purpose of effecting wildlife conservation. Although human activities including agriculture and settlements were allowed in the GCAs, game activities dominated and the management system also changed. Under the Game Controlled Area, resource management changed from traditional to government management through the Wildlife Department. This had an implication that the indigenous people no longer had power to plan for the land use as they used to.

The replacement of many traditional authorities with modern political entities changed the resource use patterns of the Maasai and led to the breakdown of traditional natural resources management systems. The involvement of the government not only changed the basic use of the area from being a traditional grazing area to Game Controlled Area and wildlife corridor but also traditional means by which resources were managed changed. Many traditional methods of accountability were no longer effective. Although at present local communities are involved in the management of the corridor, their need for the area to be managed as a livestock grazing area is not of any priority. The major focus is wildlife conservation. The Maasai are concerned that the new management gives more priority to wild animals than their livestock and that they will eventually lose the area they have managed for many years. Therefore the Maasai elders particularly in Irkaswa village have tried to retain their power to allocate land to the people by taking part of the wildlife corridor for cultivation and settlements.

4.2.6.2. Top-down approach to resource management

The study area is within Longido Game Controlled Area and among the nine (9) hunting blocks of Monduli district where hunting, safari walks and mountain climbing take place. The procedures for license take place in the upper levels of park management and natural resource offices in Dar es Salaam. The major concern by the villagers is that the procedures for licenses do not involve village levels, instead, villagers see hunters with license from Dar es Salaam and that they have no mandate to control the number and type of animals to be hunted.

Likewise, the resources accrued from wildlife are not ploughed back to the villages despite all the costs of living with animals. Therefore, wildlife utilization operates in top-down fashion, which

causes villagers to lose interest in wildlife conservation because they gain nothing. As a result of non-involvement of villagers in controlling hunting and sharing of benefits accrued from wildlife resources, people opt to use the wildlife areas for agriculture in order to raise their income levels.

5.0 OTHER FACTORS INFLUENCING THE PRESENT ANIMAL NUMBERS AND DISTRIBUTION IN THE MAIN KITENDENI CORRIDOR

It has been observed in the previous sections and from other studies that the areas available for animal grazing and migration, which have been reduced and replaced by farms and settlements, have largely influenced the number of animals present in the corridor. As a result, animals have been forced to use the small available area of the corridor that is approximately 5km^2 for grazing and migration instead of the previous approximately 21km^2 in the past twenty years. In addition to this, other factors also seem to have played an important role. For example, the Arusha Region and Monduli District authority, in particular, stopped issuing hunting licenses in the Longido Game Controlled Area in 1981 following the decrease in animal numbers, particularly elephants. Consequently, there was a natural animal population increase. This is the same period when Grimshaw and Forley (1990) noted the aggressive and juvenile elephant population structure in the area, which was a typical characteristic of a growing population.

Moreover, the inception of Community Conservation Services (CCS) by TANAPA in 1995 seems to have improved people's attitudes towards wildlife and the corridor, which has, in turn, led to the increase in animal numbers. The CCS programme includes providing education to the local people about the local and national benefits of wild animals through study tours, establishment of the village environmental committees and game scouts. Furthermore, the programme involves provision of social services like water, schools, dispensaries and milling machines to the villages adjacent to the National Park.

Recently, the inhabitants in the villages that border the corridor received assistance in the form of water, dispensaries and classrooms from Kilimanjaro National Park's Community Conservation Services (CCS). Villagers are aware that these services are the benefits from the revenues accrued from wildlife resources. And they appreciated this assistance. Nevertheless, people are concerned about the non-compensation of individual loss of crops in the farms. This is evidenced by one elder's view with regard to CCS as reported by one of the members of the environmental committee in Lerangw'a village (Box 5.1.)

The community in the study area is very much aware of the wildlife-based benefits, received by their Kenyan neighbours, which include compensation and control of problem animals. On the Kenyan side of the corridor, farmers are compensated for the crop damage, livestock killings and people's injury. Likewise, electric fencing for controlling crop damage is practiced. Thus, the communities on the Tanzanian side are wondering why this is not the case if really there should be good neighbourhood. Compensation and control of problem animals seem more important to them than other social services.

Box 5.1: The sentiments of one Maasai elder with regard to CCS

"These people say good neighbourliness, (Ujirani Mwema), but when my cattle enter the park to graze I am punished and fined heavily. When their elephants and buffaloes cross into my farm and clear all my beans and maize, they never compensate me like my neighbours in Kenya. Is wildlife in Kenya different from wildlife in Tanzania? They say this is our resource. No it is their resource. They have built schools, dispensaries and water pipes for the village, yes it is a good idea. But when children ask for breakfast in the morning before going to school, the reply from their mother is that there is no food. You all know Maasai never eat wild animal meat. Now how will these children go to school while they are hungry? We are both angry and hungry, is this what you call our resource and good neighbourliness?

In addition to CCS programme, the African Wildlife Foundation's (AWF) extension works with local communities, under the Protected Areas: Neighbours as Partners programme, have a long-standing dedication to educating and training villagers. As a result of all these efforts, the villagers' attitudes have changed and incidences of poaching are much more reduced because people are now guards to the wild animals; hence the increasing trend in animal numbers.

Fourthly, the Kitendeni village chairman suggested that the Amboseli animals are gradually moving further into the Tanzanian side. The basic reason could be that the Amboseli range is now very degraded and that there is not enough pasture and water for animals. Likewise there is currently electric fencing to reduce crop raiding in the farms adjacent to the Amboseli National Park. This denies the animals access to other routes to different directions except the one to Kilimanjaro National Park. As a result all migratory animals of Amboseli move towards Kilimanjaro.

The above argument was supported during discussions by one of AWF's researcher who was conducting elephant research in the Amboseli ecosystem. He argued that the total area available for elephants in Amboseli was not enough. According to the researcher, the Park area is 399km^2 while the elephant home range is 3000km^2. For the elephants to survive in such a small area of Amboseli they have to go out of the park boundaries. Likewise, other migratory species also have to go out of the park boundary when the park is dry. This therefore may explain the high concentration of animals in the corridor as observed in preceding sections.

Introduction of new plants, mainly crops may be another factor, which has influenced the increase in animal numbers and concentration in the corridor. Crops may have attracted some animals, such as rodents, velvet monkeys, warthog, gerenuk, birds, and antelope species, which have increased in the area. According to the interviews, animals, especially grazers, were rarely seen coming for pasture in the corridor, but now they stay in the corridor and farms throughout the year. These are reported to be the most destructive in the farms.

6.0 PEOPLE'S PERCEPTION ON FACTORS RESPONSIBLE FOR ANIMAL POPULATION DECLINE AND LOCAL EXTINCTION

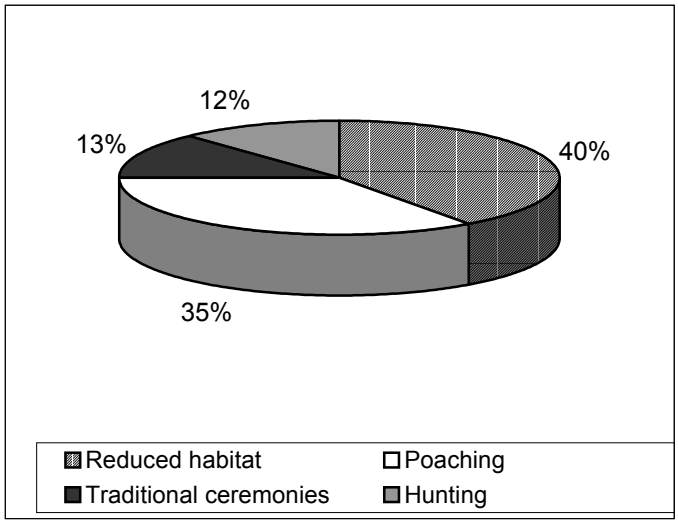
As observed in previous sections there are some animals like lions, leopards and ostrich, which have been reduced in number while rhinoceros, klipspringer and reedbuck have become locally extinct. Newmark (1993) explained that the local extinction of the rhinoceros, montane reedbuck and clipspringer in KNP/FR since the turn of the century was their historical rarity. He noted that although the rhinoceros existed in the 1960s and 70s, their numbers were lower than the other species.

The explanations given by the indigenous people for the reductions in animal numbers and extinction include poaching, hunting, reduction of habitats and Maasai traditional ceremonies (Figure 1.7). Forty percent of the respondents said that the reduction in animal numbers and local extinction results from habitat destruction and 35% said that poaching was responsible for the animal reduction and extinction. Only 12% attributed the animal reduction and extinction to hunting and 13% to traditional ceremonies.

The local people said that during the period between 1960 and 70 there were many Somalis who came in the area and stayed in the Forest reserve. These are the people villagers blamed for having poached rhinoceros and several elephants. During this period villagers found many dead elephants in the grazing areas.

The Arusha region aerial survey also found 94 dead elephants and no live elephants or rhinoceros in the area during the same period (TWCM, 1997). This period also corresponds to the period mentioned by Shemweta *et al.* (1981) that there were no rhinoceros or live elephants seen.

Figure 1.7: Factors for local extinction and reduction of animal numbers



Source: Derived from field data

According to the villagers, lions and leopards were also abundant in the period between 1960 and 80 but they are now scarce and rarely seen in the area. Forty percent of the respondents suggested that reduced natural habitats due to the increased human activities, including farming and construction activities, was responsible for the disappearance of lions and leopards. Leopards are now rarely seen in the corridor during the night while lions rarely invade cattle bomas during the night. This suggests that habitat loss and forest conversions have differently affected and will continue to affect the large mammal species in the ecosystem. Increasing isolation will most adversely affect the moorland fauna while forest conversion will most adversely affect the large mammal fauna restricted to the forest.

Traditional ceremonies are also believed to be a unique factor responsible for the reduction of lions in the area. In Maasai tradition, men were supposed to kill lions to prove their manhood after circumcision. Killing a lion was the bridge from childhood to warrior-hood and evidence that the responsible person can take care of cattle from a lion's attack. About 13% of respondents suggested this tradition to have reduced lion populations in the area to the extent that there are no more lions to kill.

7.0 IMPACTS OF LAND USE CHANGES

The land use changes have had implications on the biophysical resources of the area particularly wild animals' distribution, migration routes, species diversity and natural habitats. Also human-wildlife conflicts have increased in the area.

7.1 Impacts on the size of the corridor and natural habitat

Land use changes in the study area have had impacts on the size of the corridor and natural habitat. The size of the corridor between Lerangw'a and Kamwanga villages, which was approximately 21km^2 in 1952, has been reduced to a narrow strip of approximately 5km$^{2.}$ Apart from reduction of the size of the corridor, the new type of land uses particularly settlements and agriculture, which have emerged in the area, have led to massive destruction of natural vegetation and reduction of the area available for livestock and wild animal grazing, migration and dispersal. Although the area has been reduced, it remains significant as a grazing area and migratory route of wild animals (KWS, 1991).

7.2 Impacts on animal movements

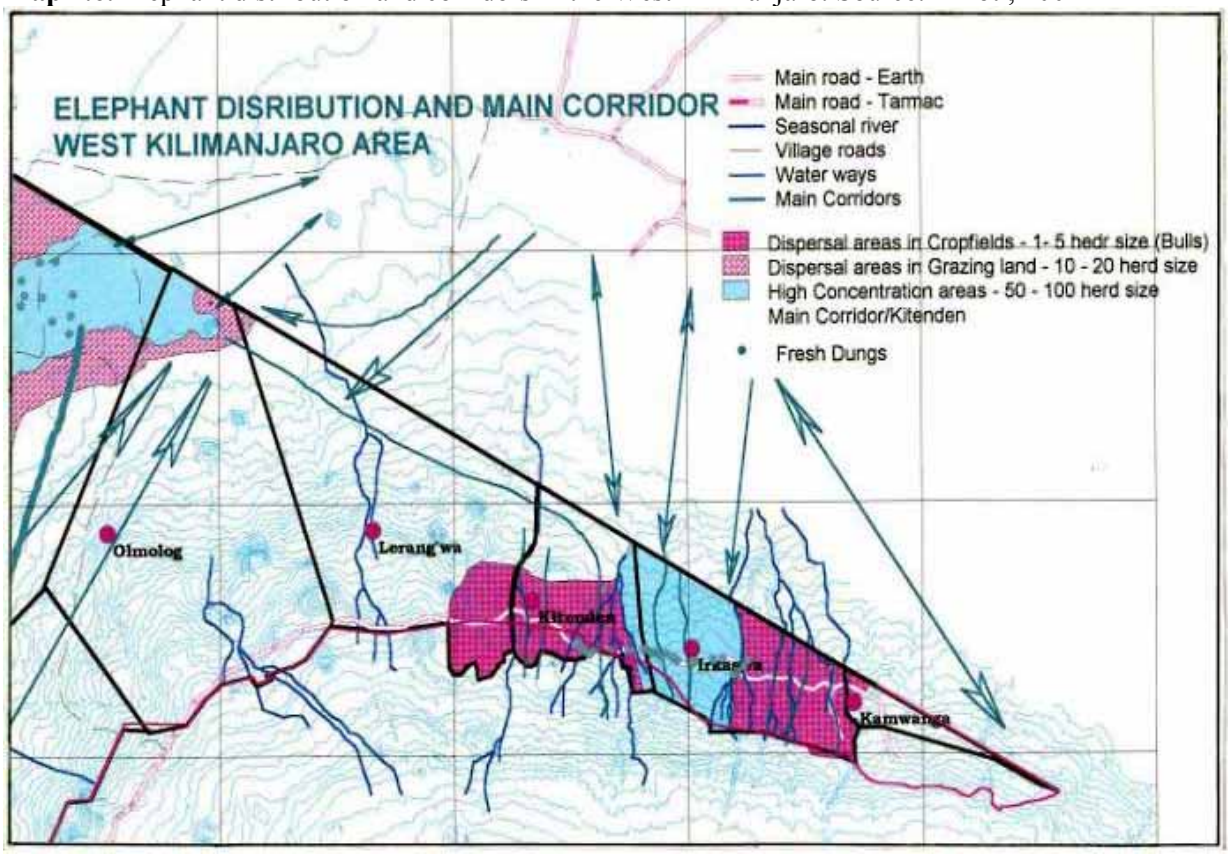
Impacts of land use changes on the movement of animals include blockage of routes outside the main corridor, decreased movement of animals in the former migratory routes outside the main corridor and increase in the concentration of animals in the main corridor. There are inadequate

records on the extent of disturbances to animals due to land use changes, but habitat change in the traditional routes must have acted as an impediment to the movement of animals. Animals are threatened by the presence of people in the farms and new features like houses in their routes. For example, it was noted by Grimshaw and Forley, (1990) that before establishment of farms and settlements in Lerangw'a village there was a high movement of elephants moving up and down the reserve through the present village centre. Now there is a low concentration and the route has changed from the village centre to the river valley to avoid settlements and people.

There are inadequate records on the extent of disturbances to the movement of animals due to land use changes, but habitat change in the traditional routes must have acted as an impediment to the movement of animals. Animals are threatened by the presence of people in the farms and new features like houses in their routes. Animals, particularly elephants and buffaloes, are forced to feed and migrate through the remaining narrow strips of natural vegetation in the river valleys for fear of human presence in other areas already occupied by farms. For example, it was noted by Grimshaw and Forley, (1990) that before establishment of farms and settlements in Lerangw'a village there was a high movement of elephants moving up and down from the forest reserve through the present village centre. Now there is a low concentration and the route has changed from the village centre to the river valley to avoid settlements and people. This is also the case in Kamwanga where farms have blocked all the routes and the only route in use is the Kamwanga river valley where no agricultural activities take place.

Data to show the movement of animals and their numbers in the migratory route are scarce. Available information, however, shows that there are more movements in the remaining natural vegetation in the main corridor than in the farms. According to Kikoti (2001), buffaloes and elephants are seen in groups of 1-5 individuals each passing in the farms and 50-100 in the remaining corridor (Map 1.6).

Map 1.6. Elephant distribution and corridors in the West Kilimanjaro. Source: Kikoti, 2001



Antelopes are seen in-groups of up to 20 individuals passing in the farms and 30-50 in the corridor. In addition, some of the moorland animal species like Baboons, velvet monkeys and warthogs have been displaced further into the forest following the disturbance of the forest in the lowlands (Newmark *et al.*, 1991).

In the farms movements increase especially when there is crop cover and this is the time when incidences of crop raiding and tramping also increase. Results from the interviews show that during the rainy season (March-May and October-December), elephants and buffaloes move up from Amboseli towards Kilimanjaro forest through Lerangw'a river valley. The same animals return to Amboseli in July/September and January/February. People found this route when they settled in the village and that the route extended as far as to the present village centre. According to the interviews, elephants now move up and down Amboseli and Kilimanjaro Forest Reserve in small herds of 3-5 individuals each in the farms particularly in Kitendeni and Irkaswa villages compared to 20-30 individuals in the past twenty years when there were no farms.

Information from the interviews also indicated that before land use changes in Kamwanga village, elephants were passing in-groups of up to 20 in their known paths in Naglingosi, Lepayon, Mlimani Park and Kamwanga river valley. Now, all routes are blocked except in the river valley. Therefore, elephants use the river valley to migrate from the forest to Amboseli. Based on the information from key informants, the number is, however, very much reduced from 20 individuals in the group to 1-5 individuals.

During the time of this study, the researcher observed a higher concentration of animals and movements in the main Kitendeni corridor than in any other places. For example, antelopes were seen in groups of 30-50 individuals while wildebeest were in-groups of 20-30 individuals. Many elephants, buffaloes, zebra and baboon were also seen in the corridor compared to other places. Information obtained from one of the game scouts in Lerangw'a village suggested that the present animal population in the corridor was the highest he has ever seen during his lifetime in the village and that the concentration increased day after day. Information acquired from the indigenous people also support the argument that there is currently a higher concentration of animals in the corridor than any other time of their experience in the area.

Therefore, the blockage of routes outside the main corridor has resulted into high concentration of animals moving through the corridor and river valleys. It should be noted, however, that the high animal concentration in the corridor does not necessarily mean that there is an increase in species diversity in the ecosystem. The possible explanations could be that the area for animal dispersal and migration is now smaller than previously due to land use and cover changes in the wildlife corridor. Although there are few signs of degradation in the corridor now, the high concentration of animals is likely to cause land degradation and a decline in the vegetation in future. This in turn is likely to cause a decline in the population of animals that graze in the corridor.

7.3 Impacts on animal numbers and species diversity

No ecological surveys have ever been conducted for the Kilimanjaro National Park and the corridor itself. This section, therefore depends more on the people's perception on the changes in animal numbers and the few available data for elephants, which were obtained from the previous surveys by different researchers.

Although there is paucity of data on the impact of land use changes on animal numbers, the probability of local extinction and displacement of animals is high because of loss of forest, conversion of bush land into farms and settlements and blockage of migratory routes, which in turn leads to isolation of animals. As remarked by Newmark *et al*. (1991), forest loss and conversion adversely affect the distribution of montane fauna and the size of these species and thus in the near future the rare montane forest species could be most seriously threatened by these activities. They noted in their research that seven species of large mammals – the Crawshay's hare (*Lepus crawshayi*), baboon (*Papio cynocephalus*), spotted hyena (*Crocuta crocuta*), black-backed

jackal *(Canis mesomelas*), side-striped jackal (*Canis adustus*), white-tailed mongoose (*Ichneumia albicauda*) and warthog (*Phacochoerus aethiopicus*), had been added to the mammal species checklist for Kilimanjaro National Park and Forest Reserve.

The possible explanation for the increase of these species is the tree felling and fires at the lower elevations of the forest which have converted the habitat in some places into a secondary disturbed woodland and have thus permitted these species, which formerly were not found in the National Park and Forest Reserve, to enter the reserve.

Apart from the emergence of new species in the reserve, available records (based on the elephant populations) show a decline in animal numbers due to changes in land use and associated impacts. Millard (1954) and Child (1965), for example, believed that in 1950s elephant population was in the order of 1500 in the Kilimanjaro-Amboseli ecosystem. Millard (1954) also noted the existence of rhinoceros in the forest and around Kitendeni. Based on the number of dead and live elephants recorded during aerial surveys, Poole *et al*, (1992) estimated that over 1000 elephants lived in the Kenyan ecosystem in the late 1960s. Since these researchers counted animals in different areas, direct comparison of numbers is not possible.

The decline of elephant numbers seems to have occurred in the ecosystem in the late 1960s. Lasan (1971) noted the apparent absence of elephants in Longido Game Controlled Area at that time. In an elephant survey conducted by the College of African Wildlife Management-Mweka in 1967, only 20 elephants and 4 rhinoceros were seen in Longido Game Controlled Area (Shemwetta *et al.,* 1981). In 1980 during the aerial survey counts of Arusha region, the area was estimated to have 95 dead elephants and non-live (Ecosystem, 1980). In addition, Shemwetta *et al*. (1981) also noted in their study that there were no elephants seen and that this had been the case for the previous three years. They also remarked that rhinoceros were long extinct in the area. This decline was associated with sport hunting, poaching and drought.

Grimshaw and Foley, (1990) also suggested a decline for the Kilimanjaro elephants between 1970 and 1980. In addition, they observed that those elephants seen in Amboseli during the early 1980s were aggressive and exhibited a very young population age structure, including a high ratio of juveniles to adults, which is typical of a poached population. The 2001 management plan for the African elephant by the Wildlife Division suggests that in the early 1990s, Tanzanian elephants were in the recovery stage and today populations are steadily increasing (MNRT, 2001).

The Tanzania Wildlife Conservation and Monitoring conducted an aerial survey of animals in West Kilimanjaro and Longido Game Controlled Area in 1997 and 2001, which involved animal counts and estimation of human activities in the area. During the survey, 30 elephants were observed in the area in 1997 while 1269 elephants were observed in the same area in the year 2001 (TWCM, 1997). An increasing trend in the population of elephants could be explained by the different time periods for the surveys. The 1997 survey was done during the wet season when migratory species are in Amboseli while the 2001 survey was conducted during dry season when animals are in the corridor and Kilimanjaro National Park and Forest Reserve. This could therefore explain the difference in the number of animals observed in the area between the two time periods.

The results from the interviews and discussions with local people also indicated an increasing trend for such animals like elephants, buffaloes, velvet monkeys, zebra, eland, giraffe, warthogs, rodents and antelopes (Table 1.7). This was also confirmed by 81% of the respondents who commented about the increase of some wild animal species while others were extinct.

Table 1.7: Animal abundance index in twenty years interval 1960-2001

Animal species / **Year**	**1960s**	**1980s**	**2001**	**Trend remarks**
Elephants	***	**	****	Increasing
Rhinoceros	**	**	*	Extinct
Lion	***	**	**	Decreasing
Leopard	***	**	**	Decreasing
Buffalo	***	***	****	Increasing
Baboon	**	***	****	Increasing
Velvet Monkey	**	***	****	Increasing
Eland	***	***	****	Increasing
Antelope	***	***	****	Increasing
Warthog	**	**	***	Increasing
Rodents	**	**	****	Increasing
Zebra	***	***	****	Increasing
Wildebeest	***	***	****	Increasing
Bat-eared foxes	*	**	***	Increasing
Ostrich	***	***	**	Decreasing
Spotted hyena	*	*	**	Increasing
Crimshay's hare	*	*	**	Increasing
Black-backed jackal	*	*	**	Increasing
White-tailed mongoose	*	*	**	Increasing
Gerenuk	*	*	**	Increasing

****= Very abundant **= Less abundant ***= Abundant *= Not at all
Source: Field survey data

Antelopes, which were seen in the corridor and the northern side towards Amboseli, are now increasingly coming and staying in the corridor and farms. Interestingly, new species of antelopes described as gerenuks are reported to have been recently seen coming in the farms and eating crops especially beans. Species like leopards, lions and ostrich, however, are reported to have decreased in the area while the rhinoceros had become extinct.

Despite the observed trends in animal populations and concentration in the Kitendeni corridor, it should be noted that the impact of land use changes on the animal populations is not very distinct and straight forward because many other factors including poaching and hunting operated in the area during the same period when land use changes were taking place. This will be discussed further in preceding sections.

7.4 Human-wildlife conflicts

Protected area boundaries separate the human settlements and farms from the natural ecosystems but these are imaginary lines, which make no ecological sense to the animals (Nahonyo, 2001). Most of the settled areas surrounding protected areas were once inhabited by wildlife and, if an opportunity occurred, animals would use these areas again leading to conflicts between people and wild animals.

Conflict occurs through incidents like crop raiding, competition for water between people and animals, particularly elephants, and consequent destruction of water systems, such as wells and water pipes. Also, livestock and human injury occurs. By virtue of living in proximity to wildlife-rich areas the local communities bear numerous costs. These costs are summarized in the equation below as adopted from Kideghesho (2001: 19):

Equation 5.1: **Wildlife-related Costs (WRC) to rural communities.**

WRC=f (DC+DL+DI+DT+DKW)

Whereby:

DC= Crop Damage

DL= Livestock Depredation

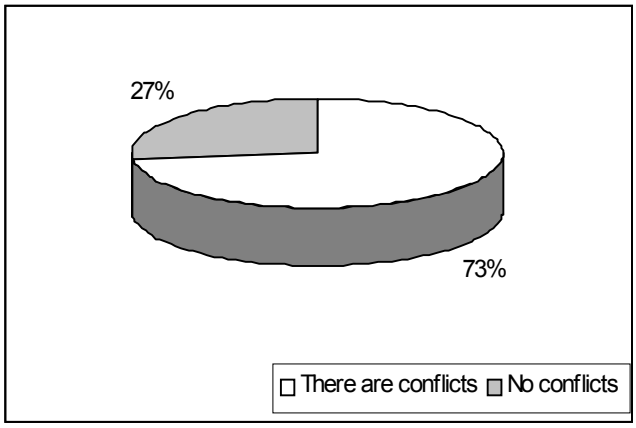
DI= Destruction of Infrastructure

DT= Disease Transmission to livestock

DKW= Danger of being killed or wounded by wild animals

The conflicts between wild animals and people in the Amboseli-Kilimanjaro ecosystem have become more evident in recent years than in the past after an increase of agricultural activities. The conflicts arise from animal crop raiding, livestock killing and water pipeline destruction. In addition, the presence of animals around homesteads causes considerable concern for the safety of the people. The current incidences of cattle diseases are also related to transmission by wild animals. About 73.3% of respondents in all villages have acknowledged the existence of conflict between wild animals and people (Figure 1.8).

Figure 1.8: Human-wildlife conflicts in the study villages as observed by Respondents



Source: Field data

Crop raiding is a serious problem in the study villages. Farms under greatest threat of being raided are those adjacent to the wildlife corridor between Kamwanga and Lerangw'a valleys. Several elephant migration routes bisect this area. The animal species mostly reported to raid crops include gazelle, baboons, elephants, warthogs, elands, buffaloes, velvet monkeys, rodents and gerenuks. Villagers regard species that raid crops at night to be much more destructive than baboons and velvet monkeys, the only two species that were reported to raid crops during the day, thus they can be chased away.

In all the study villages, people commented that the conflict between people and wild animals began in 1970s. Before this period people, livestock and wild animals were living in harmony although both human and animal populations were increasing. The likely explanation for the conflict could be related to the land use changes from total grazing to farms and settlements as discussed in previous sections. These changes have not only reduced areas for animal dispersal and migration but have also blocked some of the migration routes, forcing the animals to follow their old routes which are now farms and settlements.

The Maasai farmers usually resort to scare tactics of banging loud instruments, hitting logs, shouting and throwing stones to the invading animals. The effectiveness of these efforts, however, depends on the type of animals concerned. Some respondents said that they normally watch as buffaloes and elephants eat crops because they are afraid of them.

Initially, this researcher thought that increasing conflicts between people and wildlife would lead to reduction of crop fields where it happens that all crops in the farms have been trampled or raided. To the contrary, only 4% of the respondents reported to have reduced their farm sizes for fear of animals. This raises controversy as to whether the reported incidences of damage are exaggerated or not. The reasons for exaggeration, possibly in the hope of compensation, are understandable, and it is an important issue to consider when assessing crop damage.

Apart from crop raids, several incidences of killings of people and livestock have been reported in the villages. The most dangerous animals reported were lions, leopards, snakes and buffaloes. In Irkaswa village, for example, wild animals killed six (6) people in different incidences. Most of these incidences, however, have occurred as a result of the Maasai warriors' attempts to rescue livestock from animal attacks. In fact one incident happened during this study in Olmolog village, which borders the study villages, where a lion, which a Maasai warrior was attempting to kill after invading the cattle boma, killed him.

In addition to the above, during dry seasons elephants destroy water pipelines, which take water from the forest to the villages. These animals destroy outlets in the main wells to make sure that no drop of water goes out of their use. Consequently, villagers opt to go further up into the forest reserve, where it is unsafe, to fetch water.

8.0. CONCLUSION AND RECOMMENDATIONS

From the preceding sections, it is evident that the remaining wildlife corridor that links Kilimanjaro-Amboseli ecosystems is currently under threat following the rapid land use changes which are taking place in and adjacent to the corridor. The research findings show that there are major land use changes in the Kitendeni wildlife corridor, which are associated with expansion of agriculture and settlements into the areas previously used for wildlife and livestock grazing. These changes have had negative impacts on the wildlife as they influence animal movements, numbers and distribution they also have had significant negative impacts on the size of the corridor and natural habitats. In addition, human-wildlife conflicts have emerged as a result of land use incompatibility. The trend shows that more land use changes are likely to take place as more land is needed for agriculture and settlements, which will threaten the existence of the corridor in the future. If the link between Kilimanjaro and Amboseli ecosystems is to be maintained, efforts to stop further land use changes have to be taken.

8.1 Recommendations

1. Harmonization of traditional and village by-laws.

Successful conservation in the field requires harmonization of national policies and regulations to coordinate activities that take onboard local people's interests and priorities in order to reconcile competing management needs and national objectives. The Maasai customary laws of natural resources management have to be identified and harmonized with the village by-laws and make them as relevant as possible so that Maasai traditional rules in which natural resources are managed are not ignored. A more participatory approach of making by-laws will articulate local rules and regulations, as well as help to raise the awareness of communities concerning their rights to participate in land use and resource decision-making. This process will also provide a plan and management statements that reflect the values and interests of majority of community members, which in turn can help communities effectively coordinate with other decision making bodies.

2. Wildlife corridor protection

It is generally felt that the area is in need of a more protected status. In light of this, it is recommended that the corridor be given protected area status, and monitoring should be undertaken to ensure that its status as a protected area is maintained. In particular, the 'no farming and settlement agreement' for the corridor area should be enforced in both Tanzania and Kenya.

In any effort made to upgrade the status of the corridor, it is essential that the Maasai who have exclusively used the area continue to retain access to the land. Grazing and firewood collection as practiced by the Maasai in the past have been fully compatible with movement of wild animals between the upper and lower habitats on mount Kilimanjaro and thus the Maasai should be permitted to carry out these land use practices in the future. As described earlier, it is these land use practices that have allowed the remaining part of the corridor to remain uncultivated until now. The role of the Maasai as custodian of the land should not be changed. It is therefore hoped that the authorities concerned, in both Kenya and Tanzania, will do their best to ensure that this important area is maintained for the benefit of both its traditional pastoralists and wildlife.

3. Inventory and monitoring of the wildlife corridor
There should be periodic ecological surveys in order to have records on animal numbers and movements over time. Initial fauna survey of existing wildlife populations (and comparison with any available data on historical populations) is an essential first step to an ecological study to determine estimated carrying capacities and identify other factors that may be affecting wildlife. These data will be valuable in the monitoring process to note changes in animal number and movements as land use changes. The village game scouts should be trained to collect data for the monitoring programme and should work under the guidance of wildlife professionals who will be responsible for compilation of data and report writing.

4. Public education and extension services
In order to avoid further overgrazing and to ensure future and sustainable development of the area, agro-pastoralists and farmers should be educated and encouraged to intensify their activities. The intensification of livestock can include an introduction of better productive breeds of animals and introduction of palatable and more nutritious species of pasture in the village grazing lands. These species includes *Setaria spp.*, *Panicum spp*, *Guatemalla* as well as *Kikuyu* grass. These are necessary in replacing the less nutritious and unpalatable species, such as *Pennisetum schimperi,* in order to improve the livestock carrying capacity. Furthermore, the government should assist in facilitating accessibility to the inputs, extension services, credit facilities and competitive markets.

5. Joint management of cross-border resources
Environmental problems cut across administrative boundaries. Impact of activities on the Tanzanian side of the corridor may be felt on the Kenyan side too. For example, the electric fencing to control crop raiding adjacent farms in Amboseli National Park have denied the animals access to other routes except that to Kilimanjaro. As a result, most of the Amboseli migratory animals flow towards Tanzania. Likewise, high prices of agricultural products in Kenya greatly stimulate expansion of agricultural activities in the area of the corridor. These problems can be solved if the authorities concerned, that is Kenya Wildlife Services (KWS) and Tanzania National Parks (TANAPA), sit together and negotiate on these issues, which have international dimension. If the migration of animals between Kilimanjaro and Amboseli is to be maintained, measures must be taken to protect land in both the Kenyan and Tanzanian sides of the corridor.

6. Tourism and revenue generation
The West Kilimanjaro basin, lying between the snows capped Kilimanjaro, the volcanic cone of Mount Meru and Oldoinyo Longido, is part of a unique and complex ecosystem. It is an area of exquisite natural beauty. The area lends itself as a multiple use conservation area, including such activities as commercial and subsistence ranching, hunting, mountain climbing, walking safaris and photographic tourism.

Photographic tourism, in particular deserves a closer look since it has potential to provide income to the people and the nation at large. In Kenya it has become one of highest revenue earners. By encouraging eco-tourism Tanzania could benefit from the many visitors who would like to experience Amboseli but do not wish to cross the border. The area is also very attractive for tourists who are interested in walking safaris and is important as a staging point for those wishing to climb either Kilimanjaro or Mt. Meru. In particular, Tanzania could benefit from the well-

known elephant population of Amboseli that is increasingly using the woodlands south of the international border. This should be a wake-up call for the tourism industry in Tanzania.

7. Suggestions for further studies

This study could not explore all aspects related to animal routes and impacts of land use changes on wildlife. It is, therefore, suggested that more research should be carried out to identify other migratory routes to link not only Kilimanjaro and Amboseli but also other ecosystems like Mkomazi Game Reserve, Tsavo West National Park, Arusha National Park and Meru forest. This will help to establish new protected areas or extend the boundaries of routes that already exist. This will, however, need active community involvement because villagers may be against the idea, as this will deny them access to resources such as arable land and grazing areas. A detailed study of the attitudes of local people towards protected area status for the corridor should be conducted to design the best ways of involving them in the decision making process.

REFERENCES

Berntsen, J.L 1979*:* Economic Variations Among Maa-speaking Peoples. Kiuns, D. 1993 (Ed). *Ecology and History in East Africa*. Kenya Literature Bureau, Nairobi. PP 13-14.

Campbell, D.J 1999: Development and change in the Mount Kilimanjaro area and Kajiado District, Kenya. *Land Use Policy* 16: 59-68

Campbell, D.J, Gichohi. H, Mwangi. A and Chege, L. 2000: Land Use Conflicts in Kajiado District, Kenya. *Land Use Policy* 17: 337-348

Child, G.S 1965: Some notes on the mammals of Kilimanjaro. *Tanganyika Notes and Records* 64:77-89

Forley, C & J. Grimshawe 1991: Kilimanjaro Elephant Project. *Miombo*, 6:18

Grimshaw, J. & C. Forley 1990: *Kilimanjaro Elephant Project*. Final report to Friends of Conservation. Nairobi, Kenya

Kenya Wildlife Services: *Amboseli National Park Management Plan (1991-1996*). Unpublished report.

Kenya Wildlife Services: *Amboseli National Park Management Plan (1991-1996*). Unpublished report.

Kideghesho, J.R 2001: The Loss of Wildlife Habitat in Tanzania: What is the Way Forward? *Kakakuona*. TWPF. Issue No 23, October-December, 2001. PP 6-15

Kikoti, A 2001: *Elephant Constraints and Opportunities in West Kilimanjaro,Tanzania*.Msc Thesis, University of Wales, Aberstywitch.

Kikula. I.S. 1999: Sustainable Agriculture in Subsistence Economies. Some Overlooked Research Issues Based on Tanzania's Experience. In Boesen, J, Kikula, I. S & Maganga, F.P (EDS). *Sustainable Agriculture in Semi-arid Tanzania*. DUP, Dar es Salaam.

Lasan, A. H 1971: *Formulation of Management Plan for the Longido Controlled Area, Ngasurai*. Mweka College of African Wildlife Management, Tanzania.

Lissu, T. 2000: *Policy and Legal Issues on Wildlife Management in Tanzania's Pastoral Lands: The Case of Ngorongoro Conservation Area.* WRI, Washington, USA.

Meindertsma D.J. & Kessler. J.J 1997: *Planning for the Better Environment in Monduli District*. Monduli District Council.

Millard, J. 1954: The Fauna of Kilimanjaro: *Tanganyika Notes and Records* 36: 47-53

Ministry of Natural Resources and Tourism, 2001: *Management Plan for the African Elephants in Tanzania*. Unpublished

Nahonyo, C. 2001: *Human Elephant Conflicts in the Greater Ruaha ecosystem, Tanzania*. Phd Thesis, Durrell Institute of Conservation and Ecology, University of Kent at Canterbury

Newmark, W. D, Forley, C.A.H, Grimshaw J.M, Chambegga, D.R and Rutazaa, A.G. 1991: *The Conservation of Mount Kilimanjaro*. IUCN Gland. Switzerland and Cambridge, UK

Newmark. W. D, 1993: The Role and Design of Wildlife Corridors with Examples of Tanzania. *Ambio* 8(22):500-501

Noe. C 2002: *Impacts of land use changes on the wildlife. A case of Kilimanjaro-Amboseli wildlife corridor, Tanzania.* M.A Dissertation, University of Dar es Salaam, Tanzania.

Poole, J. H. Aggarwal, R. Sinange, S. Nganga, M. Broton, I. Douglas-Hamilton 1992: *The Status of Kenya's Elephants.* A report by the Kenya Wildlife Service and Department of Resource Surveys and Remote Sensing. Nairobi. Typescript.

Poole. J & Reuling. M 1997: *A Survey of Elephants and Other Wildlife of the West Kilimanjaro Basin, Tanzania*. TWCM, Arusha.

Resources and Tourism, DSM

Shemwetta, D.T.K, Mboye, G.F.A, Komba, I.G.M, Yaipan R, Ankinsiku, A.O 1981: *Proposal for Developing Longido Game Controlled Area in to a Game Reserve.* Mweka College of African Wildlife Management, Tanzania.

TANAPA 1992*: Kilimanjaro National Park. General Management Plan.* Tanzania National Parks Planning Unit, Arusha.

TWCM, 1997: Wildlife Aerial Survey in West Kilimanjaro. Unpublished

URT 1998: *The Wildlife Policy of Tanzania*. Ministry of Natural Resources and Tourism, DSM

URT, 1998: *Arusha Region Socio-economic Profile*. The Arusha Regional Commisioner's Office and Planning Commision, Dar es Salaam.

URT, 1998: *Tanzania Country Study on Biological Diversity,* Ministry of Natural

Wood. A. Stedman-Edwards. P and Mang. J, (1999*): Ten Case Studies- The Root Causes of Biodiversity Loss*. Earthscan, UK.