

# The Dynamics of Land use in the Wildlife Corridor between Kilimanjaro National Park in Tanzania and Amboseli National Park in Kenya and their Impacts on Biodiversity

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## **Abstract**

This article examines the dynamics of land use in Kitendeni wildlife corridor and their impacts on biodiversity. Data on land use/cover changes were obtained through interpretation of aerial photographs of 1952 and 1982 and satellite imagery of 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 data were generated through observations, interviews and discussions with indigenous people, previous researchers and Kilimanjaro National Park officials. The study established that, there have 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<sup>2</sup> in 1952 to approximately 5 km<sup>2</sup> in 2001, changes in wild animal 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 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.

## **Introduction**

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 (Figure 1), which links Kilimanjaro National Park in

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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).

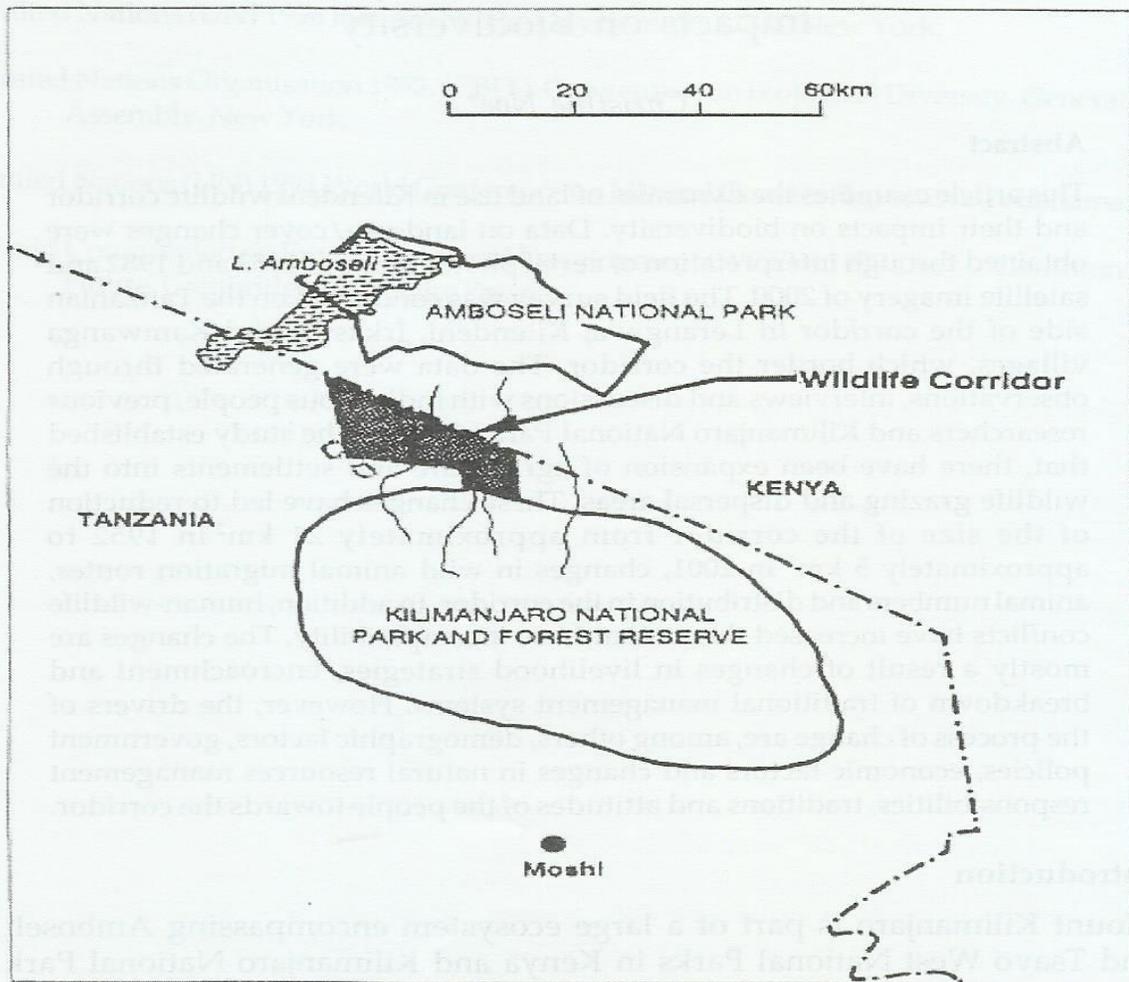


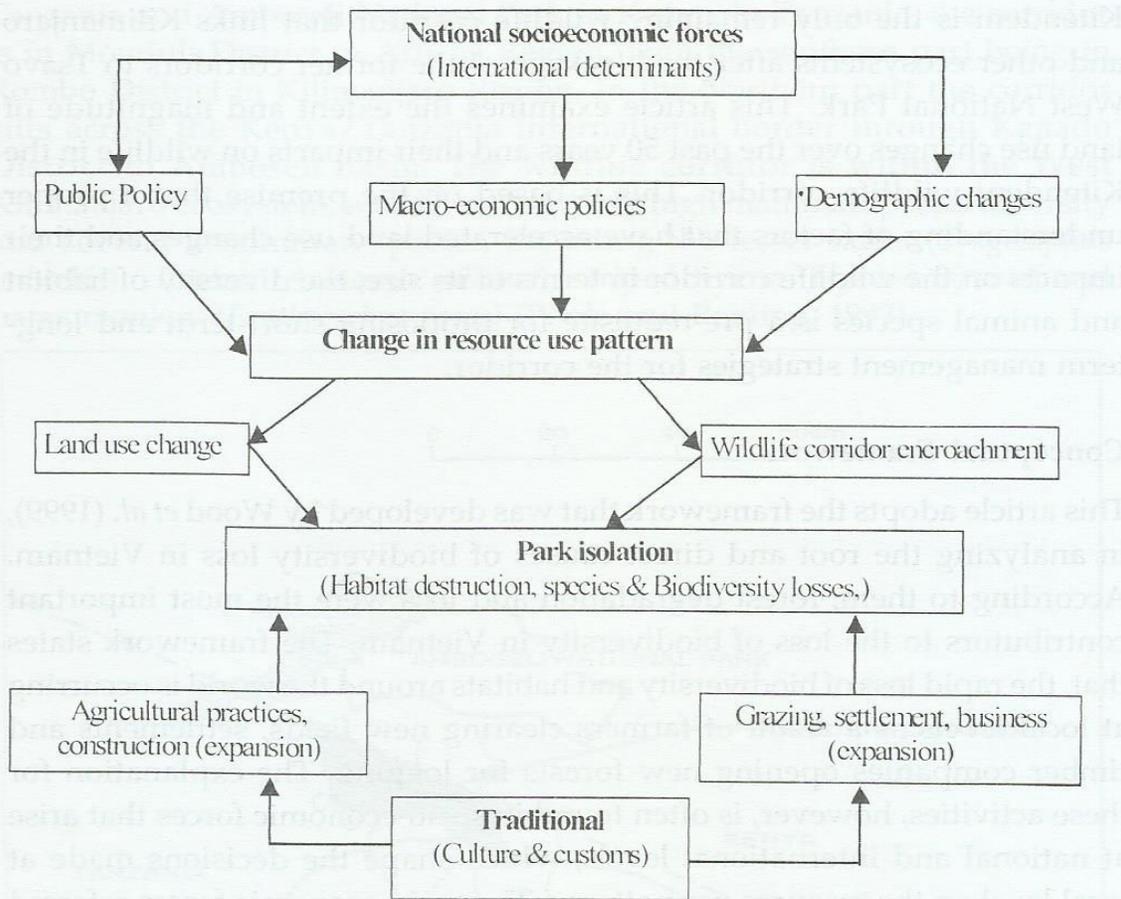
Figure 1: The Location of the Kilimanjaro-Amboseli Wildlife Corridor on the Northwestern Side of Mount Kilimanjaro

Source: Newmark *et al.*, 1991

Kitendeni is the only remaining wildlife corridor that links Kilimanjaro and other ecosystems after the blockage of the former corridors to Tsavo West National Park. This article examines the extent and magnitude of land use changes over the past 50 years and their impacts on wildlife in the Kitendeni wildlife corridor. This is based on the premise that a proper understanding of 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 is a pre-requisite for proposing short-term and long-term management strategies for the corridor.

### **Conceptual Framework**

This article adopts the framework that was developed by Wood *et al.* (1999), in analyzing 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. The framework states that, 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 mentioned forces are also associated with infrastructure construction, forest over-exploitation, immigration, 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 as shown in figure 2.



**Figure 2: Root Causes of Land Use Change and Loss of Biodiversity**

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

This 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 one another. 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.

### Land use/cover patterns and change 1952-2000

Table 1 presents the major land use/cover categories in the corridor in 1952, 1982 and 2000. It is noted that in 1952, the major land use/cover categories were closed forest, bush and scattered trees and cultivation. Others included settlements, grassland and fallow land.

In 1952, the area of closed forest was 9384 ha while the area of bush and scattered trees occupied 7069 ha or 32.3% 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.

*Table 1: A real Extent of Land Use/Cover Categories (in ha) in 1952-2000*

Use/cover types	Coverage (Ha) 1952	Coverage (Ha) 1982	Coverage (Ha) 2000	% Change and trend remarks (1952-2000)
Mature forest	9384 (42.8%)	7553 (33.9%)	6190 (29.7%)	13.1% Decline
Degraded forest	707 (3.2%)	1648 (7.4%)	3485 (16.7%)	9.3% Increase
Bush and scattered trees	7067 (32.3%)	6471 (29%)	2631 (12.6%)	19.8% Decline
Cultivation and settlements	4263 (19.5%)	4845 (21.7%)	4996 (24%)	4.1% Increase
Fallow land	257 (1.2%)	78 (0.5%)	-	Disappeared
Grassland	214 (1%)	554 (2.5%)	1980 (9.5%)	8.5% Increase
Forest Plantation	-	743 (3.3%)	604 (6.1%)	2.8% Increase

About 4263 ha, that is 19.5% 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 Lerangw'a 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. Meindertma 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 they 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 bushland 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 for common grazing by 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. In 1952, settlements were only found in Kamwanga but by 1982 there was high concentration of settlements and farms in both Kamwanga and Lerangw’a villages.

Areas of cultivation and settlement covered 4845 ha, that is, 21.7% of the total area (Table 1). 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.

Bush and scattered trees occupied the area between the two village centers and it covered 6471 ha, which is 29% of the total area compared to 32.3% 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 centers. In addition, some closed and open forest areas became farmlands as a result of encroachment. Other cover types include plantation (743 ha), grassland (554 ha) and fallow land (78 ha).

By the year 2000, natural forest covered 6190 ha (28.9%) of the study area. Some parts of the forest, however, seem to have been degraded as evidenced by the increase in the area of degraded forest, which covered 3485 ha (16.2%). This cover type has increased and dominates the area around the natural forest, which suggests that there were more forest clearings and regeneration in the year 2000 compared to 1982. Other cover categories include cultivation, which covered 4996 ha (23.3%) of the area in 2000, bush with scattered trees (2631 ha or 12.2%), grassland (1980 ha or 9.4%) and forest plantation (604 ha or 2.8%). Compared to 1982 (Table 1), 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.

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.

Until 2002, the area of the wildlife corridor occupied 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.

Clearly, it is evident that the major land use changes that occurred in the study area during this period are related to the conversion of traditional grazing areas to farms and settlements. 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 savanna in Amboseli. The wildlife corridor and livestock grazing area has 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 same area had decreased by 8.9% and 3.3%, respectively, between 1952 and 1982 (Table 1). 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 centers and institutions emerged as new land use/covers.

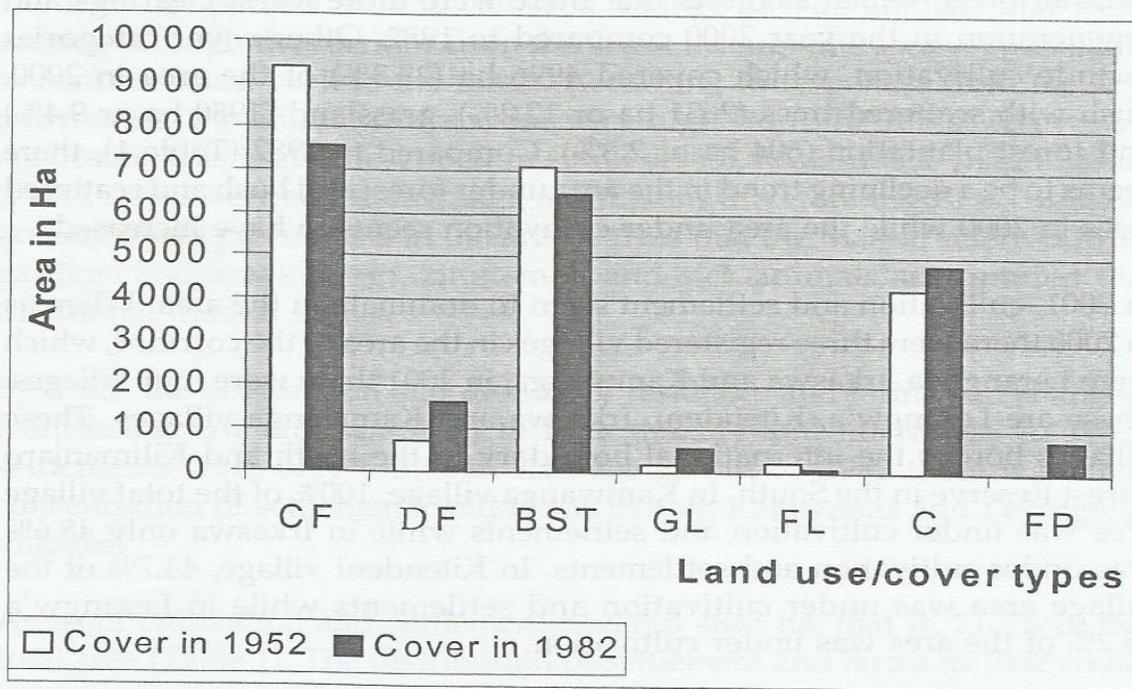


Figure 3: Land Use/Cover Changes between 1952-1982

Note: CF=Closed Forest, DF=Degraded Forest, FP=Forest Plantation, C=Cultivation

GL=Grassland, BST=Bush and Scattered Trees, FP (S)=Forest Plantation with Shamba System, RF=Riverine Forest

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 was the period when there was a transformation of the society from pastoralism to agropastoralism, 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. Consequently, the areas available for grazing both livestock and wild animals decreased and areas for settlement and agriculture increased. The extent of change between 1982 and 2000 is summarized in Table 2.

*Table 2: Extent of Change in 1982-2000*

Land use cover types	1982 (Ha)	2000 (Ha)
Closed forest (Mature forest)	7553	6190
Degraded/open forest	1648	3485
Forest plantation	743	604
Grassland	554	1980
Cultivation	4845	4996
Bush and scattered trees	6471	2631
Forest Plantation with shamba system	0	676
Degraded Bush land (Secondary bush land)	0	289
Riverine forest	0	557
<b>Total</b>	<b>21814</b>	<b>19886</b>

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. The number of villages increased from one in 1952 to four in 2001. This had significant impacts on the size of the corridor, animal movements and distribution. It has also increased human-wildlife conflicts.

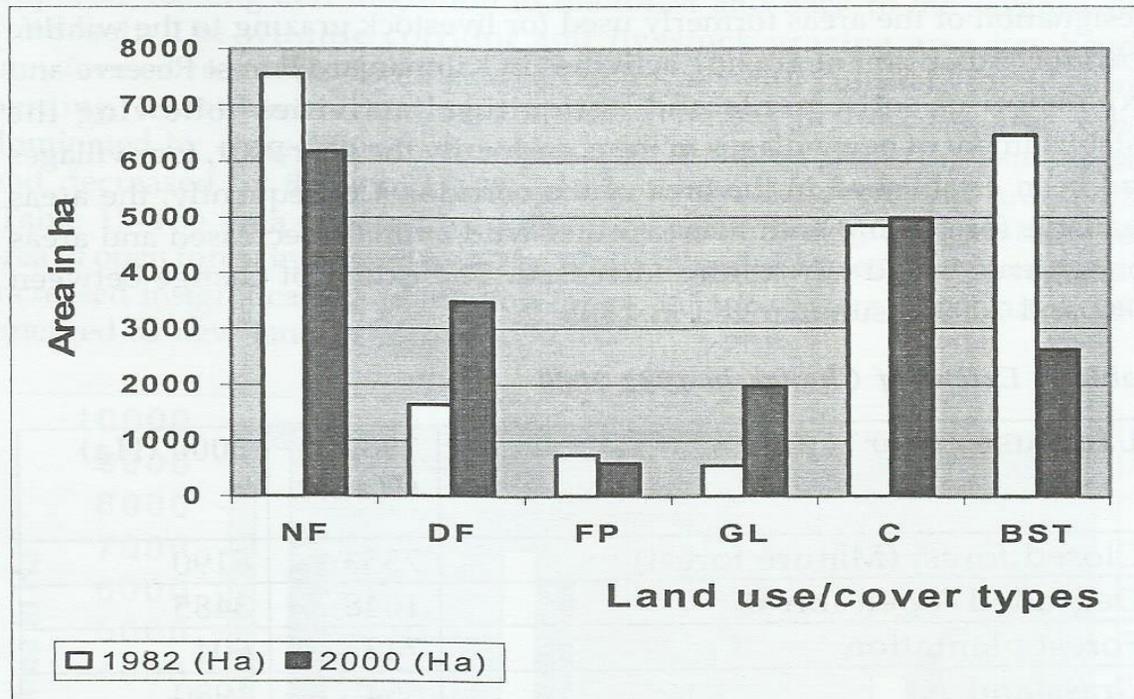
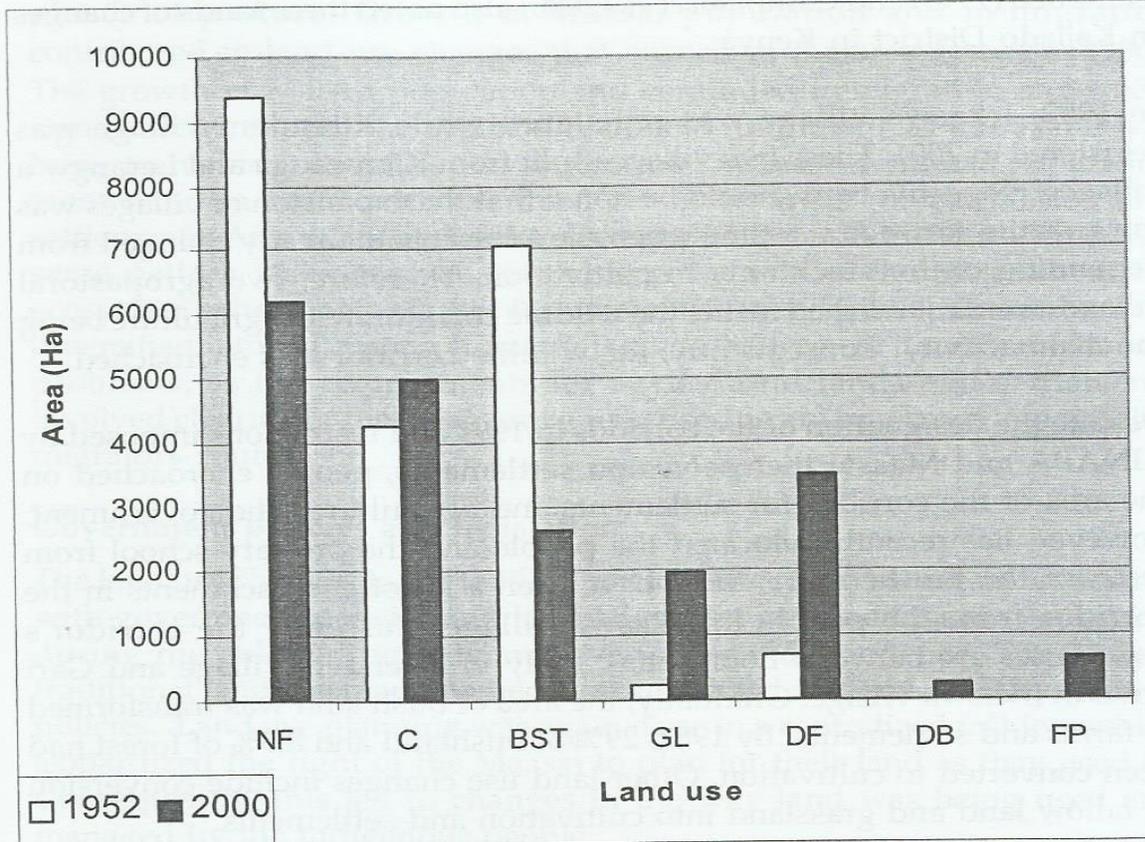


Figure 4: Land Use/Cover Changes between 1982-2000

Basing on the land use/cover maps and statistics derived from the 1952, 1982 and 2000 maps, it is apparent that there were land use changes in the wildlife corridor between 1952-2000. 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. The 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.



*Figure 5: Extent of Change in Land Use/Cover 1952-2000*

#### **Causes of land use changes**

The immediate causes of land use changes 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.

The Maasai pastoralists depended on livestock production for many years. The dependence of Maasai on livestock only co-existed with wild animal grazing. The decline of livestock production resulting from long periods of drought, limited pasture and the outbreak of cattle disease in 1970s forced them to diversify their livelihood strategies. As a result, Maasai livelihood strategies changed from depending on livestock only to cultivation.

Campbell (1999) and Campbell *et al.* (2000) also noted these kinds of changes in Kajiado District in Kenya.

In 1992, Irkaswa village was registered while Kitendeni village was registered in 2001. These two villages split from Kamwanga and Lerangw'a villages, respectively. It should be noted that the expansion of villages was towards the corridor at a time when the Maasai had already changed from depending on livestock only to cultivation. Therefore, two agropastoral villages were established inside the wildlife corridor, with agriculture being the main activity. Consequently, the wildlife corridor was encroached.

Despite the designation of the corridor in 1991 and restrictions imposed by KINAPA and Maasai themselves on settlements, people encroached on the area of the corridor for settlements and agriculture. The government, however, has recently relocated the people and the primary school from the corridor. Furthermore, there have been a lot of encroachments in the corridor from the people in Irkaswa village. Currently the corridor's 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 bushland and 8.9% of forest had been converted to cultivation. Other land use changes include conversion of fallow land and grassland into cultivation and settlements.

Availability of markets has also played an important role in fostering the process of land use changes. This has, therefore, greatly stimulated expansion of agricultural activities in the area of the corridor. In response to food shortage, people expand their farms, mostly towards the wildlife corridor.

### **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.

### **Demographic factors**

The Maasai pastoralists inhabited the area since the 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. Growth in Maasai population and in-migration contributed to land use changes that ensued in the area since the 1950s. 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. Increase in human population went hand in hand with the need for more areas for cultivation and settlements. As a result agriculture developed faster 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.

### **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 the colonial periods and even after independence. The Maasai traditional land use planning became centralized and governed by colonial policies. 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 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. The British administration introduced the Land Act No. 3 of 1923 where all the land became public land and foreigners were given unlimited land lease (Nahonyo, 2001). Changes in land ownership during the 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.

The privatization 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. 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). 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 pasture lands 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. Although people were allowed to live, keep livestock and practice agriculture inside the Game Controlled Areas, 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. As a result, this led to the 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, 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. The new Land Policy of 1995, however, proposes that the security of tenure for pastoralists in pastoral land areas should include measures like gazettement areas to protect grazing land from encroachments (Lissu, 2000). 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 a common livestock grazing area to a wildlife corridor.

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 villagization programme led to the establishment of Kamwanga and Lerangw'a villages that involved relocation of people from their scattered homesteads to clustered settlements in Lerangw'a and Kamwanga village centers. The latter 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. 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.

#### **Economic factors**

The good prices offered as a result of competition among buyers have become incentives for the people to acquire more land for agriculture. In addition, the good prices for agricultural products have increased the value of land because in-migrants and businessmen are buying land plots at high prices. 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 sale and others for agriculture and settlements.

Commercialization of resources, which were free for local communities, has also influenced land use changes in the study area. The commercialization 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.

### **Institutional factors**

The Maasai have for several hundred years co-existed with wildlife and protected animal populations within the ecosystem from hunting. Land use plans and allocations were done by traditional leaders and got blessings from traditional elders. The government interference in the management of wildlife resources since 1960s, however, led to the breakdown of these traditional natural resource 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.

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 the traditional means by which resources were managed and changed. The major focus is wildlife conservation. 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.

### **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.

### **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<sup>2</sup> in 1952, has been reduced to a narrow strip of approximately 5km<sup>2</sup>. 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).

### **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 the establishment of farms and settlements in Lerangw'a village, there was a high movement of elephants up and down the reserve through the present village center. Now there is a low concentration and the route has changed from the village center to the river valley to avoid settlements and people.

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.

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. According to the interviews, elephants now move up and down Amboseli and Kilimanjaro Forest Reserve in small herds of 3-5 individuals each compared to 20-30 individuals twenty years ago.

Information from the interviews also indicated that before the recent 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. 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 place. Many elephants, buffaloes, zebras and baboons 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. The possible explanations could be that the area for animal dispersal and migration is now smaller than before 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.

#### **Impacts on animal numbers and species diversity**

No ecological survey has 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 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. 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. 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 rhinos were seen in Longido Game Controlled Area (Shemwetta *et al.* 1981).

*The dynamics of land use in the wildlife corridor between Kilimanjaro...*

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. The 1997 survey was done during the wet season when migratory species are in Amboseli while the 2001 survey was conducted during the dry season when animals are in the corridor and Kilimanjaro National Park and Forest Reserve.

The results from the interviews and discussions with local people also indicated an increasing trend for such animals like elephants, buffaloes, velvet monkeys, zebras, elands, giraffes, warthogs, rodents and antelopes. Antelopes, which were seen in the corridor and the northern side towards Amboseli, are now increasingly coming and staying in the corridor and farms.

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 straightforward because many other factors including poaching and hunting operated in the area during the same period when land use changes were taking place.

**Table 3: Animal Abundance in Twenty Years Interval 1960-2001**

Animal species	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    \*\*\*= Abundant    \*\*= Less abundant    \*= Not at all

Source: Field survey, 2002

### **Human-wildlife conflicts**

Most of the settled areas surrounding protected areas were once inhabited by wildlife and, if an opportunity occurred, animals would use these areas again, hence 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.

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. The current incidences of cattle diseases are also related to transmission by wild animals.

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. The animal species mostly reported to raid crops include gazelle, baboons, elephants, warthogs, elands, buffaloes, velvet monkeys, rodents and gerenuks. In all the study villages, people commented that the conflict between people and wild animals began in the 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.

In Irkaswa village, for example, wild animals killed six people in different incidents. The most dangerous animals reported were lions, leopards, snakes and buffaloes. Additionally, during the dry seasons, elephants destroy water pipelines, which take water from the forest to the villages.

### **Conclusion**

Clearly, Kilimanjaro ecosystem has become almost isolated from other surrounding ecosystems such as Mkomazi Game Reserve, Tsavo West National Park in Kenya, Arusha National Park and Meru forest that ideally formed one major ecosystem, with the exception of that of Amboseli

### *The dynamics of land use in the wildlife corridor between Kilimanjaro...*

National Park. The basic reasons for the isolation of these ecosystems have been the land use changes in the wildlife migratory routes that have caused blockage of the migration corridors.

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 findings of this study show that there are major land use changes in the Kitendeni wildlife corridor, which are associated with encroachment of agriculture and settlements into the areas previously used for wildlife and livestock grazing. These changes have impacts on the wildlife as they influence animal movements, numbers and distribution but also have significant 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, therefore, shows that more land use changes will take place as more land is needed for agriculture and settlements, hence threatening 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.

#### **Recommendations**

##### **Harmonization of traditional and village by-laws**

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 to coordinate with other decision making bodies effectively.

##### **Wildlife corridor protection**

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 practised 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. Also the role of the Maasai as custodian of the land should not be changed.

### **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.

### **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.

### **Tourism and income generation**

The West Kilimanjaro basin, lying as it does between the snow 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. 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.

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