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Impacts of human settlements and land use changes in Kwakuchinja wildlife corridor, Northern Tanzania

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IMPACTS OF HUMAN SETTLEMENTS AND LAND USE CHANGES IN KWAKUCHINJA
WILDLIFE CORRIDOR THAT CONNECTS LAKE MANYARA AND TARANGIRE
NATIONAL PARKS, NORTHERN TANZANIA



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Abstract

The Kwakuchinja wildlife corridor is threatened by human settlements and land use changes. This study assesses the impacts of human settlements and land use changes in the period 1990 - 2010. Satellite images for year 1990, 2000 and 2010 were analysed in obtaining the changes in land cover types such as bushland, woodland, cultivated land, grassland and bare soil. Questionnaires were administered to obtain the history of the corridor, wildlife mammals and people's views on the impacts settlements to wildlife. A total of 250 households were randomly selected from three villages (Kakoye, Minjingu and Olasiti) which are found within the corridor. Sixty percent (60 %) of the total area of the Kwakuchinja wildlife corridor was found to be under cultivation (both continuous and scattered cultivated land). The rate natural rangeland habitats conversions to cropland cultivation are high and they are also pressured by a high rate of population growth (3.8 %) in the corridor. Wildlife habitat loss, physical developments, overexploitations of wildlife resources, wildlife competitions with other land use types and pollutions are human related impacts to wildlife in the corridor. Wildlife also caused negative impacts to people in the corridor in terms of crop damage, livestock depredations, human injuries, infrastructure damage and blocking local people to access firewood, schools, dispensaries and shopping canters. Most of the cropland expansions were in the period 2000 – 2010 that resulted into great losses of natural habitats for wildlife. This is also attributed by immigrations of people from other places opening new fields for cultivations which lead to deforestations and a dramatic decline in bushland, woodland and grassland in Kwakuchinja wildlife corridor.

There are dramatic land use changes in the period 1990 – 2010 and these changes have negative impacts in terms of loss of natural habitats for wildlife, causing negative impacts to both wildlife and people. Conservation educations, land use planning, family planning to reduce rate of natural population growth and income generating projects should be emphasised in the conservation of the corridor.

Key words: *Wildlife corridors, land use changes, human settlements and impacts to people and wildlife.*

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List of abbreviations

TME.....	Tarangire Manyara ecosystem
LKM.....	Lake Manyara National Park
TNP.....	Tarangire National Park
Ha.....	Hectares
US \$.....	US Dollar
TSh.....	Tanzanian shilling
Kg.....	Kilogram
KNP.....	Kruger National Park
SSR.....	Sabi Sand Reserve

Introduction

Background

A wildlife corridor is the area of land used by wild animal species in their seasonal movements from one part of an ecosystem to another in search of basic requirements such as water, food, space and habitat (URT 2009). Wildlife corridors allow free movements for animals to other geographical localities where access to critical resources for survival and exchange of genetic material take place Hassan (2003). Wildlife corridors are, therefore, critical components for ecological integrity and the long-term survival of the ecosystem (Noe 2003).

Globally wildlife corridors have been considered important for connectivity, for example the case of Kenha and Pench National Parks, in Madhya Pradesh, India where habitat connectivity for tiger (*Panthera tigris*) was emphasised. The major problem across Kenha-Pench landscape was however, habitat fragmentation caused by human settlement densities, railways, roads and cropland expansions. In mitigating these problems emphasis was put on identifications of suitable wildlife corridors to reduce genetic isolation, offsetting habitat fragmentation problems, and increasing animal dispersal at the same time enabling ecological processes (Rathore et al. 2012). The protections of natural landscapes that support wildlife movements was emphasised in the establishments of oil palm plantations on the structures of the agro-forestry mosaic of La Gamba southern Costa Rica which showed that its establishment would have great impacts on the wildlife species because of loss of habitats (Hobinger et al. 2012). It is important to have knowledge of wildlife corridors before development project implementations such as roads. In Northern New Hampshire, for example a study on identifications of mammalian road- crossing patters resulted in an avoidance of unnecessary habitat fragmentations and wildlife corridors were successfully modelled and identified (Leoniak et al. 2012).

In Africa a study of seasonal home ranges of elephants (*Loxodonta africana*) between Sabi Sand Reserve (SSR) and Kruger National park (KNP) where well identified wildlife corridor protections were found important because elephants depend upon resources of both parks. Thus there is an important co-operation between wildlife managers in their policy formulations and controlling human encroachment in the wildlife corridors (Thomas et al. 2012). In Nairobi National Park in Kenya wildlife migrates to Kitengela dispersal area but the challenge has been human population growth, agriculture expansions and deforestations in

Kitengela hence jeopardizing wildlife survival. In order to save wildlife migrations during wet season from Nairobi national park to Kitengela it was argued to compensate the private land owner farmers (Rodriguez et al. 2012).

In northern Tanzania Kwakuchinja wildlife corridor links the Tarangire National Park (TNP) and Lake Manyara National Park (LMNP) (Marttila 2011). The northern part of the corridor is in Monduli district, Arusha region with the southern part being in Babati district in Manyara region. The corridor is within the Tarangire - Manyara ecosystem (TME) which has relatively high mammal species diversity where wild animals migrate seasonally. This is the second largest migratory pattern found in Tanzania after the Serengeti-Masai Mara ecosystem in terms of wildlife migration (TAWIRI 2010, Trevor et al. 2012). The main factors threatening the blockage of Kwakuchinja wildlife corridor includes human settlements density, expansions of cropland which have greatly lead to loss of habitat for wildlife (Caro et al. 2009).

The concept of wildlife corridor varies between different stakeholders (wildlife managers, scientists, interested parties) in Tanzania (Goldman 2009). Five different types of wildlife corridors include; 1) unconfirmed corridors with poor documentation just based on historical movements of animals such as elephants but it is not clear whether they are still in use. 2) Uncultivated patches of lands with natural vegetation between protected areas. 3) Continuous uncultivated land with natural vegetation such as forest reserves. 4) Areas with known animal movements irrespective of habitats documented animal movements such as elephants, and 5) formally documented corridors that link protected areas (TAWIRI 2010, Trevor et al. 2012). In Tanzania many wildlife corridors fall into the fourth category with known animal movements such as elephants (Blanc et al. 2007). Many protected areas in Tanzania are becoming isolated and the reasons for the isolation include growing human population in areas adjacent to protected areas and land use change towards agriculture, infrastructure and settlement in areas that were previously unpopulated. Tarangire National Park is the most threatened national park (Newmark 2008). Also a growing human population depend on protected areas for clean and abundant water, hydroelectricity, revenue from tourism and medicinal plants while the actions toward establishing, maintaining and managing corridors between protected areas are rapidly diminishing endangering the future of the ecosystem services and the biodiversity that such areas provide (Goldman 2009).

Human settlement in wildlife migratory areas

The tendency of establishing human settlements in previously wildlife migratory areas is becoming common and endangering the future life of wildlife species (Ogotu et al. 2012). Wildlife species affected include the African elephant, the African wild-dog (*Lycaon pictus*) and other small mammals, amphibians and reptiles due to habitat destruction from increased human activities such as urbanization, cultivation, overgrazing, bushfire, and deforestation. Such activities increase hand in hand with the increase in population growth and poverty (Galanti et al. 2006). Increased human population pressure and its negative impact on habitat loss in African countries including Tanzania, is a common phenomenon (Newmark 1996, Kideghesho et al. 2006). Some of the wildlife species in the Tarangire – Manyara ecosystem are reported locally extinct due to habitat destruction and overexploitation indicating high pressure of human impacts on wildlife (Shemweta and Kideghesho 2000). Despite the high utilization of wildlife outside the protected areas yet there is not enough and sufficient funds available for monitoring wildlife outside protected areas due to high costs associated with such monitoring (Msoffe et al. 2007). Thus there is a need to sensitize the importance of different stakeholders and not the individual approach on the conservation of wildlife corridors as the important connective areas between one habitat and another for ensuring genetic flow (Goldman 2003).

The growing population pressure should be handled with care as the land is constant while the human population is growing rapidly especially around protected areas (Kideghesho et al. 2006). The current Tanzania human population reached 44.9 million in 2012 (URT 2012). This is 50 years after independence when it was 7 million. If the current growth rate continue that means Tanzania will reach 100 million in 20 years to come. Increased population growth in Tanzania goes hand in hand with the high demand on food requirement. Thus in order to meet the requirement more cropland is needed at the expense of wildlife habitats because an increasing food production is a priority. The expansion of cropland reduces natural ranges of many wild animals due to the loss of habitats and fragmentation which ultimately result into local extinctions of wildlife (Goldman 2009).

Table 1: *Nine wildlife species have been reported extinct in Kwakuchinja wildlife corridor. These species have different conservation status in the world such as vulnerable, endangered or nearly extinct.*

Species	Scientific Name	Extinction year	Status in the world
Lesser kudu	<i>Tragelaphus imberbis</i>	1957	Vulnerable
African Wild dog	<i>Lycaon pictus</i>	1960	Vulnerable
Cheetah	<i>Acynonyx jubatus</i>	1980	Vulnerable-protected by CITES and African convention
Cooks Hartebeest	<i>Alcelaphus buselaphus</i>	1982	Vulnerable
Mountain Reedbuck	<i>Redunca fulvorufula</i>	1982	endangered in Cameroun, Nigeria and Uganda
Oribi	<i>Ourebia ourebi</i>	1983	
Eland	<i>Taurotragus oryx</i>	1983	Locally endangered but overall not.
Black rhinoceros	<i>Diceros bicornis</i>	1985	Endangered; nearly extinct
Southern reedbuck	<i>Redunca arundinum</i>	1991	Total range very fragmented but not endangered

Source:(Shemweta and Kideghesho 2000)

Table 1 indicates the species and the year of extinction in the Kwakuchinja wildlife corridor as well as their conservation status in the world of different African mammals. Several factors are responsible for local extinctions of these wildlife species but the most pronounced are loss of habitat as a result of human settlement and expansion of cropland which are primarily pressured by increased human populations (Woodroffe and Donnelly 2011, Pittiglio et al. 2012).

Problem statement

Wildlife corridors are of paramount importance in the gene flow and existence of the wildlife species because most of our protected areas are not big enough to accommodate wild animals (Newmark 2008, Caro et al. 2009). Human population growth bordering these protected areas is high and has become a serious threat to the management of wild animals all over Africa

(Nichols 1999). Local communities around the protected areas conduct activities such as unsustainable agriculture practices, cutting of woody forests and making fire, all of which are destructing the vegetation cover. This is a big problem in Kwakuchinja wildlife corridor which has led to blockage of this important connective area between Lake Manyara National Park and Tarangire National Park. Illegal wildlife hunting for subsistence and commercial use is unsustainable. Harvesting of wild animals is another activity which is conducted by local communities and by poachers from outside Kwakuchinja (Pittiglio et al. 2012). While the problem of blocking wildlife corridors has reached a level that are threatening some wildlife species in the area to extinctions, yet there is no clear or true willing from the government to rescue the situation (Mwalyosi 1991).

Significance of the study

The rationale of this study is to document negative impacts to wildlife caused by human settlements and land use changes as a result of pressure from human population growth and other human activities of local communities in Kwakuchinja wildlife corridor. Also to examine the extent and magnitude of land use changes over the past 20 years and their impacts on wildlife in the Kwakuchinja wildlife corridor. Understanding negative impacts on wildlife due to land use changes and human blockage of wildlife corridor should assist in proposing short-term and long - term management strategies for the corridor to responsible wildlife departments and conservation agencies on what should be done to halt the situation for the sustainable management of and conservation of wildlife in Tanzania.

Objectives

The main objective of this thesis is to address the impacts of human settlements and land use changes in the Kwakuchinja wildlife corridor that connects Tarangire National Park (TNP) and Lake Manyara National Park (LMNP).

Hypotheses

Increased human settlements and land use changes in Kwakuchinja wildlife corridor over the last 20 years (1990 to 2010) are causing increasing threats to wildlife populations:-

- 1: The land use has changed dramatically during the period 1990-2010.
- 2: Land use changes have negative impacts on natural habitats of wildlife.
- 3: Negative impacts to both wildlife and humans are due to increased human- wildlife interactions.

Methodology

Study Area description

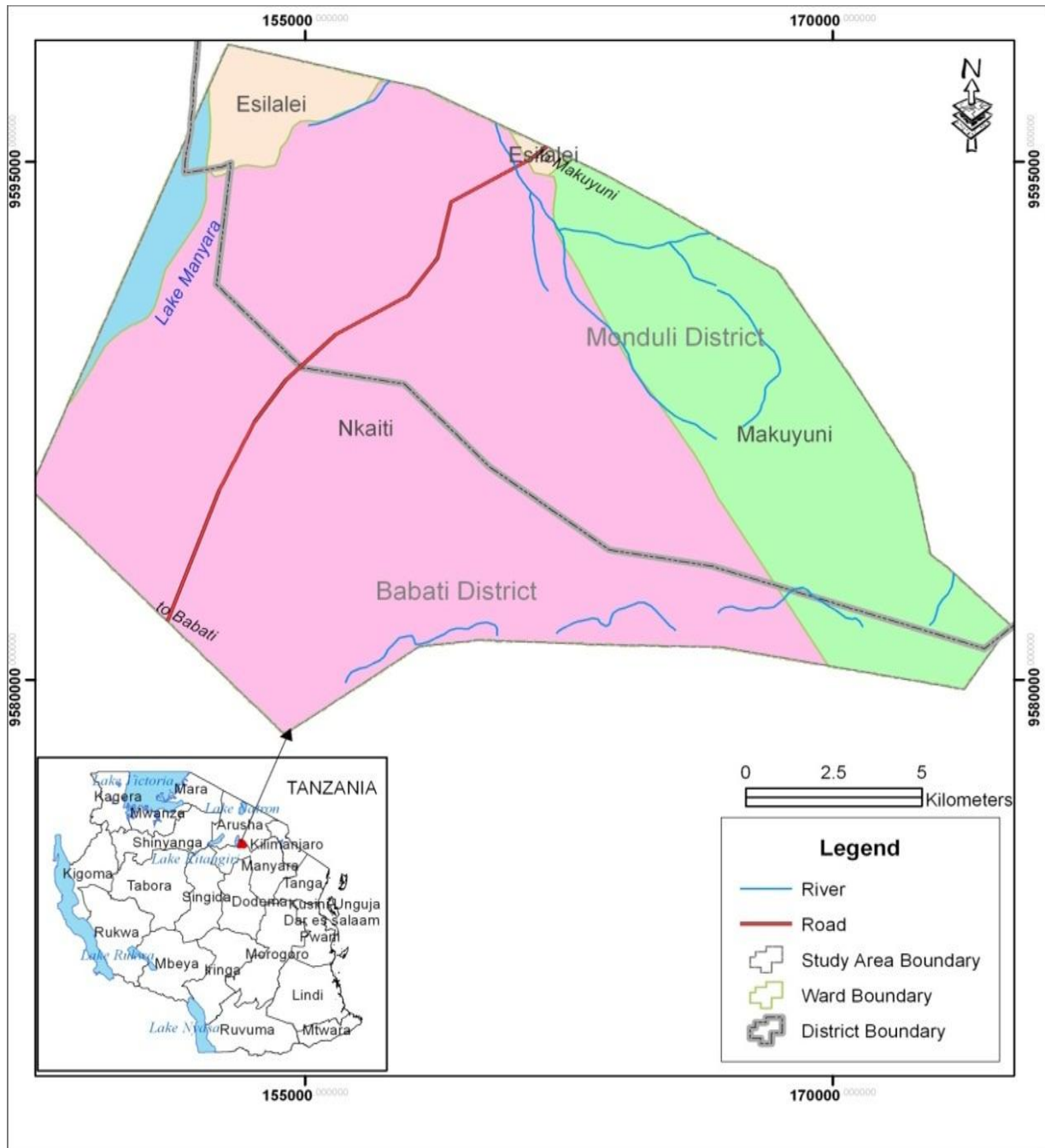


Figure 1: Map of Tanzania showing the study area (Kwakuchinja wildlife corridor).

The Kwakuchinja corridor is part of Kwakuchinja open area (600 km²) lying between Lake Manyara and Tarangire National Parks North-central Tanzania (Fig. 1). It is located between latitude 03° 35' 38" and 03° 48' 02" S and longitude 35° 48' 21" and 35° 59' 25" E. The vegetation type is primarily savanna. Two types of savanna are found in Kwakuchinja: Microphyllous

savanna on riverine areas dominated by *Acacia tortilis* and Broadleaf deciduous savanna on the ridges and upper slopes dominated by *Combretum* and *Commiphora* species (Marttila 2011, Pittiglio et al. 2012). Black cotton soil prevails in the flood plains and dark red sandy clay loam elsewhere. The annual average rainfall is 450–650 mm; the higher amounts in the west and the lower in the east with bimodal characteristic whereby short rains from November to December and long rains from February to May (Marttila 2011). March and April are the wettest months; July and August the driest (Caro et al. 2009).

The area is home to several ethnic groups in at least five sub villages (Newmark 2008). Their occupation includes livestock keeping, subsistence and or commercial agriculture and business. Moreover, fishermen nearby as far as Babati town immigrated to the area and establish temporary fishing villages when Lake Manyara was favourable for fishery area (Goldman 2003).

Types of data

The study used two types of data namely primary and secondary data. Primary data covered human activities in relation to wildlife and land use changes in the past 20 years in the Kwakuchinja wildlife corridor. These data were obtained from villagers, village leaders, tourist campsite owners and different stakeholders including Tarangire National Park.

Secondary data obtained from other research findings focuses on land use changes and their impacts on wildlife based on their habitats loss, data on wildlife extinct locally. For example various documents including, wildlife conservation laws, scientific articles, and conservation articles, conservation books. Internet and NTNU search engine ISI web of science were used on the related topic. Satellite imagery for 1990, 2000 and 2010 year were used to obtain types of land covers/ land use and land use/ cover changes in the period of 1990-2000, 2000-2010 and 1990 – 2010.

Data collection techniques

The following data collection techniques were applied such as questionnaire and informal interviews, focused group discussion, documentary review, interpretation of the satellite image obtained from the Institute of Resource Assessments (IRA) University of Dar-es-Salaam (UDSM).

Questionnaire design

Closed ended questionnaire questions were used. The first part focused on demographic variables such as gender, age, educational level, occupation and immigration status of the respondent and number of people in the household. The second part of questionnaire focused on their impacts they had on wildlife as the results of settlements, pressure from human population growth, agriculture and other social economic activities which could have negative impact on wildlife. Respondents were also asked on their views about wildlife impacts to humans.

Selection of samples

Questionnaire survey was conducted in all the three villages located within the Kwakuchinja wildlife corridor and a total of 250 households (HHs) were selected at random. Among those 250 HHs surveyed, 100 HHs were located in Olasiti village, 100 HHs in Minjingu village and 50 HHs were in Kakoye village. Selection of samples ensured representation of residents in the study area whereby number of HHs selected ensured 15 % of all households in every respective village. In most cases respondents were selected on the basis of their experience in the area, and only respondents above 18 years old were interviewed, gender balance was considered to insure representation of both males and females. Maasai tribe is dominant in the study area account for about more than ½ of all respondents, the other tribes are combined (Iraq, Chaga, Barbaig, Pare and Meru) all together account less than ½ of the interviewed respondents. The occupation of the respondents were mainly livestock keeping, crop cultivations, small buseness charcoal selling and hunting bushmeat for consumption and selling. Education level of respondents were categorised into informal and formal education (i.e primary education, secondary and higher education)

Questionnaire administration

In every household the head of the household was interviewed and when they were not able they allowed other representatives to provide the information on behalf of the household. Structured questionnaires were administered using face to face interview that provided the family member to answer. A research assistant was used in cases where the respondents could not understand Swahili language and translated into tribal language. Questions covered socio-economic and demographic information such as age, sex, education level, source of income, tribe and number of people in household (HH) and resident status of the interviewed respondents. The other part of the questionnaire covered questions about the hunting, types of

crops cultivated, crop and livestock depredations. Furthermore respondents were asked whether they had awareness of different kind of wild animals and how often they are seen in the area by providing them with the checklist of mammals from both national Parks (Tarangire and Manyara). This enabled me to know which wildlife mammals are no longer available in the Kwakuchinja wildlife corridor and I asked the respondents what might be the causes of some animals to go extinct in the Kwakuchinja.

Meeting with focus group

I conducted meetings with the village leaders and Burunge Wildlife Management (WMA) leaders. Participants for household interview were selected with the assistance of village elders and village leaders and covering the entire corridor. Focus group discussion was composed of seven (7) participants, comprising of village members who were aware on the history and patterns of settlement in the village.

Use of satellite images

I used Satellite images from ten (10) and twenty (20) years ago that were images for 1990, 2000. The image for the year 2010 was used in addition to the house hold's interview in order to capture the history of different land cover and changes over time in Kwakuchinja wildlife corridor. The GPS points of the surveyed households were recorded. The time when buildings, farms crop field, factories and business centres such as tourist campsites were established were obtained by asking the owners, neighbouring households' owners and the village leaders. The GPS coordinates used to draw a map to show the distribution of settlement.

Data analysis

Quantitative data were processed and analyzed using Statistical Package of Social Science (SPSS) version 19.0. Descriptive statistic were used to generate mean, percentages which are important for comparison purposes, chi-square tests were used in understanding the significance differences of research results. Nonparametric statistics were mostly used when data were not normally distributed. Significance level was set at $p < 0.05$. Imagery analysis was done using ArcGIS Desktop version 10.0.

Results

Land use / cover types in the period (1990 -2010)

Land use/ cover patterns during the years 1990 - 2010 are presented in Table 2. Land cover included bare soil, bush land, and cultivated land, inundated bush land, inundated grassland, scattered cultivation, water and woodland cover. The coverage is indicated in terms of hectares (Ha) and percentages coverage of the total area. The percentage coverage of different land use/ cover were derived from the three images in figures 4, 5 and 6 for years 1990, 2000 and 2010 respectively in appendix 1.

Table 2: Land use/cover types coverage in hectares and percentages as derived from images 1990, 2000 and 2010 year respectively in Kwakuchinja wildlife corridor, Northern Tanzania

Land Use/ Cover Types	Coverage					
	1990		2000		2010	
	Ha	%	Ha	%	Ha	%
Woodland	6015	18	4412	13	4374	13
Bushland	6307	19	1178	4	1730	5
Grassland	2475	7	5781	17	2224	7
Cultivated Land	4942	15	4715	14	7194	22
Scattered Cultivation	8497	26	12484	38	12592	38
Bare Soil	1105	3		0	3410	10
Total	33066	100	33066	100	33066	100

Generally it was found that total area coverage in Kwakuchinja wildlife corridor were under cultivated land, scattered cultivation and bare soil by 70 % of total area of the corridor (Table 2). The other land covers were woodland, water and grassland which occupied less than 30 % of total area of the corridor (Table 2).

Dramatic land use changes during the period 1990-2010

Cover change is indicated in hectare and percentage changes that has either decreased or increased during the periods 1990 – 2000, 2000- 2010 and 1990 -2010 (Table 3). Total area covered by bare soil increased by more than three times when compared to that of 1105 Ha in year 1990 and 3410 Ha in the year 2010 which is equal to increase of 7 % total corridor area

(Table3). Bush land declined from 1990 to 2010 year but from period 2000 – 2010 there was a little in area covered by bushland dramatic decline were in the period 1990- 2000 period which (Table 3). Cultivated land cover increased from 1990 -2010 but most of these increases were in the period 2000 – 2010 (Table 3). Grassland cover has increased during the period 1990 – 2000 but dramatically declined during the period 2000 – 2010 (Table 3). Inundated bushland and inundated grassland were also declined during the period of 1990 -2010 however there were no change during the period 2000 -2010 (Table 3). Scattered cultivation changed more during the period 1990 – 2000 but with no increase during the period 2000 – 2010 (Table 3). Woodland also declined dramatically during the period 1990 – 2000 (Table 3).

Table 3: *Land use/ cover changes during the period 1990 – 2010*

Land Use/ Cover Types	Cover Change					
	1990-2000		2000-2010		1990-2010	
	Ha	%	Ha	%	Ha	%
Woodland	-1603	-5	-38	0	-1641	-5
Bushland	-5129	-16	552	4	-4577	-14
Grassland	3306	10	-3557	-11	-251	-1
Cultivated Land	-227	-1	2479	7	2252	7
Scattered Cultivation	3987	12	108	0	4095	12
Bare Soil	-1105	-3	3410	10	2305	7

General characteristics of the socio-economic conditions of respondents

A total of 250 questionnaires were collected from three villages: Minjingu, Kakoye and Olasiti (see Table 2). The sex, age, education level, occupation, tribe and resident status of the respondents are given in Table 4. More males than females were interviewed (Table 4). Most respondents were in the age range of 18-27 years (Table 4). Furthermore, most respondents had no formal education (Table 4), while primary school was the most common education for those who had been to school (Table 4). The main social economic activities of the respondents were mixed farming and livestock keeping (Table 4) while very few depended on charcoal making and selling (Table 4). Most respondents were from the Maasai tribe while other small tribes were combined (Table 4). Finally most respondents were indigenous to the study area (Table 4). For those who had immigrated, there were different reasons for why immigrants had moved into the area includes farming (35.5 %, N = 110), small business (20.9

%, N = 110), livestock keeping (19.1 %, N = 110), employment (12.7 %, N = 110) and other reasons such as marriages (11.8 %, N = 110). Most immigrants (71.8 %, N = 110) immigrated during the period 2000 – 2010.

Table 4: *Demographic variables as age, sex, education level, source of income, tribe and the resident status of the interviewed respondents*

Attributes	Indicator % (N = 250)					
Age groups (years)	18-27	28-37	38-47	> 47		
	49.2 %	22.4 %	5.2 %	13.2 %		
Sex	Male		Female			
	61.2 %		38.8 %			
Education	Informal	Primary	Secondary & Higher			
	60.0 %	21.6 %	18.4 %			
Tribes	Maasai		Other tribes			
	61.2 %		38.8 %			
Residency	Indigenous		Non-indigenous			
	56.0 %		44.0 %			
Income Sources	Farming	Livestock	Livestock&	Charcoal	Employment	Business
	20.4 %	Keeping	Farming	, Hunting	nt	s
		20.4 %	34.4 %	4.4 %	8.8 %	11.6 %

Human induced negative impacts on wildlife

Local extinctions of wildlife and their causes

According to the respondents, lack of free space (for wildlife) was the main factor for the extinction of wildlife in the Kwakuchinja wildlife corridor (55.6 %, N = 250). Furthermore, according to about ¼ (26 %, N = 250) poaching/hunting caused local extinctions of wildlife, while 14.4 % (N = 250) reported that migration to other places resulted in local extinction of wildlife in Kwakuchinja. Human settlement in the wildlife corridor was furthermore according to the respondents the main cause for lack of free space for migrating wildlife (76.8 %, N = 250). There were different kinds of impacts indirectly and directly on wildlife induced by human settlements such as wildlife over-exploitation, loss of wildlife habitat, conflicts arising due to competing land uses with wildlife, pollution and physical developments on migratory corridor of wildlife (figure 2). Generally the frequency of habitat loss was highly mentioned by

the respondents followed by physical development in Kwakuchinja, over exploitation of wildlife, conflict with other land uses while pollution was the least ranked by the respondents in Figure 2.

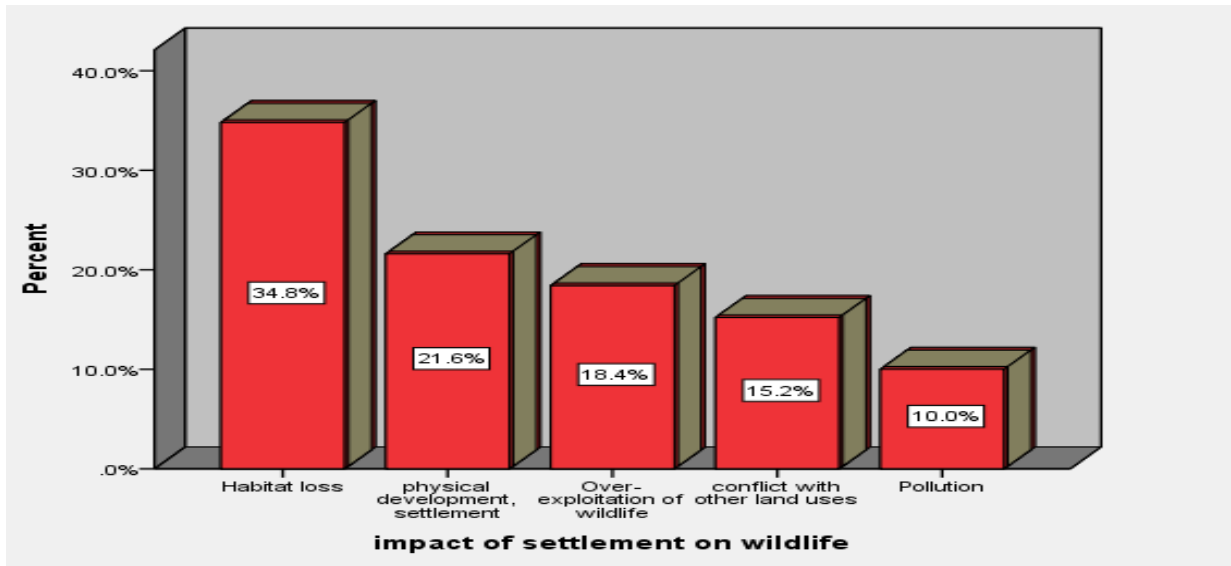


Figure 2: *Negative impacts on wildlife by human settlement in Kwakuchinja wildlife corridor*

Habitat loss

Habitat loss was significantly different between villages, more than half of respondents from Minjingu cited habitat loss and about a quota $\frac{1}{4}$ of respondents from Olasiti and only less than a quota $\frac{1}{4}$ respondents from Kakoye mentioned habitat loss (Table 5). Habitat loss was not significantly different considering respondents gender table 5 whereby males and female rarely mentioned habitat loss. According to respondents between tribes habitat loss was mentioned with significant difference in which other tribes pronounced it more than Maasai respondents (Table 5). Among age groups habitat loss impact was not significantly different (Table 5). More than half of all respondents in the age interval of 18-37 and 38-57 years reported habitat loss and more than a quarter $\frac{1}{4}$ of those in age interval above 57 years also reported habitat loss (Table 5).

Physical developments within the corridor

Physical development within the wildlife corridor was found to be significantly different between males and females (Table 5). There was significant difference between tribes; more respondents from Maasai tribes mentioned it than those from other tribes (Table 5) while no significant difference in all age groups in terms of physical developments (Table 5)

Table 5: Significance test of human impacts on wildlife between villages, sex, age and tribes

Impact	Variable				χ^2	P	d f
Habitat loss	Village	Kakoye (12.0 %, N = 50)	Minjingu (52.0%, N =100)	Olasiti (2.0 %, N = 100)	25.98	0.001	2
	Sex	Males (35.9 %, N = 153)	Females (33.0 %, N = 97)		0.229	0.632	1
	Age	18-37 (68.7 %, N = 179)	38-57 (66.9%, N = 55)	> 57 (37.5%, N = 16)	0.574	0.966	4
	Tribe	Maasai (29.9 %, N = 154)	Other tribes (42.7, N = 96)		4.296	0.038	1
Over-exploitation	Village	Kakoye (26.0 %, N = 50)	Minjingu (14.0 %, N = 100)	Olasiti (20.0 %, N = 100)	3.302	0.192	2
	Sex	Males (20.3 %, N = 153)	Females (16.5 %, N = 97)		0.552	0.458	1
	Age	18-37 (36. %, N = 179)	38-57 (43.9 %, N = 55)	> 57 (25.0 %, N = 16)	3.47	0.48	4
	Tribe	Maasai (19.0 %, N = 154)	Other tribes (17.7 %, N = 96)		0.122	0.73	1
Physical developments	Village	Kakoye (10.0 %, N = 50)	Minjingu (24.0 %, N = 100)	Olasiti (25.0 %, N = 100)	4.99	0.08	2
	Sex	Males (17.0 %, N = 153)	Females (28.9 %, N = 97)		4.90	0.026	1
	Age	18-37 (43.4 %, N = 179)	38-57 (41.3 %, N = 55)	>57 (18.8 %, N = 16)	0.34	0.98	4
	Tribe	Maasai (26.0 %, N = 154)	Other tribes (14.6 %, N = 96)		4.53	0.033	1
Competition	Village	Kakoye (26.0 %, N = 50)	Minjingu (2.0 %, N = 100)	Olasiti (15.0 %, N = 100)	41.38	0.001	2
	Sex	Males (14.4 %, N = 153)	females (16.5, N = 97)		0.206	0.65	1
	Age	18-37 (32.4 %, N = 179)	38-57 (25.5 %, N = 55)	> 57 (18.8 %, N = 16)	1.94	0.75	4
	Tribe	Maasai (14.3 %, N = 154)	Other tribes (16.7 %, N = 96)		0.26	0.61	1
Pollution	Village	Kakoye (10.0 %, N = 50)	Minjingu (9.0 %, N = 100)	Olasiti (11.0 %, N = 100)	0.22	0.89	2
	Sex	Males (12.4 %, N = 153)	Females (6.2%, N = 97)		2.56	0.109	1
	Age	18-37 (20.3 %, N = 179)	38-57 (19.7 %, N = 55)	> 57 (6.3 %, N = 16)	0.83	0.935	4
	Tribe	Maasai (11.0 %, N = 154)	Other tribes (8.3 %, N = 96)		0.48	0.48	1

Wildlife competition with other land uses types

Competition between wildlife and other types of land uses such as agriculture, settlements and grazing were significantly different between villages in the corridor with many respondents from Kakoye village pronouncing it more compare to those from Minjingu and Olasiti villages who didn't considered it as a impact (Table 5). Between males and female respondents no significant difference found in terms of mentioning competitions of wildlife against other types of land use (Table 5). No difference found between respondents from Maasai tribe and those from other tribes in terms of competition between wildlife and other land uses (Table 5). Wildlife competitions with other land use types were reported rarely by respondents in all age groups with no significant difference (Table 5).

Pollution

Pollutions in the corridor in terms of littering in wildlife areas were mentioned by respondents in the study area with small frequency of pollution among males and female respondents with no significant difference (Table 5). It was also reported rarely by respondents in all age groups and was not significantly different (Table 5). There was no significant difference found between villages in terms of mentioning pollution as an impact (Table 5). Furthermore pollution in terms of littering was rarely mentioned by the respondents from different tribes (Table 5).

Overexploitation of wildlife resources

Over-exploitation of wildlife resources was one of the factors for the decline and extinctions of wild animals in the study area. There were no significant differences between age, tribes, sex and between villages in terms of reporting impacts on wildlife due to human settlements in the corridor (Table 5). Over-exploitation of wildlife resources was also not significant between males and females (Table 5).

Beef was the main source of the protein for most of the respondents followed by chicken, pork, wild meat and others were also occasionally used as sources of proteins. Reliance on wild meat as a source of protein between villages was significantly different in Olasiti village followed by Minjingu and the Kakoye (Table 6). Between tribes difference on reliance on wild meat was significant that most of the respondents from other tribes relied more on wild meat compared to

Masai respondents consumed wild meat. However, generally Maasai relied mostly on beef followed by chicken, wild meat, others sources and lastly pork (Table 6). While for the other tribes the reliance was also on beef, chicken, pork, other sources and wild meat (Table 6). It was found significant difference in hunting between villages with the higher frequency of hunting in Kakoye village (60 %, N = 50) followed by Minjingu village (53 %, N = 100) and Olasiti village (20.9 %, N= 100) ($\chi^2 = 32.70$, N = 250, df = 4, P = 0.001).

It was reported that wild meat generally tasted better (55.2 %, N = 250) than other sources of protein (31.2 %, N = 250) and only 13.6 %, (N = 250) respondents were not able to tell the difference in terms of taste between wild meat and other sources of proteins (meat from domestic animals).

Table 6: Sources of proteins occasionally used by respondents in three villages and between different tribes

Attributes	Beef (%)	Chicken (%)	Pork (%)	Wildmeat (%)	Others (%)	N	χ^2	df	P
Kakoye	44.0	20.0	8.0	8.0	20.0	50			
Minjingu	36.0	29.0	9.0	11.0	15.0	100	18.90	8	0.015
Olasiti	60.0	12.0	9.0	12.0	7.0	100			
Masai	56.5	17.5	4.5	9.7	11.7	154			
Other tribes	32.3	25.0	15.6	12.5	14.6	96	18.00	4	0.001

A significant difference between the respondents from the three villages in terms of taste between wild meat and other sources of proteins was found (Table 7).

Table 7: Respondents taste of wild meat versus taste of meat from domesticated animals in Kwakuchinja Wildlife corridor

Villages	Wild meat taste better % (N)	Domestic meat taste better % (N)	Don't know either % (N)	N	χ^2	P	df
Kakoye	50.0	38.0	12.0	50			
Minjingu	55.0	41.0	4.0	100	24.62	0.001	4
Olasiti	58.0	18.0	24.0	100			

Respondents from Olasiti village reported more frequently that wild meat tasted better than respondents from Minjingu while about half of respondents from Kakoye had a fair taste on wild meat (Table 7). More than half of those who were not able to tell the difference were from Olasiti village while very few were from Minjingu village (Table 7). Less than half of all the respondents had asked for hunting license (45.6 %, N = 235) to get wild meat. There was a significant difference between males and females in asking for hunting license. Many female respondents (58.9 %, N = 90) had asked for a license to hunt wild animals to get wild meat while males respondents rarely did (42.1 %, N = 145), ($\chi^2 = 6.290$, N = 250, df = 1, P = 0.012). Between tribes only 43.3 %, (N = 139) of Maasai had asked for hunting license while in other tribes 53.1 %, (N = 96) had asked for hunting license but there was no significant difference in terms of asking hunting license between the tribes ($\chi^2 = 1.384$, N = 235, df = 1, P = 0.239).

Negative impacts caused by wildlife to local communities

Different impacts of wildlife from local communities are ranked in (Figure 3). These impacts were raised by the respondents as they complained about wildlife animals. Most of them performed negative attitudes due to these impacts cited in (Figure 3). Crop raiding was generally reported as the leading impact of wildlife (Figure 3). However, there were significant differences between the three villages in terms of impacts of wildlife to local communities.

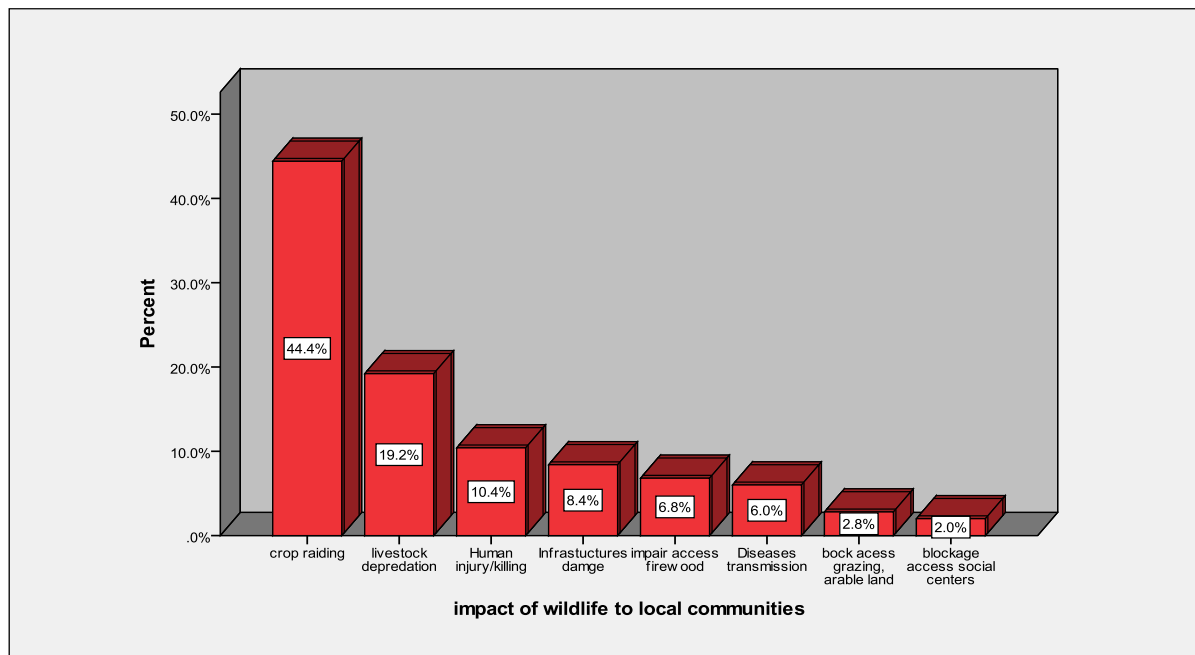


Figure 3: Negative impacts of wildlife to local communities in Kwakuchinja wildlife corridor

Diseases transmissions to livestock from wildlife

Disease transmission to livestock by wildlife was generally not significantly different in all three villages (Table 8). Between tribes there was no significant difference as all the tribes mentioned diseases transmissions to livestock very rarely (Table 8). Diseases transmissions were not significantly different as it was mentioned with small frequencies among male and females respondents (Table 8).

Human injury and damage of infrastructures

Damage of infrastructures and human injuries were mentioned significantly different between the villages with more cases reported in Minjingu followed by Olasiti and with no cases in Kakoye according to respondents (Table 8). Infrastructure damage and human injury/human life killing were found significantly different between males and females; males complained much compared to females (Table 8). However no significance difference between age and tribes in terms of mentioning infrastructure and human injury (Table 8).

Blocking access to grazing land, crop farms and social centres such as schools, dispensaries and shopping centres

People from Olasiti compared to those from Minjingu and Kakoye villages mostly complained at significant different levels about blockage of access to grazing land, crop farms, and village centres to get social services such as attending schools, shopping, and dispensaries (Table 8).

Blocking access to firewood and traditional medicines

Between the three villages blocking access to firewood was significantly different whereby in Kakoye was reported zero firewood blockage access by wildlife while there were more fear to access firewood in Minjingu and rarely in Olasiti (Table 8). There was significant different between males and females in terms of access to collect firewood and traditional medicines whereby males have less fear compared to females (Table 8). Blockage of access to firewood by wildlife was not significantly difference between all age groups of the respondents as they all equally mentioned it rarely (Table 8). Respondents from all tribes were not significantly different in terms of their views about blockage by wildlife to access firewood and traditional medicines in Kwakuchinja wildlife corridor (Table 8).

Table 8: Impacts to humans by wildlife between villages, sex, age and tribes

Impact	Variable			χ^2	P	df	
Disease transmission	Village	Kakoye (0.0 %, N = 50)	Minjingu (7.0 %, N = 100)	Olasiti (8.0 %, N = 100)	4.07	0.10	2
	Sex	Males (5.9 % N = 153)	Females (6.2 %, N = 97)		0.01	0.92	1
	Age	18-37 (12.7 %, N = 179)	38-57 (12.1 %, N=55)	> 57 (0.0 %, N = 16)	1.47	0.83	4
	Tribe	Maasai (6.5 %, N = 154)	Other tribes (5.2 %, N = 96)		0.17	0.67	1
block grazing, arable land	Village	Kakoye (0.0 %, N = 50)	Minjingu (2.0 %, N = 100)	Olasiti (10.0 %, N = 100)	10.1	0.006	2
	Sex	Males (6.5 %, N = 153)	Females (2.1 %, N = 97)		2.6	0.107	1
	Age	18-37 (12.0 %, N = 179)	38-57 (5.3 %, N = 55)	> 57 (0.0 %, N = 16)	2.35	0.67	4
	Tribe	Maasai (5.8 %, N = 154)	Other tribes (3.1 %, N = 96)		0.95	0.33	1
Damage infrastructures/ injuries	Village	Kakoye (0.0 %, N = 50)	Minjingu (24.0 %, N = 100)	Olasiti (23.0 %, N = 100)	14.5	0.001	2
	Sex	Males (22.9 %, N = 153)	Females (12.4 %, N = 97)		4.29	0.038	1
	Age	18-37 (40.4 %, N = 179)	38-57 (47.2 %, N = 55)	> 57 (6.3 %, N = 16)	4.8	0.307	4
	Tribe	Maasai (18.2 %, N = 154)	Other tribes (19.8 %, N = 96)		0.10	0.75	1
Blocking firewood access	Village	Kakoye (0.0 %, N = 50)	Minjingu (15.0 %, N = 100)	Olasiti (2.0 %, N = 100)	17.8	0.001	2
	Sex	Males (2.6 %, N = 153)	Females (13.4, N = 97)		10.9	0.001	1
	Age	18-37 (14.4 %, N = 179)	38-57 (7.9 %, N = 55)	> 57 (6.3 %, N = 16)	1.38	0.84	4
	Tribe	Maasai (5.2 %, N = 154)	Other tribes (9.4 %, N = 96)		1.6	0.20	1
Livestock depredations	Village	Kakoye (90.0 %, N = 50)	Minjingu (78.0 %, N = 100)	Olasiti (72.0 %, N = 100)	7.83	0.02	2
	Sex	Males (17.6 %, N = 153)	Females (21.6 %, N = 97)		0.61	0.43	1
	Age	18-37 (35.1 %, N = 179)	38-57 (30.8 %, N = 55)	> 57 (25.0 %, N = 16)	6.0	0.19	4
	Tribe	Maasai (17.5 %, N = 154)	Other tribes (21.9 %, N = 96)		0.72	0.39	1
Crop damage	Village	Kakoye (76.0 %, N = 50)	Minjingu (6.0 %, N = 100)	Olasiti (37.0 %, N = 100)	25.3	0.000	2
	Sex	Males (44.4 %, N = 153)	Females (44.3 %, N = 97)		0.001	0.98	1
	Age	18-37 (5.3 %, N = 179)	38-57 (7.6 %, N = 55)	>57 (62.5 %, N = 16)	3.3	0.50	4
	Tribe	Maasai (46.8 %, N = 154)	Other tribes (40.6 %, N = 96)		0.9	0.34	1

Livestock depredation

Livestock depredation was reported to be at significant different levels between the three villages; most depredations were reported in Kakoye followed by Minjingu and Olasiti (Table 8). Types and number of livestock killed includes goats (192) killed most followed by sheep (158), cattle (50), donkey (17) and other domestic animals (19) the least killed. An estimated total loss of 436 livestock belongs to 195 households that have reported livestock depredations in all three villages. On average every household lost 2.2 livestock in a year. This loss was valued at US \$ 20671.25 (that is an average of US \$ 106 per household which reported loss). A breakdown of the economic valuation of reported livestock killed by predators shows that most loss are from cattle (US \$ 9375) followed by goat (US \$ 6000), sheep (US \$ 3950), donkey (US \$ 1275) and others accounted for monetary loss of (US \$ 71.25). The most frequently reported predator responsible for livestock depredation in Kwakuchinja was the spotted hyena (*Crocuta crocuta*) (41.2, %, N = 195) followed by the lion (*Panthera leo*) (27.2, N = 195), leopard (8.8 %, N = 195) and other predators (0.8 %, N = 195).

Crop damage

Respondents from Kakoye village reported that crop raiding was the main impact of wildlife at a higher frequency than those in Minjingu village and Olasiti with a significant difference between villages in terms of crop raiding (Table 8). More than half of all respondents (64 %, N = 250) were able to estimate the amount of crop loss caused by wild animals. Respondents reported an estimated total average loss 382.91kg equivalent to US \$ 154 per household annually. Types of crops damaged include maize 56.4 %, beans 5.3 %, millet 2.5 % and other crops 36.0 %. Generally most respondents (69.2 %, N = 240) reported that the amount of loss was ranging between 99 and 499 Kg. Most crop damage were caused by elephants (71.2 %, N = 240) other wild animals combined accounted for (24.8 %, N = 240) of crop damage.

Different methods were used in controlling for crop destructions and livestock. Guarding/scaring was the main method (42.8 %, N = 247), the other methods used included reporting to district wildlife officers (22 %, N = 247), fencing farms and houses (11.6 %, N = 247), shooting (12.8 %, N = 247) and poisoning and other methods (9.6 %, N = 247). There was a significant difference between the methods applied in different villages; respondents from Olasiti mostly used guarding/scaring (63.6 %, N = 100) while respondents from Kakoye reported to wildlife officers (42 %, N = 50) and respondents from Minjingu village were guarding and scaring more (31.6 %, N = 100) ($\chi^2 = 46.23$, N = 250, df = 10, P = 0.001).

Discussion

Socio-economic condition

In Tanzania pastoralist societies like Maasai income sources of household are mainly livestock keeping and small scale crop cultivations. Rodriguez et al. (2012) they reported that Maasai tribe as pure pastoralists in East however; this is not the current case in Kwakuchinja as they have become involved in cultivation of food crops. Most of Maasai interviewed mainly depended on livestock keeping and crop cultivation as sources of household income. This is partly a strategy to meet food demand as well as realizing the cost associated with keeping large herds of cattle, because during the last drought in the area in the year 2007 large number of cattle died due to lack of grazing pasture (Muyungi 2007). Other activities such as charcoal making and hunting were found at low rates. Still such activities can have a wide negative impact such as deforestation and loss of habitat or even local extinction of wild animals. This is because such activities directly involve cutting of trees and burning which can destroy large forests and lead to desertification, this argument is also reported by Muyungi (2007).

In most cases males are the one who respond to the visitor in their household thus making women shy or sometime afraid to come out to speak to the scientist this argument is supported by (Noe 2003) and (Goldman 2003) who also argued the male dominance in Maasai traditions. This is the case in study area as many of the interviewed were males. Low level of formal education was due to tradition of pastoralist societies like Maasai who don't encourage their children to attend schools instead many of them remain home taking care of livestock. Only those who are looked upon as trouble and were not taking care of livestock properly were allowed to go to school. Therefore spending most of their life time taking care of livestock was for those who were not looked upon as trouble makers.

Land-use changes in the period 1990 - 2010

Based on the statistics derived from the 1990, 2000 and 2010 satellite images, first research hypothesis which states that there are dramatic land use changes in the Kwakuchinja wildlife corridor in the period 1990 - 2010 is supported by the findings. Most of the land use changes were negative. Proportion of cultivated land in Kwakuchinja wildlife corridor has increased over the last 20 years. This increase in cultivated land and those under scattered cultivation has put sixty percent (60 %) of total area in Kwakuchinja wildlife corridor to be under cropland. The impact of the increased cultivation in Kwakuchinja corridor is translated into dramatic

decline of woodland and bushland habitats. Range land natural habitats were changed in this period as revealed in this study. Changes that lead into declined natural habitats are regarded as negative changes which are associated with the loss of habitat for wildlife. In this survey it was discovered that woodland cover and bushland are nearly lost. The negative change in natural habitats and increased cultivation are partly due to changes in Maasai traditions whereby they start to diversify their livelihood strategies by producing crops from their fields and high rate of immigrations from other places lead to human populations increase. Declined livestock productions due to several factors including droughts might have forced Maasai to change their livelihood strategies to crop cultivation and livestock keeping (Noe 2003). Most of the immigrants are from nearby districts and many of them moved in between the period 2000 – 2010 year. This phenomenon is observed by Kideghesho et al. (2006). They reported high rate of population growth around western Serengeti National park due to immigrations of people from other places to the boundary of protected area.

Impacts of land use changes to natural habitats

This results support the second hypothesis which states that land use changes have negative impacts to natural habitats for wildlife as there are great decline of natural habitats that have been converted into other land uses such as agriculture. The increased conversions of rangeland habitats have negative impacts on wildlife as the habitat of wildlife is lost especially to bushland, woodland dwellers and grassland habitats. The new types of land uses such as agriculture which have occupied large space have lead to destructions of natural vegetations and reduced area available for wild animals grazing and movements. Kideghesho et al. (2006) mentioned the loss of wildlife habitats to cultivation in western Serengeti wildlife corridor support this result. Rodgers et al. (2003) reported that 16 % of the corridor has been converted to cultivation since the year 1987 to 2001 this also support results as most land use changes in Kwakuchinja occurred in the period from 2000 to 2010 year. The rate of conversion of range land habitats to cultivation is high and is accompanied by increased human populations with the growth rate of 3.8 in the Kwakuchinja (URT 2012). Loss of habitats for wildlife can have ecological impacts including local extinctions of wildlife species also indicated by (Hassan (2003), Kideghesho et al. (2006) Galanti et al. (2006), Goldman (2009)).

Negative impacts of human settlements to wildlife

The third hypothesis which states there are negative impact to both wildlife and humans is supported by the results derived from interviewed people in the Kwakuchinja wildlife corridor.

This section depends on the people's perceptions on the impacts of human settlements in the wildlife corridor and few available data on the extinct species which were obtained from the previous surveys by different researchers.

Local extinctions of wildlife

Extinctions of nine large mammals in Kwakuchinja were mainly attributed by over-exploitation of wildlife resources through hunting (both legally and illegal), loss of wildlife habitat to cropland expansion (as discussed in above section) and human settlement which were result of high rate of human population growth (Caro et al. 2009). During this survey it was obtained low level of hunting instead habitat loss highly ranked by respondents; however its impacts can be detrimental as it sometimes involves use of traditional hunting gears such as snares that can kill even untargeted wildlife. Unmonitored hunting can also affect the social structures of species as poachers are not selective or they hunt wildlife that can't be regenerated naturally (Marealle et al. 2010).

Over-exploitation of wildlife resources

Over-exploitations for consumption as bushmeat or poaching are according to the respondents, generally accounting for 18.4 % of the causes of declining and extinctions of wild mammals in Kwakuchinja. This is due to the fact that Kwakuchinja is part of a Game Controlled area which in Tanzania does not provide strict protection of wildlife making it susceptible to poachers (both substance and commercial purposes). Although Maasai traditions are well known for not eating bushmeat, in Kwakuchinja some of the Maasai have changed and they consumed bushmeat. Magige et al. (2009) reported that Maasai used feathers and eggs of Ostrich and hunted small birds. Few of the Maasai who tasted wild meat in the study area obtained it by hunting themselves while others bought it from other persons or obtained it from carcasses of wild animals. This change of behaviour to eating bushmeat might also be connected to the tendency of the current increased poaching in the area as many Maasai's didn't bother to look for hunting license. It may be due to interactions with other tribes in the area or lack of awareness and switching to taste wild meat.

Physical development within the wildlife corridor

Increased physical development within the corridor accounted for 21.6 % causes of wildlife decline in Kwakuchinja. Examples of physical development ranging from institutions such as schools, dispensaries to factory Minjingu phosphate mining located in Minjingu village within

the corridor. Others included tourist campsites. Some of them are right on the migratory routes within the corridor thus impeding wildlife movements which may have resulted into diversions of wildlife routes. Others have addressed the effect diversion due to establishment of physical structures within the migratory routes of wildlife (Soini 2006, Ogotu et al. 2012). Apart from those institutions and factory it was also found that human settlements in Minjingu village are expanding becoming a small town also indicated by Hassan (2003). During focus group discussions one of the elder (Noah Teveli) said "there were only 25 HHs in 1965 and less than 10 HHs in 1945"; he continued saying that "Maasai already settled during WWII" - meaning that they were only less than 10 HHs before 1945 and they were all Maasai. The population grew very fast from 25 HHs to 315 HHs in only ten years from 1965 to 1975 year according to Ward Executive Officer and continued growing to more than 1500 HHs currently with more than a population of 16,000. Minjingu village is currently subdivided into three villages which included Minjingu (now town centre), Olasiti village and Kakoye village (bordering Tarangire National Park). This is due to the increased human population which was also mainly pressured by immigration of people from different neighbour districts such as Arusha town, Karatu, Mbulu and many other parts of the Tanzania.

The increased human settlement in the area has contributed greatly to lack of free space for animal movements as it can be translated to increased human settlements as observed in the study area during this survey, this observation is also supported by Ndibalema (2010) in Serengeti Ecosystem, and Magige (2010) who also reported loss of habitats for birds to agriculture expansions. This has also resulted in shrinkage of the corridor area and might block the whole corridor in the near future if the current trend of human population growth continues in Kwakuchinja. Noe (2003) observed the shrinkage of size of Kitendeni wildlife corridor in Kilimanjaro National Park to about 5 km² in 2001 from 21 km² in 1952 and the main reasons were cropland expansions and human settlements and land use changes, the same threats operates in Kwakuchinja too.

Failure of wildlife to compete with other types of land uses

Agriculture is still the backbone of Tanzania economy as many people in the rural areas like Kwakuchinja depend directly on agriculture to meet their daily demands and wildlife doesn't provide incentives directly to these people. Therefore they can't see the importance of wildlife rather than just as enemies to them (Ogotu et al. 2012). As a result wildlife animals are killed

(especially carnivores) whenever encountered in the cropland farms and when attacking the livestock in their houses. Pettorelli et al. (2010) findings suggest that agriculture had serious impact for carnivore species as they were found to have avoided cropland this is also the case in this survey two prides of lion are reported extinct in Tarangire Ecosystem and the remaining pride is believed to have reduced in number also. This may have been attributed to Maasai tradition of killing lions to be recognized as warriors in protecting their livestock (Woodroffe 2000, Kolowski and Holekamp 2009). Previously there were ten lion prides in the park. Those two prides which got extinct were known to be in Kwakuchinja. One pride that is still found in Manyara ranch that is also bordering the Kwakuchinja wildlife corridor was reported to have attacked livestock.

Wildlife related negative impacts to local communities

Based on the third hypothesis which state that there are negative impacts to humans by wildlife in Kwakuchinja wildlife corridor the results support this hypothesis as derived from people's perception. Crop losses and livestock depredations were the most pronounced impacts to local communities in Kwakuchinja where by others included disease transmissions to livestock, human injury/killing by wild animals. Also infrastructures such as water tape damaged by elephants are reported at small scales. Children also reported to miss classes due to fear of wildlife when lots of elephants roam in the area especially during wet season (April/May). Tarangire is a dry refuge to some mammals such as zebra, wildebeest and giraffe therefore most animals return inside the park during dry season and in the wet season they roam outside the park (Gereta 2010). Thus during the wet season there are more cases of crop destructions and livestock attack. Although reported at small scales such as lack of access to grazing and arable land as well as firewood collection more women complained about difficulties in accessing firewood in the bush for fear of being attacked by wild animals. women complain is explained by the fact that in most African traditions as to those in Kwakuchinja they are responsible for that activities such as firewood collections therefore making them to have great fear to wildlife attack.

Livestock depredation

Loss of livestock to predators was mostly pronounced in Kakoye village compared to Minjingu and Olasiti villages. This is due to the fact that Kakoye village is bordering the Tarangire National park, thus more the probability of coming in contact with predators such as lions, spotted hyenas, leopards and others which search for prey outside the park due to edge effect as

also supported by Woodroffe and Ginsberg (1998), Woodroffe (2000). Every household in the study area those reported depredations of livestock are estimated to be losing average 2.2 livestock annually this loss affect farmers economically and also spending more time in guarding livestock from predators hence resulting into human injury from predators. An average loss of US \$ 106 in every household annually due to predations is also supported by study in western Serengeti by Holmern et al. (2007) they reported average loss of US \$ 97.7 due to livestock depredation. In the study area cattle were mostly attacked by lions and spotted hyena while goats and sheep were frequently attacked by spotted hyena and leopard. In Tarangire - Manyara ecosystem spotted hyena are the large predator with high density followed by lions this also reflected in the depredations cases as mostly caused by spotted hyena followed by lions and leopard. This loss of livestock to predators lead to retaliatory killing of carnivores as the livestock owners become anger toward predators the argument supported by (Røskaft et al. (2007), Røskaft et al. (2013) and Holmern et al. (2007)).

Crop damage

Most cases of crop damage by wild animals are experienced in Kakoye village by more than three quarter (3/4) of all total crop losses in the study area. Kakoye village is bordering Tarangire National park. (Emerton and Mfunda (1999), Noe (2003), Kidegesho (2010)) they reported that farms that are close to the boundaries of protected areas are more probably attacked by wild animals. This is due to the edge effects as those living more closely to the boundary of the national park the more contact they get with the wild animals such as elephants (Woodroffe and Ginsberg 1998). This is the case in Kwakuchinja wildlife corridor as those farms close to TNP are mostly attacked. Loss of 382.91 kg of crops per household annually is great loss taking into account that most people in study area depend on farm produced food as they are not able to buy from market /shop, this is equal to say a loss of US \$ 154 per household annually. This amount is far less than that estimated by Kidegesho (2010) who earlier reported an average loss of US \$ 516 per household in western Serengeti corridor, but more close to US \$ 155 per every household that suffered crop damage in western Serengeti estimated amount by Emerton and Mfunda (1999). With a difficult bureaucratic system to get compensations of their crop loss these households end up by just complaining and filling the paper forms but they never get compensated for the loss by the wildlife departments. Most destruction was in the form of trampling when they move around and foraging mostly by elephants.

Conclusion and recommendations

Conclusion

By these findings it is evident that Kwakuchinja wildlife corridor is under threat due to rapid land use changes within the corridor this results also supported the first hypothesis that there are land use changes. Research findings show that there are major land uses changes which are associated with expansions of cropland cultivation and human settlements into areas previously used to be wildlife habitats. These changes have negative impacts on the natural habitats as it was found dramatic decline in the woodland and bushland this support hypothesis which states that land use changes in the study area have negative impact on the natural habitats for wildlife. There are negative impacts to both wildlife and humans due to land use incompatibility with wildlife as revealed in this research. More negative impacts on wildlife were in terms of local extinctions associated with habitat loss. With this current trend of agriculture expansions which has already put 60 % under cultivation up to now it is of no doubt that existence of Kwakuchinja corridor is threatened in the future. This findings also supported the third hypothesis as it was earlier hypothesized that there negative impacts to wildlife and humans.

Recommendations

The following strategies should be adopted to overcome the problem of increased rangeland habitat destructions caused by human settlements and crop land expansions.

Population growth should be an agenda

It is of no doubt that the current rate of population growth is detrimental to wildlife through habitat destructions to meet food production demand by growing population. Family planning educations should be emphasized to those societies around protected areas and in other places. To make it practical it is important to be introduced at primary and secondary educations as one of the subject to curb the rate of population growth down.

Enhancing conservations educations

Creating awareness among communities through conservation education is important. When local communities are provided educations on different activities they can do without causing unnecessary threat to wildlife then conservation of wildlife and corridor objectives could be attained. Provide education to children at primary schools, nursery level and even at college level but most important is that children they can educate their parents back home about conservation. Children will grow with that knowledge and it is most likely they will have

positive attitude to wildlife and wildlife conservation. Conservation education should focus on the value of wildlife, importance of wildlife corridor, the impacts of habitat destructions and different ways of controlling or mitigating those impacts.

Land use planning

There should be participatory land use planning between different stakeholders like village members and other institutions that are present in the Kwakuchinja wildlife corridor should be well involved from designing to implementation stage. One of the problems in Kwakuchinja was lack of land use planning in all three villages surveyed that is clearly put in place officially. The remaining area of the corridor should be protected from other land uses such as crop cultivation otherwise if the current cropland expansions continue without land use planning put in place immediately Kwakuchinja wildlife corridor will be lost in near future.

Adoption of poverty reduction policies

There is no way encroachment of wildlife corridors and protected areas can be avoided if local communities around are left to extreme poverty. Income generating projects should be emphasised that can meet economic development to local people at the same time conservation objectives hence reducing reliance on natural resources. Government should therefore have a better strategy on alleviating poverty in rural areas and putting effort in supporting agricultural sector to enable better and sustainable agriculture. Establishment of conservation projects such as wildlife management areas (WMA), apiary projects and forest owned by village members are examples of projects that can provide both conservations and economic benefits. These projects should be designed and implemented by the villagers the role of government must be identified clearly to avoid the current confusion in many projects such as WMAs where all matters of these projects are mostly conducted through government directives.

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Appendices

Appendix 1: Satellite images for 1990, 2000 and 2010 years showing different land uses/cover types present in Kwakuchinja wildlife corridor

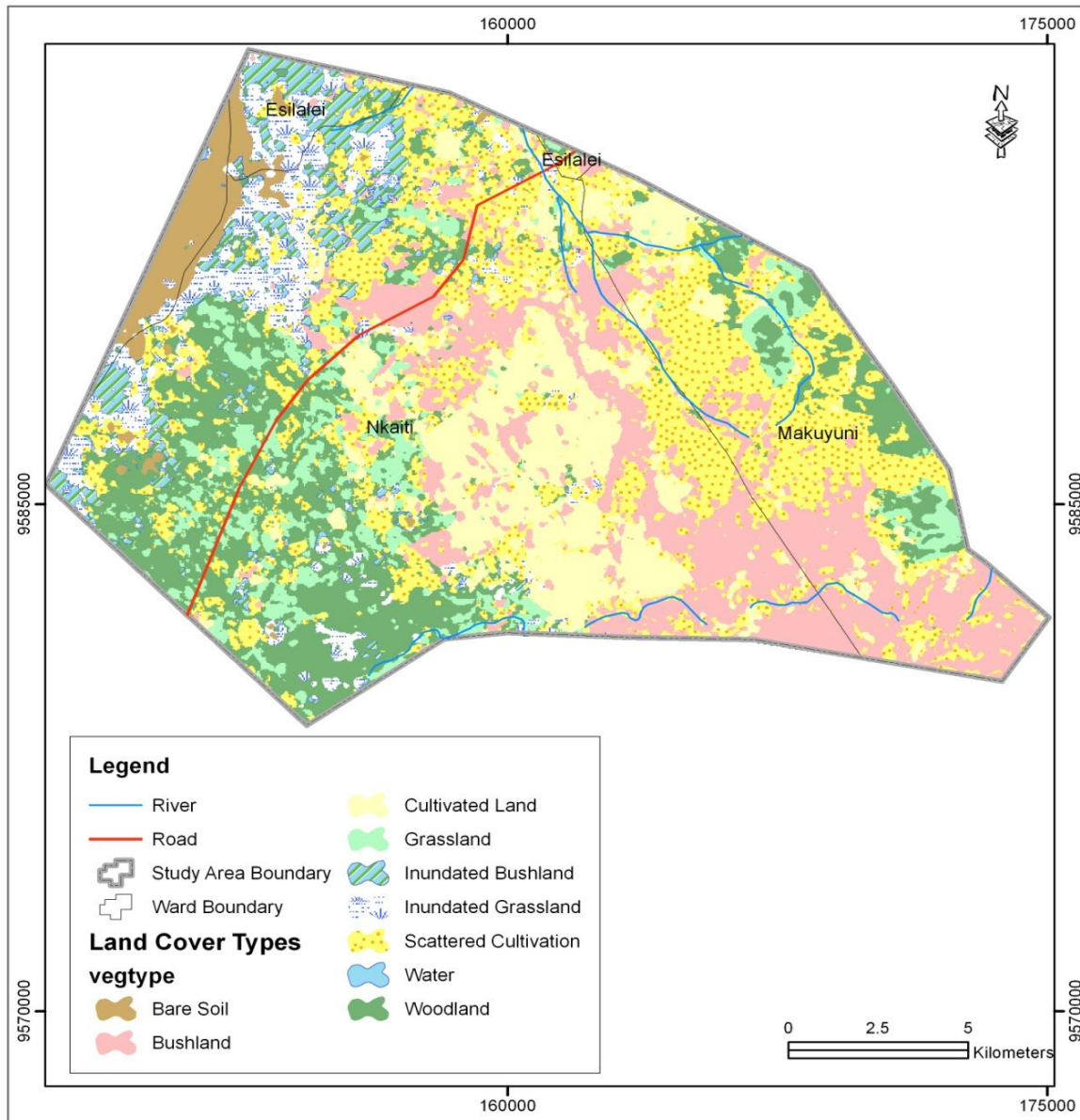


Figure 4: Different land use/ cover types and their distributions in the image for the year 1990

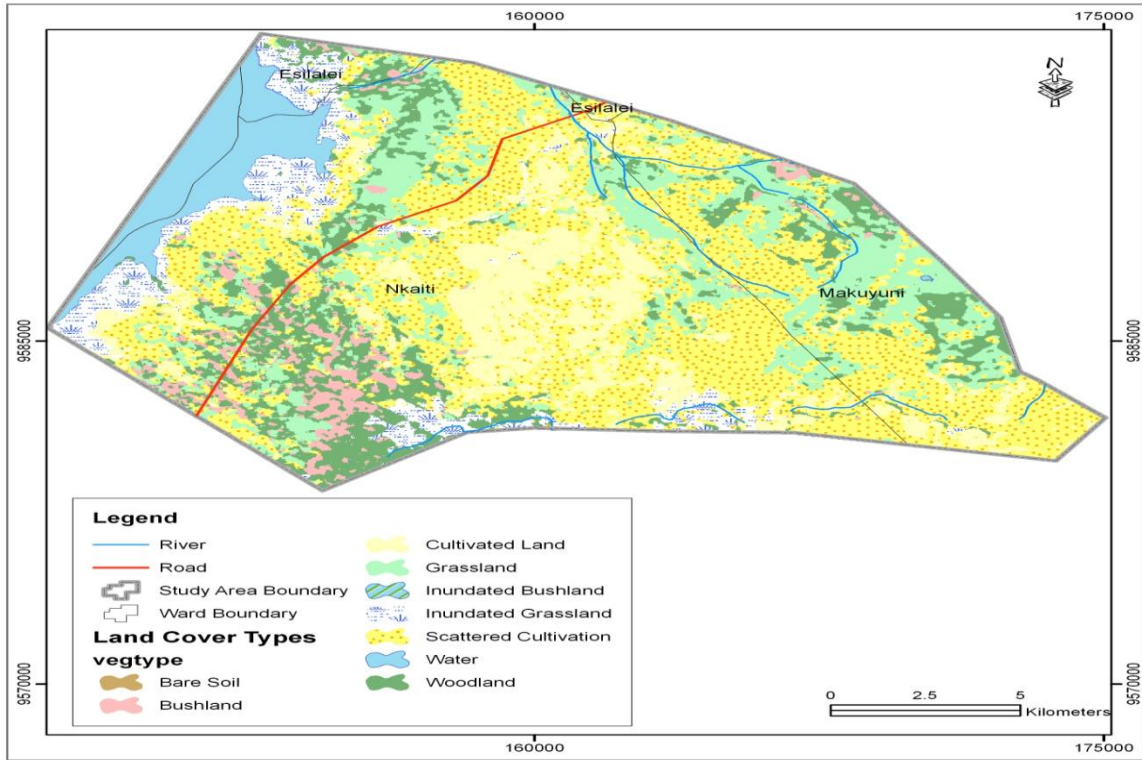


Figure 5: Land use / cover types in year 2000 in Kwakuchinja wildlife corridor

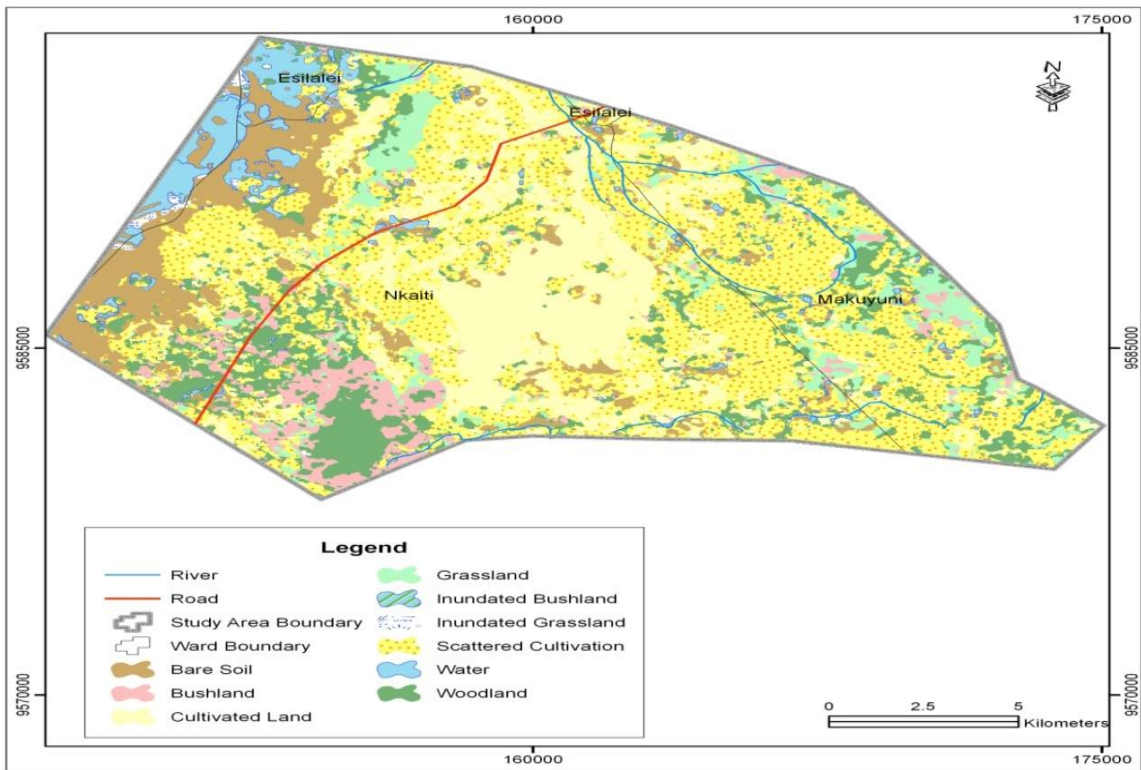


Figure 6: Land use/cover type's distributions and coverage shown in the image for the year 2010 in Kwakuchinja wildlife corridor

Appendix 2: Questionnaire survey in Kwakuchinja wildlife corridor, Northern Tanzania 2012

1. Questionnaire no..... 2. GPS No.....
3. GPS coordinates.....N.....E 4. Date 5. Name of respondent.....
6. Place of birth7.Tribe----- 8. Sex a).male b) female 9. Age..(a) 18-27
(b) 28-37 (c) 38- 47 d 48/57 (d) > 57. 10. Are you married? Yes No
11. How many children do you have (a) 0-4 (b) 5-9 (c) > 9
12. Are you indigenous to this area (kwakuchinja)? (A) yes (b) No
- If not when did you immigrate in this area (b) 1981-2000 (c) > 2000
13. What was the reason for immigrating to the area?(a)Agriculture (b) Small business
entrepreneur (c) livestock keeping (d) fishing (e) Employment (f) others
please specify
14. Do you normally see wild animals? (a) Yes (b) No
15. When did you see them? (a) Very recently (b) long time years ago
(c) Can't remember even
16. Do you remember which mammal species you saw? (a)Yes (b) No
17. If yes can you please write their names?
18. Do you think they are still available the area? a) Yes b) No
19. If no what is the reason you think might cause those animals to disappear in the area?
a). Due to lack of free space for animal movement b) Habitat destroyed
c) Others specify
20. What activities you conduct to get income (a) Agriculture b) Livestock keeping
c) Employment d) Hunting e) Business f) charcoal making
21. Which kind of crops do you cultivate (a) maize (b) beans (c) millet (d) Others
.....
22. What is the size of your farm? (b) 1-2 Ha (b) 3-5 Ha (c) 6-10 Ha (d) >10 Ha
23. Is there any case of crop damage by wild animals in your farm? a) Yes b) No

