THE IMPACT OF HUMAN ACTIVITIES ON WILDLIFE IN KWAKUCHINJA MIGRATORY CORRIDOR - TARANGIRE/MANYARA ECOSYSTEM (TME), NORTHERN TANZANIA

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A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN WILDLIFE MANAGEMENT AND CONSERVATION OF SOKOINE UNIVERSITY OF AGRICULTURE. MOROGORO, TANZANIA.

2014

ABSTRACT

Human population growth in areas bordering protected areas is high and has become a serious threat to the management of wildlife all over Africa. Local communities around the protected areas conduct illegal activities which are destructive to habitats and threatens wildlife migratory corridor. Furthermore, there is a local extinction of five species of large mammals in the Kwakuchinja. This study therefore focused on assessment of impacts of human activities on wildlife in the Kwakuchinja migratory corridor in the TME, Northern Tanzania. Data were collected using transect walk, household questionnaires, key informants and secondary materials. Wildlife group size comparison data were analysed using Mann Whitney U- test while Pearson test was used to compare relationships between wildlife, livestock and human settlement numbers. Moreover, Chi-square test was used to compare relationship between wildlife status and the respondent's time spent in the study area.The study found that wildlife migratory corridors had declined from five to three. Common wildebeest had a highest density (Area 450 square kilometers) while Thompon's gazelle was the least. Wildlife trend from aerial survey data show a 50% reduction in numbers of large mammals in the ecosystem in 2000s compared to 1990s and land use changed to cultivation by 4.2% increase in the study area. Insignificant relationship between wildlife and human settlement numbers ($r=0.714$) was observed. These findings therefore suggest that human settlement has negative impact on wildlife numbers and distribution. Since wildlife and livestock share grazing and drinking areas, the study recommends use of an integrated land use plan, law enforcement and sustainable use of natural resources to safe guard Kwakuchinja wildlife corridor.

DECLARATION

I, YUSTIN RICHARD NJAMASI, do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my original work and has neither been submitted nor concurrently being submitted for a degree award in any other institution.

……..…… ……

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MSc. candidate

The above declaration confirmed

……..… **……..**

Prof. V.G. Ndibalema Date

(Supervisor)

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ACKNOWLEDGEMENTS

First and foremost, I would like to express my heartfelt gratitude and appreciation to my supervisor Prof. V. Ndibalema, from the Department of Wildlife Management, Sokoine University of Agriculture, Prof. J. Kioko from Center for Wildlife Studies, Karatu-Arusha for their tireless supervision, encouragement, guidance, valuable suggestions and interest which paved a way to the fulfillment of my research work.

My sincere thanks are also extended to The Director General, TANAPA and Chief Park Warden, Tarangire National Park for their assistance during data collection.

I sincerely, thank my assistants Oscar Njamasi, Innocent Mremi, Gipson Mwapongo, Driver Selemen Hamis, Emmanuel Clamian and Saning`o Mgambo Sub-Village Chairmen; Abel Mtui GIS Center Tarangire National Park.

Last but not least, I would like to express special gratitude to my classmate Zakayo Frank for his moral support and encouragement for the whole period of my studies at SUA.

DEDICATION

This work is dedicated to my wife Joyce, my daughter Paulina and my son Oscar for encouraging me to undertake this course of study and also for their tolerance during my long absence from home for the entire study period.

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LIST OF ABBREVIATION AND SYMBOL

GIS	Geographical Information System
GPS	Geographical Position System
IIED	International Institute of Environment and Development
Km	Kilometer
KNP	Kruger National Park
LMNP	Lake Manyara National Park
Mm	Millimeter
NGO	Non-Governmental Organization
SCP	Selous Conservation Programme
SE	Standard Error
SPSS	Statistical Package for Social Science
SSR	Sabi-Sand Reserve
TANAPA	Tanzania National Parks
TAWIRI	Tanzania Wildlife Research System
TME	Tarangire-Manyara Ecosystem
TNP	Tarangire National Park
U	Mann Whitney- U test
URT	United Republic of Tanzania
UTM	Universal Transverse Mercator
WGS	World Geodetic System
WMA	Wildlife Management Area
r	Pearson's Correlation

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background information

A wildlife corridor is an area of land used by wild animals 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 of animals to other geographical localities where access to critical resources for survival and exchange of genetic material take place (Hassan, 2007). 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 important. The major problem across Kenha-Pench landscape was habitat fragmentation caused by human settlement densities, railways, roads and cropland expansions (Rathore *et al.*, 2012). In mitigating these problems emphasis were put on identifying suitable wildlife corridors so as to reduce genetic isolation, offset habitat fragmentation problems and increase animal dispersal at the same time enabling ecological processes (Rathore *et al*., 2012).It is important to have knowledge of wildlife corridors before project development and implementations such as roads. In Northern New Hampshire, for

example a study on identification of mammalian road-crossing patters resulted in avoidance of unnecessary habitat fragmentations and wildlife corridors were successfully modeled and identified (Leoniak *et al*., 2012).

In Africa a study of seasonal home ranges of elephants *(Loxodanta africana*) between Sabi Sand Reserve (SSR) and Kruger National Park (KNP), wildlife corridor protections were found important because elephants depend upon resources of both parks (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 hence jeopardizing wildlife survival. In order to save wildlife migrations during wet season from Nairobi National Park to Kitengela it was decided to compensate the private land owner farmers (Rodriguez *et al*., 2012).

Tarangire-Manyara Ecosystem (TME) in Tanzania encompasses a huge area of about 35 000km^2. The area extends far along the eastern boundary of the Great Rift Valley and includes the Lake Natron and Mto-wa-mbu Game Controlled Area; Lake Burunge and Burunge Game Controlled Area; Kwakuchinja Open Area and Lake Manyara National Park; Mkungunero Game Controlled Area and Kimotorok; Loikisare and Simanjiro Game Controlled Area and the Simanjiro Plains (Maasai steppe). There are many wildlife species found in this area. Many of these animal species especially elephant, zebra and wildebeest are dependent on the high nutritional value of the Maasai grasslands.

The Kwakuchinja wildlife corridor is found in TME, northern part of Tanzania linking Tarangire National Park (TNP) and Lake Manyara National Park (LMNP) (Marttila, 2011).The corridor is a semi-arid area and it is among many wildlife areas whose biodiversity are threatened by growing human settlements and agricultural development (Msoffe *et al*., 2011). The Kwakuchinja wildlife corridor being a subset of an area designated as Game Open Area, a conservation category which does not restrict settlement or cultivation (Gamassa, 1989) faces serious threat from human activities.

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 (Newmark, 2008). There are also human related impacts that are taking place in and around protected areas such as wildlife habitat loss, physical developments and overexploitations of wildlife resources, wildlife competitions with other land use types and pollutions which have serious impacts on wildlife.

Increased human population pressure and its negative impact on habitat loss for wildlife in African countries including Tanzania is a common phenomenon (Kideghesho *et al*., 2006). This situation applies in TME where some of the wildlife species are reported locally extinct due to habitat destruction and overexploitation indicating high pressure of human impacts on wildlife populations (Shemweta and Kideghesho, 2000).So far in TME, five large mammal species of oryx (*Oryx gazelle*),

hartebeest (*Alcelaphus buselaphus)*, cheetah (*Acinonyx jubatus*), leopard (*Panthera pardus*) and black rhino (*Diceros bicornis*) are locally extinct (Hassan, 2007). The extinction is largely attributed to growth in settlements and agriculture which block animal movements, increased poaching and human disturbance.

Wildlife corridors, however, are under serious threat from human population pressure attributed to a number of population-pull factors in the rangelands and push-factors in the areas of high agricultural potential. Secondly, there is lack of by-laws to protect the corridors against unsustainable use and activities that are incompatible with biodiversity conservation. TME is one of the areas which have been experiencing an increasing population pressure. The major population pull-factors at this area include demand for agricultural land, construction of Minjingu Phosphate factory, establishment of fishing camps, small mining activities (Marang Forest), growth of tourism, and other economic opportunities. Population push factors from the areas with acute land shortage, such as Kilimanjaro region, have also affected the lake Manyara basin. The major outcome of all the identified factors is an increased threat in the existing wildlife corridors, which provide ecological links between Lake Manyara National Park and Tarangire National Park (Jones *et al*., 2009). Since the extent of the identified factors are not well known, there is a need to document the extent of the impacts caused by these identified factors above to wildlife and the Kwakuchinja wildlife migratory corridor.

1.2 Problem statement and justification of the study

Wildlife corridors are of paramount importance in the gene flow and existence of the wildlife species. This is 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 (Msoffe *et al.,* 2011). Local communities around the protected areas conduct activities such as agriculture practices, cutting of wood forest and setting bushfires, all of which are destructive to the vegetation cover. Illegal wildlife hunting for subsistence and commercial use is uncontrolled. The hunting activity is often conducted by poachers from outside Kwakuchinja (Pittglio *etal*., 2012).Therefore, the problem of corridor encroachments has reached a level that threatens wildlife habitat and animal species that are using the area as a migratory corridor.

The rationale of this study was therefore to document negative impacts caused by human activities to wildlife as a result of human population pressure and other related activities from communities in and around Kwakuchinja wildlife corridor. This study explores the existing human activities and their impacts on wildlife as well as the distribution of wildlife, livestock and human settlements in relation to the current status of wildlife. This contributes to efforts towards development of land use plan for any wildlife corridor in Tanzania. This will also be useful to the managements of Tarangire-Manyara ecosystem to foresee the future existence of the Kwakuchinja wildlife corridor.

1.3 Objective of the study

1.3.1 Main objective

The main objective of this study was to assess impacts arising from human activities on wildlife in Kwakuchinja migratory corridor in the Tarangire/Manyara Ecosystem.

1.3.2 Specific objectives

The specific objectives were to:

i. Map distribution of wildlife, livestock and human settlement in the Kwakuchinja wildlife migratory corridor in relation to their habitat.
ii. Assess population trends and present status of migratory corridors in relation to wildlife use for the past sixteen years (1998-2014).
iii. Assess impacts of land use/cover changes to wildlife in the Kwakuchinja wildlife corridor

1.4 Research Questions

The study attempted to answer the following questions:

i. Is the distribution of wildlife and livestock in a way influenced by human settlement and habitat nature?
ii. Which wildlife species are currently using Kwakuchinja wildlife corridor?
iii. Has wildlife use of Kwakuchinja area increased or decreased?
iv. How is the area being used?
v. How can wildlife habitat be conserved here?

1.5 Conceptual Framework

This study is guided by the conceptual framework modified from Wood *et al.*(1999) in analyzing the root causes of biodiversity loss (Fig. 1).The focal problem of this study is the loss of wildlife habitat and protected areas isolation. Environmental changes cause changes in resource use pattern leading to land use changes, community engages in poaching and loss of wildlife habitats. Human beings are dynamic and they change their life style according to changes in environmental condition. Change in agricultural practices (farm expansion), grazing, settlement and business expansion all modify natural habitats. This modification of natural habitat, therefore, causes loss of habitat to wildlife and contributes to protected areas isolation and biodiversity loss. This framework fits with the situation in the study area (Kwakuchinja wildlife corridor).

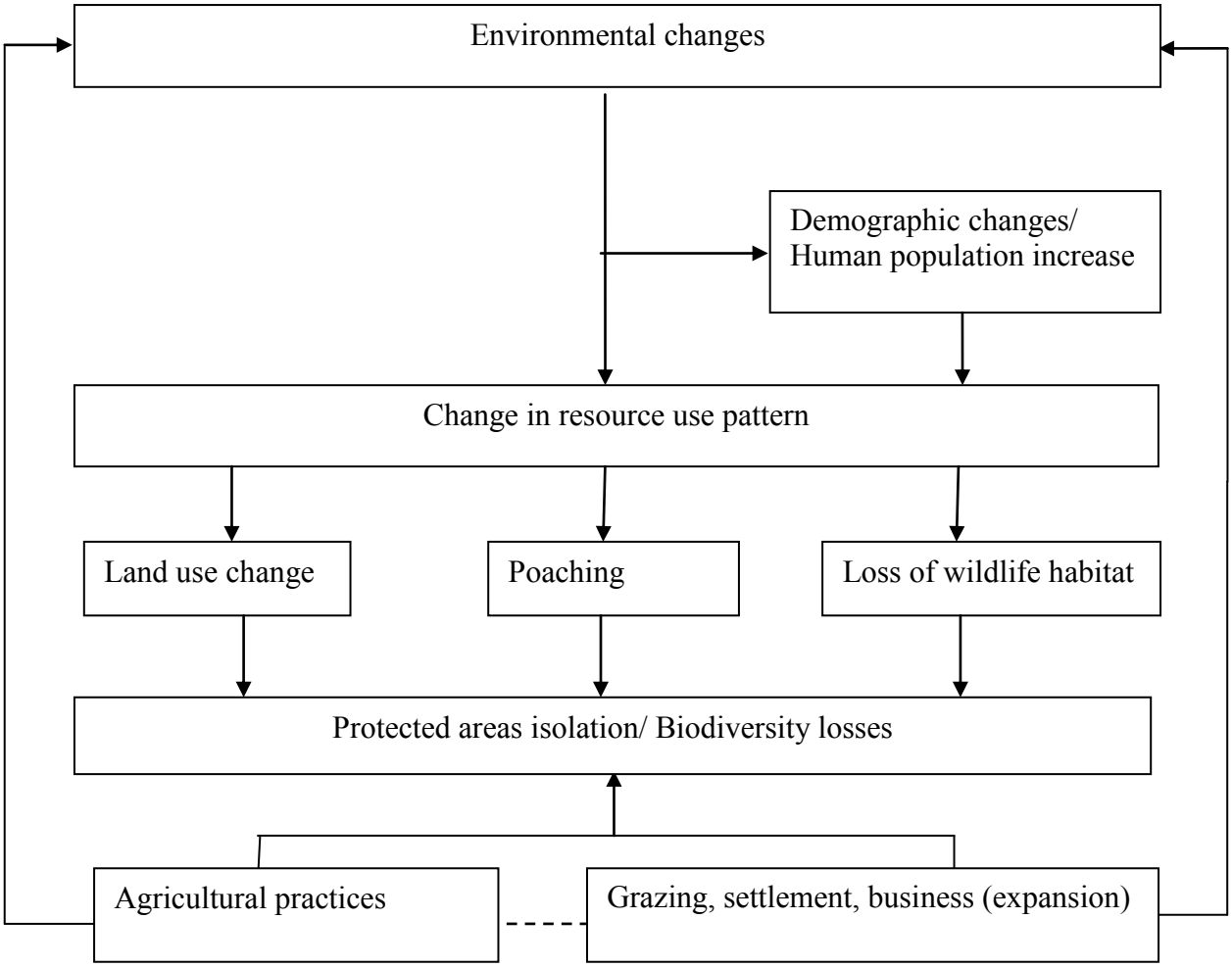

Figure 1: Conceptual framework (source: Wood *et al.*, 1999).

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1Wildlife Migratory Corridors

Wildlife corridors play vital ecological roles in enhancing biodiversity and survival of a large number of species. In addition, the function of wildlife corridors include serving as areas of habitat, connecting wildlife populations separated by human activities (such as roads, development, or logging), facilitating the re-establishment of populations that have been reduced or eliminated due to random events (such as fires or disease), and allowing an exchange of individuals between populations, preventing the negative effects of reduced genetic diversity potentially associated with long-term population isolation (Henle *et al.,* 2004; Frankham, 1996). Also, wildlife corridors increase the area and diversity of habitats over and above the area of the two habitat patches connected.

2.2Habitat Destruction and Loss of Wildlife

Habitat degradation and loss are the primary causes of biodiversity loss worldwide. This has been exacerbated by growth of human population in nearby protected areas causing destruction of wildlife habitats and thus reduction of biodiversity (Nahonyo, 2001). To understand why extensive alteration and destruction of habitats are occurring, it is essential to know what the proximate causes are. The main driving forces behind biodiversity loss arise from human activities and can be distinguished in terms of economic, social, political and cultural factors that lie behind the

economic activities leading to the indirect depletion of species, destruction and degradation of their habitats (underlying causes) and on the other hand to the relationship with wildlife (proximate causes) (International Institute of Environment and Development, 1994).

2.3Buffer Zones in Wildlife Conservation

A buffer zone can be defined as an area adjacent to a protected area on which land use is partially restricted to give an added layer of protection to the protected area itself while providing valued benefits to neighboring rural communities (Murphree, 2000). A wildlife buffer zone means an area bordering a protected area in which wildlife; particularly large mammals use it in different seasons of the year for food, water and reproduction (IIED, 1994). They are also defined as areas in which wild animals move more or less freely in search of seasonal niches, for reproduction and/or nutritional purposes (Fisher, 1992).

2.4 Impacts of Wildlife Corridor Decimation on Wildlife

Isolation of a protected area can cause massive deaths of wildlife that can lead to local extinction of some resident species (Newmark *et al*., 1991; TANAPA, 1992). Also, as a result of isolation, protected areas may experience vegetation loss if wild animals, particularly elephants, exceed carrying capacity resulting into overuse of plant resources. The loss of indigenous vegetation due to increasing settlements, logging and cultivation of areas surrounding protected areas affect wildlife adversely

by reducing critical habitats and restricting movement between adjacent lands (Newmark *et al*., 1991).

2.5 Wildlife Management Areas

The Wildlife Policy of Tanzania calls for better management of protected areas, sustainable use of wildlife, devolution of wildlife user rights to communities and sharing of benefits derived from wildlife uses (URT, 2007). Also, the policy aims at promoting conservation of wildlife and its habitats outside core areas by establishing Wildlife Management Areas (WMA), preventing illegal use of wildlife and transferring of WMAs to local communities. The policy ensures that the communities obtain substantial tangible benefits from wildlife. Therefore, this will allow local communities to take care of buffer zones, corridors and migratory routes and involve local communities in safeguarding the integrity these wildlife areas and their habitat

CHAPTER THREE

3.0 Methodology

3.1 Description of the study area

3.1.1 Location

The study was carried out in three villages of Mswakini, Olasiti and Kakoi found in Kwakuchinja Open Area. The Kwakuchinja wildlife corridor is part of the Kwakuchinja Open Area (450 km^2) lying between Lake Manyara National Park and TNP. It is located between latitude 03° 35' 38" and 03° 48'02"S and longitude 35° 48' 21"and 35° 59' 25"E. (Fig 2).

3.1.2 Soil and vegetation

The vegetation is primarily savanna with pockets of woodlands along waterways. Two types of savanna are found in Kwakuchinja wildlife corridor. These include *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 floodplains (foot slopes) and dark red sandy clay loam in areas upper slopes.

3.1.3 Rainfall

The rainfall pattern is bimodal with short rains from November to December and long rains from February to May (Marttila, 2011). March and April are the wettest months while July and August the driest. The rainfall estimate is between 450-650 mm (Caro *et al*., 2009).

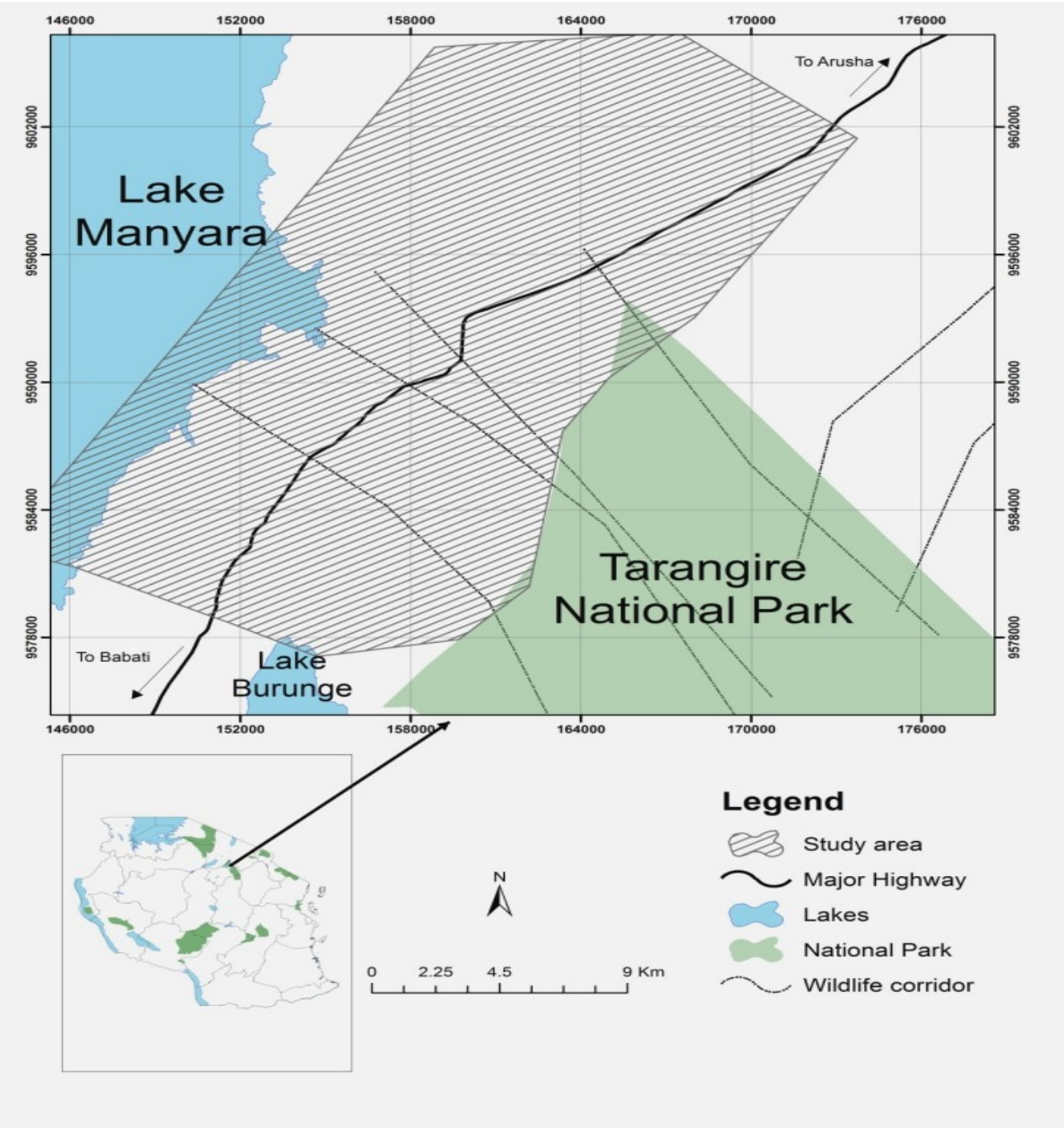

Figure 2: Map of Tanzania showing Kwakuchinja wildlife corridor **(Source:** GIS Center Tarangire **N**ational Park, 2013).

3.1.4 Wildlife

The Kwakuchinja wildlife corridor was once vital to 25 large mammal species, some of which (including elephants) moved between the two parks (Msoffe *et al*.,2011). Field observations for the two decades ago suggested that elephants (*Loxodanta africana*) moved from LMNP into the corridor via Marang forest (adjacent to LMNP) then preceded to TNP via the Lake Burunge Area. Currently some populations of bushbuck (*Tragelaphus scriplus*), impala and vervet monkey (*Celcopithecus oethiops*) together with livestock utilize the corridor throughout the year (Hassan, 2007).

3.1.5 Ethnicity and socio-economic activities

Kwakuchinja wildlife corridor is home to several ethnic groups in five villages (Hassan, 2007). In this study, a cluster of huts under one family or families under the same roof of one elder was regarded as one settlement. This was necessary due to the social-life style (polygamist) of many ethnic groups in the area, particularly the pastoralists and agro-pastoralists. Their occupations include livestock keeping, subsistence and/or commercial agriculture and business. Moreover fishermen from nearby areas and as far as Babati town immigrated to the area and establish temporary fishing villages (Goldman, 2003).

3.2Research design

The study used cross-sectional research design for data collection. The design allowed data collection at one point in time from a sample selected to represent the larger population. The design used is quick and appropriate for descriptive and interpretation as recommended by Babbie (1990).

3.3 Sampling procedure

Purposive sampling (Babbie, 2007) was used to select three villages out of six available villages. Selected villages were Olasiti, Kakoi and Mswakini. These villages were selected because of being within the Kwakuchinja wildlife corridor. Households were randomly selected from the lists provided by the respective village government officers for each village. Communities found in Kwakuchinja wildlife corridor formed the study population whereby households were used as basic sampling unit in each village. The sampling frame used was the list of available population in each village. To have precise data, the sampling intensity involved taking 45 households in each village and a total of 135 households were sufficient for the study. Bailey (1994) reported that, for studies in which statistical analysis is to be done, a sample size of ≥ 30 is required regardless of the population size. The criteria to select 45 households meet Bailey's recommendation which is above required minimum. Because of time and resources that was the maximum number I could afford.

3.4 Reconnaissance surveys

A preliminary survey of the study area was conducted in order to familiarize with the study area and collect general information on wildlife migratory corridor, identification of areas for transect walk survey, terrain, and accessibility of the study area. The survey also involved the selection of three study villages. During the reconnaissance survey, questionnaires were pre-tested in one of the villages and necessary modification made to suit the existing local circumstances.

3.5 Data Collection

Data collection involved both primary and secondary data collection methods in the study area. Primary data were collected from the field through direct observation, household questionnaire, transect walk and key informants interview. Both quantitative and qualitative data were collected.

Direct observation

Direct observation was used in collecting information relating to human activities. It involved observing activities like farming, firewood collection, cutting of trees and grazing animals. The direct observation method was basically used to bind together the more separate elements of data collected by other methods.

Household questionnaire

Semi-structured household questionnaire were used to heads of the household (Appendix 1).The questionnaire was administered whereby the researcher asked

questions from the questionnaire and respondents' replies were recorded. Questionnaires were used to obtain information on demography, wildlife information, human migration pattern, habitat conservation and land use. A total of 135 respondent households were involved in the questionnaire survey.

Transect walk

Data collection on distribution of wildlife, livestock and settlement were carried out by foot sampling. Foot sampling involved eight (8) transects of varying length and inter-distance (Western and Grimsdell, 1979) in the study area. These transects were made at Manyara ranch, Mswakini juu, Oltukai, Community Open Area, Burunge WMA, Vilima vitatu and Malamboi following transects set by Hassan (1998) in Kwakuchinja wildlife corridor. Recording of wildlife, livestock, settlement and their respective perpendicular distance was done within a fixed transect width of 400m on each side of a line transect (Norton-Griffiths, 1978; Hassan, 2007) due to habitat type and visibility. Transect were arranged in two sets running from East-West at compass reading of 279^0.One set ran from Tarangire National Park boundary to Arusha - Babati tarmac road and the other set ran from the tarmac road to the shores of Lake Manyara. GPS coordinates were used to establish locations of wildlife, settlements and livestock and their respective perpendicular distances. Digital camera was used to take wildlife, livestock and settlement photographs. Accessibility, land use type and vegetation cover governed the distribution of transects.

Key informants interview

Interview with key informants were used to collect data on various issues on wildlife, livestock human settlement, historical use of the corridor and poaching. The key informants in this study included Village leaders, Councilors, Ward Executive Officers and staffs from Tarangire National Park, Manyara ranch and Burunge WMA present in the study area. Checklist of questions was used to obtain information from key informants (Appendix 2). Overall, five (5) key informant interviews were carried out in the study area.

Secondary data on wildlife population trend, habitat types and migratory corridors used by animals were obtained from published and unpublished reports at Tanzania National Parks (TANAPA), Tanzania Wildlife Research Institute (TAWIRI) and NGOs that have undertaken research in the study area.

Land use/cover data were obtained from Tarangire National Park GIS center. The data were aimed at assessing land use/cover changes and their impact on wildlife based on their habitat loss and local extinction. Satellite imagery for 2000 and 2013 years were used to generate land use/cover changes in the period of 2000 to 2013.

3.6 Data Analysis

Both qualitative and quantitative data were analysed. Quantitative data were analysed usingStatistical Package for Social Sciences (SPSS) version 16.1wherebydescriptive analysis involving measures of central tendencies, frequencies and standard deviations were computed.

3.6.1 Mapping distribution of wildlife, livestock and human settlement in Kwakuchinja wildlife migratory corridor in relation to their habitat.

During transect walk wildlife sighting coordinates were identified using GPS and then Arc GIS was used for mapping. FollowingSutherland (2001), calculations on population density and size was calculated as follows:-

Density

$$D=n/2WL \quad \text{.....(1)}$$

Population size

$$N=DA=An/2WL \quad \text{.....(2)}$$

Where: -***N*** = population size estimate;

D =density estimate of the population;

A = total area of the census zone;

n = total number of animals or objects counted;

L = total length of the transect lines; and

W= mean perpendicular distance.

Mann Whitney - U test was used to test for the differences in wildlife group size between the Manyara ranch and Burunge WMA. Pearson correlation was used to analyse relationship between wildlife numbers and livestock, as well as wildlife numbers and human settlements. A justification of employing Pearson correlation analysis was that wildlife, settlements, and livestock are numerical values.

3.6.2 Assessment of the population trend and present status of migratory corridors in relation to wildlife use for the past sixteen years (1998-2014).

Data based on questionnaire survey were analysed using SPSS and Chi square test was used to test the decrease or increase of wildlife based on respondents perception. Also was used to test the relationship between wildlife increase and respondents time spent in the study area.

3.6.3 Assessing the impact of land use/cover changes to wildlife in the Kwakuchinja wildlife corridor

Landsat TM imagery (UTM/WGS84) obtained from Tarangire GIS Center was interpreted using Arc GIS (Projection 1960) programme-Patch analysis to generate land use/cover maps for 2000 and 2013. They were also used for comparisons on the land use changes. Interpretation of aerial photographs and land use maps were employed in order to capture information and generate tables about land use changes. Content analysis was used to analyze the respondents' views on land use changes and wildlife status in the study area.

CHAPTER FOUR

4.0 Results and Discussions

4.1 Demographic and Socio-economic Characteristics of the Respondents

The demographic and socio-economic characteristics of the respondents composed of sex, age, education level, occupation, residency status, human population and tribe of the respondents. More males were interviewed than females (Table 1)this is due to Maasai male dominance character. Maasai traditional ethics is male dominance, in most cases males are the ones who respond to visitors in the household thus making women shy or sometimes afraid to come out to speak to the enumerators. This argument is supported by Noe (2003) who also reported on the male dominance in Maasai traditions. This is the case in the Kwakuchinja study area as many of the interviewed respondents were males.

Most respondents interviewed had age above 47 years (Table 1). Involvement of different age groups in the study was very important because different age groups had different experiences on the past situation of Kwakuchinja wildlife corridor particularly on the movement pattern and status of wildlife.

The study also found that, most of the respondents had attended primary education and very few attended secondary school (Table 1). Low level of formal education

was due to traditions of pastoralist societies like Maasai who do not encourage their children to attend schools; instead many of them remain at home taking care of the livestock. Only those who were considered as trouble makers 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 and these are the illiterate in the community.

Table 1: General demographic and socio-economic characteristics of the respondents

Attribute		**Percentage %**
Sex	Male	60.7
	Female	39.3
		98.5
Tribe	Maasai	
	Others	1.5
		43.7
Residency	Indigenous	
	Immigrants	56.3
		1.5
Occupation	Farmer	
	Livestock keeper	0.0
	Farmer and livestock	98.5
		36.4
Education	Illiterates	
	Primary	60.7
	Secondary	2.9
		22.9
Age (Years)	18-27	
	28-37	31.2
	38-47	13.3
	>47	32.6
		100.0
Human population	Increasing	
	Decreasing	0.0

In Tanzania Maasai are traditionally pastoralists (Rodriguez *et al*., 2012), However, this is not the current case in Kwakuchinja as they are also involved in cultivation of food crops. Thus, this study found that the main socio economic activities of the respondents were mixed farming and livestock keeping and very few are farmers only (Table 1). Most of the respondents interviewed mainly depend on mixed crop cultivation and livestock keeping as their main source of income. This is partly a strategy to meet food demand and other expenses after realizing the cost associated with keeping large herds of cattle and lack of grazing pasture. Moreover, during 2007 drought, large number of cattle died due to lack of grazing pasture (Muyungi, 2007). The situation therefore, may have forced many of the pastoralists to shift from their normal tradition lifestyle of livestock keeping to mixed farming system.

The study indicated that most of the respondents were from Maasai tribe and very few from other tribes (Table 1). It was also found that most of them were immigrants to the study area from Arusha, Arumeru and Monduli mainly for cultivation and livestock grazing purposes. Moreover, all the respondents interviewed said that the number of human population in the study area is currently increasing.

4.2 Wildlife Distribution, Livestock and Human Settlements in Kwakuchinja Wildlife corridor

4.2.1 Wildlife sightings, abundance and distribution

Five species of large herbivores were recorded at twenty-seven sighting points in Manyara ranch and Burunge WMA. These included burchell's zebra (*Equus*

burchelli), common wildebeest (*Connochaetes taurinus*), maasai giraffe (*Giraffa camelopardalis*), impala (*Aepyceros melampus*) and thomson's gazelle (*Gazella thomsonii*) (Figure 3). The results show that burchell's zebra were more sighted than other wildlife species while thomson's gazelle were the least sighted. Elephant (*Loxodanta africana*) dung were also observed but excluded from the population estimates since it was not possible to estimate their numbers. Two cheetahs (*Acinonyx jubatus*) were found dead on 12 December 2013, after being killed by villagers at Olasiti village as they were linked to livestock killing (according to interviewed key informants).

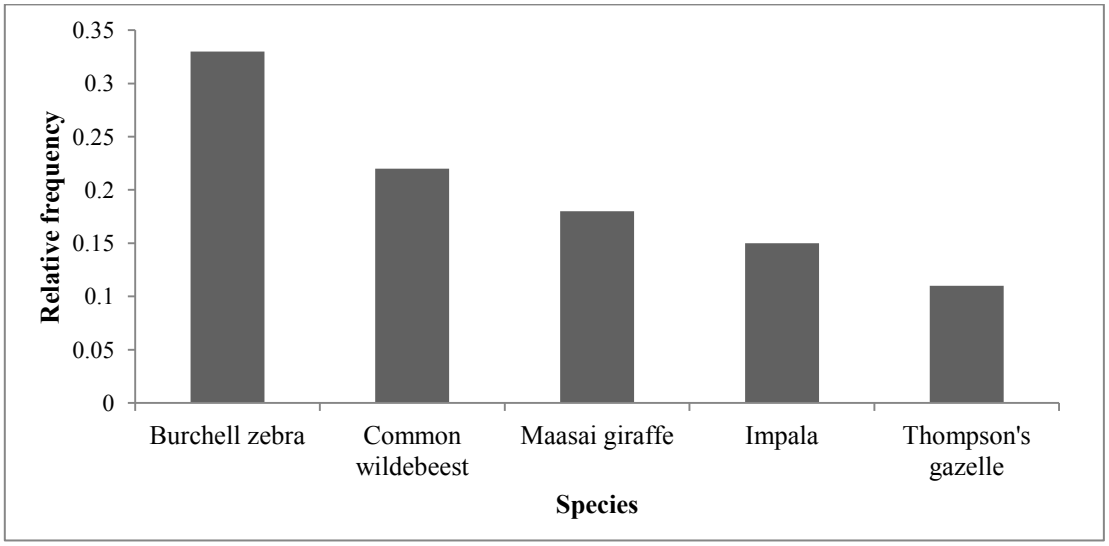

Figure 3: Wildlife species sighting relative frequencies in Kwakuchinja wildlife corridor (n=27)

The results from transect survey showing the abundance of species is presented in Table 2.

Table 2: Wildlife abundance

Species	Counts(number)	Density (number/Area)	Mean group size(counts/sightings)	Population	Percentage %
Common wildebeest	1324	177.2	221	4646	75.4
Burchell's zebra	283	37.9	28	993	16.2
Impala	125	16.7	7	1096	7
Maasai giraffe	15	2	3	53	0.9
Thomson's gazelle	4	0.2	4	8	0.5

A comparison of densities among the species of large mammals in the study zone shows that common wildebeest ranked high with an average number of 221 ± 102SE, followed by burchell's zebra 28±20SE, impala 7± 5SE, giraffe 3±2SEand thomson's gazelle 4 ±0SE (Fig. 4).The variation is so high due to small data collected due to time and resources.

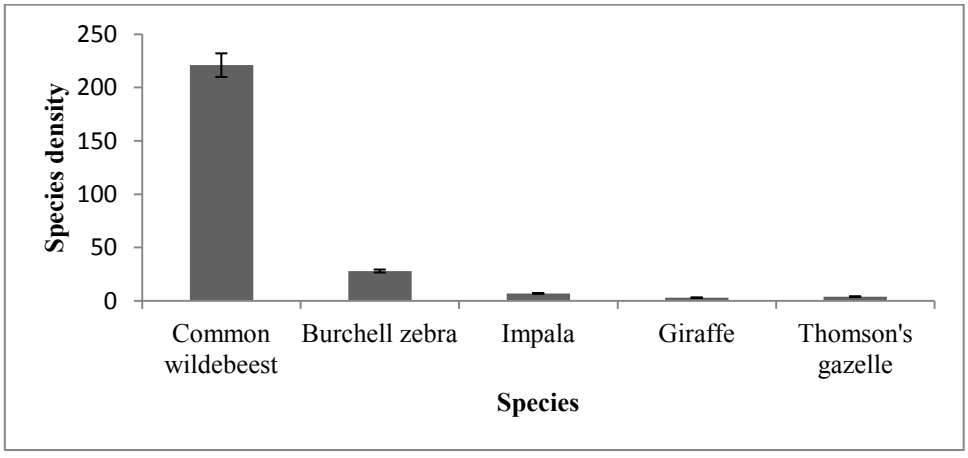

Figure 4: Wildlife species group size comparison (N=1751)

A comparison of group size of common wildebeest between Manyara ranch and Burunge WMA was done. The mean group size of common wildebeest was 221 ±102SE. In Manyara ranch only one group of common wildebeest was found about 2 km from the tarmac road heading to Manyara ranch dam, while in Burunge WMA five groups was found adjacent to Lake Manyara an area called Malamboi.

The group size of zebra did not differ between Manyara ranch and Burunge WMA in the study zone. The overall group size for zebra was 30±7SE, (n_1=48, n_2=23,U=8.5, p=0.712). The group size of giraffe did not differ between Manyara ranch and Burunge WMA. The overall group size for giraffe in the study zone was 3±1SE, (n_1=1, n_2=5, U=0.5, p=0.264).The group size of impala did not differ between Manyara ranch and Burunge WMA in the study zone. The overall group size for impala was 8±3SE, (n_1=3, n_2=33, U=0.5, p=0.1). Thomson's gazelle only one group was found in Burunge WMA adjacent to Lake Manyara-Malamboi area.

4.2.2Wildlife distribution

During transect survey, wildlife species were recorded in Manyara ranch and Burunge WMA and not in Open Area (Table 3).In Manyara ranch wildlife were found in grassland habitat. Manyara ranch has a protected land use status, rangers patrol the ranch, monitoring wildlife and warding off poachers. Burunge WMA (protected by the community) wildlife was found in woodland and bushland areas that are ecologically important for wildlife (Fig. 5). Burunge WMA occupies the land and the migratory corridors between Tarangire, Lake Manyara, and the adjacent

Manyara ranch, making it an area of high conservational significance. The community open area has no any wildlife protection status. The studies found that, wildlife were not present in community open areas due to displacement and habitat loss.

Increased physical development within the corridor causes wildlife displacement hence decline in Kwakuchinja wildlife corridor. 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 impending 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; Ogutu *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).

Table 3: Wildlife numbers counted in respective areas

Species	Manyara ranch	Burunge WMA	Community open area
Zebra	145	138	0
Wildebeest	18	1306	0
Impala	25	100	0
Giraffe	3	10	0
Thomson gazelle	0	6	0
Total	**191**	**1560**	**0**

4.2.3Livestock distribution

During transect survey livestock were sighted in all three areas in the study zone. Livestock sighting in open community area were high, followed by Burunge WMA and lastly Manyara ranch (Table4).

Table 4: Livestock population in Kwakuchinja study zone

Area	Counted number(n)	Density(n/A)	Population	Percentage%
Manyara ranch	130	18.1	475	8.1
Burunge WMA	525	73.2	1919	32.8
Community open area	945	131.8	3455	59.1
Total	**1600**		**5849**	**100**

Findings revealed that although correlation coefficient of both settlement and livestock to wildlife are not statistically significant at 5% level of significance, there is more correlation between wildlife population and settlement (r = 0.714) than that between wildlife and livestock (r = 0.263). This implies, reasonably, settlement has more impact on wildlife than livestock. The findings that settlement is more correlated with wildlife population is consistent with the remarks given by Kideghesho *et al.* (2006) that human activities including settlement, deforestation, bushfires, mining, cultivation and overgrazing are key causes of habitat destruction and hence reduction of wildlife population.

4.2.4 Land use practices

With respect to land uses, all of the respondents interviewed in the study area (100%, N=135)indicated that livestock and wildlife species share the same grazing area and

drinking water at different times of the day without problems. They also said that livestock and wildlife have co-existed for long time without problems. This was witnessed during the study period in transect walk survey that, wildlife and livestock shared the same habitat. The findings suggest that coexistence between wildlife and livestock is possible, provided that changing land use patterns are regulated in a way that does not compromise the habitat requirements necessary to maintain wildlife. It was also reported that cultivation is bad land use to wildlife. In an attempt to conserve wildlife habitat, majority of the respondents said that it can be achieved through law enforcement. Also by preventing animals going out of protected areas and preventing tree cutting (Table 5). Bhola *et al*. (2012) suggests that livestock facilitate feeding to both small and medium herbivores in the wet season but also contribute to creating and maintaining the conditions that make movements possible.

Table 5: Respondents views on land use practice

Parameter	Response	N=135	Percent %
Land use	Livestock keeping	1	0.7
	Cultivation	4	3.0
	Livestock keeping and cultivation	130	96.3
Bad land use	Cultivation	115	85.2
	Hunting	9	6.7
	Cultivation and hunting	11	8.1
Habitat conservation	Tree cutting	25	18.5
	Law enforcement	64	47.4
	Prevent animals	46	34.1

4.2.5 Settlement distribution

Settlements were found in open community area and not in Manyara ranch or Burunge WMA. Results also show that wildlife and livestock were found in woodlands and bushland habitats (Fig.5). These habitats are ecologically favorable to both wildlife and livestock.

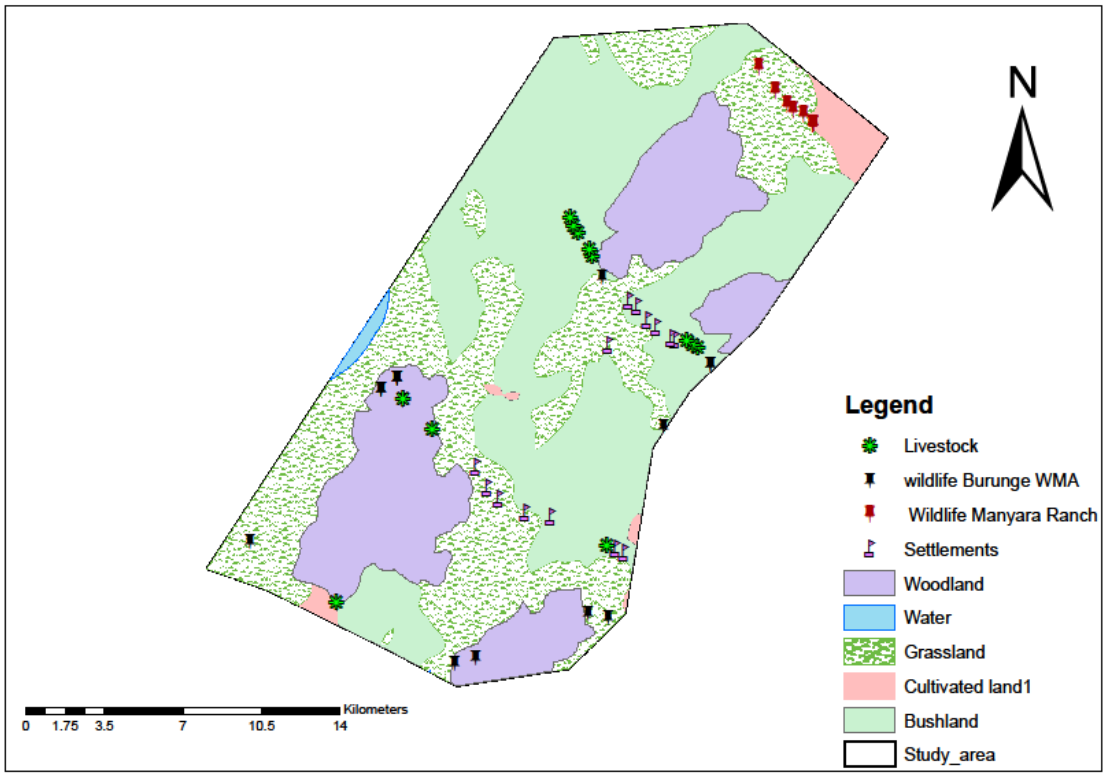

Figure 5: Map of Kwakuchinja showing wildlife, livestock and human settlement distribution in relation to habitat.

Estimate of human population in the areas surrounding TME are constantly changing, but it has been assumed that there are almost a million humans living in the areas

covered by the wildlife migration and grazing patterns (Marttila, 2011). Result from this study shows that since 1998 to 2013 there was an increase of human settlement by 33.5% representing an annual increase in settlement by 3.3% (Table6). This concurs with the study done by Gamassa (1989) and Hassan (1998) in the study zone who indicated that there was an increase in human settlement by 23.5% representing an annual increase in settlement by 2.4%. In addition, all kind of human activities such as settlement, farming, ranching, livestock keeping, charcoal burning and even commercial agriculture are increasing at an accelerating pace around Kwakuchinja study area.

The annual growth in human population (3.8%) is higher than the average for Tanzania (2.8%) (URT, 2012). Therefore this trend of human population increasing and the current trend of agriculture expansions is of no doubt that the existence of Kwakuchinja migratory corridor is in threat and danger in the near future.

Table 6: Human settlement in Kwakuchinja study zone

Year	Settlement	Increase	% increase	% annual increase
1988	1281	0	0	0
1998	1582	301	23.5	2.4
2013	2378	795	33.5	3.3

4.3 Assessment of the Population Trend and Present Status of Migratory Corridors in Relation to Wildlife use for the Past Sixteen Years (1998-2014)

4.3.1 Wildlife population trend

During the study, it was observed that in Manyara ranch and Burunge WMA wildlife and livestock were harmoniously grazing except that in Burunge WMA where hunting is allowed, animals were very vigilant, anxious and they kept a long flight distance. Hunting alters reproductive behavior, population structure, spatial and temporal distribution pattern of wildlife. The study observed that the hunting exercise in the study area may have an impact to wildlife whether legal or illegal (poaching). Also the study observed that in Manyara ranch the level of wildlife protection is high as scouts have patrol equipments to deploy law enforcement. This is not the case in Burunge WMA where protection is poor as scouts lack patrol equipments, thus poaching is inevitable in Burunge WMA. Moreover, during questionnaire survey 51.1% of the respondents said that lion numbers were decreasing. The reason for decreasing is due to trophy hunting and retaliation.

The total number of large mammals was estimated from aerial count to be over 120 000 in 1980, but 1999-2000 placed the number at around 45 000 large mammals of which seasonal migrants counted 34 000, oryx (*Oryx beisa*), lesser kudu (*Tragelaphus imberbis*), gerenuk (*Litocranium walleri*) included (Arron, 2001). Two migratory species counted were zebra (15664) and wildebeest (9103). This aerial survey data point shows reductions of over 50% in the numbers of large mammals in the ecosystem over the past decade (2000s compared to 1990s) (Arron, 2001) and the long change have been more dramatic. The aerial survey of 2004 counted 23 440 large mammals including 5249 buffalo (*Synceruscaffer*) 12 000 thomson's gazelle

(*Gazella thomsonii*), 1151 eland (*Taorotragus oryx*), 113 oryx (*Oryx beisa*), 1426 Maasai giraffe, (*Giraffa camelopardalis*), 338 Common water buck (*Kobus elipsiprymnus*), 170 Common bush buck (*Tragelaphus sylvaticus*), 72 leopard (*Panthera pardus*), 140 hyena (*Crocuta crocuta*), 25 cheetah (*Acinonyx jubatus*), 48 wild dog (Arron, 2004) and 200 lion (*Panthera leo*)(Marttila, 2011).

Previous studies have indicated that during migration, lions expand their territories partly outside TNP where conflicts with cattle herders inevitably occur. Most lion prides leave Tarangire National Park and spend 4-5 months outside the park in the dispersal areas where lions are subject to retaliatory killing by pastoralists due to livestock predation (Kisui, 2011). There are three mortality sources for lions in the Maasai steppe including retaliatory killing, trophy hunting and natural mortality. Although the decline in lion population is attributed to combined effect of trophy hunting, natural death and conflict, retaliatory killing could be the leading cause of lion mortality in the Maasai steppe (Kisui, 2011).However, more analysis needs to be done to disentangle the relative contribution of each mortality source.

Retaliatory killing of lions due to livestock predation has continued to be a great challenge facing lion conservation in the Maasai steppe. Because of the seasonal migratory nature, lions are only safe when inside the park during the dry season (Kisui, 2011). In the wet season when most lions follow the migratory herbivores into communal land, there is an increased interaction between lions and livestock. This is the time when lions are at greater risk of being killed as a result of livestock

predation. Record from Tarangire lion project shows at least 226 lions were killed from 2003-2011 in relation to livestock predation, an average of 20-30 lions being killed every year. The prediction is that there will be very few lions, if any, left in TME by 2020 (Marttila, 2011) (Figure 6). This study observed that as lions expand their territories outside TNP, they are hunted and or killed by Maasai. It was further noted that there is poor management of sport hunting; sport hunters do select older and matured males for good trophy leaving the pride with juvenile males. During female pride take over cub mortality is higher as the new males will kill all the cubs at that time. The dilemma in TME is the shortage of time for males to defend their young against other males as hunting season does not allow sufficient time for reproduction and protecting the young to maturity. Therefore, reproduction rate is low and the number of lions will keep on decreasing in the area in each hunting season.

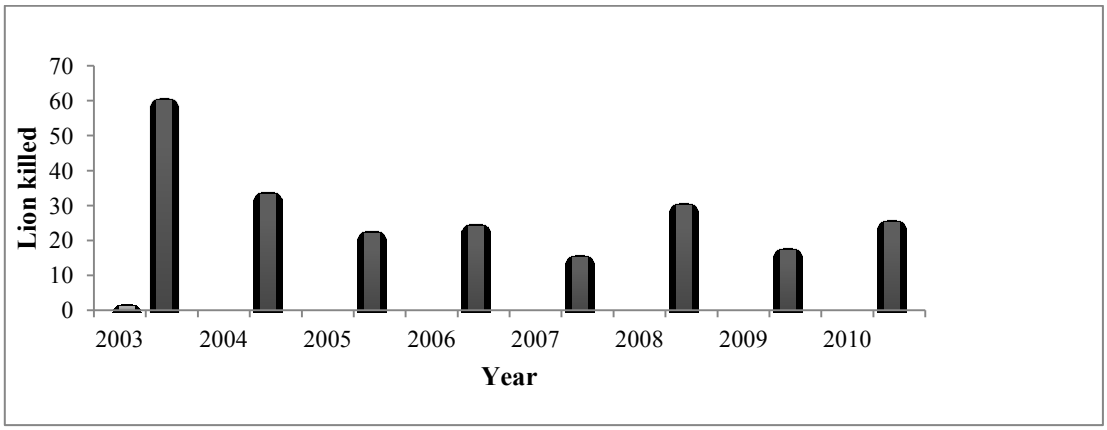

Figure 6: Number of lion killed as a result of livestock predation in Maasai steppe (Source: Tarangire Lion Project, 2011).

Because retaliation is the primary motivation for killing lions (Kisui, 2011), one strategy for reducing human-lion conflict is by improving livestock husbandry. For example, improvement of livestock security against predators at night using low technology and low cost techniques such as chain-link fences to reduce livestock predation in bomas (a man made structure for securing livestock) has the potential for reducing the impact of the conflict to lions and livestock keepers. More effort should be focused towards reducing the impact of retaliatory killing through participatory approaches that engage pastoralist communities in the surrounding villages. Improved law enforcement that deals with lion killings may also help reduce the rate of retaliatory killing of lions.

Data from 2003-2011years shows that lion population in Tarangire was estimated at around 170 individuals (Kisui, 2011). This shows about 15% decline from the 2003 population estimates when systematic and continuous monitoring begun (Figure 7). In 2005, the population showed a brief recovery from the 2004 drop, but the numbers has shown a persistent decline since 2005 with the largest drop in 2006. The first half of 2007 and 2008 showed signs of recovery, but in 2009 the population crashed again and reached its all time low before beginning a new recovery phase during the 2010/2011 year. These fluctuations in population size could be reflecting regular dynamics in the population but it remains to be seen if the upward trend seen in 2011 will be sustained to reach the 2003 levels over the next few years (Kisui, 2011).

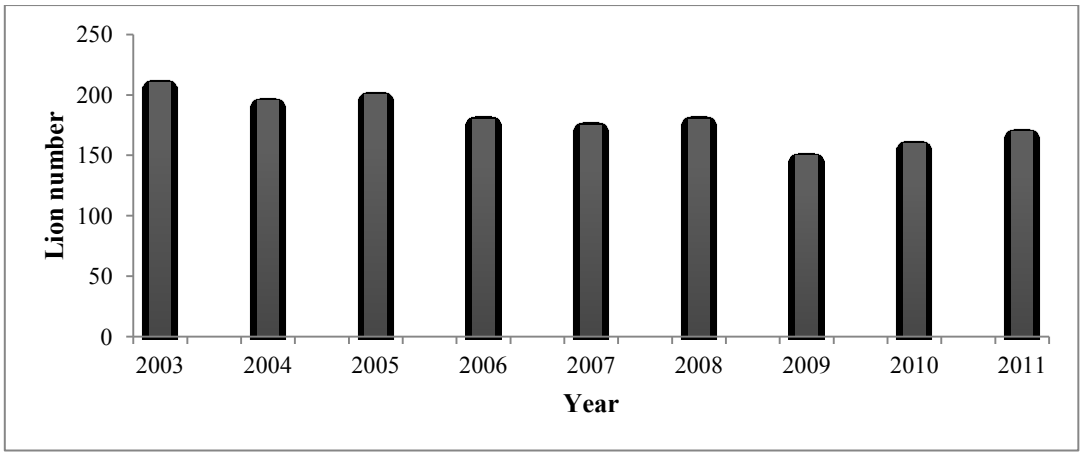

Figure 7: Estimated lion population size in Tarangire National Park from 2003-2011 (Source: Tarangire Lion Project, 2011).

The most numerous resident ungulates in TNP are the Impala (4088) although its number has decreased considerably, the present day figures being only just a tenth of what were 30 years ago (1980 counted 30 750). The drop in numbers is assumed to be connected with severe increase in human activities all over the TME (Arron, 2004).

Tarangire and Lake Manyara National Parks are highly protected by the Tanzania National Parks where livestock grazing and sport hunting are not allowed. Manyara ranch is protected with scouts employed by Manyara ranch Conservancy. Manyara ranch Conservancy is an enterprise operating in partnership with the Maasai communities through the Tanzania Land Conservation Trust and the African Wildlife Foundation. The Conservancy exists to protect the migration corridors that lie between Lake Natron, Ngorongoro, Manyara, Tarangire, and the Maasai lands to the

South. On the other hand Burunge WMA is an area set aside by the community for wildlife and habitat protection where also livestock grazing and sport hunting is allowed.

4.3.2 Respondents perceptions on wildlife status

During questionnaire survey all the respondents said that there are no new wildlife species that are found now in the study zone which were not present in the past or immigrated to the study area. However, respondents said maasai giraffe, buffalo, wild dog, lion and elands are decreasing in the area (Table 11).

Table 7: Respondent's perception on wildlife status (N=135)

S/n	Species	Status	Percent	Reasons
1	Giraffe	Decreasing	84.4	Human disturbance and loss of habitat
2	Impala	Increasing	97.8	Conducive habitat
3	Buffalo	Decreasing	68.9	Hunted for meat and trophy Poached
4	Elephant	Increasing	99.3	They are not hunted in the area and they are frequently seen in villages
5	Wild dog	Decreasing	99.3	Loss of habitat, disease, route /corridor blockade
6	Zebra	Increasing	100	Conducive habitat
7	Lion	Decreasing	51.1	Hunted for trophy Migrated with ungulates Killed by Maasai
8	Hyena	Increasing	100	Availability of food
9	Eland	Decreasing	88.9	Hunted for trophy Poached Loss of habitat and displaced

On the status of wild animals, most of the residents (80.7 %,) said that wildlife were increasing with a significant different relationship ($\chi^2 = 51.03$, $p < 0.0001$) (Table

12). The views on whether wildlife were increasing or decreasing were dependent on number of variables such as gender and time that the respondents have spent in the study area. The perception of the respondents that wildlife are increasing and gender was insignificant ($\chi^2 = 0.28$, $p = 0.59$). Most of the respondents interviewed felt that wildlife were increasing (81.5%) in general according to time they have spent in the study area. There is a positive and significant relationship between wildlife increase and respondents time spent in the study area ($\chi^2 = 53.09$, $p=0.05$).

Table 83: Responses of the respondents on the wildlife trend

Wildlife status	**Frequency**	**Percent %**
Increasing	109	80.7
Decreasing	26	19.3
Total	**135**	**100.0**

4.3.3 Migratory corridors used by wildlife for the past sixteen years (1998-2014)

Most of the migratory wildlife species gather around the Tarangire River during the dry season but, once the rain season begins in November (with a year-to-year variation of up to two months) the animals spread all over TME. The two wildlife migrant species, Common wildebeest and burchell's zebra, leave the TNP completely. There are some common wildebeest and burchell's zebra that head both north and south of TNP, but the main bulk move east to grazing and calving areas on the Simanjiro plains which is 20 to 60km away. Approximately, 16000 wildebeests and zebras have been estimated together in the plains. In the period of June to July when the plains dry rapidly, the migratory species returns to the Tarangire River, by

August all the animals become available in TNP. The distant migrants such as the beisa oryx may even today travel as far as Lake Natron, or possibly into southern Kenya, and will not be among the first to return (Kahurananga and Silkiluwasha, 1997). Elephants as many as 1890 (2004); 1447 (76%) counted remained within the boundaries of TNP (Arron, 2004). According to Gamassa (1989), the wildlife migratory species particularly zebra and wildebeest, start moving into the study area on the way to TNP from mid June and the peak is in July/August (dry season).The animals re-use the corridor on their way back from TNP at the onset of rains (early November) and highest wildlife density is experienced by the end of December.

It was observed that agricultural activities, settlement, crop cultivation and livestock keeping are being conducted on some areas which were previously used as wildlife corridors and dispersal areas. These human activities have affected wild animals which were previously using the areas for drinking water or for getting mineral nutrients which are not found in other areas. The principle threats to the long-term sustainability of Tarangire/Manyara ecosystem are the loss of some of the migratory corridors and dispersal areas outside the National Parks. Migratory corridors and dispersal areas have been diminishing and some of them lost due to human activities.

The study conducted by Lamprey (1964) identified eight wildlife corridors originating from Tarangire National Park, two of which are linked with Lake Manyara National Park, Borner (1985) ascertained that only five were remaining. By 2000, five wildlife corridors were still remaining in the ecosystem (Msoffe*et al*.,

2011). Currently only three corridors have remained, (i) on the north-east, the Kwakuchinja wildlife corridor, used mainly by wildebeest and zebra from TNP to Manyara Ranch and Lake Manyara National Park (LMNP); (ii) the corridor from TNP through Loikisare Game Controlled Area up to Losimingori Mountains, used mainly by elephants and (iii) the third corridor to the east from TNP to the Simanjiro Plains, used mainly by wildebeest and zebra to the calving grounds. All these are currently being seriously threatened by extensive agriculture and settlements.

Two corridors that have been blocked include the corridor from Tarangire National Park -Vilima vitatu - Mwada - Magara to Lake Manyara National Park and that from Tarangire to Mkungunero dispersal area. There has been immigration of people from other areas (Babati, Monduli, Simanjiro and Kiteto) to the study area for cultivation, animal grazing, employment and fishing. The immigration process has increased human population leading to the formation and registration of new villages in areas which were previously used by wildlife. The new villages have been established due to political in fluencies. It was observed that the established villages have no land use plan. This has caused communities to have no specific areas designed for a particular activity and hence destruction of habitat due to the needs acquired by the community from natural habitat (e.g. fire woods, infrastructure development, cultivation and grazing area).

The study observed also that human population increase was associated with infrastructure development especially the tarmac road from Babati to Arusha, electricity and the Minjingu Phosphate Mining factory. On the other hand extensive

agriculture expansion in Mkungunero area has lead to the blockage of the corridor. The dispersal areas have been converted to Mamire agricultural fields. These activities have seriously affected the corridor and dispersal areas which were formerly used by wild animals.

The existence of a strong overlap between lands suitable for agriculture and the main wildlife corridors and the wet season dispersal areas shows that agricultural development is the single most important factor which blocked five of the eight wildlife corridors. It is obvious that, the blockade of the two former historical routes linking Tarangire National Park and Lake Manyara National Park denies the animal's right of way in migrating between the two parks. It was observed during the study that agriculture expansion is leading to loss of these remaining corridors. In rural areas like Kwakuchinja study zone many people depend directly on agriculture which is still the backbone of Tanzanian economy to meet their daily demands. The lack of community awareness on the importance of wildlife has lead communities to consider wildlife as nuisance because they do not provide incentives directly to them. Therefore they cannot see the importance of wildlife rather than just as enemies to them (Ogutu *et al*., 2012). As a result wildlife are killed (especially carnivores) whenever encountered in the cropland farms and when attacking the livestock in their houses. This is also the case in this survey where lion, leopard and cheetah have been reduced in numbers. Pettorelli *et al* (2010) findings reported that agriculture had serious impact for carnivore species as they were found to have avoided cropland.

4.4 Assessment of the Impacts of Land use/cover Changes to Wildlife in the Kwakuchinja Wildlife Corridor

Land use/cover change in square kilometer and percentage was derived from satellite images of 2000 and 2013 years in the study area. In year 2000 cultivated land was 29.6 km^2 (6.6%) (Fig. 8a) and 2013 was 48.4km^2(10.8%) (Fig. 8b). The results show that from 2000 to 2013 cultivated area increased by 4.2% in the study area in thirteen years. It was observed during the study period that a large area in Kwakuchinja wildlife corridor was under cultivated land. Therefore, there has been a modification of 4.2% of natural land to cultivation which decreases the habitat used by wildlife.

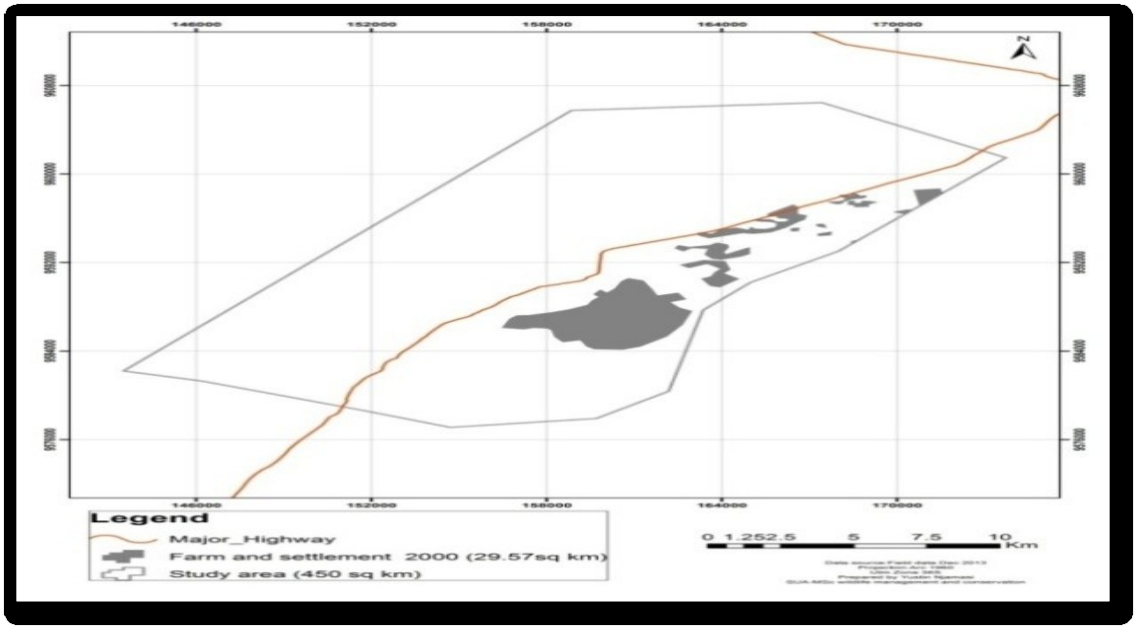

Figure 8a: Map of Kwakuchinja study area showing land use/cover year 2000

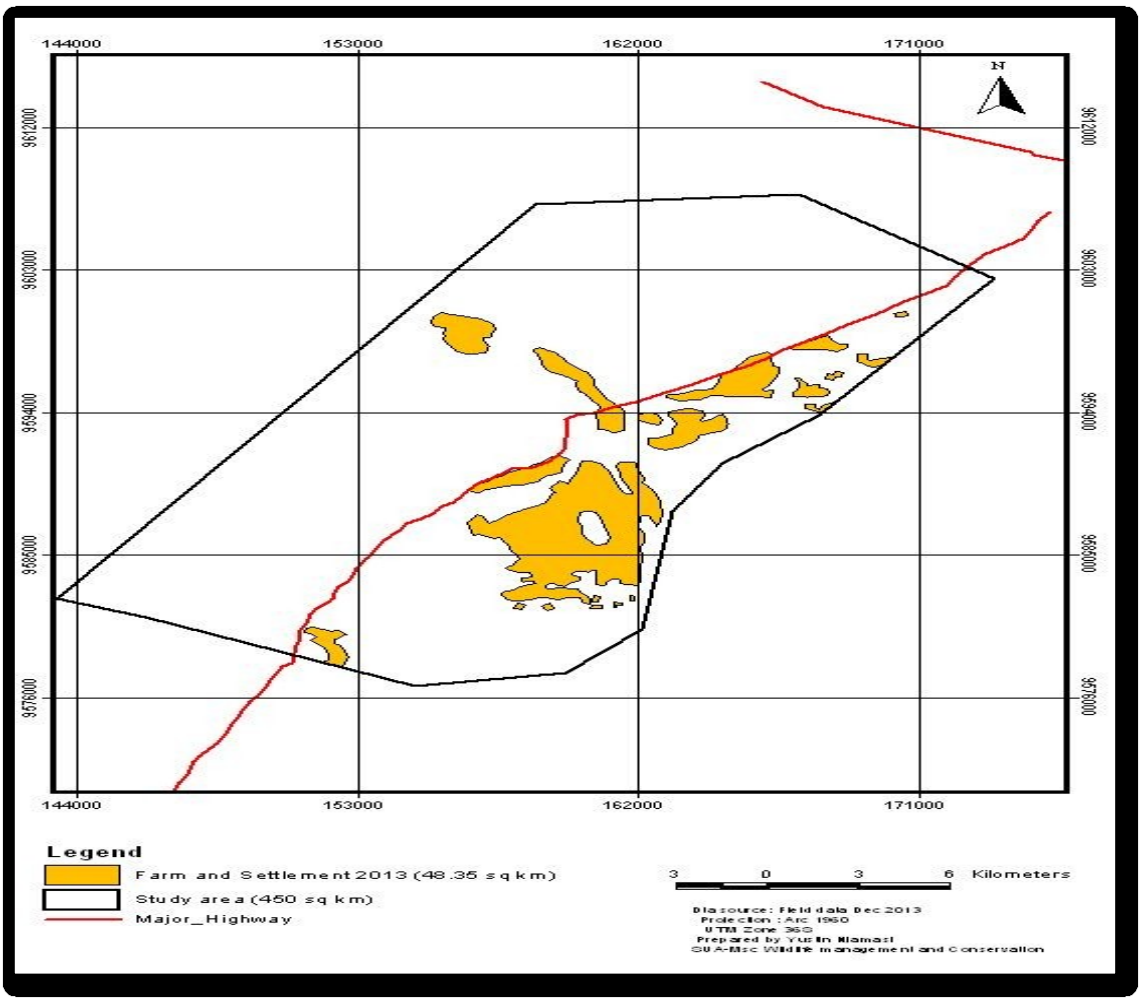

Figure 8 b: Map of Kwakuchinja study area showing land use/cover change for year2000-2013 (Source**,** field data December 2013, Arc GIS projection 1960)

The current modification of natural land into crop cultivation which is occupying large space has led to destructions of natural vegetations and reduced area available for wildlife grazing and movement. It was observed during the study that, the current increase in human settlement between Mswakini, Olasiti and Kakoi Villages goes hand in hand with increase in crop field to sustain the growing human population.

The study also observed that, reasons for people migrating to the study area includes farming, fishing, small business, livestock keeping, employment as well as marriages. Most immigrants migrated during the period of 2000-2010. Physical developments which took place such as schools, dispensary, tourist camps and Minjingu phosphate mining located in Minjingu village are within the corridor. These developments threaten wildlife movement which may have resulted into diversion of wildlife routes, reducing population size of wildlife, food availability which has impact on species diversity.

This study is supported by Kideghesho *et al.* (2006) who mentioned the loss of wildlife habitats to cultivation in western Serengeti wildlife corridor. It was also reported by Rodgers *et al*. (2003) that 16% of the Kwakuchinja corridor has been converted to agriculture since the year 1987 to 2001. Most land use changes in the Kwakuchinja corridor occurred in the period from year 2000 to 2010.

Hassan (2003) reported that expanding human settlement in Minjingu village was causing the village to be a small town. Minjingu village is currently subdivided into three villages namely Minjingu, Olasiti and Kakoi villages. This has been caused by immigration of people from nearby districts such as Arusha, Arumeru and Monduli. The increased human settlement in the area has contributed greatly to lack of free space for wildlife movements as it was witnessed 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 due to agricultural expansion. This has

resulted in shrinkage of the corridor area and might block the whole corridor if the current human population increase trend continues in Kwakuchinja wildlife corridor. Noe (2003) observed the shrinkage of the size of Kitendeni wildlife corridor in Kilimanjaro National Park to about 5km^2 in 2001 from 21 km^2 in 1952 and the main reasons were cropland expansions, human settlements and land use changes. The same threats is featuring Kwakuchinja to date as activities such as settlements, farming, livestock keeping, charcoal burning and even commercial agriculture are increasing at an accelerating pace.

CHAPTER FIVE

5.1 Conclusions

The study found that wildlife and livestock were found in areas that has less human habitat destruction. It was further noted that common wildebeest had a highest density in the study area. Also there is more correlation between wildlife population and settlement than that between wildlife and livestock.

The study found that traditional migratory corridors have declined from five to three and further noted a local extinction of five species of large mammals. Wildlife trend from aerial survey data shows reduction of over 50% in numbers of large mammals in the ecosystem in 2000s compared to 1990s.

These results imply that wildlife and livestock can share pasture and drinking areas. Increase in livestock numbers has no effect on wildlife numbers but, increase in human settlement and cultivation has impact to wildlife and their habitat.

5.2 Recommendations

The following strategies should be adopted to overcome impacts from human activities to wildlife and the problem of the Kwakuchinja wildlife corridor encroachment.

Land use planning

Land use planning is essential for biodiversity conservation. The planning will enable allocation of land use types such as WMA, settlements, agriculture, livestock grazing, mining etc. to appropriate land units (Hassan, 2007).Kwakuchinja lack land use plan in all three villages surveyed. There is no land use plan that is officially and clearly in place. The study recommends that there should be a participatory land use planning involving different stakeholders like village members and other institutions that are present in the Kwakuchinja wildlife corridor; they should be well involved from designing to implementation stage.

Law enforcement

Part of the reasons why WMAs have not been truly participatory is that much of Tanzania's laws and regulations are often contradictory, which means what is enforced and enacted in one sector of the government can conflict with another (Igoe and Croucher, 2007).Law enforcement and by-laws should be participatory involving community members and other stakeholders such as Manyara ranch, TNP and LMNP to safe guard the wildlife habitat and practice sustainable natural resources use as is the case in Manyara ranch and Burunge WMA.

Family planning

The current annual population growth rate in the study area (3.8%) is above that of national annual population growth rate (2.8%) (URT, 2012). This rate of population growth is detrimental to wildlife through habitat destructions to meet food production demand by the growing population. The study recommends that family planning

education should be emphasized to societies around protected areas and also in other places. To make it practical it is important to be introduced at primary and secondary schools as one of the subject to curb the rate of population growth.

Community conservations education

Creating awareness among communities through community conservation education is important. When local communities are provided with education on different activities they can do without causing unnecessary threat to wildlife then conservation of wildlife and corridor objectives could be attained. 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. Provide education to children at primary schools, nursery level and even at college level but most important is that, children 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.

Income generation project

Income generating projects should be emphasized 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 apiary projects and forest owned by community members are examples of projects

that can provide both conservations and economic benefits. These projects should be designed and implemented by the community and 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: Household questionnaire

PART I: General Information

1. Village ……
2. Respondent No. _____
3. Sex
(1)Male (____)
(2)Female (____)
4. Age_____years
5. Tribe_____
6. Marital status
(i)Single (___)
(ii)Married (___) for men, number of wives _____
(iii)Separated/Divorced (____)
(iv)Widowed (____)
7. Family size (i) 1-5 years (____)
(ii) 6-18 years (____)
(iii) 19-45 (____)
(iv) 46 and above (____)
8. Education:
(i)No formal education (____)
(ii)Adult education (____)
(iii)Primary education (____)_____years
(iv)Secondary education (____)_____years
(v)Other (____) Specify_____
9. Time spent in this village _____years
Indigenous (____)
Immigrant (____)
10. If your household immigrated to this village, where did it come from?
Village …… District ……..
11. If your household immigrated to this village, when did it settle here (year)? ……

12. Occupation (if more than one rank)

Type of occupation	Rank (1= main; 2=additional)
(1) Fisherman	
(2) Farmer	
(3)Livestock keeper	
(4) Others (specify)	

PART II: Wildlife Information

13. What wildlife (animal) species are seen here nowadays? (List them)

14. Which wildlife (animal) are here nowadays but were not here years ago? (List them)

15. Are there many animals today or long time ago?

16. For the following animals say if they are increasing, decreasing or no change

species	giraffe	impala	buffalo	elephant	wild dog	zebra	lion	hyena	Eland
Status									
Reason (why)									

17. What do you use this land for? E.g. firewood collection, livestock keeping/grazing, cultivation, beekeeping

18. What uses would you say are bad to wild animals?...state how

19. How do you think wildlife (animal) habitats can be conserved here?

20. Which land uses do you think are good to wild animals? State how?

21. Has the number of people in this area increased, decreased or remained the same?

Appendix 2: Checklist for key informants

1) What have been the human population trends in the area and their causes over the past fourteen years?
2) What have been the land uses in the area over the past fourteen years?
3) Are there changes in the size of the wildlife area?
4) To what extent have wildlife populations and movements been affected by land uses
5) What wildlife species were seen before these changes and what species are still seen, after the changes?
6) What is the local people's perception of land use practices and their impacts on wildlife populations?
7) How do the local people use wildlife resources?
8) What do the people think needs to be done to ensure normal wildlife movements?
9) To what extent are the local people involved in the conservation of wildlife?
10) What are the measures used to ensure that wildlife continues to be conserved in a sustainable way in TME?

THANK YOU FOR YOUR COOPERATION