Review Article

LAND USE PRACTICES ALONG SAADANI-WAMI-MBIKI WILDLIFE CORRIDOR AND THEIR IMPLICATIONS TO WILDLIFE CONSERVATION

ABSTRACT

Saadani-Wami-Mbiki wildlife corridor has been facing conservation threats as a result of various LUP carried out in and around the corridor. The understanding of changes happening in the corridor over time is important for establishing the management baseline data. This study aimed at identifying land use practices along Saadani-Wami-Mbiki wildlife corridor and their implications to wildlife conservation. Specifically, the study identified land use practices in and around the corridor, sought to determine the rate of land cover changes in the corridor between 1975 and 2011 and the effects associated with land use practices on wildlife conservation. Land sat imageries of 1975, 1995 and 2011 were used to assess the rate of vegetation cover changes as a result of various land use practices carried out along. Household survey and Key informants interview methods were used to obtain socio-economic data which were analysed using SPSS while GIS data were analysed using the ERDAS IMAGINE 9.1 and ArcGIS 9.3 programmes. In the past 36 years (1975-2011), the cultivated land increased by 25%, settlement by 13%, open forest by 10% while closed forest and grassland decreased by 18% and 3% respectively. Shifting cultivation, over grazing, charcoal burning, settlements and poaching were identified as major land use practices threatening wildlife conservation within the corridor. Basing on the results, it was recommended that, the Government should set land use management plan and introduce the community-based natural resources management plans to improve natural resources utilization and reduce human stress to the corridor.

Key words; Wami-Mbiki, Saadan National Park, Wildlife Corridor, Pastoralist, Wami River

1.0 INTRODUCTION

The rapid loss of biodiversity and habitat around the world is occurring as a result of farmers clearing land for new fields, settlements and timber companies opening new forests for logging. In Tanzania, shifting in land use pattern has caused rapid degradation that has led into reduction of biodiversity in various protected areas resulting in natural habitat destruction (Karpati, 2003; Ogungo and Njuguna. 2004 in Ntongani et al., 2009). Following these practices some protected areas are now becoming ecological islands because of emerging various land use practices blocking the corridors, resulting in loss of wildlife critical areas i.e. Wildlife corridors, dispersal areas, foraging grounds, salt licking areas and breeding sites (Kideghesho, 2000; Mpanduji,2004). Wildlife corridors are central to the health of the wildlife, but have been interfered and shrinking as a result of various land use practices that are carried out in and around them (Vincent *et al*., 1999). In Tanzania corridors have been easily invaded because of lack of legal protection status (Frontier, 2003). The study done by Noe (2003) between Mt. Kilimanjaro and Amboseli National Parks revealed that, settlement and agriculture have resulted into reducing the actual size of the corridor from the approximately $21km^2$ in 1952 to $5km^2$ in 2001. This also has caused changes in the number of migratory routes and wildlife distribution. Some corridors, such as Kwakuchinja and Kitendeni are seriously threatening the ecological integrity because they are under very intensive pressure of agriculture, settlement and extensive livestock grazing (Shauri and Hitchcock L, 1999; Kideghesho, 2002).

Wildlife corridors secure the integrity of physical environmental processes that are essential for the requirements of particular species (Mulongoy, 2006). A population to

be in a good health and be able to reproduce needs among other factors, a sufficient foraging area and each population has its own habitat requirement which most of the protected areas do not meet. This marks the necessity to have the corridors linking Protected Areas allowing animals dispersal in searching for their basic needs, maintain and sustain viable populations (Tran, 1997). Moreover Corridors are the key for the survival of wildlife and ecosystems. They are important for conservation of wildlife by acting as extension of the core protected areas and hence contribute in maintaining the biodiversity inside and outside the core protected areas.
This is done by maintaining the genetic variation in populations where inbreeding is inevitable (Massawe, 2010). This enhances the colonisation, recolonization and prevention of inbreeding through gene flow which increase genetic variation. As a results the vigour for the animal are increased that increases the ability of the animal to cope to its environment. In addition, they provide refugia when the environment in the territorial areas becomes adverse, increases foraging areas and lower diseases incidences. Therefore protection, restoration and establishment of wildlife corridors are referred as the appropriate measures to improve the ecological values of ecosystems by manifesting ecological networking (Mpanduji, 2004; Kisingo *et al.*, 2005; Jimenez-Osornio *et al.*, 2008). The focus of this study was to identify various land use practices carried out along the Saadani-Wami-Mbiki WMA and their implications to wildlife conservation.

Materials and Methods

Study Site Description.-The Saadani-Wami-Mbiki Wildlife Corridor lies in the coastal area of Tanzania (Figure 1). The corridor extends between Saadani National Park and Wami-Mbiki Wildlife Management Area, hence a link between them. The corridor lies in the northern side and about 80 km from Dar es Salaam. The area occupied by the corridor is interspersed with rocky hills of thin soil cover and valleys with deep clay or alluvial soils; altitude varies between 350 and 400m. The corridor can easily be accessed by road in some areas e.g. if one crosses from Chalinze - Segera road through Mandela village, but in some areas is difficult to access it as there are no reliable paths e.g. the areas through Matipwili village. The size of the corridor is estimated to be about 62 km long and 10 km wide. The corridor is surrounded by 29 villages which are Pongwe Msungura, Pongwe Kiona, Kifleta, Mandela, Kwang'andu, Kwa Msisi, Matipwili, Gongo, Saadani, Mkange, Mihuga, Mkoko, Kwa Msanja, Miono, Msata, Kiwangwa, Vigwaza, Kilemela, Lugoba, Talawanda, Ubenazomozi, Mandamazingara, Masimbani, Kikaro, Kilemela, Kwa Ruhombo, Kimange, Kihangaiko and Rupugwi.

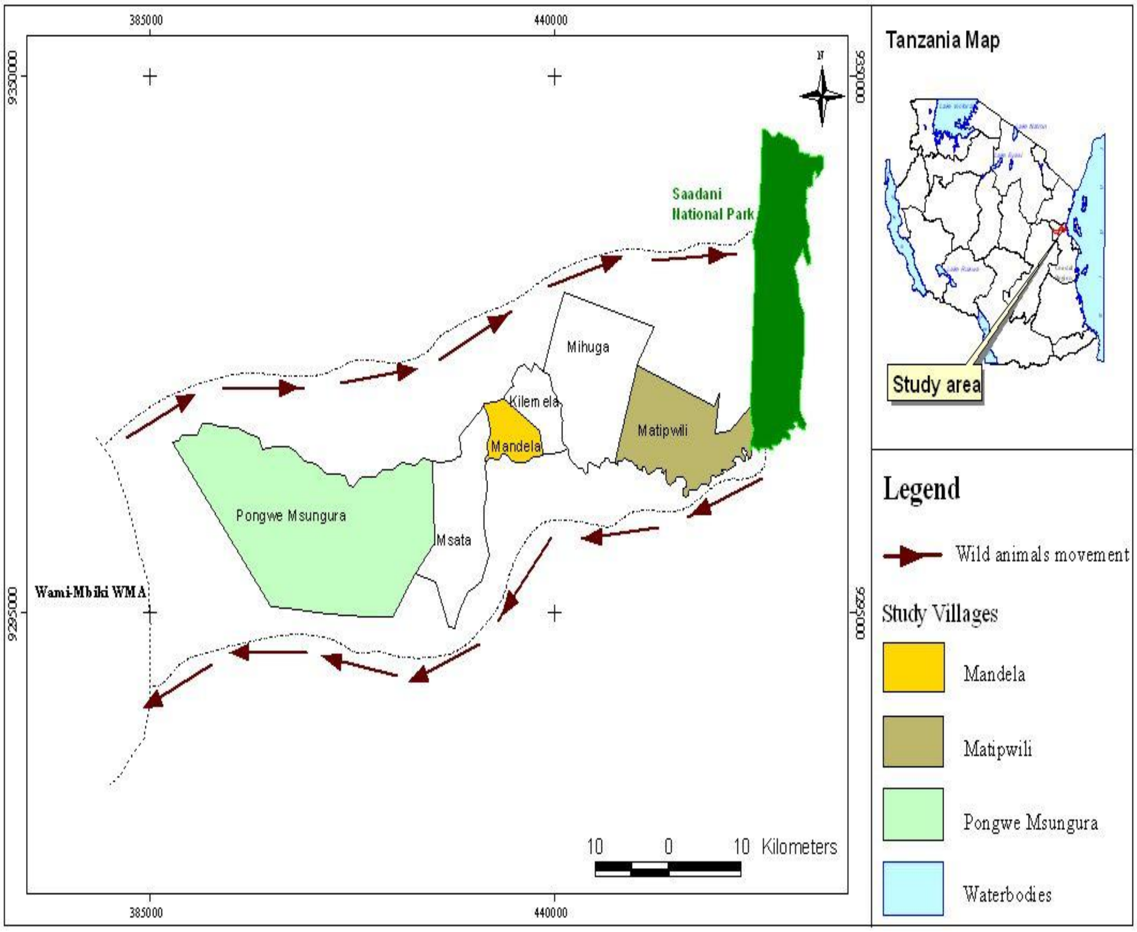

Figure 1: Location of the corridor and study villages

Sampling Procedure. - A cross-sectional design which allows data to be collected at one point in time was adopted as suggested Kothari, (2004) and Saunders *et al*., (2007). Based on the list of villages from the District office and reconnaissance survey, a purposive sampling method was used to select three villages namely Matipwili, Mandela and Pongwe Kiona. The villages were selected on the basis of location with respect to accessibility and proximity to the corridor. The sampling units of 30 households in each village were randomly selected from the sampling frame (village register). This sample size is recommended by Saunders *et al.*, (2007) on grounds that it is a reasonable sample size for socio-science studies as it is statistically large enough to make scientific conclusions. In most of the Africans traditions and customs, the household is the basic unit of social structure (Libida, 2004; Sherbinin, 2006).

The survey was conducted using a structured questionnaire containing both open and closed ended questions (Appendix I). The method was used to obtain information on land use practices, socio-economic and cultural activities undertaken in and along the corridor. Also, the technique was used to obtain villagers' views on the remarkable impacts associated with these land use practices on the corridor and wildlife. Key informants included individuals who were conversant with their environment and willing to talk to the researcher. They also included the most influential people in the village such as District Game Officer (DGO), Village Game Scouts (VGS), Village Agricultural Extension Officers, and Wami-Mbiki WMA and Saadani National Park Officials. The discussion was guided by a checklist (Appendix III) and aimed at collecting information concerning the types of land use practices done in and around the corridor and their associated impact to the wildlife conservation. Furthermore, the collected information was on the trend of wild animals and human wildlife interaction within and along the corridor. This was supplemented by direct observation and secondary data which included variousdocuments and publications obtained through grey literature, literature search using Internet and from Wami-Mbiki WMA office.

Data Analysis.-Quantitative data from household surveys were processed and analysed using Statistical Package for Social Sciences (SPSS) version 12.0 computer programme and Microsoft Excel Spreadsheet. Descriptive statistics was applied to determine frequencies, percentages and multiple responses. The qualitative data were analysed using content and structural-functional analysis techniques. Content analysis method was used to analyse in detail the components of verbal discussions held with key informants and from open-ended questions.

Remote sensing and GIS techniques were employed to assess vegetation cover changes as a result of land use systems along the corridor. Three sets of Landsat satellite imageries for 1975, 1995 and 2011 were purchased by considering the possible minimum presence of cloud cover, spatio-temporal characteristics, image data availability and image data costs. Image pre-processing, rectification/geo-referencing, enhancement and correction for distortions for all acquired images were done. The researcher used a hand held GPS for ground truthing/geo-referencing purposes that was so done by recording coordinates which later on were used to allocate features for verifying and documenting types and magnitude of vegetation cover change in the area.

Materials used in the study were Multispectral Scanner (MSS) of 27th July 1975, landsat 7 ETM+ imagery of 27th July 1995 and Landsat 7 ETM + of 21st February 2011. The images were obtained from the Institute of Resources Assessment (IRA) of the University of Dar es Salaam. Topographical maps with a scale of 1:50,000 were acquired from the Survey and Mapping Division of the Ministry of Lands, Housing and Human Settlements Development for geo-referencing Landsat images preparation of land use/cover interpretation key. The sub scenes covering the Saadani-Wami-Mbiki wildlife corridor were extracted from the mentioned images. Global Positioning System (GPS) was used in land use and cover map verification and updating land use and land cover map to include land use pattern up to year 2011. Images were selected based on low cloud cover, seasonality, date and phonological effects. Supervised Maximum Likelihood Classifier (MLC) remote sensing classification methodologies were utilized to create a base map for ground truthing. Supervised classification process involved classification of training sites on the image which represent specific land classes to be mapped.

Data analysis. - Assessment of the rate of cover change**.** The estimation for the rate of change for the different covers was computed based on the following formulae; (Kashaigili and Majaliwa, 2010):

$$\%\ Change_{year\ x} = \frac{Area_{i\ year\ x} - Area_{i\ year\ x+1}}{\sum_{i=1}^{n} Area_{i\ year\ x}} x\ 100 \quad (1)$$

$$Annual\ \ rate\ \ of\ \ change = \frac{Area_{i\ year\ x} - Area_{i\ year\ x+1}}{t_{years}} \quad (2)$$

$$\% \ Annual \ rate \ of \ change = \frac{Area_{i \ year \ x} - Area_{i \ year \ x+1}}{\sum_{i=1}^{n} Area_{i \ year \ x} \ x \ t_{years}} x100 \quad (3)$$

Where; Area $_{i\ year\ x}$ = area of cover i at the first date
Area $_{i\ year\ x+1}$ = area of cover i at the second date
$\sum_{i=1}^{n} Area_{i\ year\ x}$ = the total cover area at the first date and
t_{years} = period in years between the first and second scene acquisition dates

RESULTS

The Spatial Extents of Different Land Cover Classes.-The main land use/land cover maps for 1975, 1995 and 2011 are presented in Figures 4, 5 and 6 respectively. The proportion of each land cover category between the three time periods of analysis. Analysis show that in the year 1975 (see Fig. 2) the land use/cover in the study area was dominated by closed forest and bushland occupying 30% (59 413 ha) and 25% (50 788 ha) respectively followed by cultivated land occupying 13% (26 165 ha) then grassland 12% (24 278 ha) and shrubs 11% (22 007 ha). Others were open forest and settlement, occupying 4% (8 599 ha) and 4% (7 618 ha) respectively and finally open water bodies comprising 1% (1 095 ha).

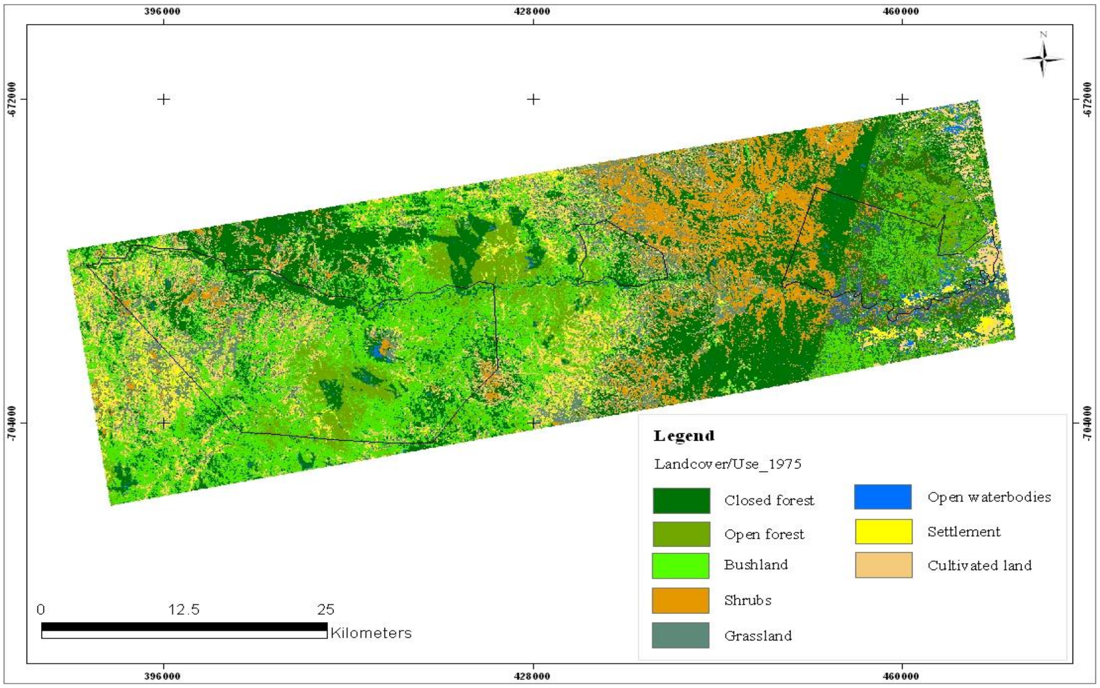

Figure 2: Land cover/use Map of Image scene, 1975

Fig. 3 shows that in 1995, closed forest continued to occupy the largest land cover. It comprised 23% (46 681 ha) of the total land cover, followed by cultivated land 18% (35 608 ha). Bushland and shrubland occupied 13% (26 616 ha) and 13% (25 362 ha) respectively. Others included settlement and grassland which occupied 12% (24 474 ha) and 11% (22 812 ha) respectively. The open forest occupied 9% (18 493 ha) and open water bodies 1% (1 095 ha).

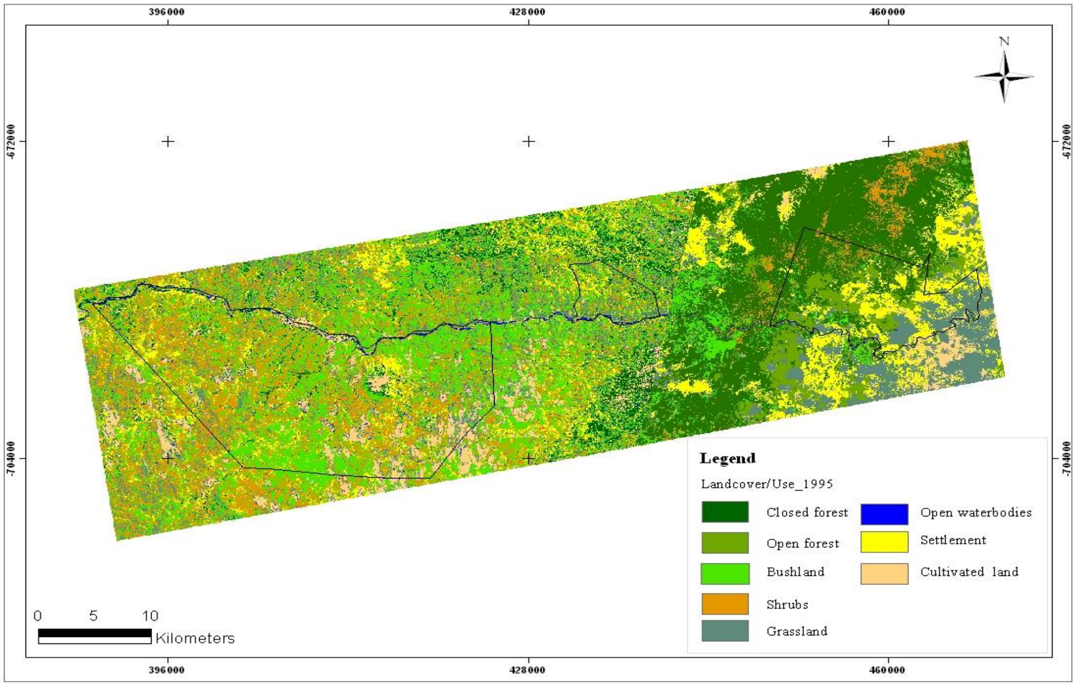

Figure 3: Land cover/use Map of Image scene, 1995

In 2011, the cultivated land occupied 38% (76 791 ha) followed by settlement which counted for 19% (37 282 ha) of the total area (Fig.4). Furthermore, the closed forest occupied 17% (33 392 ha) followed by bush land 12% (24 509 ha), open forest 8% (15 577 ha), grassland 6% (12 690 ha), and open water bodies that occupied 0.01% (900 ha).

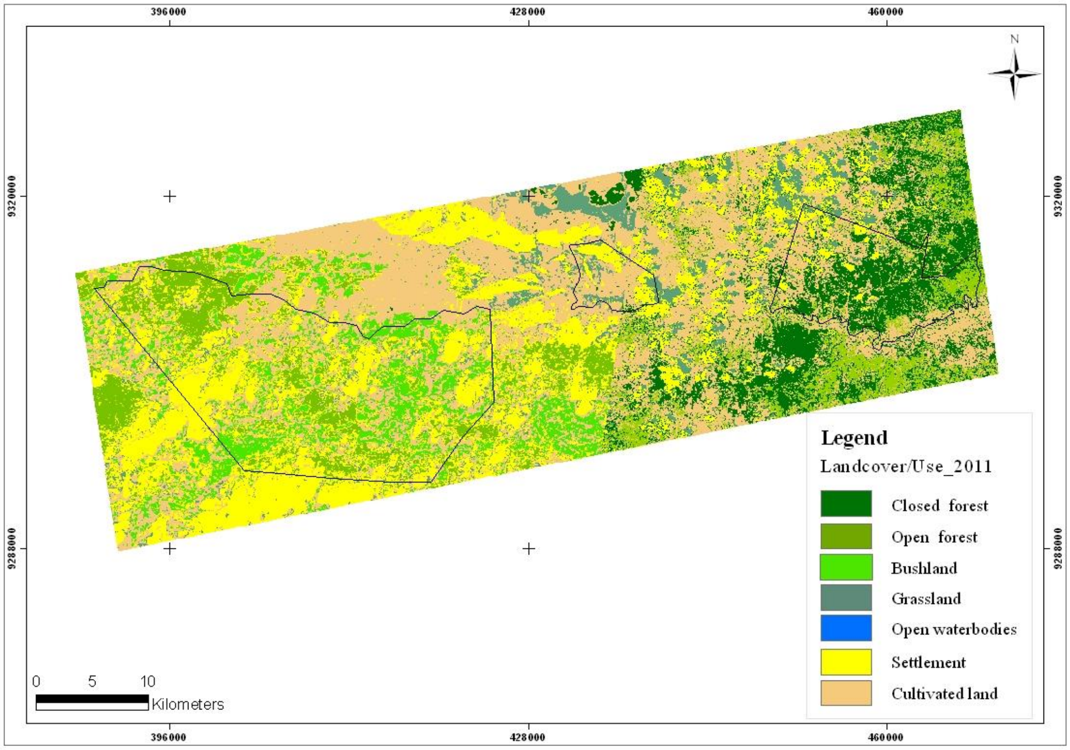

Figure 4: Land cover/use Map of Image scene, 2011

Areas used for cultivation and settlement seemed to be increasing gradually throughout the study period from 26 165 ha (13%) and 7 618 ha (4%) in 1975 to 76 791 ha (38%) and 37 282 ha (19%) in 2011 while closed forest, grassland and bush land decreased from 59 413 ha (30%), 24 278 ha (12%) and 50 788 ha (25%) in 1975 to 33 392 (17%), 12 690 ha (6%) and 24 509 ha (12%) in 2011 respectively (Fig. 5). The combined land cover areas of closed forest, grassland and bush land decreased from 1 343 479 ha (67%) in 1975 to 70 591 ha (35%) in 2011. The areas used for cultivation increased from 26 165 ha (13%) to 76 791 ha (38%) in the same period. Also the area used for settlement increased tremendously from 7 618 ha (4%) in 1975 to 37 282 ha (19%) in 2011.

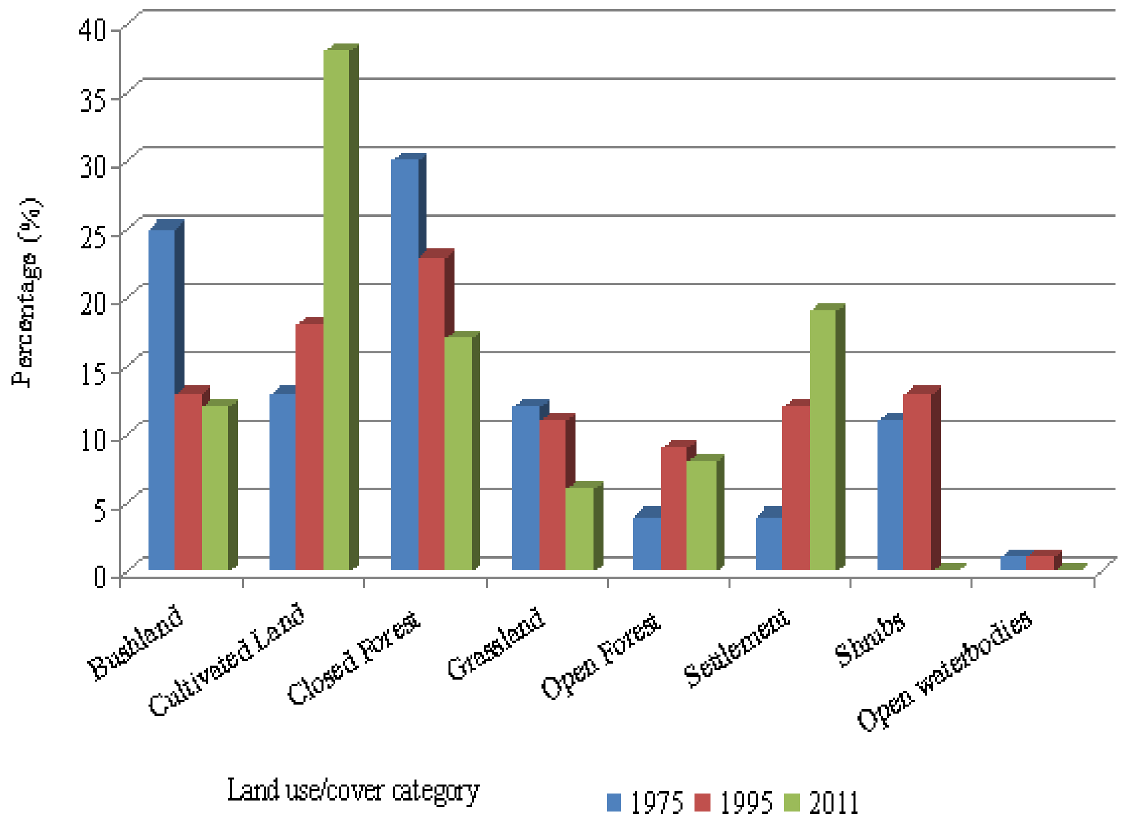

Figure 5: Land Use/Cover Distribution for Saadani-Wami-Mbiki wildlife corridor between 1975 and 2011

Changes in Land Use/Cover in the Saadani-Wami-Mbiki Wildlife Corridor.- According to Table 1, the period between 1975 and 1995 show that the cultivated area increased by 9443 ha (5%); bush land decreased by 24 172 ha (12%) while the area for grassland shrunk by 1466 ha (1%). In the same period, settlement increased significantly by 16 856 ha (8%) as opposed to closed forest which indicated a decrease by 12 732 ha (6%) while open forests and shrubs recorded an increase by 9894 ha (5%) and 3355 ha (2%) respectively.

Moreover, in the period between 1995 and 2011, the closed forest decreased by 13 289 ha (7%), grassland by 10 122 ha (5%), shrubs by 25 362 ha (13%) and bush land by 2 107 ha (1%) while the open forest decreased by 2 916 ha (1%) (Table 1). However, the cultivated land increased by 41 183 ha (20%) and settlement by 12 808 ha (6%).

Table 1: Changes in different land use/cover coverage (ha) in the Saadani-Wami-Mbiki wildlife corridor 1975 - 1995 and 1995 – 2011.

	1975		1995		2011		Relative Change (1975-1995)		Relative Change (1995 -2011)	
Vegetation Types	**Area_ha**	**%**	**Area_ha**	**%**	**Area_ha**	**%**	**Area_ha**	**%**	**Area_ha**	**%**
Bushland	50788	25	26616	13	24509	12	-24172	-12	-2107	-1
Cultivated land	26165	13	35608	18	76791	38	9443	5	41183	20
Closed forest	59413	30	46681	23	33392	17	-12732	-6	-13289	-7
Grassland	24278	12	22812	11	12690	6	-1466	-1	-10122	-5
Open forest	8599	4	18493	9	15577	8	9894	5	-2916	-1
Settlement	7618	4	24474	12	37282	19	16856	8	12808	6
Shrubs	22007	11	25362	13	0	0	3355	2	-25362	-13
Open waterbodies	2273	1	1095	1	900	0	-1178	-1	-195	0
Total	**201141**	**100**	**201141**	**100**	**201141**	**100**				

Source: Institute of Resources Assessment, (2011).

Rate of Land Use/Cover Change in the Saadani-Wami-Mbiki Wildlife Corridor.- Tables 2 and 3 show the rate of land use/cover change in the Saadani-Wami-Mbiki wildlife corridor. It was found that grassland decreased at a rate of 73 ha (0.1%) per year between 1975 and 1995 and continued decreasing at the rate of 633 ha (0.3%) per year between 1995 and 2011. Furthermore, it was revealed that the closed forest decreased at the rate of 637 ha/year (0.3%) between 1975 and 1995 while decreasing at the rate of 831 ha/year (0.4%) in the period between the 1995 and 2011. Furthermore it was found that cultivated land increased at a rate of 472 ha (0.3%) per year between 1975 and 1995 and at a rate of 2574 ha (1.3%) per year between 1995 and 2011. Bush land decreased at the rate of 1209 ha (0.6%) per year between 1975 and 1995 and 132 ha (0.1%) per year between 1995 and 2011. In addition, settlement increased at the rate of 843 ha (0.4%) per year between 1975 and 1995 and 801 ha (0.4%) per year between 1995 and 2011. The open forest increased at the rate of 495 ha (0.3%) per year between 1975 and 1995 and continued increasing at the rate of 182 ha (0.1%) per year between 1995 and 2011. The other land cover that seemed to be changing was shrubs which indicated that they increased at the rate of 168 ha (0.1%) per year between 1975 and 1995 and decreased at the rate of 1 585 ha (0.8%) per year between 1995 and 2011.

Table 2: Area Cover, Area Change and Rate of Change between 1975 and 1995

	1975		1995					
Vegetation Types	**Area (ha)**	**%**	**Area (ha)**	**%**	**Area change (ha)**	**%**	**Annual rate of change (ha/yr)**	**Annual rate of change (%/yr)**
Bushland	50788	25	26616	13	-24172	-12	-1209	-0.6
Cultivated Land	26165	13	35608	18	9443	5	472	0.3
Closed Forest	59413	30	46681	23	-12732	-6	-637	-0.3
Grassland	24278	12	22812	11	-1466	-1	- 73	-0.1
Open Forest	8599	4	18493	9	9894	5	495	0.3
Settlement	7618	4	24474	12	16856	8	843	0.4
Shrubs	22007	11	25362	13	3355	2	168	0.1
Open water bodies	2273	1	1095	1	-1178	-1	-59	-0.1
Total	**201141**	**100**	**201141**	**100**				

Source: Institute of Resources Assessment, (2011)

Table 3: Area Cover, Area Change and Rate of Change between 1995 and 2011

	1995		2011					
Vegetation Types	**Area (ha)**	**%**	**Area (ha)**	**%**	**Area change (ha)**	**%**	**Annual rate of change (ha/yr)**	**Annual rate of change (%/yr)**
Bush land	26616	13	24509	12	-2107	-1	-132	-0.1
Cultivated Land	35608	18	76791	38	41183	20	2574	1.3
Closed Forest	46681	23	33392	17	-13289	-7	-831	-0.4
Grassland	22812	11	12690	6	-10122	-5	-633	-0.3
Open Forest	18493	9	15577	8	-2916	-1	-182	-0.1
Settlement	24474	12	37282	19	12808	6	801	0.4
Shrubs	25362	13	0	0	-25362	-13	-1585	-0.8
Stream	1095	1	900	0	-195	-0	-12	-0.0
Total	**201141**	**100**	**201141**	**100**				

Source: Institute of Resources Assessment, (2011)

Changes Detection Matrix of Different Land Use/Cover. -The change detection of land cover/use in the corridor between 1975 and 1995 is presented in Table 4. During this period, 5 202 ha of closed forest was converted to bush land, 3 980 ha to cultivated land, 759 ha to settlements, 7 412 ha to grassland, 10 ha to open forest, 10 226 ha to shrub land while 15 851 ha remained unchanged. The bush land experienced the same sequence whereby 3530 ha were converted to grassland, 3230 ha to cultivated land and 874 ha to settlements while 5331 ha remained unchanged. Furthermore, 1268 ha of open forest were converted to bush land, 330 ha to cultivated land, 728 ha to grassland, 1373 ha to shrub land and 40 ha to settlement while 750 ha remained unchanged. About 6167 ha of shrub land were converted to cultivated land, 1733 ha to settlements, 3337 ha to grassland while 1792 ha remained unchanged.

Table 4: Change detection matrix for 1975 – 1995

	Classes in 1975								
Classes in 1995	BL	CL	CF	GL	OF	SE	SB	OW	Total

Bushland	(5331)	3230	6955	3515	3816	874	2752	143	26616
Cultivated Land	13560	(5018)	6717	2722	1704	1589	1591	262	35608
Closed Forest	5202	3980	(18565)	7412	10	759	10226	527	46681
Grassland	6760	3874	6627	(1884)	15	1396	1652	604	22812
Open Forest	1268	330	6008	728	(750)	40	1373	114	18493
Settlement	5598	3448	5304	3950	2202	(1186)	2526	360	24474
Shrubs	12783	6167	8995	3337	10	1733	(1792)	239	25362
Open waterbodies	286	118	342	97	92	41	95	(24)	1095
Total	**50788**	**26165**	**59413**	**24278**	**8599**	**7618**	**22007**	**2273**	**201141**

Source: Institute of Resources Assessment, (2011)

BL=Bushland, CL=Cultivatedland, CF=Closed Forest, GL=Grassland, OF=Open Forest, SE=Settlement, SB=Shrubs, OW=Open waterbodies

The analysis of land use/cover change detection for the period between 1995 and 2011 is presented in Table 5. The closed forests changed by 1716 ha to grasslands, 4190 ha to cultivated land, 1491 ha to settlements, 2090 ha to bush land, 4 ha to open forest, 4480 ha to shrub land while 1457 ha remained unchanged.

Table 5: Change detection matrix for 1995 - 2011

	Classes in 1995								
Classes in 2011	BL	CL	CF	GL	SE	OF	SB	OW	Total
Bushland	(393)	5155	4399	4865	3780	833	4965	119	24509
Cultivated Land	10846	(12254)	18724	10689	8381	1835	13547	515	76791
Closed Forest	2090	4190	(1457)	1716	1491	4	4480	149	15577
Grassland	1936	1959	3877	(1347)	1240	205	2061	65	12690
Settlement	3750	8260	7057	3574	(5042)	584	8753	262	37282
Open forest	8047	4058	9167	3483	3950	(4117)	500	70	33392
Open waterbodies	3	76	0	11	9	300	1	(500)	900
Total	**27065**	**35952**	**44681**	**25685**	**23893**	**7878**	**34307**	**1680**	**201141**

Source: Institute of Resources Assessment, (2011) *BL=Bushland, CL=Cultivatedland, CF=Closed Forest, GL=Grassland, OF=Open Forest, SE=Settlement, SB=Shrubs, OP=Open waterbodies*

About 8047 ha of the open forest were converted to bush land, 4058 ha to cultivated land, 3483 ha to grassland and 3950 ha to settlements while 4117 ha remained unchanged. About 4865 ha of bush land were converted to grassland, 5155 ha to cultivated land while 393 ha remained unchanged. Also, 1 959 ha of grassland were converted to cropland, 1240 ha to settlements while 1347 ha remained unchanged.

4.5 Land Use Practices along Saadani – Wami-Mbiki Wildlife Corridor

Results in Table 6 show various land use practices that were identified along Saadani – Wami-Mbiki wildlife corridor. It was revealed that 23% of the local community were involved in shifting cultivation. Furthermore, it was found that 21% of the local community were involved in livestock keeping. In addition, charcoal burning activity was performed by 17% of all local communities in the area. Other activities included poles extraction and fishing.

Table 6: Respondents practicing different land uses along the corridor

LUP	Frequency (N=90)	Percent
Shifting cultivation	44	23
Livestock grazing	40	21
Charcoal making	33	17
Illegal hunting (poaching)	15	8

Poles extraction	11	6
Lumbering	6	3
Firewood collection	11	6
Mining	4	2
Fishing	3	2
Sand/gravel extraction	4	2
Infrastructure development	1	1
Settlement	22	11
Total	194	100

The perception of Local community on the Implications of Various LUP to Wildlife Conservation.- About 24% of the respondents perceived loss of habitat as the implication of various LUPs done along the corridor (Table 7). Furthermore, 17% of the local community indicated that the various LUPs in the area caused disturbance of the wildlife movement. Other implications of LUP activities in the area were land degradation, reduction of animal fodders, declined animal populations and blockage of the corridor.

Table 7: Perceptions of the people on implications of various LUP to wildlife conservation

Implication	Frequency (N=90)	Percent
Interrupt animal movements	29	17

Loss of habitats	41	24
Degradation of the area	16	10
Reduce animal fodders	20	12
Reduce places to hide	23	14
Reduce animal population	16	10
Blockage of the corridor	21	13
Total	169	100

DISCUSSION

Rate of Land Use/Cover Change in the Corridor.-Results presented in figs 4, 5 and 6 revealed that there were different rates of land use/vegetation cover changes as observed in the analysed satellite imageries of 1975, 1995 and 2011. This could be attributed to an increase of the human population in the area as the population increased from 173 871 to 228 967 during the period 1988-2002 with the average annual growth rate of 2% (URT, 2006). The major population pulling factors to this area included adequate and fertile land to cater for livelihoods through cultivation, settlements, livestock keeping and charcoal making, amongst others. Introduction of new crops for commercial purpose such as sesame and pineapples in the area have also attracted people to open new virgin lands which are more fertile to maximize production. Loss of corridors for agriculture and other land uses is common in many parts of Tanzania. Jones *et al.*, (2009) for example, reported that the Mikumi–Wami-Mbiki and Tarangire – Lake Manyara Corridors were under increasing pressure due to cultivation, human settlements, charcoal making and extraction of timber/poles. Furthermore, the study by Noe (2003) found that the increase in population along the Kitendeni Wildlife Corridor created more demand on land for cultivation and settlement.

Furthermore, results showed that shifting cultivation was among the land use practices being undertaken in the area. This could have been caused by factors such as population growth, lack of land use management plan, loss of soil fertility, inefficient agricultural extension services and poverty of local communities in the area. The study done by Rahman *et al.,* (2011) in Eastern Bangladesh, reported that population pressure influence farmers' decision to continue shifting cultivation. Furthermore, URT (2006) reported that population increase lead in opening more land for production while increasing pressure over resources. In the same vein, Ntongani et al., (2009) reported that increase in population in Selous-Niassa Corridor resulted in shifting cultivation ending up in degrading the corridor.

In addition, poverty of local communities along the corridor has been the driving factor for shifting cultivations. This is because local communities are primarily subsistence farmers and fail to go for alternatives such as purchase of fertilizers. Thus, the only option for the local community in this area was to open new virgin land for cultivation. The study done by Rahman *et al.,* (2011) in Eastern Bangladesh found that villagers who are primarily subsistence farmers produce enough foods for their family's survival as their priority on agricultural production. In some regions, poverty-driven cultivation can occur if small-scale and subsistence farmers lack resources or secure land tenure and are forced to move into forested areas to grow food and earn their livelihoods (Sanchez *et al*., 2005). Particularly in Sub-Saharan Africa where Tanzania lies, small-scale farmers who lack resources for increasing crop productivity on nutrient-depleted soils may use additional forested lands to maintain production and their livelihoods (Palm *et al*., 2010).

Additionally, livestock keeping was among the land use practices being undertaken in the area. The observed livestock keeping activities in the area were probably due to lack of binding laws that restrict them from grazing in this corridor. WCST (2009) stated that weak policy and law enforcement were the main conservation challenges facing wildlife corridors in Tanzania. This has been the factor leading to in-migration of pastoralists to this corridor from other areas. Elsewhere in Tanzania, Malmer and Nyberg, (2008); Killebrew and Wolff, (2010) attributed overgrazing to lack of land management plan and weak laws.

Charcoal making and fuel wood extraction were identified as other major land use practices threatening the corridor. Charcoal was regarded as profitable business in this area. Msuya *et al*. 2011 stated that for Tanzania mainland, the demand for charcoal has constantly increased and prices were also rising. Sawe (2004) found charcoal as one of the big industry on Tanzania mainland whereby its contribution to people's livelihood security seemed to be enormous; estimated at the value of over Tshs. 20 billion. Massawe, (2010) found that charcoal making and fuelwood collection were used by household as a source of energy for cooking since the Government had not yet provided a strategy for providing an alternative energy source. Only about 14 percent of Tanzanians have access to electric power energy (Worldbank, 2010).

The results showed that various land use practices have far reaching implications on wildlife conservation in the corridor. These included loss of habitats and decreased animal species (Appendix III). The invasion caused by livestock, shifting agriculture and charcoal burning (Plate 2 and 3) were ranked as major factors degrading the corridor. Scientific studies have shown that animals are threatened by the presence of features like houses and farms located in their routes as substitutes of the natural vegetation cover (Noe, 2003; Ntongani at al,, 2009; Massawe, 2010). This scenario might have contributed to local extinction of some mammal species in the area. By the time this study was being conducted, 7 species were locally extinct as local communities had not seen them for the past 36 years. These species included Black Rhino (*Diceros bicornis*), Cheetah (*Acinonyx jubatus*), Wildebeest (*Connochaetes taurinus*), Wild dogs (*Canis familiaris*), Impala (*Aepyceros melampus*), Blue duiker (*Cephalophus monticola*) and Eland (*Taurotragus oryx*). However, the population for some mammals had increased because of the beliefs attached to them such as Bush pig (*Potamochoerus porcus*) and Warthog (*Phacochoerus asthiopicus*) since the area is dominated by Muslims who do not feed on them. Other increased animals included Striped polecat (*Ictonyx striatus*), Hippopotamus (*Hippopotamus amphibious*), Crocodile (*Crocodilus niloticus*), Yellow baboon (*Papio cynocephalus*), and Monitor lizard (*Varanus indicus*).

Furthermore, there were reduction of foraging ground for wild animals due to encroachment caused by agriculture and settlement. The area suitable for grazing by wildlife declined from 145 351 ha (82%) ha in 1975 to 86 168ha (43%) in 2011 (IRA, 2011). Human-wildlife contacts observed in the corridor had aggravated conflicts. Some of the reported conflicts included those related to crop damage, destruction of houses, livestock depredation, diseases (zoonotic) transmission, and illegal hunting, just to mention few. However, the declining trend of wildlife population in this area could be a reflection of ecosystem degradation due to other factors than human induced factors. Such factors could be a change in climatic condition which as well influences food availability.

Charcoal making and firewood collection require large volume of wood which in turn depletes tree stocks resulting in various forms of environmental degradation such as soil erosion, lowering and affecting abundance and diversity of trees in an area of concern (Monela *et al.*, 1998; 1999; Monela & Abdallah, 2007). The demand for charcoal from the corridor was relatively increasing in which people were cutting both dead and green woods. The situation resulted in a bush clearing which caused patches of bare land hence negatively impacting the biodiversity in the corridor. This was revealed on the changes seen in the classified satellite imageries from 1975 to 2011 (Figure 4, 5 and 6). The amount of charcoal that was carried out daily from the area was between 40 and 60 sacks. Furthermore, there are inadequate records of the extent to which illegal tree harvesting was carried out in the area but a habitat change in the traditional route must have acted as an impediment to the wild animal movement.

The study has shown that although the Saadani-Wami-Mbiki Wildlife Corridor forms an important connection between the Saadani National Park and Wami-Mbiki WMA, its status has been decreasing with time as a result of various land use practices carried out in and around. There were nine recognized human induced types of land use practices carried out in and around the corridor, among them being the agriculture that was singled out as the major land use practice. This type of land use was mainly practiced along and within the corridor. Livestock keeping was the second activity but was mainly practised by immigrants. Other activities included firewood collection, extraction of poles/withies, charcoal making, illegal hunting, fishing, sand extraction, mining and logging which had profound negative impacts to the welfare and conservation status of the corridor. These land use practices were influenced by increase in population and poverty of local communities along the Saadani-Wami-Mbiki Wildlife Corridor.

The vegetation cover of the corridor has been decreasing for over 36 years. This tendency has influenced the destruction of wildlife habitats, decrease in foraging ground, loss of natural vegetation, elimination of important cover for prey, interruption of animal movements and blockage of the corridor. As a result, some mammal species have disappeared and others had their population decreased tremendously.

t is recommended that both Government and other conservation stakeholders should introduce and implement the community based conservation approach so that the active involvement of the villagers in the protection of the wildlife in and outside this corridor is realized. This could be a solution to harmonise with the conservation of this corridor. Rural and poor communities can engage in conservation activities if and only if co-operation and support are granted to them.

It is recommended that The Government should support land use management plan in villages bordering the wildlife corridors in order to reduce human pressure on natural resources found within. The Government should prepare village strategic land use plans, surveying villages, demarcating the corridors and public natural resources available in order to have the proper use of the resources in the area.

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