The Impact of Human Migration on Land Degradation in Mpanda District, Katavi Region in Tanzania

Florian S Silangwa[3]

Abstract

The study on the impact of human migration on land degradation was conducted in fiveselected wards of Mpanda district. Over the years, human population has been increasing in Mpanda district. The increase in population have changed land use systems that have caused a reduced land cover and subsequent land degradation. The main objective of this study was to examine the relationship between the increase in human population and land degradation over a period of 30 years from 1985 to 2015. Specific objectives of the study sought to: determine the extent of land degradation emanating from human activities, to assess the relationship between and human activities on land use and land cover changes, to assess and describe the types of land conservation and management measures that are practiced in Mpanda district. To achieve these objectives, the study utilized three land-sat satellite imageries (1985 TM, 2000 ETM and 2015 ETM+) that were processed and analyzed using GIS software to produce GIS maps to detect and quantify land cover changes in Mpanda district during the years: from 1985, and 2000 to 2015. A field observation and household survey was also carried out in the study area to identify the activities that are responsible for land use changes and degradation. The results showed that since the 1985 to 20015, Mpanda district has experienced a rapid growth in human population density during 30 years since 1985. The growing trend of the population and consequent demand for food, energy, and area for settlement and agriculture have considerably altered land use practices, reduced natural vegetation cover stratum and severely caused land degradation at large. In order to correct this anomaly,the local population can be sensitized on the importance of growing trees and seedlings can be planted in nurseries for onward transmission to these lands. Similarly, pastoralist can be encouraged to practice zero grazing in a bid to manage grazing lands. The movement of people with their livestock should also be restricted to control the rate of vegetation growth. Such measures will prevent land exhaustion that is a constant threat to the biodiversity of the environment.

Introduction

Land degradation remains a major threat to the world's ability to meet the growing demand for food and other environmental services. According to

[3] Lecturer Institutes of Resource Assessment, University of Dar es Salaam

UNCCD (1994) land degradation refers to any reduction or loss in the biological or economic productive capacity of the land caused by human activities, exacerbated by natural processes, and often magnified by the impacts of climate change and biodiversity losses. Land degradation is caused to a certain extent by natural factors. However, the main cause is associated to anthropogenic activities through one or a combination of the following: deforestation; bush burning; cultivation of marginal lands; intensive farming without fallowing; excessive and indiscriminate use of chemicals; overgrazing; population transmigration; land pollution through improper disposal of waste and oil spillage and infrastructural development in ecological sensitive areas (URT, 2004; URT, 1997).

Land use activities, whether converting natural landscapes for human uses and needs, or changing management practices on human dominated land, have transformed a large proportion of the planet's land surface (Ouedraogo, 2006c). Bottomley (1998), Loveland *et al.* (1999) and Foley *et al.* (2005) report that land use activities, while varying greatly across the world, ultimately result in the same outcome; namely the acquisition of natural resources for immediate human needs, often at the expense of degrading environmental conditions. Local land use and land cover changes are fundamental agents of global climate change and are significant forces that impact biodiversity through the loss, modification, and fragmentation of habitats, degradation of soil and water resources, and overexploitation of native species (Wezel &Lykke, 2006; Kristensen &Balslev, 2003; Lambin*et al.*, 2003; Riebsame*et al.*, 1994), as well as radiation budgets, trace gas emissions, and perturbation of hydrological and biogeochemical cycles (Sala *et al.*, 2000). At the local and regional levels, land cover change can have profound impacts on aquatic

According to Ademiluyi et al (2008), Africa has the fastest rate of deforestation in the world. Competing land uses which are mainly agriculture and human settlements are said to be contributing to the decline of forest and woodland areas and the rising demand for fuel wood and charcoal is also a major cause of deforestation and land degradation. Over harvesting, agricultural encroachment and unregulated burning of vegetation are believed to be contributing to the decline of many species in the wild. Depletion and degradation of the natural resource base intensifies competition to less stressed areas (Ademiluyi et al, 2008).

In Zimbabwe for instance, Mark and Kudakwashe (2010) stated that since the early 1980's, vast transformations have occurred in the land use and land-cover patterns as evidenced by persistent expansion in cultivated land, decrease in natural woodland, and grassland in the world as well as in Zimbabwe. They further indicate that land is becoming a scarce resource due to immense agricultural and demographic pressure in Zimbabwe and that land use and land cover change has become a central component in current strategies for managing natural resources and monitoring environmental changes such as land degradation. In South Africa, land degradation is severe and widespread. It threatens food and water security, economic development, and natural resource conservation.

In Tanzania land degradation threatens the sustainability of growth and the welfare of many people who depend on agriculture natural resource and other land based production systems for their livelihoods Land degradation diminishes soil quality and thereby reduces productivity of agricultural, and forest ecosystems. The changes inflicted on soils by human-induced land degradation over many years are significant and have resulted to invaluable land becoming unproductive. Therefore strong efforts to combat land degradation are justified on these ground and also based on other global concerns such as climate change mitigation and conservation of biodiversity and genetic resources.

In Mpanda district, human population has been increasing over the years. According to the National Bureau of Statistics, the population of Mpanda district increased from 2,120 in 1988 to 412,683 in 2002. However, after the district became part of new region of Katavi, some of the of wards and villages remained to Rukwa region, therefore, the 2012 Population and Housing Census showed that, the district's population was 282,036 people compared to 119,939 inhabitants counted in 2002 Population Census. The population of Mpanda district has experienced a constant growth rate. The growth rate of the district was 3.2 percent during the 1988 - 2002 inter-censual period and remained at the same rate of 3.2 percent in 2002 -2012 inter-censual period.

Land fertility for agricultural activities in most areas of Katuma plain, Sibwesa, Mpandandogo and Kabungu wards; and the virginity of the land favours pastoralists to migrate with their flocks of livestock in the district. The influx of people have changed land use systems that have caused a reduced land cover and subsequent land degradation. The main objective of this study was to examine the relationship between the increase in human population and land degradation over a period of 30 years.

Objectives of the Research Study

Specific objectives of the study sought to:

(1) Examine the extent of human migration in Mpanda district,

(2) Assess the level of land degradation emanating from human activities

(3) Assess the relationship between human activities on land use/ land cover changes

Drivers of land degradation

Land degradation is always caused by multiple interacting factors originating from different levels of organization of the linked human-environment systems (Lambin et al., 2003). These driving forces vary tremendously in time and space, according to specific human-environment conditions. Drivers of land degradation and land use change have been widely identified and studied at the global level (e.g. Foleyet al., 2005; Meyer & Turner, 1994; Ojima et al., 1994; Turner IIet al. , 1993; Turner II &Butzer, 1992), the regional level (e.g. Drigoet al., 2009; Geist et al., 2006; Lambin et al., 2003; Geist &Lambin, 2002; Geist &Lambin, 2001) and the local level (e.g. Ouedraogo et al., 2009; Alo& Pontius, 2008; Braimoh, 2004; Kok, 2004; Serneels&Lambin, 2001; Mertens&Lambin, 2000).

There are various land degradation analytical frameworks which include Millennium Ecosystem Assessment (MA), Strategic Environmental Analysis (SEA), Sustainable Rural Livelihoods Approach (SRL) and Driving Force, Pressure, State, Impact and Response (DPSIR

Framework. However, in this context the assessment of land degradation has employed DPSIR framework (Figure 1). The analytical framework has been widely used in the assessment of land degradation in some geographical areas such as in the drylands (see for example Ponce-

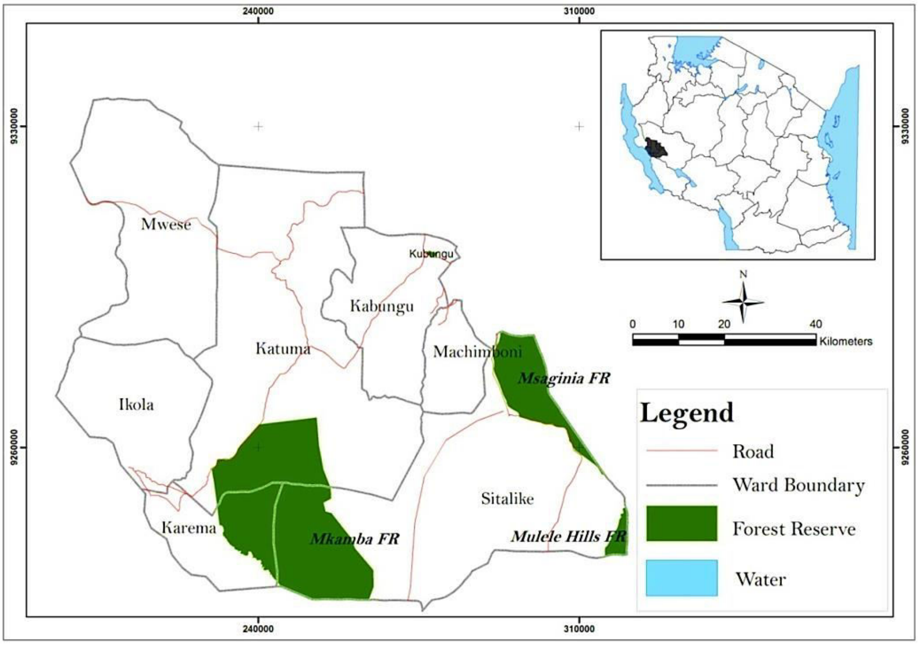
Hernandez, R. and P. Koohafkan, 2004; UNEP 2006). It is clear and simple, with five concepts that are readily obvious to stakeholders. It also provides clear understanding of land degradation, its causes and consequences as well as simplifying the complex connections between humans and the environment. It is a flexible framework that can be used in the decision-making process.

Materials and Methods

Description of the Study Area

Mpanda district lies between latitudes 5° 15’ to 7° 3’ South of Equator and longitude 30°31’to 33° 00’East of Greenwich. It also lies between 1040m and

1100m above the sea level. It covers an area of 349.03km2 of which 109.11 km2 are urban areas and 240.92 km2 are rural areas. It is found within Katumba Plateau which is among the five agro economic zones of Mpanda District. It receives rainfall ranging from 1000-1300mm per annum and the maximum temperature is 32 0C in October and whereas minimum temperature is 13ºCin July. The study covered seven wards, namely Ikola, Kabungu, Karema, Mwese, Katuma, Machimboni and Sitalikeof Mpanda District which is one of the three districts of Region (Fig. 1) (MDCP, 2008).



Map 1: The location of the Study area in Mpanda District

General characteristics of the study area

According to National Population and Housing Census 2012 had total population of 282,036 out of these 139,702 were males and 142, 334 were females. It has a total area of 16,911 sq. kms which is about 36 percent of the total area of Katavi region and most of which is plain land with very few hills and valleys which can be further subdivided into three broad classes according to utilization. These areas are natural and forest plantations, arable land and area for settlements. Table 1 show the population trends in selected wards of Mpanda district.

Table 1: Population trends in selected ward in Mpanda District

Wards	Population Census		
	1988	2002	2012
Ikola	2,120	13,428	17,659
Kabungu	2,519	20,741	22,676
Kapalamsenga**			8,853
Karema	5,034	11,542	7,465
Katuma	1,263	7,092	9,470
Mpandandogo	5,578	11,959	25,293
Mwese	2,904	5,122	7,520
Sibwesa	522		19,183
Sitalike	2,912	7,190	9,638

Source: NBS, 1988, 2002 and 2012
** New ward

The climate in Mpanda district is tropical, experiencing a mean the average temperature ranges between 26^{0}C and 30^{0}C per year (Figure 2). However temperature can drop to less than 20^{0}C in cold month of June, July and August particularly in the highlands (Mpanda district investment profile 2011). The area has a single rainy season from November through May with short rain around September or October and dry months during the rest of the year. The Mean annual rainfall ranges from 920 mm to 1,200 mm (Figure 3) with precipitation varying from year to year and with geomorphology of the area

In terms of drainage and hydrology the district has three main rivers which are Ugalla, Rungwa and Katuma. Ugalla River ends up into Lake Tanganyika; while Rungwa and Katuma ends up in Lake Rukwa. The geology of the district is characterized by bedrock units comprising amphibolite- and granulite-facies metamorphic rocks of the Ubendian belt, with dominantly NW structural trends and the terrains are marked by NW-SE oriented multphase strike slip mylonite zones of different ages (Theunissen 1996; and Boven 1999). Moreover, the most predominant vegetation of the district includes, tropical and savannah wooded grassland and thorny bushes. The most predominant vegetation is miombo woodland

Methodology of the study

The study utilized four Landsat satellite imageries that were obtained from DRSRS and Regional Centre. The satellite imageries covered the area of study for the period ranging from 1985 to 2015. The land sat images for the area were available since 1985, had high temporal resolution, and were easily available and affordable. The images were processed and analyzed using GIS software to produce GIS maps that were used to quantify and detect land use and land cover changes in the district for the years 1985, 2000 and 2015. These years were selected based on the land sat images that had been secured covering the entire area of study. The study also conducted a survey using a set of questionnaires in 120 sampled households on socio economic aspects such as land use activities, household composition, migration history, means of livelihood, land management and conservation measures at household levels.

Satellite image analysis

The satellite image analysis used Landsat images of 1985, 2000 and 2015 to examine the changes which took place from 1985 to 2015. Landsat TM imagery was chosen because of its high spatial resolution, regularity of acquisition and it's readily availability for multiple days and years. This imagery was obtained from the United States Geological Survey Global Visualization (USGSGLOVIS). Ground reference data from a field study was available as a source of ancillary data and was of much importance in the classification of the satellite imagery. The images were classified into thematic land use maps and changes between different land use classes were computed. The classification process involved translating the pixel values in a satellite image into meaningful categories. In the case of land cover classification these categories comprised different types of land cover defined by the classification scheme that was being implemented. There are dozens, if not hundreds, of classification methods that can be used to group image pixels into meaningful categories.

Field Survey and Observation

In addition to satellite analysis, quantitative as well as qualitative interviews with elders, agricultural officers at village, ward and district levels as well as government officials were used to understand their perception with regards to the land use changes which have occurred and the underlying driving factors of these changes. There are two reasons which necessitated the use of a combination of methods in assessing the land use/cover changes of the study area. The first reason was to allow the investigation of the research objectives that are situated at the interface of natural and social sciences included in this study. One of the objectives in this study needs to examine the extent to which population mobility and migration have contributed to land transformation in the area.

The second reason was motivated by Fairhead's and Leach's (1996) findings on forest changes in West Africa who found striking differences in land use changes between the findings based on the analysis of satellite images and their own findings from intensive anthropological fieldwork. Therefore, a combination of methodology appears to be the most effective approach, as remotely sensed data can provide focus for research questions and for testing broad-scaled hypotheses (Guyer and Lambin, 1993). Furthermore, social science methodologies can be used to improve the interpretation of remotely sensed data (Rindfuss and Stern, 1988). The results from the remote sensing analysis and from in-depth interviews with local stakeholders complement each other to yield a more holistic perspective.

Results and Discussion

The extent of Migration and Population change in Mpanda district

From the household survey it was found that rural – rural migration is the most common pattern of migration since the majority of agro-pastoral migrants in the study area reported to come from the villages in different regions and districts as shown in Figures 3 and 4 the majority of respondents were from Geita district which accounted for 88 per cent of the respondents and was followed by Sumbawanga (18%, Kahama and Sikonge district with 14.7 percent of migrants. The push and pull factors for the majority (80%) of migrants were shortage of land for agriculture and grazing in their area of origin which are available in Mpanda district. Other reasons which were mentioned includes searching for business and employment opportunities especially in some of the developed village centers such as Sibwesa, Kasekese and Karema.

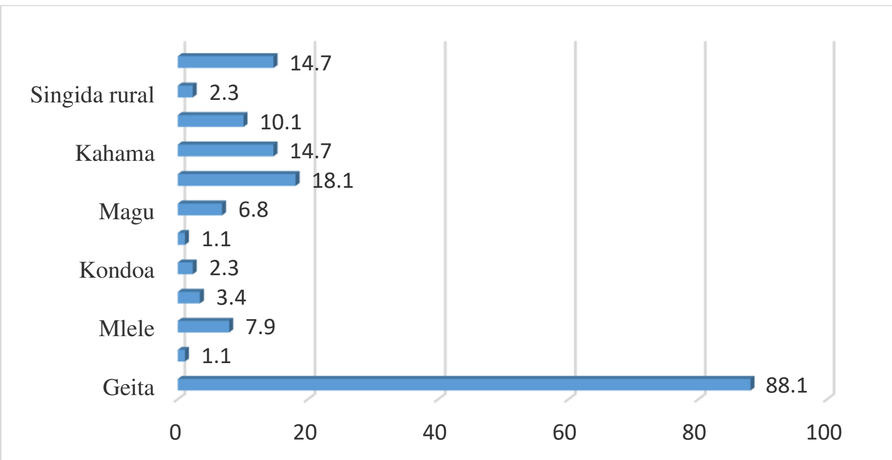


Figure 3: Percentage distribution of Migrants place of original in Mpanda district

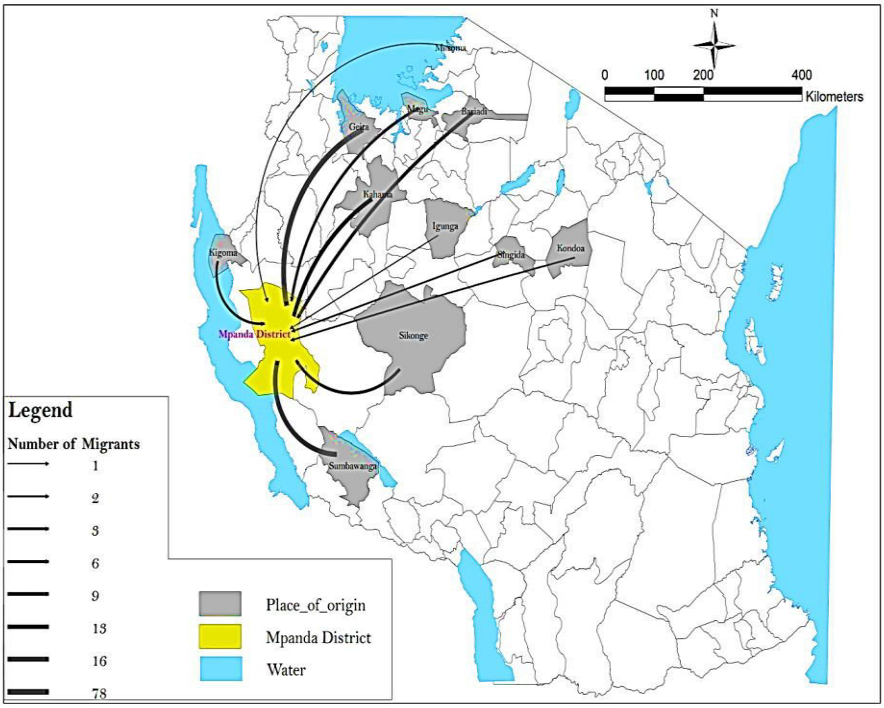


Figure 4: Migration pattern in Mpanda district

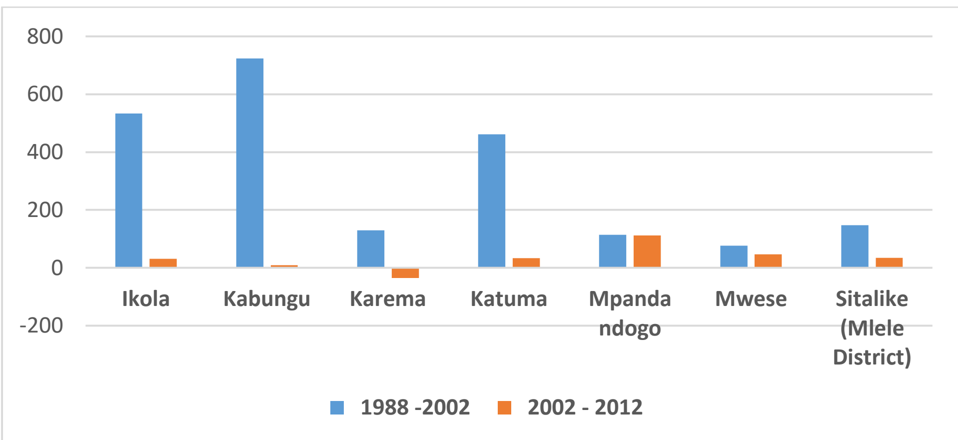


Figure 5: Population change in selected wards in Mpanda district

Furthermore, Figure 5 shows the population change in two intercensual periods that is 1988 – 2002 and 2002 –2012. As a whole Mpanda district had a significant population increase than other districts in Rukwa and Katavi regions. Karema ward have shown a decreasing trend of population not because there were no migrants but the ward was divided into two wards which are Karema and Kapalamsenga. As shown in Figure 4, the relative population change in the district was largely due to large scale migration of people from other villages of mainly Geita, Shinyanga and Simiyu regions. Information on population change is vital if programs relating to agriculture, land-use conflicts, environmental degradation, and competition for scarce resources are are to be administered equitably.

Land Cover /UseChange from 1985 to 2015

The assessment of general trend for agricultural land use in the district show that agricultural land use has been on the rise throughout the study period. For example, the area of land under rainfed agriculture increased from about 40,434 to 172,308 ha (Table2 and 3) for the year between 1985 and 2005, this made a percentage change of 423. In the period of 2005 to 2015 the area of land under rainfed agriculture changed slightly from 172,308 to 226,706, which made a percentage of 31.6.

Similarly, for the period of 1985 to 2005 there was an expansion in human settlements from 653 ha to 1,243 ha with a percentage of 90.4. From 2005 to 2015 the settlements expanded from 1,243 ha to 2,389 ha with a percentage change of 92.2. A major change in the settlement pattern and localization took place as a result of migration process because a significant number (85 percent) of the migrants arrived in the district between 2,000 to 2,008. Further analysis shows that the expansion of agricultural land and settlements have led to a significant decreasing trend of woodlands cover from 455,177 ha (54.9%) in 1985 to 304,588ha (36.8%) from 1985 to 2005. Also woodlands cover continued to decrease from 304,588 ha (36.8%) to 251,645 ha (30.4). The grassland area has also been reduced to a great extent and the analysis shows that the percentage change for the grassland cover was -12.9% for the year between 1985 to 2005, -7.4% between 2005 to 2015 and -19.3% for the year between 1985 to 2015. The increasing and decreasing trends of land use changes are very clear for the category of bush lands, settlements, cultivated land, woodlands as well grasslands. The increasing and decreasing trend of land use/cover change from 1985 to 2015 is shown in Table 2a and 2b in which its results are shown in Figure 6.

Table 2a: Population percent change in selected wards

Types of Land Cover/Use	1985		2005		2015	
	Ha	%	Ha	%	Ha	%
Natural Forest	337	0.04	285	0.03	150	0.02
Woodlands	455,177	54.92	304,588	36.75	251,645	30.36
Bushland	48,621	5.87	44,306	5.35	46,803	5.65
Grassland	95,483	11.52	83,201	10.04	77,059	9.30
Innundated Swamp	143,402	17.30	180,260	21.75	181,800	21.93
Permanent Swamp	33,947	4.10	31,095	3.75	25,602	3.09
Agricultural land use	40,434	4.88	172,308	20.79	226,706	27.35
Settlement Area	653	0.08	1,243	0.15	2,389	0.29
Water	10,763	1.30	11,531	1.39	16,663	2.01
	828,817	100.00	828,817	100.00	828,817	100.00

Table 2b: Population percent change in selected wards

Types of Land Cover/Use	1985 – 2005		2005-2015		1985-2015	
	Ha	%	Ha	%	Ha	%
Natural Forest	-52	-15.4	-135	-47.4	-187	-55.5
Woodlands	-150,589	-33.1	-52,943	-17.4	-203,532	-44.7
Bushland	-4,315	-8.9	2,497	5.6	-1,818	-3.7
Grassland	-12,282	-12.9	-6,142	-7.4	-18,424	-19.3
Innundated Swamp	36,858	25.7	1,540	0.9	38,398	26.8
Permanent Swamp	-2,852	-8.4	-5,493	-17.7	-8,345	-24.6
Agricultural land use	131,874	423.0	54,398	31.6	186,272	460.7
Settlement Area	590	90.4	1,146	92.2	1,736	265.8
Water	768	7.1	5,132	44.5	5,900	54.8

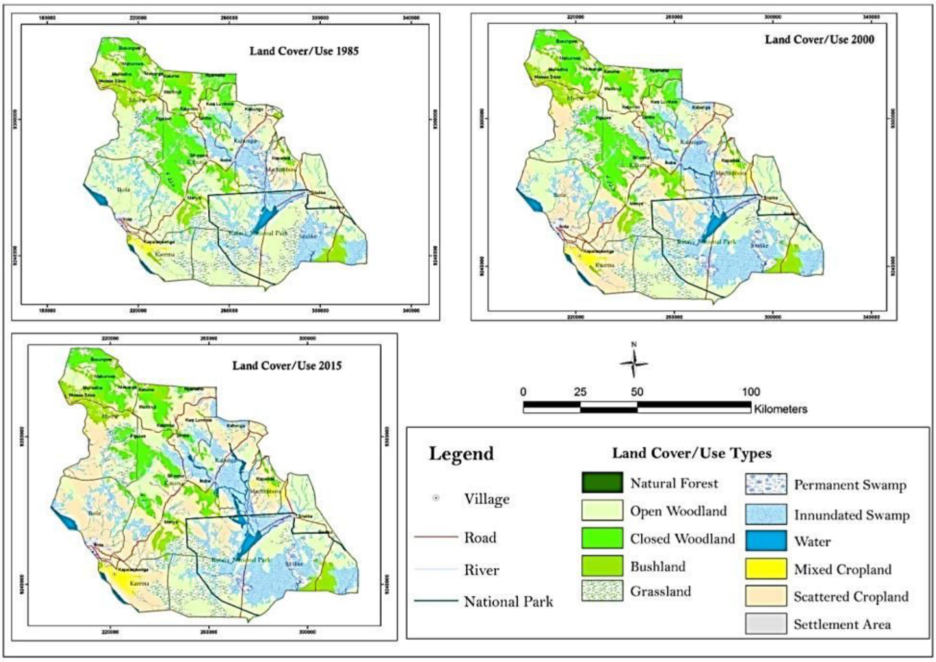


Figure 7: Land use changes in Mpanda district from 1985 to 2015

Vegetation clearance for agriculture

Discussion with farmers and livestock keepers in selected villages revealed that more than two thirds of 58 households heads stated that the landscape of the area has become more open due increased agricultural activities and establishment of settlements which has caused a significant clearance of vegetation as it is shown in Plate 1 and 2.

Plate 1: Deforestation due to farms preparation in Mpanda district

Plate 2: Brick making leading to environmental degradation in Mpanda district

Livestock raising has significantly increased in Mpanda district since 1985. Most of the livestock keepers are the Sukuma agro –pastoralists from Geita and Shinyanga regions. The data from Mpanda district council show the basic trend in cattle population growth in the 2015 – to 2016. The Sukuma agro-pastoralists decided to establish permanent settlements in view of getting grazing land and water from River Katuma for their livestock. The most immediate impact of greater numbers of cattle grazing in the district has been a reduction in plant biomass. In particular, grazing pressure has been greatest on the savanna grasslands

Conclusion

Based on the field observation, discussion with villagers and analysis of satellite images, there is a strong evidence that the land degradation which is manifested by significant change of land use/cover in Mpanda district has mostly occurred due to in migration and increased human activities between the period of seven years from 1985 and 2015. The growing trend of the population and consequent demand for agricultural land, food, energy, and area for settlement have considerably altered land use practices, reduced both the grasslands and natural vegetation cover stratum and severely caused land degradation at large. In order to correct this anomaly, various techniques can be employed.The local population can be sensitized on the importance of growing trees and seedlings can be planted in nurseries for onward transmission to these lands. Similarly, pastoralist can be encouraged to practice zero grazing in a bid to manage grazing lands. The movement of people with their livestock should also be restricted to control the rate of vegetation growth. Such measures will prevent land exhaustion that is a constant threat to the biodiversity of the environment.

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