Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 2, No. 8, p. 36-49, 2012
http://www.innspub.net

RESEARCH PAPER OPEN ACCESS

Land use/cover dynamics in lowland Ethiopia since 1957: the case of Mandura district, Benshangul-Gumuz Regional State

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Received: 14 July 2012
Revised: 06 August 2012
Accepted: 07 August 2012

Key words: Land use/cover dynamics; lowland; highland; population dynamics; indigenous population; Ethiopia.

Abstract

The main objective of this study is to investigate land use/cover changes since 1957 in Mandura district of Benshangul-Gumuz regional state, Ethiopia. Aerial photographs of 1957, 1982 and spot-5 image of the 2006/07 were used to generate data on land use/ cover changes. The results show that from the total land use/cover conversions, which totals 5,8403 ha of land, the share that goes to farm land constitutes 90.1 % (52,600 ha), reverine trees 8.7 % (5,082 ha), and settlements 1.2 % (721 ha). Thus, conversion to farmland has increased in an unprecedented rate in the district. In contrast, forest land has significantly declined by 5.17 % and 2.59 % in 1957 and 1982, respectively. In 2006, forest cover was almost non-existent. Similarly, land use/cover transition was high for woodlands, shrub lands, grassland with scattered trees and bare land in the study period. Between 1957 and 2006, these land use/cover types have lost a total of 58,403 ha of land. The finding indicates that the natural environment is degrading at an alarmingly rate. This has accentuated resources losses that have endangered the livelihoods of the indigenous population. The study finds population dynamics (including size, growth, migration, and urbanization) and socioeconomic, land tenure changes and haphazard decision making processes as major factors triggering these dynamic changes. Customary land tenure system has changed following the intrusion of highlanders from the neighboring region. As a result, the indigenous population has been forced to engage in extractive economic activities such as selling charcoal and firewood, activities that have never been practiced in the area in the past. This has, in turn, negatively affected the natural environment. Land use/cover alteration, which is a serious problem in highland Ethiopia, is now gradually shifting to the lowland regions of the country. Urgent attention is required to deal with this growing problem in lowland Ethiopia.

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Introduction

Land use/cover changes have a profound effect on earth's system. These include biodiversity loss, climate change, loss of wetland, land fragmentation, livelihood change, an increase of diseases, and desertification (Geist and Lambin, 2002; Grau *et al.*, 2003; Lambin *et al.*, 2003; Zhao *et al.*, 2006; Falcucci *et al.*, 2007; Haque *et al.*, 2008; Kamusoko and Aniya, 2009; Kangalawe, 2009). Land use/cover change is the results of interplay of many factors. The simple assumption that land use/cover changes have caused by few factors do not hold true. Rather, many interrelated complex factors best explain the processes of land use/cover changes (Lambin *et al.*, 2001; Lambin *et al.*, 2003). Lambin, *et. al.*, (2003) further contend that "identifying the causes of land-use change requires an understanding of how people make land-use decisions and how various factors interact in specific contexts to influence decision making on land use." Decision making processes are, in turn, affected by different factors prevailing at local, regional and global level.

Different researchers have put the reasons for land use/cover changes in two broad categories as proximate (direct) and underlying (indirect or root causes) (Geist and Lambin, 2002). Lambin *et al.*, (2003) further contend that proximate factors occur at local or household/farm level whereas underlying factors emanate from regional, country or even global level. Consequently, proximate variables are context and region specific while the root causes on the other hand are the result of complex political, economic and social conditions occurring at a distance. Furthermore, farm level analysis allows to address proximate causes and to interpret them in reference to underlying causes (Mottet *et al.*, 2006). Long, *et al.*, (2007) identify industrialization, urbanization, population growth, and China's economic reforms as major factors of land use changes in Kunshan. A study in Zimbabwe also recognized that pressure for agricultural land, building materials, and fuel wood triggered land use/cover changes (Mapedza *et al.*, 2003).

A study conducted in Afar, Ethiopia identified over fifteen factors causing land use/cover changes (Tsegaye *et al.*, 2010). The study documented migration from nearby highlands triggered by drought, land tenure, and government policy changes as driving forces (Tsegaye *et al.*, 2010). Another study in the central rift valley of Ethiopia revealed that population growth, decline in agricultural productivity, land tenure change, and erratic rainfall as the major drivers of land use/cover change in the area (Garedew *et al.*, 2009). The study of land use/cover dynamics in the northwestern Ethiopia suggests that population dynamics, existing land tenure, and institutional and socioeconomic conditions should be critically examined in order to put in place any land related policy (Zeleke and Hurni, 2001).

In sum, the factors that affect land use/cover changes are complex and interrelated. The study of land use/cover changes demands a careful investigation of these complex and interrelated factors at local, national and global level.

The objective of this study is, therefore, to investigate land use/cove changes in Mandura district since 1957. Specifically the objectives are to: (1) identify major land use/cover types in different time periods and (2) examine and categorize major human drivers of land use/cover changes.

Materials and Methods

Description of the study area

The study district is found in Metekel zone of Benshangul-Gumuz regional state. Mandura is situated between 10°.50'.743 N and 11°.10'.766" N and 36°.02'.48"E and 36°.32'.42"E longitude, about 546 kilometers away from Addis Ababa, the capital of Ethiopia. The total area of the district is about 1,005 square kilometers (100,500 ha). Physiologically, it is part of the northwestern lowlands where many development endeavors, including the great Renaissance Dam, are currently taking place (Fig. 1). Rainfall and temperature records for the last twenty four years (1987-2011) are

computed from the data obtained from Pawe metrological station. The mean annual rainfall received by the study station amounts to 1579.8 mm. More than 65 % of the total annual rainfall is concentrated between June and August. More than 96 % of the total annual rainfall occurs in six months (from May to October). The main agricultural activities are carried out during these months. The average annual temperature of the area is 24.5°C. The corresponding amounts of maximum and minimum temperatures are 32.6 °C and 16.4°C respectively. In general, the study district is classified under the wet tropical (wet Kolla) agro-climatic region. Altitudes range between 1,015m and 1,480m above mean sea level.

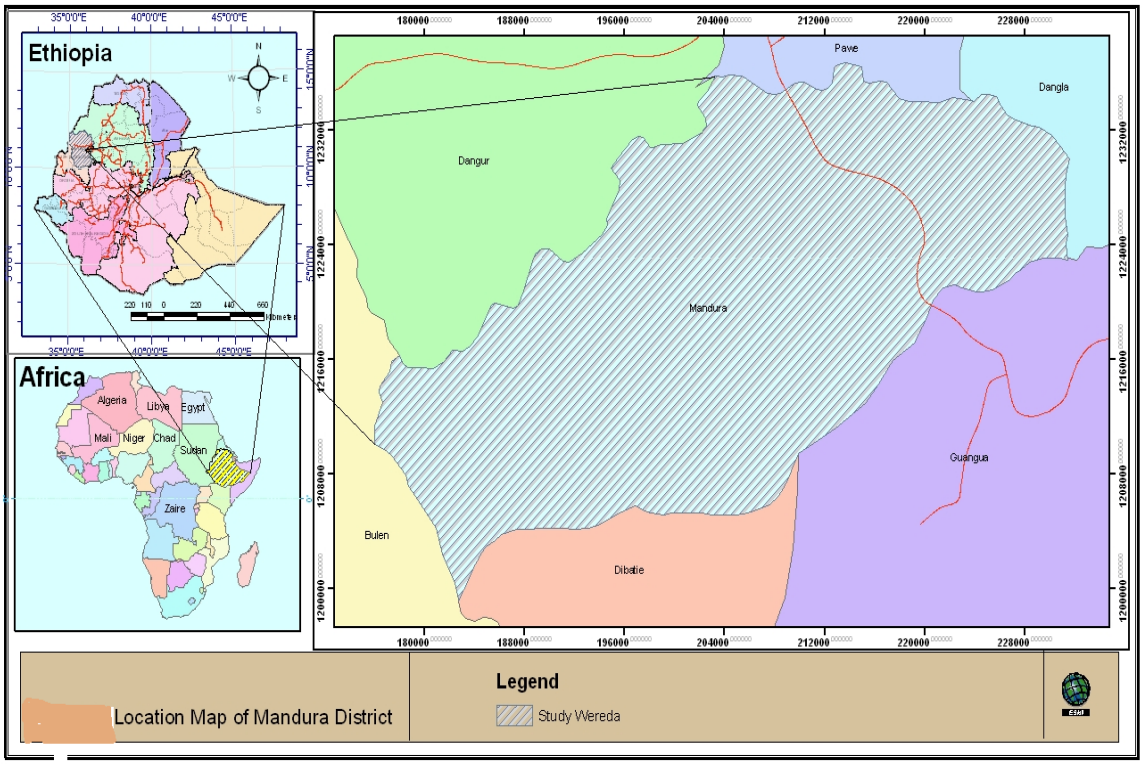

Fig. 1. Location Map of the study Area

Data sources and methods of analysis

Data pertaining to land use/cover changes were assessed by analyzing aerial photographs of different time periods (1957 and 1982), remotely sensed image of the 2006/07(Spot_5 image 2006/07), and toposheets with scale of 1:50,000. Aerial photographs, satellite image (spot) as well as toposheets were acquired from the Ethiopian Mapping Agency (EMA). The aerial photographs of the year 1957 and 1982 were converted into Tag Image Format (Tiff) by a scanner of VX-4000 and VIDAR, respectively. The scanned photographs were geo-referenced and extracted for the study area using area of interest (AOI).

The aerial photographs were classified into different land use/cover types visually using a technique called onscreen digitization with the help of ArcGIS software. During interpretation of the photos those elements (tone, texture, shape, association, pattern and size) that aid for visual interpretation had been used. However, the satellite image was interpreted with aid of field collected ground truth using global positioning system (GPS) and ERDAS IMAGINE 9.1 software.

A total of 210 households selected through a stratified random sampling have been surveyed using structured and pre-tested questionnaire. Simple frequency and contingency tables were used

to analyze the data. A group containing 8-10 elderly people with deep knowledge of the study sites was selected for an in-depth interview and focus group discussions. A participatory tool was used to generate information on the tenure systems and agricultural practices in the study area through historical analysis and through semi-structured interview. In addition, secondary information from central statistical agency (CSA) was used to consolidate the data generated. The sample size and profile of household heads interviewed was presented as depicted in the table below.

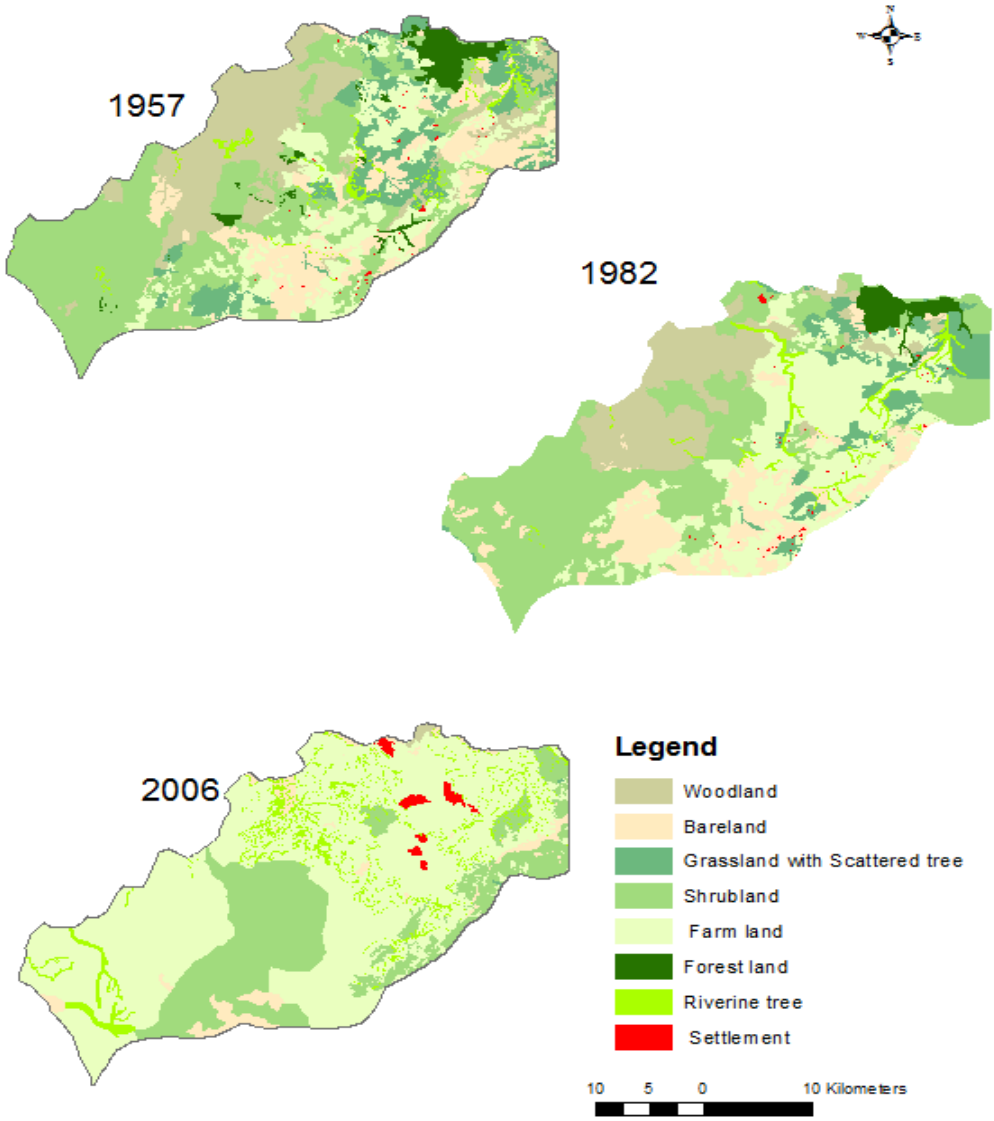

Fig. 2. Land use/cover types in Mandura district in 1957, 1982 and 2006.

Results and discussion

Land use/cover dynamics since the 1957

The major land use/cover types identified are based on the description given in the Table 2. Eight major land use/cover types including forests, woodlands, shrub land, grassland with scattered trees, reverine trees, bare land, farmland, and settlement have been identified in the area.

The area coverage and spatial distribution of land-use and land cover types identified is presented in The table 3.

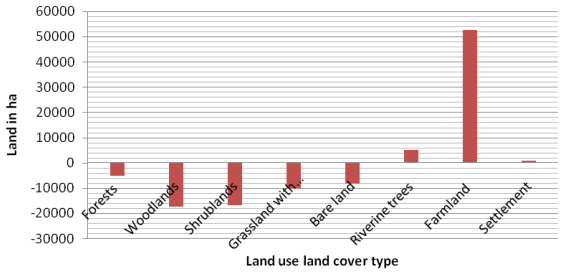

Fig. 3. Land use/cover dynamics in Mandura district, 1957-2006.

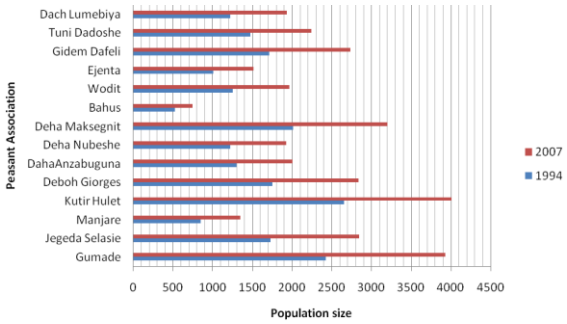

Fig. 4. Population size of peasant associations in 1994 and 2007, Mandra District.

Forests

As elsewhere in Ethiopia, the forest cover of the study area shows a gradual decline during the study periods (1957-2006/07). Forest cover decreased from 5.17 % in 1957 to 2.59 % in 1982. There was almost no forest left in the district in 2006. In terms of land area the district lost 2,602 ha of forest cover between 1957 and 1982 and 2,598 ha of forest cover between 1982 and 2006.

Bamboo forest: Importance and degradation

Ethiopia is one of the countries in the world endowed with rich resources of fauna and flora. Despite its rich endowment of biodiversity, the country is facing a great challenge stemming from the degradation of its natural resources, which, as a consequence, is a threat for the nation in general and the study area in particular.

One of the resources that the country endowed with is bamboo forest. Ethiopia has about one million ha of high- and lowland bamboos (Study on sustainable bamboo management cited in Embaye, 2000). This represents 67 % of Africa's and 7% of world's bamboo resources (Embaye, 2000). The bamboo forests in Ethiopia can be classified as highland and lowland depending upon where it grows. However, lowland bamboo forest are predominates in terms of area coverage. The lowland bamboo, which is the main concern of this study, is mainly found in BenshangulGumuz regional state, specifically in Assosa, Kamash and Metekel Zones. Bamboo trees are one of the fastest growing tree species in Ethiopia (Embaye, 2000). They provide a variety of advantages to the rural residents. Smallholders extensively depend upon bamboo trees for multiple purposes, including tukul (hut) construction, fencing, the production of furniture, containers for water transport and storage, baskets, agricultural tools, beehives, household utensils, and various artifacts. Despite its wide ranging significance, currently bamboo forests are declining at an unprecedented rate. Bamboo forest deterioration in Mandura district was summarized by Embaye as follows: "Most of the bamboo in that wereda(Mandura district) flowered and eventually died about a decade ago. Four spots of a quarter of a hectare each were fenced and protected from fire in order to observe the performance difference of natural bamboo forest regeneration in protected and unprotected conditions. Now, after a decade, bamboo can only be found in the protected spots and has totally disappeared from the rest of the area" (2006:6).

This partly explains how forests in the district have declined and eventually disappeared. The principal factors that have caused the deterioration of bamboo forests in the area include the conversion of bamboo forests to farmland and unsustainable cutting for income generation, house construction, and fuel. During field investigation, one of the residents states that "twenty years ago it was possible to harvest bamboo trees for different purposes from around the homesteads but now we are forced to travel long distances outside of our peasant association, where

at times we may not succeed in finding a bamboo tree."

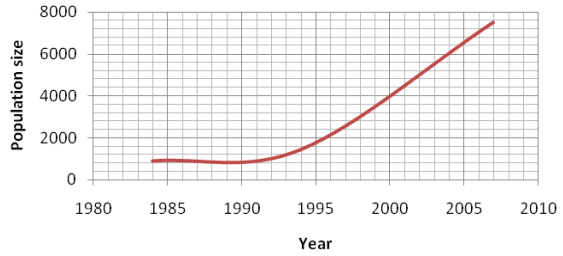

Fig. 5. Urban population growth in Mandura District, 1994-2007.

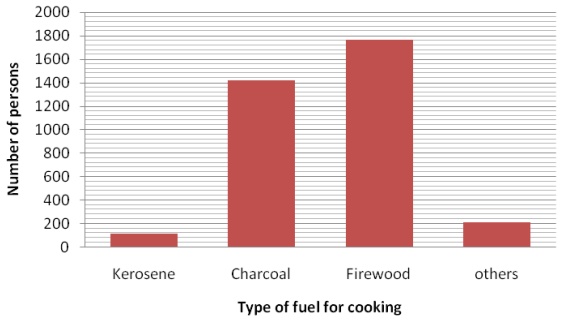

Fig. 6. Distribution of population by Type of Fuel for Cooking.

Plate 1. The Gumuz Women along the way to Chagni from Gilgel-Beles to sell charcoal.

Plate 2. Cultivated Steep-slope without vegetation cover.

Plate 3. Gumuz woman in Gelgel-Beles town Selling wood

Woodlands and Shrublands

In terms of area woodland is one of the largest land use/cover types in the study district. The proportion of woodland cover at different periods also shows change. In 1957 it constitutes 17.61 % and declined to 15.63 % 1982. The change was dramatic in 2006 where the proportion dropped to a mere 0.23 %.Woodland loss in the district totaled 11,988 ha between 1957 and 1982 and 15,480 ha between 1982 and 2006. In other words, a total of 27,468 ha of woodland has been converted to different land use/cover type(s) in the span of less than 50 years.

Shrublands were the largest in terms of area in 1957 constituting a little more than 40 % of the total area in the district. The proportion declined to 33.5% between 1957 and 1982, the largest changes in the land use/cover category under consideration. The proportion further dropped 24 % in 2006. Thus, a total of 16,900 ha of shrublands have been converted to different land use/cover types over a period of 49 years.

Grasslands with scattered trees and bare land

Like land use/cover categories mentioned above, grassland with scattered trees follow similar pattern of decline. The grassland in the area has declined from 10.45 % in 1957 to 5.83 % in 1982 to 0.04 % in 2006. Overall, 10,455 ha of grassland with scattered trees have been converted into farmland between 1957 and 2006.

Table 1. Sample size and profile of household respondents in Mandura

Characteristics	Sample Size
Number of Peasant Associations	3
Household heads interviewed	210
Percentage of total household heads	16.2 %
Age range (years)	22-80
Average age (years)	41.7
Average family size	6.2
Average land size(ha)	1.2
Male	161
Female	49

Source: Field Survey, 2011

Table 2. Land use/cover type and their respective definition

Land use/cover type	Description
Farm land	Contiguous areas used for rain fed and irrigated cultivation, including fallow plots, cultivated land mixed with some bushes, trees and rural homesteads but dominated by farmland.
Forest	Areas covered by trees forming closed or nearly closed canopies (70-100%); predominant species are Bamboo Arundinaria alpina
Wood Lands	Land covered by an open stand of trees taller than 5m and up to 20m height and a canopy more than 20%.
Bush and Shrub land	Land covered by an open stand of trees/or-scattered shrubs 2 to 5m tall and canopy cover of more than 20% as well as short shrubs and thorny bushes with little useful woods found along rugged micro-relief.
Grass land with scattered trees	Areas with permanent grass cover mixed with scattered trees along ridges steep slopes and plain areas used for grazing; usually private as well as communal
Bare Land	Areas that have little or no vegetation cover, mainly with gullies and exposed rocks. (Barren eroded lands mostly on top of mountains, open areas near homesteads).
Reverine trees	Trees and shrubs growing along river and stream courses
Settlement	Include both rural and urban settlements

Adopted from Zeleke and Hurni (2000), Bewket (2003), Amsalu (2006)

Table 3. Land use/cover changes in Mandura district between 1957 and 2006.

Land use/cover classes	Land use/cover Changes						Area changes of Land use/cover between the study Period		
	1957		1982		2006		1957-1982	1982-2006	1957-2006
	ha	%	ha	%	ha	%	Ha	ha	ha
Forests	5200	5.17	2598	2.59	0	0	-2602	-2598	-5200
Woodlands	17700	17.61	15712	15.63	232	0.23	-11988	-15480	-17468
Shrublands	41000	40.80	33649	33.48	24100	23.98	-7051	-9549	-16900
Grassland with scattered trees	10500	10.45	5858	5.83	45	0.04	-4642	-5813	-10455
Bare land	11900	11.84	5466	5.44	3520	3.50	-6434	-1946	-8380
Riverine trees	1800	1.79	2502	2.49	6882	6.85	+702	+4380	+5082
Farmland	12200	12.14	34534	34.36	64800	64.48	+22334	+30266	+52600
Settlement	200	0.20	181	0.18	921	0.92	-19	+740	+721
Total	100500	100	100500	100	100500	100			

Source: Aerial Photographs of 1957, 1982 and Spot -5 image 2006/07

Table 4. District level land under Cultivation and amount of Yield (2005-2011)

Year	Cultivated Land (hectare)	Percentage change	Yield Obtained(Quintals)
2005	10636	-	110604
2006	12460	14.7	228834
2007	14156	12.9	269479
2008	17340	18.4	302914
2009	18556	6.6	352943
2010	23195	20	228154
2011	31147	25.5	731978

Source: Mandura District Agriculture and Rural Development Office, 2012

Table 5. Population Size in Mandura between 1957 and 2007.

Year	Population size	Rate of growth in %
1957♦	8925	
1964♦	10708	
1974♦	13890	
1984	18017	2.6♥
1994	22593	4.54♠
2004♦	35585	
2007	40746	-

Source: CSA, 1987; 1996; 2008 and own calculation♦

♦The estimated population for 1957, 1964, 1974 and 2004 based on 1984, 1994 and 2007census results.

♥The growth rate was calculated under the assumption of exponential increase for the period 1984-1994

The growth rate was calculated under the assumption of exponential increase for the period 1994-2007

Table 6. Inter-censal population estimate of Mandura district, 1984-2007

Year	1984*	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994*	1995
Population size	18017	18475	18932	19390	19847	20305	20763	21220	21678	22135	22593	23989

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007*
Population size	25386	26782	28179	29575	30971	32368	33764	35161	36557	37953	39350	40746

* Source: CSA, 1987; 1996 and 2008

❖ For other years population size was calculated using linear interpolation method $P_t = P_o + t/n (P_n – P_o)$

Table 7. Population growth in rural Mandura between 1994 and 2007

Peasant Associations	Population		Growth between 1994 and 2007	Rate of Growth (%)[c]	Number of years after which the population will have doubled (after 2007)
	1994[a]	2007[b]			
Gumade	2428	3931	1503	3.71	19
Jegeda Selasie	1730	2843	1113	3.82	18
Manjare	850	1347	497	3.54	20
Kutir Hulet	2657	4008	1351	3.16	22
Deboh Giorges	1753	2840	1087	3.71	19
DahaAnzabuguna	1300	2003	703	3.33	21
Deha Nubeshe	1221	1929	708	3.52	20
Deha Maksegnit	2013	3197	1184	3.56	20
Bahus	523	746	223	2.73	25
Wodit	1255	1962	707	3.44	20
Ejenta	1008	1512	504	3.32	21
Gidem Dafeli	1713	2731	1018	3.59	19
Tuni Dadoshe	1472	2242	770	3.24	21
Dach Lumebiya	1222	1937	715	3.54	20
Total	21145	33228	12083	3.48	20

[a]Source: CSA, 1996

[b]Source: CSA (2008)

[c]The growth rates were calculated on the bases of the assumption of exponential growth: $P_t = P_o e^{rn}$

Therefore, $r=1/n \ln (p_t / P_o)$; the doubling period in years is given as ln2/r

Table 8. Numerical and Percentage Distribution of Perception on Population change (1980s-2000s).

Rate of population increase	Year					
	1980s		1990s		Since 2000s	
	No	%	No	%	No	%
Very high	2	1.0	21	10.0	88	41.9
High	29	13.8	111	52.9	122	58.1
Low	93	44.3	51	24.3	0	0.0
no change	6	2.9	2	1.0	0	0.0
don't know	80	38.0	25	11.9	0	0.0
Total	210	100.0	210	100.0	210	100.0

Source: Field survey, 2011

Table 9. Reasons of Population Increase.

Reasons for Population increase	No	%
In-migration	98	46.7
Excess of births over deaths (natural increase)	45	21.4
Due to In-migration and natural increase	67	31.9
Total	210	100.0

Source: Field survey, 2011

Table 10. Numerical and Percentage Distribution of urban population growth (1994-2007)

Urban centers	Population			Growth between 1994 and 2007	Rate of growth (%)	Number of years after which the population will have doubled (after 2007)
	1984[d]	1994[e]	2007[f]			
Genete Mariam	910	1448	4556	3646	7.00	9.9
Gelgel Beles	-	-	2962	-	-	-
Mandura	910	1448	7518	6608	9.2	7.5

[d]Source: CSA (1987)

[e]Source: CSA, (1996)

[f] Source: CSA (2008)

The growth rates were calculated on the bases of the assumption of exponential growth: $P_t = P_o e^{rn}$

Therefore, $r=1/n \ln (p_t / P_o)$; the doubling period in years is given as ln2/r

Bare lands have also been transformed into other land use types. Their proportion declined from 11.84 % in 1957 to 5.44 % in 1982 and to 3.50 % 2006. The conversion totaled 8,380 ha.

Riverine trees

In the study district, it is common to see trees growing along river banks. In fact, most tall trees in the district are found along the banks of rivers and streams. The information generated from land use land cover maps for different years reveals that this

class of land cover constitutes 1.79 %, 2.49 % and 6.85% of the total area in 1957, 1982 and 2006 respectively. The trend shows a gain of 5,082 ha of land between 1957 and 2006.

Farmland and Settlement

Farmland expansion was huge and it is the largest land use type that gained the largest proportion of land from other land use/cover types. In 1957, farmlands constituted 12.14 % of the total land area in the district but the proportion increased dramatically to 34.36 % in 1982 and to 64.5% in 2006. Between 1957 and 2006, a total of 52,600 ha of land have been converted to farmland. Of the total 58,403 of land that underwent conversion, farmland constituted 90. 1%, riverine trees 8.7% and settlements 1.2%.

Though a small increase, settlements have expanded between the study periods. The proportion of land under settlements constituted 0.20 %, 0.18 % and 0.92 % in 1957, 1982, and 2006, respectively. A total of 721 ha of land have been converted to settlements between 1957 and 2006.

Attempts were made to assess the current land use in the study district. As elsewhere in Ethiopia, the majority of rural residents of the district derive their livelihoods from agricultural activities. As a result, agriculture predominate the land use than any other activities.

As can be seen from Table 4, the land that has been brought under cultivation is significantly high each year. It is also evident that the yield increase each year was obtained at the expense of bringing more land under cultivation. In subsistence agriculture, where the use of modern agricultural input is little or none existent, yield increases are achieved by bringing more land under cultivation. Subsistence agriculture is inherently ineffective and, therefore, large areas of land are needed to meet the needs of rural households (Worku, 2007). As previous studies have indicated, much of the agricultural expansion targets marginal and ecologically fragile environments such as forests, woodlands, and steep slopes (Aredo, 1990; Abi, 1994; Abute, 2002; Yntiso, 2003), which are not in most cases occupied and put under cultivation. Such expansion may eventually result in several land degradation. Based on data obtained from the district Agriculture and Rural Development Office, it is apparent that on average 2,930 ha of land has been brought under cultivation each year between 2005 and 2011, and the percentage change of cultivated land shows a remarkable increase each year (Table 4).

Drivers of land use/cover dynamics

Land use/cover change is the result of interplay of a complex set of factors that range from natural processes to human intervention. This paper focuses on the human drivers of land use/cover changes in the study area. The most prevalent drivers include population and institutional dynamics, mainly land tenure arrangements and institutional decision-making processes and structures.

Population Dynamics

Population dynamics are discussed in terms of changes in population size and the rates of population growth and urbanization.

Ethiopia has made three national population and housing surveys in 1984, 1994 and 2007. The size of population of the study area is shown in Table 5. The population size of the district was 18,017 in 1984, 22,593 in 1994, and 40,746 in 2007. An attempt was made to estimate population size of the district prior to 1984. Assuming an exponential growth rate of 2.6 % per year between the two census periods of 1984 and 1994, the estimated population size for the district was about 8,925 in 1957, 10,708 in 1964, and 13,890 in 1974. This means, on average, 292 people were added to the district each year. Between 1957 and 2007, on average, 636 people were added each year, reaching 40,746 in 2007. Furthermore, taking the base population of 18,017 for 1984, on average, 458 persons were added each year to reach 22,593 in 1994 (Table 5). Based on the 1994 population, on average, 1,396 persons were added per year to reach

40,746 in 2007(Table 5). The overall trend shows a continuing population increase in the district.

The three census returns reveal that population growth rate of the study district was high. Between 1957 and 1984, a period of 27 years, the population grew at 2.6 % per year. But this rate of growth rose considerably to 4.54 % between 1984 and 2007, which is in a period of 23 years.

Table 11. Numerical and percentage distribution of population by type of fuel for cooking.

Geographical Area	No. of Respondents	Type of Fuel for cooking								
		Kerosene (1)	%	Charcoal (2)	%	Firewood (3)	%	Others (4)	%	(2+3) %
Genete Mariam	1686	15	0.9	587	34.8	897	53.2	187	11.1	88
Gelgel Beles Town	1816	97	5.3	831	45.8	867	47.7	21	1.2	93.5
Mandura District	3502	112	3.2	1418	40.5	1764	50.4	208	5.9	90.9

Source: CSA, 2008

Table 7 reveals that the population growth of the peasant associations was extremely high, averaging a 3.48% growth rate per year. At this rate of increase, the population would double in 20 years. This is a short time for a district with fast deteriorating natural resources and one that is predominantly dependent upon subsistence agriculture.

Farm households were asked to rate their perception on population increase in their respective peasant associations. As depicted in Table 8, population increase in the 1980s was slow. A momentous population increase began to take place since the 1990s confirmed by a little greater than 62 % of respondents as very high and high. The corresponding share for 2000s is complete support by respondents (100 %).

The respondents were asked why such an increase has occurred since the 1990s but not before. As indicated in table 9, the causes for such a change were in-migration from the surrounding region (46.7%), natural increase (21.4 %) and both factors (31.9 %). Furthermore, according to the information obtained from residents, mortality has decreased due to immunization and the birth rate has been increasing due to improved maternal and child care as compared to the situation prior to the 1990s.

Research findings at the national and international levels reveal that population dynamics in combination with other factors have profound effects on land use/cover changes (Bewket, 2003, Amsalu, 2006; Etter *et al.*, 2006; Pabi, 2007; Boone *et al.*, 2007; Nguyen, 2008). Large population size with higher rate of growth causes increased pressure on the natural resource stocks like land for agriculture, trees for fuel and construction, and water, which are at present deteriorating at fast rates in the district. Specifically, land for agriculture is desperately in short supply in the area due to the fastly growing population (see Table 4 above).

At present, many developing countries are experiencing fast rates of urbanization, which is partly explained by population increase. Ethiopia is also experiencing a similar trend. One of the measures of urbanization is population size. Change in population size is the result of either natural increase or in-migration. As can be seen from Table 5, the rate of population increase in the study district has been considerable. Mandura district encompasses Gelgel Beles, which is the capital of Metekel zone since 2000/2001. Because of this both zonal and district government and non-governmental offices have been established at Gelgel Beles town. This eventually triggered the inflow of population to the town and considerably reduced the doubling time.

This fast increasing population is resulting in mounting need for forest and other natural resource products such as wood for fuel, construction and so on. It is evident that forest products are widely used for different purposes in Gilgel Beles as well as Genete Mariam towns. Thus, the unprecedented urban population increase has resulted in resource loss and degradation emanating from corresponding increase in demand for natural resources.

It is clear from Table 11 that the principal source of wood for fuel in major towns of the study area is the natural forest. In view of this, in all the three geographical areas indicated above charcoal and wood utilization as source of fuel constitutes well above 85 percent. The share of other alternative sources on the other hand is negligible (Table 11 and Fig. 6).

Institutional factors

Land tenure, institutional setup and decision making process.

Considerable socioeconomic changes have been taking in the district since the 1957. Under the indigenous land tenure system, the Gumuz had full rights to access common resources like land, forest, grazing land, and water resources. But this has changed significantly over time. A historical study by Mekuria (2008) indicates that communal land tenure system of the indigenous population has changed since the 1960s following the coming of migrants from the highland region. As a matter of fact, prior to the coming of many migrants to Metekel lowlands, the Gumuz practiced shifting cultivation as an important agricultural activity. The process involved clearing and burning of land, usually called slash and burn, and then cultivating crops for two to three years. After the fertility of the soil has been exhausted, they moved to a new plot of land and repeated similar routines. Yntiso (2003) states that the Gumuz used to fallow their land for several years, often 5-7 years to restore soil fertility. After the 1984 massive government sponsored resettlement programs and self-initiated spontaneous resettlement, the land use and tenure system started to change because of land scarcity. In addition, shifting cultivation practice has virtually ended since the 1990s (Yntiso, 2003). Indeed, during field survey farmers as well as agricultural experts explained that there is not enough land to practice shifting cultivation. The net result of all these changes were wearing down of customary laws where the Gumuz started to lease their holding to the migrants' cash or payment in kind. As a result, the Gumuz began to clear as much land they can locate, for the purpose of leasing it to migrants, without the knowledge of traditional leaders who were previously responsible for the administration and management of land. Consequently, communal grazing lands, forests, and other common resources have significantly deteriorated. Furthermore, institutional changes in the area have also resulted in economic activities (dynamics) omit that led to the practice of selling charcoal and wood by the indigenous population in order to supplement their livelihoods (Plate 3). Charcoal and wood selling has never been practiced before by the indigenous population. This coping strategy, in turn, has profound effects on land use/cover changes that have taken place in the study area. Today, it is not uncommon to observe charcoal traders of the indigenous population along the Chagni-Gilgel-Beles road (Plate 1).

Decision making process at the level of the peasant association regarding natural resources management is uncoordinated and lack genuine participation of the major actors. According to informants, the indigenous population (the Gumuz) are not willing to participate in natural resources management practice. The migrants also strongly hold the Gumuz responsible for the deterioration of the natural resources, particularly forests and woodlands (Plate 2). On the other hand, the Gumuz put the blame solely on the migrants for pushing them to engage in wood and charcoal selling and the abandonment of shifting cultivation, hunting, fishing, and honey collection in the district. Whatever the case may be, natural resources management demands coordinated effort from all actors, which is not the case in the study area. The Gumuz totally ignore

development agents' advice on proper management and utilization of natural resources. As a result, the Gumuz, as decision makers of the peasant association, keep on adversely altering land use/covers in the district.

Conclusion

In the study area, land use/cover changes have occurred at an unprecedented rate for nearly the past half a century. Farmland has vastly expanded at the expense of forests, woodlands, shrub lands, scattered trees, and grasses. This trend is bound to continue for years to come, especially given the continuing in flow of population from the nearby regions and absence of any coordinated resource management practices at different administrative levels in the district.

Indigenous institutions, which sustain natural resources for centuries, have collapsed thereby triggering adverse land use/cover changes. This situation necessitates the re-establishment of traditional institutions in order to stop land grabbing and leasing by the indigenous population. To this effect, experts and responsible bodies should bring onboard the local leaders to participate in the planning and re-institution process. Equally important is creation of awareness among the indigenous population as well as migrants concerning the long-term impacts of natural resources degradation. Decision making institutions should also operate effectively to reduce spontaneous and uncoordinated activities.

Farm households are now forced to travel long distances to find reeds for roofing and trees for different uses. Based on this study, it appears that farm households are willing to protect and properly manage their natural resources, if they are provided with alternative sources of income.

In conclusion, it is quite evident that land use/cover changes in the study district are considerable and require proper attention and appropriate intervention to promote sustainable natural resources use and management. We fell that prompt and effective land use planning is indispensable.

Acknowledgments

The authors gratefully acknowledge the financial support they received from Haramaya University. UNISA also deserves our genuine appreciation for providing material support and helpful training during the development of the proposal for the project.

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