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Analysis of Land use and Land Cover Change, Causes and Effects on Agricultural Productivity: The Case of Anlemo District in Hadiya zone, Central Ethiopia

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Abstract

Change in land use land cover (LULC) is one of the constraints which can influence the development of sustainable agricultural in the study area. The change in LULC can negatively affect the possible use of land and completely lead to soil and vegetation degradation that have an influences on crop productivity. LULC change analysis was conducted in Anlemo District in Hadiya zone, Ethiopia for the period of 2000-2018, using Remote Sensing satellite image and Geographic Information System with field verifications. This was to look at LULC change, its causes and influences on crop productivity in Anlemo District. In this study, LULC maps of 2000, 2010 and 2018, and change maps of 2000-2010 and 2010-2018 were produced. Results from LULC change analysis revealed an increase in agricultural land from 36.6% in 2000 to 55.764% in 2018. The increase of agricultural land was mainly at the cost of vegetation and grazing land cover change. Vegetation cover decreased from 21.81% in 2000 to 14.601% in 2018. Shrub land area was 38.81% in 2000 that decreased to 19.933% in 2018 and wetland which was 0.817% in 2000 increased to 1.057% in 2018. The study also made known that the main reasons of LULC changes were mainly, expansion of agricultural land and clearing vegetation. Therefore, these urges to initiate mechanized farming system that permits small land holder farmers to obtain more crop products from their small plot of land and to use alternative sources for fuel to reduce the complete reliance of rural community on forest products.

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Introduction

Globally land use and land cover change today is altered principally by direct human use, by agriculture and livestock rising, forest clearing and mismanagement and urban and suburban construction and development (Shiferaw and Singh, 2011; Baude *et al.*, 2019). A serious problem the world is facing at present is the deterioration of both the natural environment and natural resources. Human activities generate environmental pressure in different ways. Among them is overexploitation of renewable resources such as forests, and degradation of basic resources such as land and water (Alemu, 2014; Gessesse *et al.*, 2015).

The awareness about the importance of land use and land cover change (LULC) study among global issues has risen for its nexus on global human security and quality of the environment. Furthermore, LULC change is a critical issue due to its great influence on land degradation, biodiversity loss, water quality, effects, and human life. Analyzing the land cover changes and understanding the subsequent trends of change contribute to present complex dynamics of LULC and are important for planning and policy making and sustainable management of resources (Firdaus *et al.*, 2014; Wessels *et al.*, 2016). Land use and cover changes could lead to a decreased availability of different products and services for human, livestock, agricultural production and damage to the environment as well (Islam *et al.*, 2002).

In Ethiopia, the causes of land cover change particularly natural forest destruction were agricultural expansion, both through shifting cultivation and the spread of sedentary agriculture; the demand for increasing amounts of construction material, fuel wood and charcoal (Kahsay,2018). According to Ejigu (2016), the main causes of land use land cover change and fertility decline in the study area are deforestation, removal of crop residues from fields, land fragmentation, reduction of fallowing periods, overgrazing, low fertilizer inputs, inadequate soil and water conservation practices and cropping of marginal lands. These have resulted in lowering of agricultural production, leading to food insecurity and increased poverty.

Anlemo District is part of Hadiya zone which is exposed to high land degradation as per the previous observation of the researcher in many ways. The reasons for land use and land cover change drivers and its impact on agricultural productivity in the study area may include rapid population growth, resettlement and land shortage which forced farming families to increase their agricultural fields in to shrub and/or natural vegetation. In addition, local vegetation cover changed by biophysical and socio-economic drivers, especially vegetation cover change by animal feed/grazing, construction materials and charcoal production/fuel wood has significant and cumulative impact on the study area.

These factors also would cause seasonal flooding of farmlands in the bottomlands, which might affect several farming families and agricultural productivity. Furthermore, rising and falling topography which makes it vulnerable for soil fertility decline, deforestation and causing soil erosion. However, none of these situations of the study area have been systematically investigated by previous studies.

Therefore, this study aims to analyze land use and land cover changes, Causes and effects on agricultural productivity in Anlemo District from 2000 to 2018. As well having the research questions (1) what are the major cause of land use and land cover change in the study area? (2) What are the fundamental services behind forest and other land use and land cover change? (3) How does land use and land cover change affect agricultural productivity in Anlemo District?

Material and methods

Description of the Study area

The study was conducted in Anlemo District, Hadiya zone, Ethiopia. The District lies between 37° 53' 26"-38° 3' 26"E Latitude and 7° 32' 24"-7° 43' 44"N longitudes, with an elevation ranging from 2200-2600 meters above sea level (Figure 1). Regarding the

Agro-ecology, 21.5% is "Dega", 57% is "Woina Dega" and 21.5% is "Kolla". The annual temperature shows that 25ºC annual mean maximum temperature. Mean minimum annual temperature is 23ºC. Also the District experiences medium temperature or the climate in the District is mild tropical type. The rainfall was a bimodal type, the short rainy season was between (February to March) and the long between (June to September). The average annual rainfall ranges from 1001mm to 1200mm.

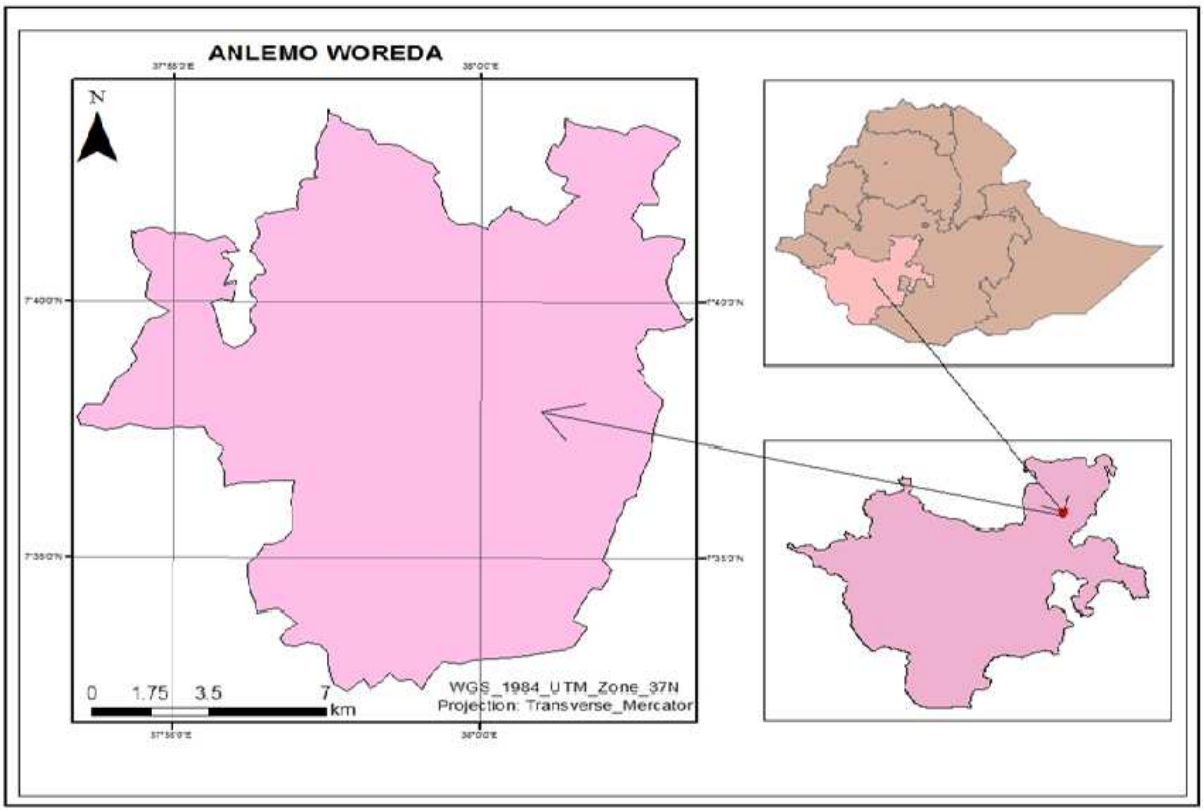

Fig. 1. Location of Anlemo District in Hadiya Zone, Ethiopia.

Types and sources of data

A satellite images was the main source of spatial data for the study. Landsat with path and row 169 and 055 respectively and spatial resolution of 30mx30m were obtained from Global Land Cover Facilities (GLCF) and United States Geological Survey (USGS). The three satellite images were acquired in the same season. The satellite images were used to evaluate land cover and land use changes of the past twenty eight years. Tools of data collection for spatial one were by using internet and Global Positioning System.

The primary sources of socio-economic data were through questionnaires, interview and observation. Secondary sources of data were collected from published and unpublished materials such as office records and reports, journals and articles, books; data was also be collected from Agricultural office of Anlemo (study District), Ethiopia Meteorological Agency (EMA). Socio economic data was collected by using direct field observation, Digital Camera, Key Informant Interview, structured and open-ended questionnaire were used to gather information about the process and reasons of land use and land cover changes, its causes and effects on crop productivity in the past and present.

Sample size determination

Two stage (multi-stage) sampling methods were employed to select sample from population. First, 3 kebeles were selected purposively out of the 28 kebeles existing in Anlemo District: secondly, sample households were selected from each sample kebele by using random sampling method from list of kebeles households. The simplified formula of (Yamane, 1973) was used to determine sample sizes. The

formula assumes a 95% confidence level and the maximum variance (p = 0.05):

$$n = \frac{N}{1+N\ (e)^2}$$

Where: n -is the sample size, N -is the population size, e -specifies the desired level of precision, where e = 1– precision (0.05 limit of tolerable error) level of precision= 95% (0.091 = a theoretical or statistical constant). By applying the above formula, sample household heads was selected from the 3 kebeles. Additionally, 3 groups of key informants (1 from each kebele) consists of 8 members were purposively selected. Prior to the beginning of the actual survey and interview processes, consent was presented of each respondent to request their willingness to participate in the final interview.

Data analysis

Spatial data analysis was performed to get important information from the acquired landsat TM and ETM+ satellite image of the years 2000, 2010 and 2018. In order to generate images ENVI 4.7 was used at different stages. Land use and land cover classification accuracy were assessed in order to examine whether the classification result reflects the reality on the ground. The classified images were exported to ArcGIS 10.5 and land use and land cover maps of the year 2000, 2010 and 2018 were produced. Analyses of socio-economic data were done after checking completeness of quantitative data, descriptive measures like frequency and percent were generated.

Results and discussion

Land Use Land Cover Change Analysis

For the purpose of land use land cover change analysis the techniques used were ArsGIS10.5 software, Land use and land cover classification for 2000 from TM satellite image in showed that majority of the study area was under crop land/ agricultural land accounts (36.6%) but settlements and wetland coverage amounted to be about (3.83%) and (0.96%) respectively in agreement with (Kindu *et al.*, 2013). The land use land cover classification for 2009 from ETM+ satellite image in the (Figure 4) showed that crop land/agricultural land cover accounting for (46.95%). This showed that crop land/agricultural land increased from 36.6% in 2000 to 46.95% in the year 2009.

Table 1. Land use land cover change of 2000 to 2009 in hectares.

	Area (Hectares)	2000 LULC								
		Forest	Grass land	Settlements	Shrub land	Crop land	Wet land	Bare land	Row Total	Class Total
2009 LULC	Forest	37	3	0	209	57	11	0	317	320
	Bare land	0	0	0	0	13	1	0	15	15
	Grass land	2	1521	3	74	506	427	15	2548	2557
	Settlements	0	7	9	15	17	5	1	55	55
	Shrub land	66	39	0	1887	1349	206	4	3551	3561
	Crop land	62	1124	2	2701	9728	1507	74	15197	15237
	Wet land	1	28	0	65	322	337	19	772	774
	Class Total	169	2736	15	4973	12037	2505	114	0	0
	Class Changes	132	1215	6	3086	2309	2168	114	0	0
	Image Difference	151	-180	40	-1412	3200	-1731	-100	0	0

The land use and land cover classification for 2018 from Landsat 8 satellite image on (Figure 5) showed that crop land/agricultural land cover is dominant class while, vegetation cover was decreasing that is in harmony with that of (Mussa *et al.*, 2017; Sewnet, 2016). The identified details through assessment of land use land cover were summarized in the following (Figures 2: 01-07). According to satellite image classification in more than half of land use and land cover classification covered by crop land/agricultural land compare to other classes. In the year 2000 to 2018, most portion of the land use land cover class was agricultural land. The increment of agricultural land and built up area was because of large number of population pressure in the study District. In the (Figures 3, 4 & 5) and Table 1, 2, 3, 4, 5 & 6) Land use

land cove types in different years which is in agreement with the study of (Abate and Lemenih, 201; Kidane, *et al.*, 2012). Most portion of the land use land cover class was agricultural land during this period. Generally, agricultural land and built up area also shows increment through 2000 to 2018 indicates population pressure in the district. But forest cover shows continuous decrease in the above time interval which the same idea has been reported by (Fidaus *et al.*, 2014).

Table 2. Land use land cover change of 2000 to 2009 in percentages.

	Percentages	2000 LULC								
		Forest	Grass land	Settlements	Shrub land	Crop land	Wet land	Bare land	Row Total	Class Total
2009 LULC	Forest	21.81	0.104	0	4.201	0.476	0.454	0	99.213	100
	Bare land	0	0.003	0	0.005	0.112	0.032	0	100	100
	Grass land	1.009	55.587	22.527	1.494	4.201	17.035	13.442	99.666	100
	Settlements	0.192	0.249	61.538	0.302	0.145	0.198	1.138	100	100
	Shrub land	38.81	1.443	2.198	37.953	11.207	8.206	3.201	99.726	100
	Crop land	36.6	41.07	13.187	54.31	80.819	60.147	64.794	99.738	100
	Wet land	0.817	1.012	0.549	1.303	2.674	13.449	16.572	99.706	100
	Class Total	100	100	100	100	100	100	100	0	0
	Class Changes	78.19	44.413	38.462	62.047	19.181	86.551	100	0	0
	Image Difference	89.1	-6.561	271.978	-28.397	26.589	-69.105	-87.198	0	0

Table 3. Land use land cover changes of 2009 to 2018 in hectares.

	Area (Hectares)	2009 LULC								
	Class name	Forest	Shrub land	Wetland	Settlements	Grass land	Crop land	Bare land	Row Total	Class Total
2018 LULC	Crop land	151	2200	580	5	808	11227	9	14980	14980
	Forest	85	133	0	0	0	78	0	296	296
	Shrub land	72	1032	17	0	3	929	0	2054	2054
	Wet land	1	41	140	0	0	274	0	458	458
	Bare land	0	17	8	0	21	235	0	282	282
	Settlements	0	29	3	49	4	58	0	142	142
	Grassland	12	102	29	1	1733	2466	5	4347	4347
	Class Total	321	3554	778	55	2568	15268	15	0	0
	Class Changes	236	2522	637	6	836	4041	14	0	0
	Image Difference	-25	-1500	-320	87	1779	-288	267	0	0

Result of accuracy analysis

Classification accuracy could be affected by lack of high resolution of images used and lack of previous knowledge of the area, always error expected consequently. To assess the classification accuracy, confusion matrix was used. Confusion matrix indicates the nature of the classification error. As it is shown (Table 7) and (Figure 4) for 2000 the overall accuracy and kappa coefficient is 88.37% and 0.8238 respectively. This shows 88.37% of the land use and land cover classes are correctly classified. Based on assessment made, producer accuracy of crop land/agricultural land was found to be 88.51% and user accuracy is found to be 89.53% respectively that is in agreement with study of (Kaul and Sopan; Srivastava *et al.*, 2012).

Table 4. Land use land cove changes of 2009 to 2018 in percentages.

	Percentages	2009 LULC								
		Forest	Shrub land	Wet land	Settlements	Grass land	Crop land	Bare land	Row Total	Class Total
2018 LULC	Crop land	46.945	61.9	74.627	9.329	31.451	73.532	61.963	100	100
	Forest	26.485	3.743	0.023	0	0	0.51	0	100	100
	Shrub land	22.534	29.037	2.198	0	0.13	6.087	0	100	100
	Wet land	0.42	1.162	18.061	0.164	0	1.797	0	100	100
	Bare land	0	0.468	1.064	0	0.817	1.541	2.454	100	100
	Settlements	0.028	0.826	0.336	88.871	0.137	0.38	0	100	100
	Grass land	3.587	2.864	3.691	1.637	67.466	16.153	35.583	100	100
	Class Total	100	100	100	100	100	100	100	0	0
	Class Changes	73.515	70.963	81.939	11.129	32.534	26.468	97.546	0	0
	Image Difference	-7.791	-42.202	-41.178	159.083	69.26	-1.885	1819.018	0	0

In the (Table 8) and (Figure 5) Accuracy assessment report of 2009 classification based on assessment made, producer accuracy of crop land/agricultural land is found to be 96.72% and user accuracy was found to be 88.06%. Generally, overall classification accuracy is 86.87% and kappa coefficient found to be 0.8546. This shows that land use land cover classes were almost correctly classified. In the same way, accuracy assessment of 2018 (Table 9) and (Figure 6) shows that user accuracy of crop land/agricultural land was 87.88% and producer accuracy was found to be 93.55%. Over all accuracy of the classification was 85.86% and kappa coefficient was 0.8335 which is more or less similar to the findings of (Fahad *et al.*, 2020; Kaul and Sopan, 2012).

Table 5. Land use land cover changes of 2000 to 2018 in hectares.

	Area (in hectare)	2000 LULC								
		Forest	Shrub land	Wet land	Bare land	Settlements	Grass land	Crop land	Row Total	Class Total
2018 LULC	Crop land	94	3169	1683	88	4	1104	8776	14919	14958
	Forest	25	199	16	0	0	3	50	292	294
	Shrub land	34	1057	199	3	0	22	737	2052	2058
	Wet land	2	153	151	2	0	2	146	454	456
	Bare land	0	18	15	4	0	10	234	280	281
	Settlements	0	42	15	2	9	13	61	143	143
	Grass land	13	315	415	14	2	1568	1988	4315	4328
	Class Total	169	4973	2505	114	15	2736	12037	0	0
	Class Changes	144	3916	2355	111	6	1168	3261	0	0
	Image Difference	124		-2049	167	128	1592	2922	0	0

Table 6. Land use land cover changes of 2000 to 2018 in percentages.

	Percentages	2000 LULC								
		Forest	Shrub land	Wet land	Bare land	Settlements	Grass land	Crop land	Row Total	Class Total
2018 LULC	Crop land	55.764	63.729	67.189	76.956	26.923	40.343	72.911	99.734	100
	Forest	14.601	3.992	0.623	0.142	0	0.101	0.417	99.447	100
	Shrub land	19.933	21.254	7.94	2.703	0	0.807	6.126	99.692	100
	Wet land	1.057	3.067	6.008	1.707	0.549	0.059	1.213	99.662	100
	Bare land	0.24	0.354	0.6	3.129	1.099	0.353	1.941	99.74	100
	Settlements	0.192	0.836	0.61	1.92	59.341	0.484	0.511	100	100
	Grass land	7.445	6.336	16.552	12.589	12.088	57.321	16.516	99.698	100
	Class Total	100	100	100	100	100	100	100	0	0
	Class Changes	85.399	78.746	93.992	96.871	40.659	42.679	27.089	0	0
	Image Difference	73.583	-58.607	-81.798	145.946	866.484	58.176	24.272	0	0

Socio-economic Analysis

Characteristics of households

Majority of the households 102(85.8%) were farmers and the remaining 17(14.3%) were doing small trade in addition to farm activities. all of the respondents households 112(94.1%) were married. Widowed and divorced households constituted less than 7(5.9%).

The educational status of households involved in the survey indicated that 76(63.9%), 10(8.4%) and 10(8.4%) were at elementary, primary and secondary education respectively (Table 10).

Table 7. Analysis result producers and users Accuracy of 2000.

S/N	Class name	Reference Totals	Classified Totals	Number Correct	Producers Accuracy	Users Accuracy
1	Bare land	0	0	0	---	---
2	Forest	1	1	1	100.00%	100.00%
3	Shrub land	42	40	37	88.10%	92.50%
4	Crop land	87	86	77	88.51%	89.53%
5	Wet land	24	22	20	83.33%	90.91%
6	Grass land	17	22	16	94.12%	72.73%
7	Settlements	1	1	1	100.00%	100.00%
Overall Classification Accuracy = 88.37%						
Overall Kappa Statistics = 0.8238						

Regarding land owned by household, 98(82.4%) were less than 1 hectares, 15(12.6%) were 1-2 hectares and 6(5%) of the respondents land size was greater than two hectares. Concerning means of land acquisition majority of the respondents about 89(74.8%) owned by inherited and 30(25.2%) was owned through reallocation of land (Table 10).

Table 8. Analysis result of producers and users accuracy of 2009.

S/N	Class Name	Reference Totals	Classified Totals	Number Correct	Producers Accuracy	Users Accuracy
1	Forest	1	1	1	100.00%	100.00%
2	Bare land	0	0	0	---	---
3	Grass land	15	11	9	60.00%	81.82%
4	Settlements	0	0	0	---	---
5	Shrub land	18	16	14	77.78%	87.50%
6	Crop land	61	67	59	96.72%	88.06%
7	Wet land	4	4	3	75.00%	75.00%
	Overall Classification Accuracy = 86.87%					
	Overall Kappa Statistics = 0.8546					

Table 9. Analysis result of producers and users accuracy of 2018.

S/N	Class Name	Reference Totals	Classified Totals	Number Correct	Producers Accuracy	Users Accuracy
1	Crop land	62	66	58	93.55%	87.88%
2	Forest	1	1	1	100.00%	100.00%
3	Shrub land	9	9	7	77.78%	77.78%
4	Wet land	3	2	2	66.67%	100.00%
5	Bare land	1	1	1	100.00%	100.00%
6	Settlements	1	1	1	100.00%	100.00%
7	Grass land	22	19	15	68.18%	78.95%
	Overall Classification Accuracy = 85.86%					
	Overall Kappa Statistics = 0.8335					

Besides general characteristics of the study focuses, years of experience of households living in the District were more than 25 years and above in the study area. Majority about 98.3% responded that land use land cover change is a problem in their locality. From respondents 47.9% the main cause of land cover land use change was over cultivation, 11% illegal cutting of tree, 32.1% need of crop land and 9% over grazing. This comes from different reasons. Among them mostly 100% believed due to soil degradation followed by 85.7% it is due to soil fertility decline. According to remote sensing data in the (Table 1, 2, 3, 4, 5 and 6) confirms this idea which similar concept to the study of (Islam *et al.*, 2002).

Table 10. Household's characteristics.

No.	Characteristics	Specifications	Frequency	Percentage
1	Respondents age in years	25-35	10	8.4
		36-45	38	31.9
		>45	71	59.7
2	Households size in number	< 4	15	12.7
		4 to 7	67	56.3
		>7	37	31
3	Respondents occupation	Farmer	102	85.7
		off-farm	17	14.3
4	Size of land holding	< 1 ha	98	82.4
		1 to 2 ha	15	12.6
		>2 ha	6	5.0
5	Educational status	Elementary (1-4)	76	63.9
		Primary (5-8)	10	8.4
		Secondary (9-12)	8	6.7

(Source: Field survey).

The crop land/agricultural land of Anlemo District accounts 36.6% in 2000. In the year 2009 forest and shrub land coverage of the District surprisingly decreased. In the year 2018 the total coverage of crop land/agricultural land also increased to 55.76% of the total area of the District. This indicates that the main cause of land use land cover change in the study area was vegetation removal. Generally, remote sensing data and socio-economic data of the study area were indicated land use land cover change is a challenging problem in the District and the main cases for the changes were over cultivation, settlement, illegal cutting of forest for different purposes and over grazing were driving factors for land use and land cover change in the study area.

Table 11. Households versus crop production.

S/N	Characteristics	Types of major crops grown	Frequency Vs percentage
1	Most common	Wheat	89(74.8%)
2	Very common	"Teff"	60(71.4%)
3	Common	Maize	42(35.3%)

*Owing to multiple responses percentages do not sum to 100 (Source: Field survey)

Table 12. Respondents versus percentages on crop productivity.

Descriptions	Before 20 Years	Before 10 Years	Current
	Respondents Vs Percentage	Respondents Vs Percentage	Respondents Vs Percentage
Crop production per unit area			
Wheat			
15.25 Quintals	34 (28.6%)	28(23.5%)	37(31.1%)
26-35 Quintals	45 (37.8%)	56(47.1%)	67(56.3%)
> 35 Quintals	40 (33.6%)	35(29.4%)	15(12.6%)
Total	119(100%)	119(100%)	119(100%)
"Teff"			
6-10 Quintals	32(26.9%)	52 (43.7%)	74(62.2%)
11-15 Quintals	87(73.1%)	67 (56.3%)	45(37.8%)
>15 Quintals			
Total	119(100%)	119(100%)	119(100%)
Maize			
15-25 Quintals	51(42.9%)	66(55.5%)	78(65.5%)
26-35 Quintals	68(57.1%)	53(44.5%)	41(34.5%)
>35 Quintals			
Total	119(100%)	119(100%)	119(100%)

(Source: Field survey).

Main Causes of Land Use and Land Cover Change in the Study Area

Causes are the direct pressures exerted on land resources. The driving forces in the study area include population pressure, demand for agricultural land, over cultivation, resettlement, increased demands for forest products such fire wood and charcoal, less soil and water conservation practices, overgrazing, deforestation, declining crop productivity and agricultural encroachment in to marginal areas which is similar to the study report by (Betru *et al.*, 2019; Alemu, 2015). Fast population growth and the consequent high pressure on resources are expected to have an adverse effect on the existing natural resources of the area. Such rapid population growth in the area has already exerted pressure on the existing land resources through increasing the demand for food, wood for fuel and construction purposes, and other necessities.

The expansion of agricultural lands toward forest and marginal lands, including continuous and over cultivation, has resulted in deforestation and soil degradation which is similar to that of (Perović *et al.*, 2018; Gashaw *et al.*, 2014). Similarly, increased demands for fuel wood in the absence of alternative sources of energy have led to the destruction of forests.

Table 13. Possible causes for crop yield reduction.

S/N	Possible Causes	Respondents Vs. Percentage
1	Soil Degradation	119(100%)
2	Land Fragmentation	62(52.1%)
3	Climate Change	102(85.7%)

*Owing to multiple responses percentages do not sum to 100 (Source: Field survey).

According to socio-economic survey and key informant interview responses the major causes for land use land cover change in the District indicated that over cultivation 47.9%, illegal cutting of trees 11%, need of crop land 32.1% and over grazing accounts 9%. Fuel wood have been the most important energy sources in rural Ethiopia in general and in the Anlemo District in particular; 83(69.8%) of the respondents confirmed that fuel wood was most important, while 26(21.8%) confirmed that charcoal was most important for cooking and heating. A few respondents 10(8.4%) told that they used crop residues as energy sources the idea is in harmony with the study of (Hishe *et al.*, 2021).

Table 14. Respondents versus livestock productivity.

S/N	Descriptions	Characteristics	Respondents' Vs Percentage
1	Quantity	Cow	107(89.9%)
		Ox	95(79.8%)
		Shoat	116(97.5%)
	Total *Owing to multiple responses percentages do not sum to 100		
2	Trends in productivity	Increase	15(12.6%)
		Decrease	104(87.4%)
	Total		119(100%)
3	Reason for decreasing trend	Shortage of grazing land	93(78.2%)
		Lack of fodder	81(68.1%)
		Disease	54(45.4%)
	Total *Owing to multiple responses percentages do not sum to 100		
4	Sources of fodder	Open grazing	14(11.8%)
		Control grazing	107(89.9%)
		Crop residues	107(89.9%)
Total *Owing to multiple responses percentages do not sum to 100			

(Source: Field survey).

Effect of Land Use and Land Cover Change on Agricultural Productivity

Crop productivity

Land use and land cover changes degrade the land's capacity for sustained use and regaining its natural cover. Specifically, changes in land use and land cover have a significant influence on soil resources and biodiversity. Its cumulative change has impact on reducing agricultural productivity. The major crop types grown in the study area were wheat, "teff" and maize. According to Anlemo District agricultural office and sampled households Wheat is the dominant crop in the District and more than 89(74.8%) of respondent produce wheat, 60(71.4%) of respondents produce "teff", 42(35.3%) produce maize and minor crops like fava-bean and peas are not in considerable amount which is with the same perception to that of (Tefera, 2011). Regarding crop productivity in the study area before 20 years, households obtained from one hectare of (Table 12). Wheat was 34(28.6%) respondents got 15-25 quintals and 45(37.8%) respondents got 26-35 quintals and 40(33.6%) respondents got greater than 35 quintals before 20 years, 28(23.5%) respondents got 15-25 quintals, 56(47.1%) respondents got 26-35 quintals and 35(29.4%) respondents got greater than 35 quintals before 10 years and currently 37(31.1%) respondents got 15-25 quintals, 67(56.3%) respondents got 26-35 quintals and 15(12.6%) respondents got greater than 35 quintals.

Fig. 2. Results of identified land use land cover in the study area.

"Teff" was 32(26.9%) respondents got 6-10 quintals and 87(73.1%) respondents got 11-15 quintals before 20 years, 52(43.7%) respondents got 6-10 quintals and 67(56.3%) respondents got 11-15 quintals before 10 years and currently 74(62.2%) respondents got 6-10 quintals and 45(37.8%) respondents got 11-15 quintals.

Maize was 51(42.9%) respondents got 15-25 quintals and 68(57.1%) respondents got 26-35 quintals before 20 years, 66(55.5%) respondents got 15-25 quintals and 53(44.5%) respondents got 26-35 quintals before 10 years and currently 78(65.5%) respondents got 15-25 quintals and 41(34.5%) respondents got 26-35 quintals. From the result, it is possible to understand the decline of agricultural productivity per individual household though the results of remote sensing data on land use change showed an increasing trend of agricultural land in the study District.

The total agricultural land was increased in the past 30 years, but the agricultural productivity per unit area was decreased which is in harmony to study of (Amenu *et al.*, 2017).

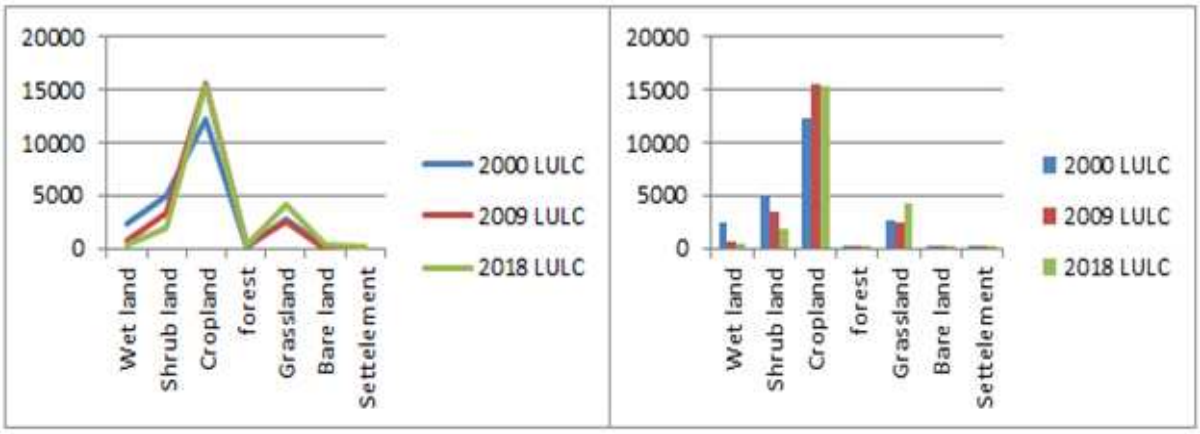

Fig. 3. Land use land cover changes in 2000, 2009, and 2018.

The major causes for crop yield reduction in the study area as perceived by respondents were soil degradation 119(100%), climate change 102(85.7%) and small farmland size 50(42%) as it has been indicated in the (Table 13). From this it is possible to realize that the degradation of agricultural land was accountable for the reduction of crop yield in the study area which is in agreement with study of (Wyman and Stein, 2010; Amenu *et al.*, 2017). They also reported high variability of rainy season recently as compared to before two decades ago. In addition, the data obtained from Ethiopia Meteorological Agency of Hawassa branch office indicated that the mean annual temperature of the study area was increased from 16.49^{o}c in the year 2000 to 17.6^{o}c in the year 2018. In the same way, mean annual rain fall of the District was erratic or changing from year to year which is similar to study report by (Guzha *et al.*, 2018). Thus, these climate changes also contributed to less agricultural productivity since the farming system of the study area is greatly reliant on rain-fed agriculture.

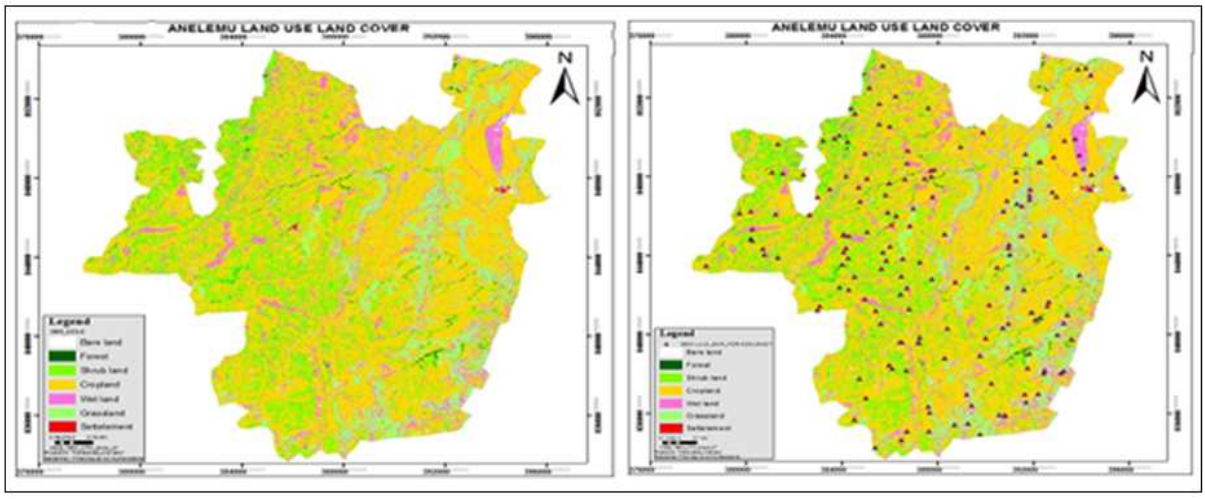

Fig. 4. Land use land cover changes and accuracy and analysis of 2000.

Moreover, key informants and survey respondents reported that the sedentary agricultural practice dominated since 2000, led to over cultivation of the land which has resulted in declining of soil fertility and a drop in agricultural productivity that is in agreement with study of (Tadesse *et al.*, 2017). From all these, it is possible to confirm that the decline of agricultural productivity is due to change in land use and land cover. Regarding the production and productivity of major crops in the study area, (Table 11 and 12) indicated the responses of participant households which is almost similar to the study result of (Mengistu *et al.*, 2012).

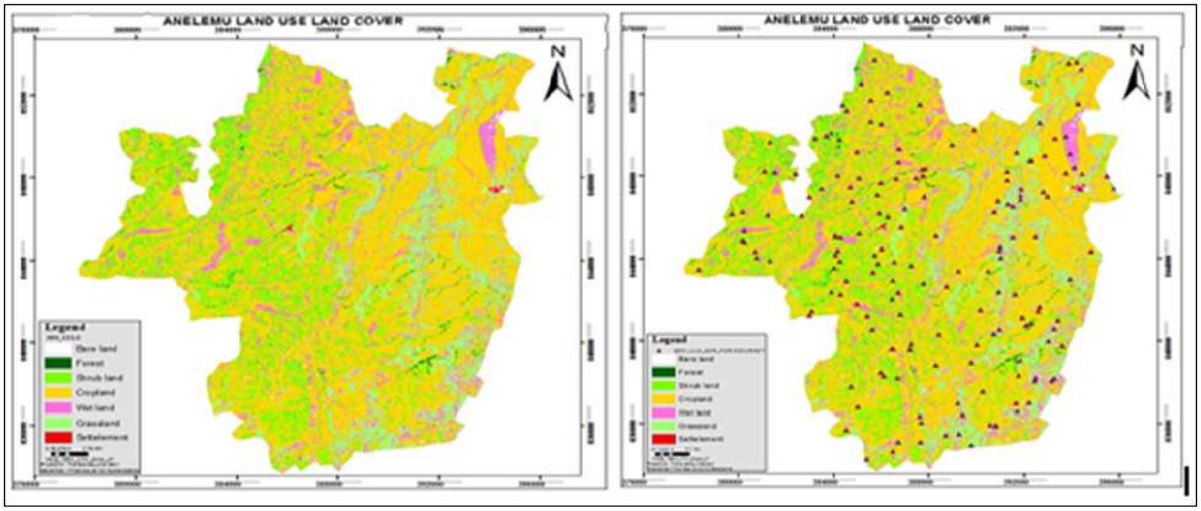

Fig. 5. Land use land cover changes and accuracy analysis result of 2009.

Livestock productivity

Anlemo District, as in most other parts of the country, livestock is an important part of the agricultural system in the area. As it can be seen from the (Table 14), the majority of respondents owned cow, accounted for 107(89.9%), oxen 95(79.8%), shoat for 116(97.5%). Regarding the trend of the livestock in terms of their number and productivity over the past 20 years or from 2000 to 2018, about 104(87.4%) of the respondents reported that livestock numbers and productivity had decreased in the area, while 15(12.6%) of the households reported an increase in numbers and productivity. The number and productivity of livestock of the households was decreasing from past to present which is similar to the study result of (Mekasha *et al.*, 2014).

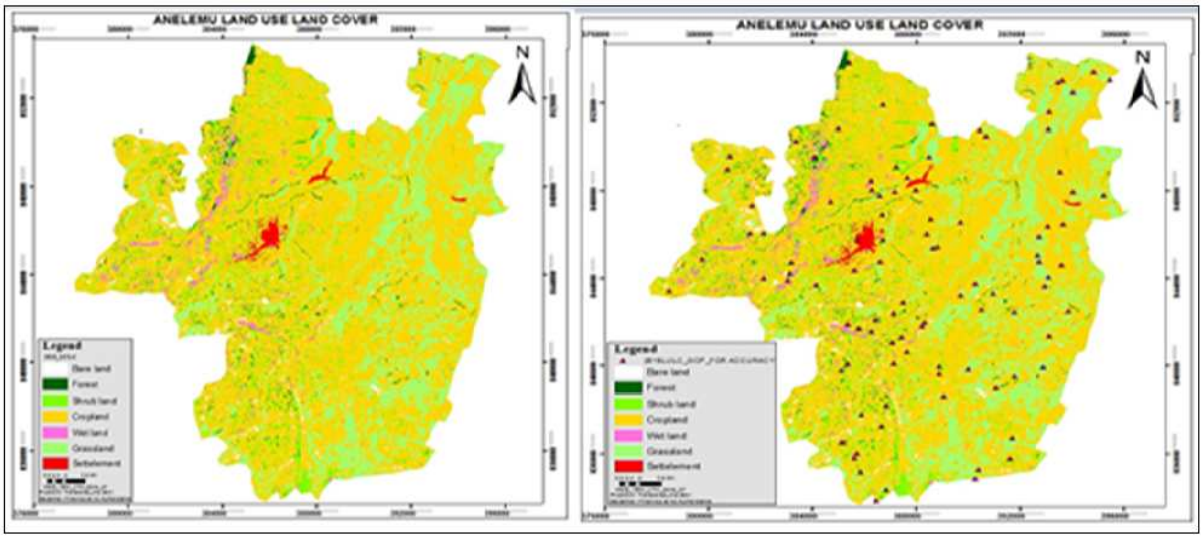

Fig. 6. Land use land cover changes and accuracy analysis result of 2018.

The main reason for reduction of livestock number and productivity, about 93(78.2%) of respondents indicated that the main reason for the decrease in productivity and numbers of livestock per households had been shortage of grazing land, 81(68.1%) is due to lack of fodder and the remaining 54(45.4%) is rated for diseases. Respondents indicated that the main reason behind the shortage of livestock feed was expansion of agricultural land towards grazing and forest land. According to interview with respondents the source of livestock feed were 14(11.8%) open grazing, 107(89.9%) control grazing (one's own possession) and crop residue accounts for 107(89.9%).

As it has been stated by Weindl *et al.*, (2017) the land use change data shows that, declining of forest and grazing land that affects the availability of feed resources for the livestock. According to the socio-economic survey data obtained from key informant interview and households response, the trends of livestock number and productivity shows decreasing to the same as crop production from past to present. The reasons for the decreasing of livestock number and productivity were identified. The respondents recognized that grazing area had decreased due to expansion of agricultural land, decrease size and productivity of grazing land and expansion of cultivated land. Based on the study, 119(100%) of interviewed households depend on agriculture (both crop production and livestock production) which is the same to study of (Wirsenius *et al.*, 2010). However, results of the survey showed that the crop and livestock productivity were mainly due to removal of vegetation cover and increasing demand of agricultural land induced by human population pressure in the study area that is in agreement with (Amsalu and Addisu, 2014).

Conclusion

The study used an integrated approach to understand past and the present conditions of the study area by using satellite images provided necessary data for study area. Based on the findings, analysis of land use and land cover classification for the study periods shown that there is rapid increase in agricultural land and built up area, while there is a decreasing trend in forest cover. Generally, the results also show that the extent of agricultural land and built up area has increased the whole periods at the expense of deforestation or forest cover change. The general trend observed was a decrease in forest cover. A corresponding increase was observed in agricultural land, built up areas. The decrease in forest cover particularly reflects the considerable expansion of agricultural land, resettlement and illegal cutting of trees in the area. In the study area, the vegetation cover was converted to cultivated land and built up area. As a result, land degradation occurs and productivity is decreasing; consequently, the current crop yield per unit area is gradually declined. Similarly, the number of livestock productivity per household also declined that may be due to the low availability of livestock feed. Land use and land cover changes also related with the livelihoods of the local population, i.e. socio-economic conditions and access to agricultural land and population growth. The area is one of densely populated areas of the country more than 87.3% of sampled house hold heads replied that their family size greater than four members per household and land use and land cover change may affect natural resources and reduce agricultural productivity on which the livelihood of the local community mainly relied on.

Recommendations

From the result obtained from satellite image and actual field observations made during the study, the following recommendations are forwarded:

In the face of the growing household size, land shortage and growing number of landless youths, rather than agricultural activities the enhance vegetation or forest clearance, other fields of job like manufacturing and service provision and related activities should be created at the local level.

In order to improve agricultural productivity the small landholding size of the area necessitated the intensification of agriculture through specialization and diversification with the use of special seeds, chemical and natural fertilizers are very important with continuous supporting of Development Agents (DAs) at the kebele level in order to improve agricultural productivity.

Agriculture and rural development office of Anlemo District and other governmental and non-governmental organizations should take their own share of responsibilities in solving the challenges related to crop productivity, livestock productivity and natural resources management.

This research can help as an initial point. However, further research in the area is highly recommendable

in order to demonstrate radical conversion of one land cover type to the other and to take conservation and rehabilitation action.

Therefore, the current trends in land use and land cover must be improved towards the resources management and conserving of the existing natural resources in the study area through community participation and using sustainable land resources management plan so that agricultural productivity can be improved.

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