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Impacts of Resettlement on Land Use Land Cover Changes and Natural Vegetation Conservation Practices of Resettlers in Abobo Woreda, Gambella, Ethiopia

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Abstract
This study was conducted to explore extent, trends, and identifies causes of land use land cover (LULC) changes over the period, 1987 to 2009 along with inspecting resettlers' involvements in natural vegetation conservation in Abobo Woreda. The design followed in this study was sequential explanatory strategy, a mixed research method. To this end, primarily maximum likelihood supervised classification detection techniques were applied to Landsat images acquired in 1987, 2002 and 2009 to produce three maps with field trip verification. Software used for this aspect was Arc GIS 9.3and ERDAS Imagine 10. Secondly, among 6 resettlers' menders in the Woreda, 4 menders were involved in the study; thereby data were collected from a total of 68 households (HHs) using semi structured questionnaire, focus group discussion, key informant interview and field observation. Software used for this part was SPSS Ver-20. Accordingly, results of this study revealed that seven LULC types were recognized namely: forestland, wetland, woodland, farmland, bare land, water body and grassland which account about 361324.42 hectares (ha). The trends observed from 1987 to 2002 indicated decreases at rates of 0.51ha of forestland, 1.467ha of grassland and 2.837ha of woodland per year; meanwhile, 37.3ha of farmland and 9.50haof bare land increments were also observed. Correspondingly, from 2002 to 2009, bare land and farmland continued to escalate with mean annual rate of 859.43ha and 9.88ha per year respectively; while forestland and grassland were decreasing at the rates of 1.27 and 10 ha each year respectively. Besides, the causes of LULC changes were identified as farmland expansion, fuel wood extraction and wildfire; being the former a major cause. Moreover, this study disclosed that majority of sampled HHs were involved in tree planting as conservation practice. Therefore, the government should limit further expansion of extensive farmland and implement rehabilitation practice of degraded land. Eventually, to ensure results of this study additional research is required that covers wide area of the study Woreda.
Keywords: Landsat images, LULC changes, natural vegetation and resettlement.

1. Introduction

Land cover (LC) refers to bio-physical covers of land surface (Ellis, E. & Pontius, R. 2007). While, land use (LU) is arrangements, activities and inputs carried out in certain LC. Change of LU refers to alteration in management of land by humans, which may lead to LC change (IPCC, 2001). For instance, among other activities agriculture is the major LU that has led to environmental problems (FAO, 2016). Environmental deprivation limits ecosystem services capacity to produce food, fibers and energy. Such problem is common in Africa, sub-Saharan regions, where internal and across territories displaced people exist (Jacobsen, K. 1997).

In the central and northern high lands89% populations lives, which comprises 38 % land mass of Ethiopia. Whereas the low land has 11% of population, that covers 62 % of land mass. Population growth and environmental degradation in northern parts of the country has led to an adoption of resettlement as policy option in past times (Barana, D. 2013).. So, resettlement is not new experiences to Ethiopia; since 1960s either spontaneous or planned resettlement took place. For example, during 1980s peasants from the central parts were resettled in South-west of Ethiopia (Dessalegn, R. 2003).

Nevertheless, on the basis of government assessment, the resettlement project was failed due to several factors including: inadequate planning, inappropriate resettlers' selection, inadequate budgetary support, and inexperienced staff. Even recently, the current government also has recently executed voluntary resettlement programs (CFS, 2003).

In connection to the aforementioned incidence of resettlement, Gambella region was one of the resettlement areas in Ethiopia, during 1980s. During these times, 50,000 to 60,000 resettlers from the highlands were settled in this region (Mengistu, W. 2005). The resettlers perhaps have impacts on ecosystem services, predominantly on natural vegetation of the region (Dereje,T. 2007). For instance, Gebremarkos,W. (1999) reported that forest and woodland of the region is diminishing due to resettlement, farming, shifting cultivation and fuel demands. Henceforth, this study has assessed impacts of resettlement on LULCC in *Abobo Woreda* that covers over two decades, 1987 to 2009. Consequently, this study provided firsthand information, for policy and decision maker, which helps to enhance natural resources management of the *Woreda*.

2. Materials and Methods

2.1 Description of the Study Area

Abobo Woreda is one of the five Woredas of Agnwa zone in Gambella regional State. It is located 813 Km Southwest of Addis Ababa, Ethiopia. Geographically, it lays between $7^0 35' 0''$ and $8^0 10' 0''$ North latitudes as well as $34^0 30' 0''$ and $35^0 0' 0''$ East longitudes (AWOARD, 2010).

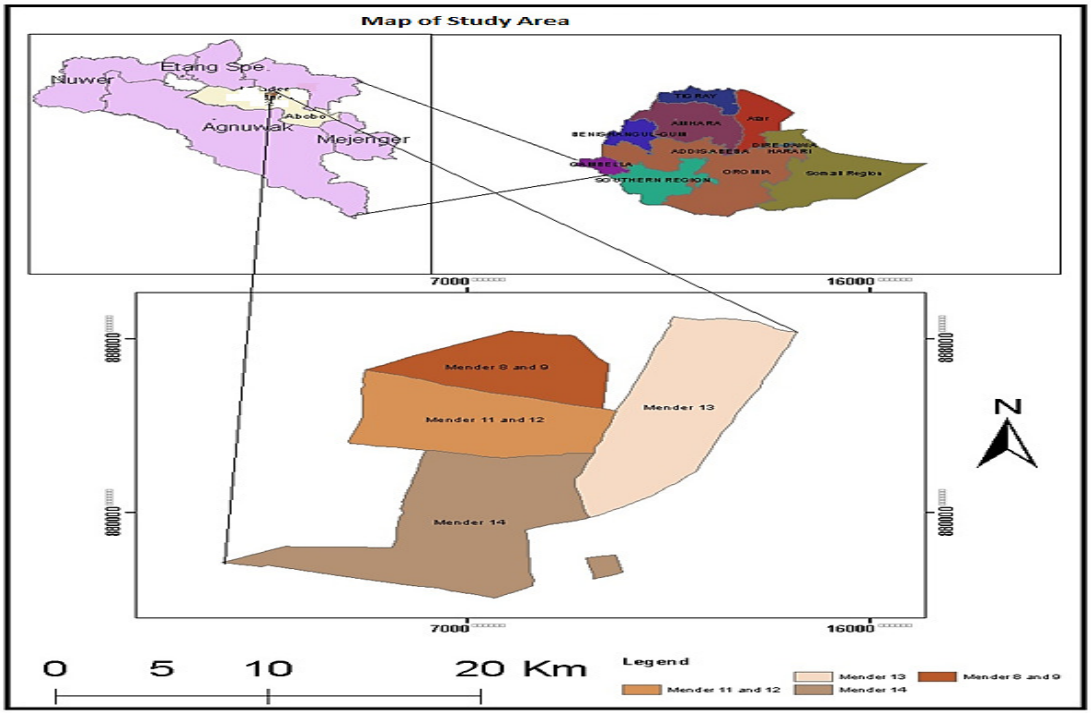

Figure 2: Map of the study area adapted from Ethio-GIS.

2.1.1 Land use land cover (LULC), Climate and Topography:

Total area of the *Woreda* covers about 361324.42 hectares. According to the FAO (2004) report, since 1987 there were six LULC types namely: woodland, forestland, grassland, wetland, farmland and bare land.

The *Woreda* has two agro-climatic zones: Woynadega (10%) and Kolla (90%). Accordingly, the mean annual minimum and maximum temperature ranges between 18ºC and 39ºC, respectively. The average annual rainfall ranges between 900-920 mm. The main rainy season is from mid-April to October (NMSA, 2014)..The elevation of the Woreda varies from 414m.a.s.l in the Western and central part to 2223 m. a.s.l in the North-eastern and South-eastern part. The North-eastern and South-eastern parts of the *Woreda* are relatively highest elevation and Western most parts of the area are characterized by the lowest elevation

2.1.2 Means of livelihoods:

Agriculture is the main means of livelihood, which is mixed agriculture type. Consequently, crop production, traditional animal husbandry and fishing are practiced. Majang people have been engaged in beekeeping in the past and are still producing honey using traditional hives and kept on top of tree branch in the forest. The major crops produced in the area are sorghum, maize, rice, cotton and groundnut. In addition, seasonal fruit such as papaya, mango and vegetables such as tomato and onion are also produced on a small scale. There are a few numbers of dwellers involving in off-farm activities as a means of livelihood as well. Since study area is potentially favorable for agriculture. Today a number of both local and foreign investors are also engaged in agricultural crop production such as rice, cotton and mango (AWOARD, 2010).

2.2 Data Collection and Analysis Methods

2.2.1 Sample Size Determination of Respondent HHs

For this study Abobo *Woreda* was selected, which is a resettlement area. There are 6 resettlers' *Menders* in the *Woreda.* Among these *menders*, this study included 4 *menders* intentionally. Specifically chobo mender 8 and 9, chobo mender 11and12, chobo mender13and chobo mender 14 were involved in the study. Sample size was determined, following the formula of Cochran (1977) cited in (Haile Fesseha, 2007).Therefore the total numbers of sample HHs required for the study were 68 and randomly involved in the study.

2.2.2 Data Collection and Analysis

In this study primary and secondary sources of data were used. The primary data were collected by two approaches: (i) satellite image of 1987, 2002 and 2009 were used to detect LULC changes of the study area. Satellite images

acquired from Land sat TM of 1987and ETM+ of 2002 were obtained from EMA, while ETM+ of 2009 from Global Land Cover Facility (GLCF). On top of that (ii) surveys tools: questionnaire, focus group discussion, key informant interview and field observation were also used. While, the secondary sources were obtained from published and unpublished reports.

Pre-classification image processing was done using false color composite of bands 3, 2, and 1 in RGB-read, green and blue transformation. Digital image processing and visual interpretation of satellite images were made by using Arc GIS 9.3and ERDAS Imagine version10. Then original satellite image was subset to fit the digitized study area that was delineated based on the ground survey at study area. Following that, classification was made through supervised methods in order to determine required number of LULC types (Tudor G., *etal*. 1998).. Moreover, after classification, majority analysis was used in order to avoid minor fragmented classification arrangements in output maps. The majority analysis was repeated four times until fine classification had removed. Finally, ground verification after classification was made in order to check the precision of classified LULC maps. Based on the ground verification necessary correction and adjustments were made. For each LULC rate of change was estimated following a formula developed by Barana, D. (2013).

Eventually, the collected data from respondent HHs were subjected to descriptive statistics such as average, percentage and frequency and presented in table, graphs and charts. The computer software used was SPSS, version 20.0.

3. Results

Exploring the overview of respondent profiles, particularly demographic and socio-economic aspects of sampled HHs were crucial in terms of identifying and understanding driving factors of land use land cover changes as well as natural vegetation situation of the study area. To this end, some characteristics of sample HHs in the study area are provided as bellow (Table1and 2).

Table 1: Respondents by age classes and sex

Age classes	Males	Females	Total (%)
Less than 34	21	10	31(45)
34 to 47	8	8	16(24)
48 to 65	8	9	17(25)
65 and above	3	1	4(6)
Total	40	28	68(100)

Source: Field survey (2016).

Table 2: Respondent HH's family size before and after resettlement

HH family size	Before Resettlement	After Resettlement
	Frequency (%)	Frequency (%)
less than 5	65(95.5)	27(39.8)
5 to 7	2(3)	35(51.5)
8 to10	1(1.5)	6(8.7)
Total	101	334
Average	1.49	4.91

Source: Field Survey (2016).

3.1 Land Use Land Cover Changes Of 1987, 2002 And 2009

Generally, six LULC types in 1987 and seven in 2002 to2009 were identified. The major LULC in the study area includes: woodland, forestland, grassland, wetland, farmland, water body and bare land. The detail changes of LULC are presented as follows (Figure 2 and 3).

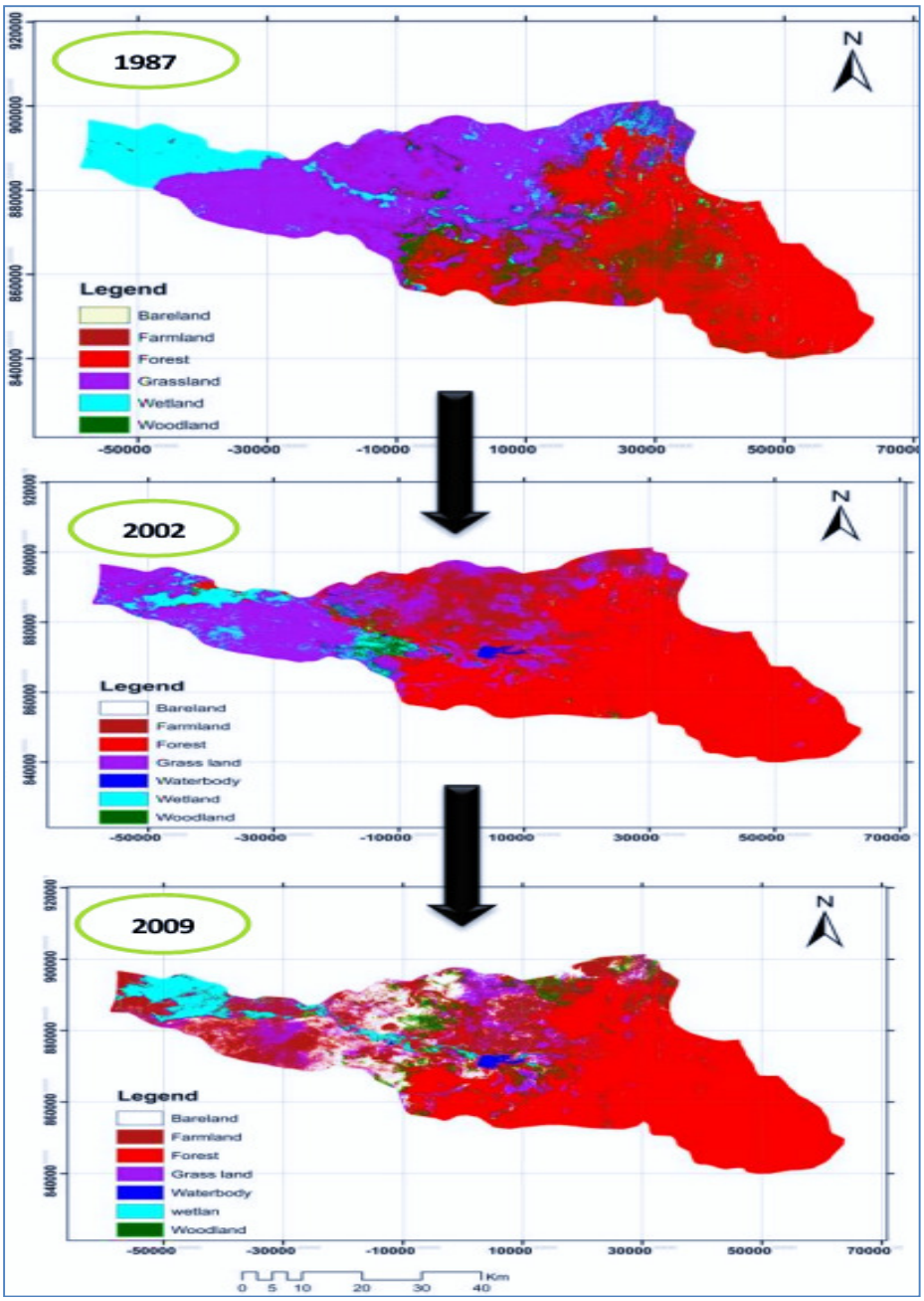

Figure 3: land use land cover of 1987, 2002 and 2009 (Source: EMA)

Based on the patterns of LULC satellite image analysis of 1987 indicated that six LULC categories were identified, namely: forest, wetland, woodland, farmland, bare land and grassland. The extent of their coverage were 58.5% of forestland, 31.4% of grassland, 4.4% of woodland, 3.6% of wetland, 2.1% of farmland and 0.1% of bare land. The LULC classification in1987 indicated that the largest cover of the study area was forestland (Figure 3).

Analysis patterns of the land sat7 ETM+ imagery of 2002 revealed spans of forest land, wetland and woodland were 53.9%, 4.7%) and 2.5% respectively. While, bare land, farm land, grassland and water body covered 0.2%, 13.7%, 24.5% and 0.5% respectively. The result of patterns Landsat ETM image of 2009 indicated extent of area coverage were: forest (49.1%), wetland (4.8%), woodland (2.52%), bare land (0.2%), farmland (13.7%), grassland (24.48%) and water body (0.56%). The major part of the study area was covered still by forest (Figure3).

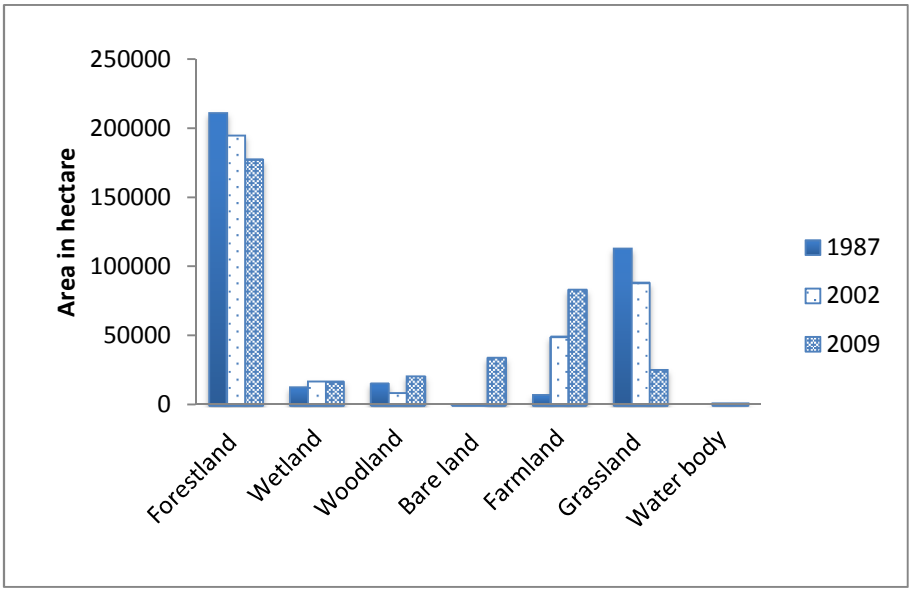

Figure 4: Comparing LULC types of 1987 with 2002 and 2009

3.1.1 LULC Changes Detections of 1987, 2002 And 2009

Table 3: Rate of changes in LULC between 1987, 2002 and 2009

LULC types	Rate of changes between:	
	1987 and 2002	**2002 and 2009**
Forest	-0.516	-1.279
Wetland	+2.097	-0.02
Woodland	-2.837	+19
Bare land	9.503	+859.43
Farmland	+37.301	+9.88
Grassland	-1.467	-10.12
Water body	-	-0.89

Note: The sign -/+ indicate reduction/ increase in LULC

i) **Changes detection of LULC in 1987 and 2002:** Changes was detected, as LULC of 2002 compared with that of 1987; these changes depict that there were a decrease or increase in particular LULC types. Accordingly, the LULC types indicated increases were wet land, bare land, farmland and water bodies. The average rates of change for these LULC types were 2.097 ha, 9.5ha, 37.3ha and 6.67 ha per year respectively. In contrast, the LULC types: forest land, woodland, and grassland showed a decrease with an average rate of changes of (0.516 ha), (2.83ha) and (1.467 ha) per year respectively (Tabe3).

ii) **Changes detection of LULC in 2002 and 2009**: When the LULC classification of 2009 compared with that of 2002, there were changes that indicate a decrease or increase in LULC. The LULC, which showed increase were: woodland (12088.16ha), bare land (33887.67ha) and farm land (34245.77ha). The average rates of change of these were: (19 ha) per year, (859.4ha) per year and (9.88 ha) per year respectively (Table 3). On the other hand, forest land, wetland, grass land and water bodies showed decreasing accounting (17441.66 ha), (27.27 ha), (62650.91ha) and (102.10ha) respectively (Table4).

Table 4: LULC changes matrix of 1987 versus 2002

LU/LC types		LULC types of 2002 (in Ha)							
		Forest	Wetland	Woodland	Bare land	Farmland	Grassland	water body	**Total**
LULC types of 1987 (in Ha)	Forest	**194712**	81.20	4947.51	44.35	350.74	11068.1	6.34	211210.3
	Wetland	2.43	**11785.7**	46.70	33.55	463.60	493.40	298.91	12825.43
	Woodland	39.10	374.45	**3953.68**	31.84	3341.24	7938.49	146.53	15678.8
	Bare land	4.74	29.08	30.38	**102.07**	56.89	4.85	4.22	228.01
	Farmland	4.84	2.40	48.00	16.89	**7217.08**	0.14	211.27	7500.90
	Grassland	85.30	4980.93	62.80	334.59	38039.10	**68960.9**	968.20	112463.60
	Total	194848.4	17253.8	9089.07	563.29	49468.65	88465.9	194848.4	359907.04

Source: Land sat TM of 1987, ETM+ of 2002

In the study area a part of the land was covered with 211210.3 ha of forest in 1987.However, this cover of forest was declined between 1987 and 2002 in to194848.4ha which is about 8% decreased(Table 4).

Table 5: LULC changes matrix of 2002 versus 2009

LULC types		LULC types of 2009 (in ha)							
		Forest	Wetland	Woodland	Bare land	Farmland	Grassland	Water body	Total
LULC types of 2002 (in ha)	Forest	**177321.9**	3432.26	12286.21	855.17	762.4	159.98	30.53	194848.4
	Wetland	9.65	**12753.9**	500.67	2546.15	239.1	1193.38	10.97	17253.82
	Woodland	69.46	980.63	**7164.60**	110.06	143.1	621.07	0.16	9089.07
	Bare land	0.46	3.82	17.79	**186.11**	278.4	76.76	0.00	563.3
	Farmland	0.00	2.09	68.52	8406.38	**31625.3**	9366.30	0.00	49468.59
	Grassland	5.32	23.36	1139.43	22327.6	50657.	**14312.8**	0.16	88465.67
	Water Body	0.00	30.45	0.00	19.49	9.2	84.69	**1491.5**	1635.37
	Total classes	177406.8	17226.5	21177.22	34450.9	83714.4	25814.98	1533.4	361324.2

Source: Land sat ETM+ of 2002 and ETM+ of 2009

Similarly, 194848.4ha of the study area was covered with forestland in 2002.But, between 2002 and 2009, forest cover dropped to 177406.8 ha of land that is about 9% declined over this period of time. In the same way the other LULC alterations can be observed from Table5.

3.2 Respondents' Perceptions Concerning LULC Changes

Based on the majority (92.6%) respondents' views natural vegetation was existed in the study area during 1985. The vegetation was habitat for several wild animals such as lion, tiger, pig, monkey, antelopes and baboons.

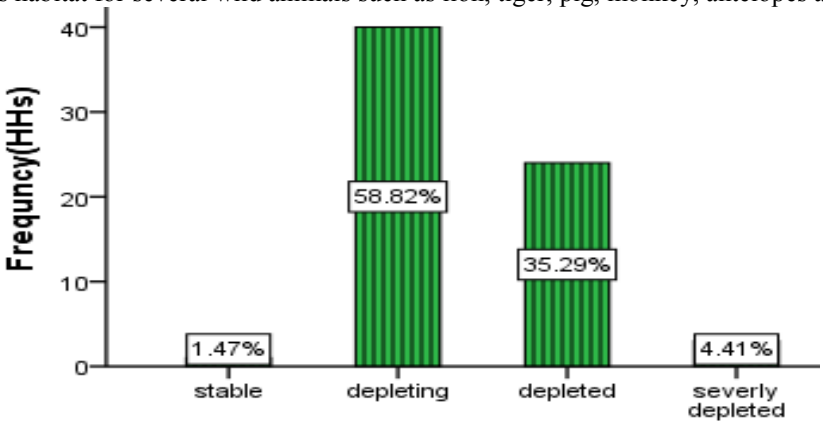

Figure 5: Status of natural vegetation in the last three decades (Source: Field survey, 2016)

Table 6: Causes of LULC changes

Variables		Frequency (%)
Cause of LULCC	Farmland expansion by resettlers	25(36.8)
	Farmland expansion by investors	39(57.4)
	Fuel wood and charcoal extraction	4(5.9)
	Total	68(100.0)

Source: Field survey (2016)

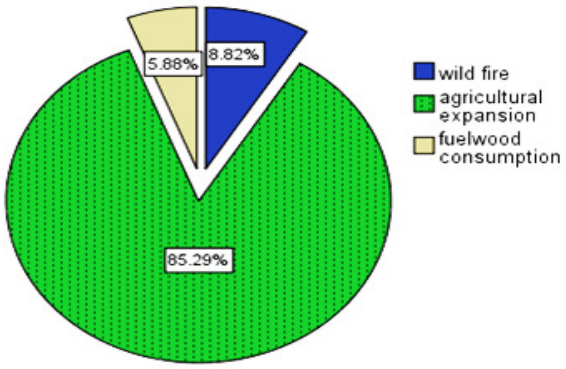

Figure 6: Causes of natural vegetation reduction (Source: field survey, 2016)

3.3 Natural Vegetation Conservation Practices of Resettlers

Despite these burdens of the natural vegetation in the study area, organized efforts made to replace deforestation

and degradation was insignificant. But, majority (95.59%) of the respondent HHs have practiced tree planting in their home and farmlands.

Table 7: Respondents views on management of natural vegetation

Variables		HHs (%)
Management methods	Controlling over harvest	58(85.3)
	Wildfire control	1(1.5)
	Illegal farm expansion control	9(13.2)
	Total	68(100.0)

Source: field survey (2016)

4. Discussion

The LULC in the study area identified for the specified study period were woodland, forestland, grassland, wetland, farmland, water body and bare land. There were changes observed in LULC. Specifically, changes were detected, as the LULC of 2002 and 2009 compared with that of 1987; these changes depict that there were a fluctuations in particular LULC types. Accordingly, the LULC showed an increase were wet land, bare land, farmland and water bodies. In contrast, the forestland, woodland, and grassland showed a decrease. So, in border sense this study seems to agree with a study conducted in different Woreda of the same region that cover from 1987 to 2000 (Woldesemayat A. 2007). However, the present study is different in the LULC identification which comes with two more, wetland and water body. Similarly, a study from Kenya point out that seven LULC with one different, built up areas, from the current study (Cheruto MC. *etal* 2016). Thus, slight difference is real and most probably attributed to the socio-economic, spatial and temporal difference of study areas. Consequently, LULC changes should be detected and analyzed on local contexts of study areas. Similarly, the LULC of 2009 vis-à-vis 2002, there were changes that indicate a decrease or increase in dimension. The LULC, which showed increase were: woodland, bare land and farm land (Table 3). On the other hand, forest land, wetland, grass land and water bodies showed decreasing (Table5). As compare to the previous years, an absolute reduction was recorded in forestland, grassland and wet land between 2002 and 2009. Most likely, the increasing demands of extra farm land, grassland and forest product by the HHs have directly contribution to these reduction and degradations. For instance, the population of the study area has tripled in number over the last three decades (Table 2). This study is in line with the report of FAO (2016) showed that in Africa, fluctuations in population density have had costs for forest cover changes.

On top of that, according to the views of the majority respondents, the driving forces of LULC changes in the study area were farmland expansion, wildfire and fuel wood extractions (Figure7). Meanwhile about 57.4 % of respondents mentioned that major causes of LULC changes were farmland expansion, as well as fuel wood and charcoal extractions (Table 5). These major factors were commonly reported in many studies conducted in Ethiopia and elsewhere (Messay , M. & Bekure, W. 2011; Yonas *et al.* 2013; Oshore, S. 2015 and FAO, 2016). Hence, LULC of study area was facing a great challenge from agricultural expansion and fuel wood harvest.

Based on the majority (92.6%) respondents' views natural vegetation was existed in the study area during 1985. This vegetation was habitat for wildlife. However, nowadays due to habitat destruction the wild animals have declined. Almost the *Mender leaders* ascertained that in the last decade natural vegetation have been depleted. The result of this study was in line with a study by Tamrat K. (2010) argued that an impact of resettlement in *Abobo* has significantly affected natural vegetation, which leads to sever deforestation and degradation. Therefore, this implies the resettlement has contributed in changing LULC of the study area. Furthermore, regarding the current status of the vegetation; respondents have difference in their views, for instance, 1.5% of the respondent said that the vegetation is still stable while most (58.8%) said the vegetation is depleting and considerable (39.7%) respondents also responded from depleted to severely depleted (Figure 6). These variation in vies may be due to their experience or perception of the environment. However, most likely it seems as the vegetation is declining; also this was supported by the satellite image analysis (Figure2 and 3).

In connection with that, even though it is not formal and regularly activity the majority (95.59%) respondent HHs have practiced tree planting. So, it is good habit to plant trees for different purpose by implication it can lessen the pressure on the natural woodlands of the study area. Similarly, Neggalign Seifu (2013) argued that farmers' tree planting and management are essential for the products and service for sustainability of ecosystem. Hence, there is a hope to develop and use plantation forest along with conserving and protection of the remained vegetation, woodlands and natural resources.

5. Conclusion

The study reveals that there were changes in LULC at the study area in the specified study period of time. In 1987 the LULC were: forestland (58.5%), wetland (3.6%), woodland (4.4%), bare land (0.1%), farmland (2.1%) and grassland (31.4%). Whereas, from 1987 to2002 these become 49.1%, 4.8%, 2.52%, 0.2%, 13.7%, 24.48% respectively and water body (0.56%). In the same way from 2002 to 2009 changes were observed in all the LULC;

the extents were: forestland (49.10%), wetland (4.77%), woodland (5.86%), bare land (9.53%), farmland (23.17%), grassland (7.14%) and water body (0.42%) of the total land mass of the study area. Even though, the cover is decreasing, this finding indicated that the dominant land cover of the study area is forest.

The results of this study showed that trends of LULC changes over the period were fluctuating. Trends observed from 1987 to 2002 were decreased in forestland by a rate of 0.52ha, grassland at rate of 1.47ha and woodland at rate of 2.84ha per year. On the contrary, increase was observed in farmland with a rate of 37.3ha and bareland with rate of 9.50ha per year. Between 2002 and 2009, the bareland and farmland were continued to increase with a mean annual rate of (859.43ha) and (9.88ha) respectively. Nevertheless, the overall land cover of forest and grassland trend over the specified study period was declining.

This study also identified causes of LULC changes viz: farmland expansion, fuel wood/charcoal production and wildfires; farmland expansion being the principal cause. Moreover, the study disclosed that majority respondents were engaged in tree planting for their private uses and protections. Therefore, to ensure more dependable information regarding impacts of resettlement on LULC changes; a further longitudinal research is mandatory, that covers wide areas of the Woreda. Hence, based on this study the following recommendations were forwarded:-

a) Resettlement and forest preserving are incompatible, so it is essential to take into account in planning and execution of future resettlements programs.
b) Trainings should be provided to development agents and extension workers concerning ecosystem service; thereby support communities' awareness.
c) Reforestation activity should be promoted through actively involving the local peoples.
d) The *Woreda* administrators in cooperation with responsible government authorities should struggle illegal farmland expansion.
e) The federal and regional government should design environmentally friendly alternative investment options. Besides, ensure alternative fuel energy sources to reduce burden of natural vegetation.

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