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Assessment of Land Use Land Cover Change and Its Implication on Agro-Pastoral Area of Gode District, Somali Regional State, Ethiopia

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Abstract
Studying land use/land cover change plays an important role in order to understand the economic, environmental and social consequences of the changes. The current study was conducted aiming to assess the temporal land use/land cover changes, Drivers of these changes and its implications on the environment and agro-pastoral communities. Remote sensing and GIS tools were used to detect the changes in land use/land cover between 1973 and 2012. Formal household survey and key informant interviews were employed to collect socioeconomic data. Five land use/land cover categories (bare land, agricultural land, settlement, woody shrub land and grass land) were identified. The study area has experienced with severe land use/land cover changes as a result of human pressure and has an adverse impact on local communities, livestock and the environment. Bare land (22% - 51%), agricultural land (1.2 – 5%) and settlement (0.8% - 1.3%) areas have been increased whereas woody shrub land (30% - 10%) and grass land (46% - 32.7%) declined. Drought, overgrazing, erratic rainfall and charcoal production were the major causes behind the decline of woody shrub land and grass land while the increasing of bare land. Livestock and crop production are the major livelihood sources, which were seriously affected by land use/land cover changes as a result of population pressure, recurrent drought, desiccation of water points, and ecological degradation. Sustainable woodland management like conservation and rehabilitation of natural resources, control grazing (zero grazing), and proper irrigation could help to improve the natural environment and the livelihood of agro-pastorals. Looking for alternative income generation from fishery and energy alternative skims are also indispensable to reduce natural resources degraded features beyond strengthening household income sources.
Keywords: GIS, RS, LULCC, Formal Survey, Livelihood, Somali Region

1. INTRODUCTION

Studying land use/land cover change plays an important role in order to understand the economic, environmental and social consequences of the changes (Muhammad, 2008). It emerged in global environmental change research agenda from several decades ago (Bilsborrow and Ogendo, 1992; Turner *et al*., 1995; Rudel *et al*., 2005). Today, it becomes also the major concern and core environmental and social agenda (Adams *et al*, 2004; Zhang *et al*, 2007; Clavero *et al*, 2011).

Tropical forests are the most affected land use/land cover type (FAO, 2001), however these forests are important for reducing climate change impacts and increasing carbon trading (Laurance, 2007; Malhi *et al*., 2008). The major driving forces of land use/land cover change in different time period, extent and forms is associated with a number of prevailing and complex natural, socio-economic and policy forces (Geist and Lambin, 2002).

Research has shown that there had been considerable land use/cover changes in Ethiopia during the second half of the 20th century (Woien, 1995; Gete, 1997). Massive forests and wood lands were lost as a result of unsustainable extraction of wood and non-wood products for various purposes. The leading factors were human population growth, expansion of agricultural land, lack of land use policy and weak forest administration (Grepperud, 1996; Hurni, 1993; Belay, 2002; Dwivedi *et al*., 2005; Dessie and Kleman, 2007; Garedew *et al*., 2009; Kidane *et al*., 2012; Emiru *et al*., 2012). Environmental degradation processes in the form of surface runoff, soil erosion, expansion of desertification, depletion of bio-diversity, climate change disturbance of ecological balance, vegetation degradation and water scarcity are major difficulties facing Ethiopia in the past and today (Hurni. 1988; Tadesse, 2001; Dregne, 2002; Feoli *et al*., 2002; Ayele, 2005; Mohammed, 2011; Mekasha *et al*, 2014). To reveres these scenarios, the Ethiopian Government has launched series of strategies and programs including the Plan for Accelerated and Sustained Development to end Poverty (2005 to 2010), the Growth and Transformation Plan (GTP) I& II, 2010 to 2015 and 2015 to 2020, respectively.

This particular study was expected to answer major questions of land use/land cover changes for the past four

decades and the major driving forces of these changes and their implications. Therefore, the objective of this study was to generate spatial and temporal information on land use/land cover changes in agro-pastoral area of Gode district of Somali regional state of Ethiopia and provide recommendation for policy makers and resource managers, which have been a gap to manage in most dry land forests and woodland resources sustainably.

2. MATERIALS AND METHODS

2.1. Study Area

The study was conducted in "Gode" district, Somali Regional State of Ethiopia. It is located between Latitudes (5°46' -6°27' N and longitudes (43°2'-43°50' E.) (Figure1).

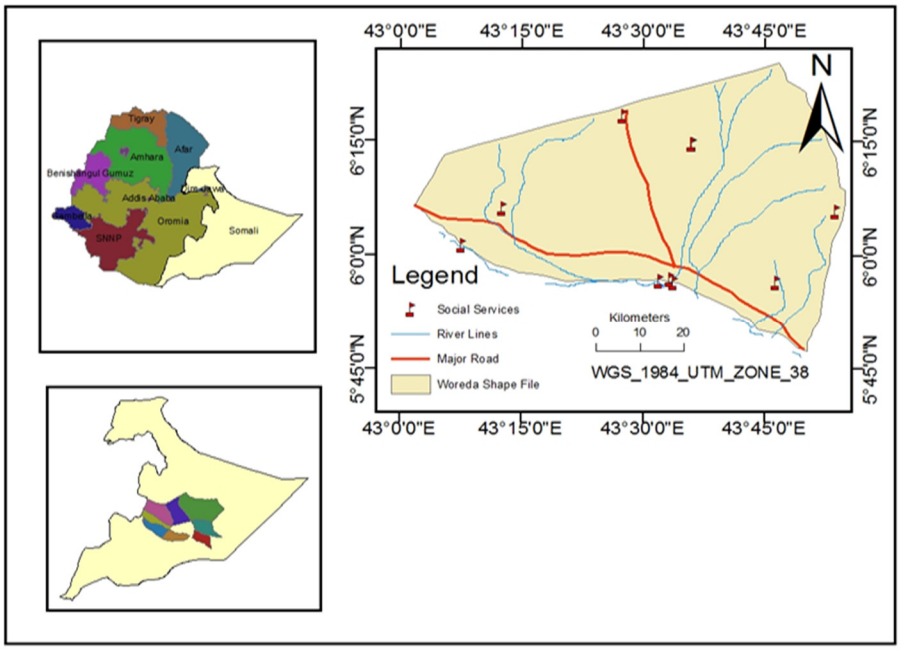

Figure 1: Location Map of the study area

The climate of this district is characterized by arid to semi-arid agro-ecological zone, which is known by recurrent drought and erratic rainfall (Ayele, 2005). The average minimum temperature was22^{0}cwhile the maximum37.8 ^{0}c.The annual rainfall amount is highly variable ranging from 0 to 301 mm. The average minimum and maximum rainfall are 22 and 34.1 mm, respectively. Gode is distinguished by an extensive flat land to gently sloping topography (Malede, 2013). The major soil types are Calcisols, Gypsisols, Leptosols, Vertisol and Fluvisol (Ayele, 2005).The area is highly denuded and exposed to abrupt runoff and wind erosion. The natural vegetation is located at the upper slopes and along river sides. They are a mixture of deciduous bush and shrub land dominated by various species like *Tamarixaphylla, calotropisprocera, parkinsonia aculeate, balanitesaegyptica, dodonaeaanguistifolia, rumexneurosus, combretummolle* (Ayele, 2005).

The main mode of production in the study area is agro-pastoralism (Ayele, 2005).Major crops grown are maize, sorghum and sesame. Trade is more attractive towards the cities of Mogadishu, Somaliland and Hargessa. Currently, Chat (*Chata edulis*) is popular cash crop importing from Diredawa and creating big market opportunities to the urban traders in Gode town. Moreover, the major economic activities of the rural communities are livestock and crop production, and forest related trade (charcoal and fuel wood sale). The district human population was estimated to be 109,584, of which 62,014 are men and 47,570 women (CSA, 2007).

2.2. Methods

Two methods were employed to capture the relevant data. Remote sensing and GIS for land use/land cover change detection (1973, 1985, 1995 and 2012),whereas socioeconomic approaches to identify the causes of land use/land cover change and their impacts on the study area.

2.2.1 Remote Sensing and GIS

Three dates of Land Sat Imageries of MSS1973; TM 1986 and ETM$^+$2012 were acquired. The 1973 image is associated with the major drought events of the 1972-1974 and the Ethio-Somalia war of the 1977-1978.The 1986 image is associated with the 1984-1985 drought events whereas the 2012 image is employed to detect the recent land use/land cover trends. The brief data description of imageries is summarized in Table 1.

Table 1: Description of Remote Sensing Data

Sensors	Producer	Path	Row	Bands	Pixel Size (m)	Observation date
MSS	USGS	165	056	4, 2 and 1	60x60	1973
TM	USGS	165	056	4, 3 and 2	28.5x28.5	1986
ETM$^+$	USGS	165	056	4, 3 and 2	28.5 x 28.5	2012

Source: www//ftp.glcf.umd.edu/glcf/Landsat/WRS2/p165/r056/L5165056_05620101204.TMGLS/

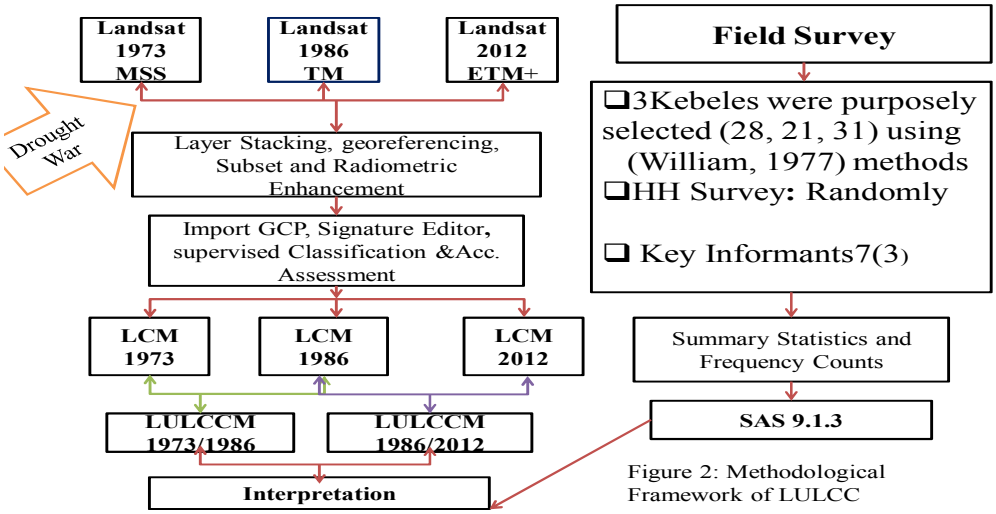

Figure 2: Methodological Framework of LULCC

Both image enhancement and geometric correction were executed (Lillesand *et al,* 2008).The details of all images were enhanced by assigning the image maximum and minimum brightness values and image-to-image registration was executed for geo-referencing strategy (Lillesand *et al,* 2008). First of all, the digital topographic map(1:50,000) of the study area, which is rectified for the Universal Transverse Mercator (UTM) Geographic Projection of datum Adindan Ethiopia was used to rectify the 2012 ETM+ image. In turn, the remaining images of 1973 and 1986 were rectified by the 2012 output image. Finally, all images were clipped with the study area shape file.

Over five hundred GPS points were collected from the various land use/land cover categories and supervised classification was employed to categorize all images using training areas. Five land use/land cover categories were identified for the purpose of monitoring and mapping (Table 2). Intensive walkthroughs were conducted to have a clear understanding of categories of land use/land cover as well to find out what types of changes are expected over time.

Table 2: Descriptions of Land use/land cover Categories

No	Land use/land cover categories	Description of each land use/land cover categories
1	Bare Land	The lands without vegetation cover which may take place in flat surface, rangelands including gullies and exposed rocks (degraded lands).
2	Grass Land	An area which is dominated by grasses over a vast communal grazing land outside tree canopy in the study area.
3	Woody Shrub Land	Mainly shrub lands together with woody vegetation are falling under this category. A Bush land which grows thickly with several stems as well as a scrap of grazing lands and may be interpreted under this category.
4	Agricultural Land	The area under crop cultivation with agro-pastoral system, scattered on farm trees, scattered rural huts, farm irrigation lines and likes.
5	Settlement	This feature in the study area is included nucleated buildings (commercial and social services, sport fields, bare grounds, and nucleated residential areas).

Source: (Parent, 2000)

The categorized land use/land cover maps may hold some sort of errors. In order to use these maps, errors must be quantitatively evaluated through accuracy assessment and intended to produce information that describes the degree of correctness (Foody, 2001). Therefore, an accuracy classification assessment was performed through the standard method (Congalton, 1991). Independent samples were identified from Google Earth and from the field. Therefore, total accuracy and Kappa statistics were computed. The final work was measured and accepted because the accuracy assessment values met the minimum 85% accuracy (Anderson *et al*., 1976).

Moreover, comparison of features and matrix analysis hasimplemented to define the land use/land cover

change detection (Lu *et al*, 2004). Areas of categories that are converted from each class to any other classes were figured out and the change directions were also determined.

2.2.2 Socio-Economic approach

The district totally contained eight kebeles, three were purposely selected for the study by considering agro-pastoral areas, security issues and transportation facilities. Physical observation, household survey and key informant discussions were arranged with selected households, Kebele councils and extension workers.

A total of twenty one key informants, seven per kebele, were selected and interviewed individually. The selection criterion of key informants were considered local knowledge about the history of land use/land cover, causes and its implications of land use/land cover changes, household heads have lived continuously in the area for more than 30 years and willingness to be interviewed. The information obtained during key informant discussions were employed in the development and modification of questionnaires for the formal household survey.

Lists of all household heads of the three selected Kebeles were collected from the district agricultural office and the corresponding Kebele and development agents. Then, formal survey was undertaken for about 5.3% households selected randomly from each kebele's number of households (Table 3). The sample size was determined based on Cochran (1977), formula as: $n = \frac{N}{1+N(e^2)}$,where n = stands for sample size, N = number of total population and e = is the level of precision.

Table 3: Sample sizes of households for respective kebeles(N=101)

No	Name of Kebele	Total population	Sample size (n)	How to drive it?
1	"Kunka"	4643	35	4643/13420*100
2	"Hididole"	3560	27	3560/13420*100
3	"Hadawe"	5217	39	5217/13420*100
4	Total	13,420	101	101

Questionnaires were developed and modified based on the information gathered during the informal survey. Moreover, questionnaires were pre-tested using few selected households to make sure the clarity of communications between interviewers and the interviewed. Enumerators were trained, and regular monitoring and also final evaluation were made during and after data collection. The household survey was then covered household characteristics, socio economic situation and vulnerability to land use/land cover change.

2.3 Data Analysis and Interpretation

The qualitative data were narrated and summarized whereas the quantitative data were cleaned, coded and analyzed using descriptive statistics and selected statistical tests. The result was illustrated in the form of table and graph using SPSS V.20 software.

3. Result

3.1 Land Use/Land Cover Dynamics in Gode district

Based on the land use/land cover analysis, five categories were classified (Table 2 and 4) and maps were generated for each image of the year 1973, 1986, and 2012. From the assessment of accuracies that measured how many ground truth pixels were classified correctly, overall accuracy of 89% and kappa coefficient of 0.84 were achieved. These values describe a strong agreement between the classification and geographical data.

In 1973 much of the district physical coverage was grass land (Table 4 and Figure 3), whereas the category of bare land overwhelmed and contained the largest share of the total area of the study in 1986 and 2012.

In the first study period (1973-1986) the woody shrub land was appeared to be vigorous; however its conversion rate to other classes was harsh. As a result, the share of bare land has been increased from 22% (86714.02 ha) in 1973 to 47.5 % (187411.58 ha) in 1986. The expansion in the extent of settlement (Figure 2) and agriculture land categories also tracked in similar trends as bare land did, and hence their area coverage in 1986 were about 1.32 and 2.56 times higher than their original cover of 1973. In contrast, the woody shrub land and grass land coverage declined by 2.8 and 1.19 times respectively.

In the second study period (1986-2012) similar pattern has been observed as the first, the area of bare land increased from 187411.58 ha (47.5%) in 1986 to 200928.98 ha in 2012 (Table 4). Similarly, settlement and agricultural land has increased by 1.32 and 2.56 times, respectively.

The land use/land cover change matrices have illustrated the converted area and directions in LULC categories (Table 5). Substantial increase has been detected in the area of bare land during the first study period, even though some portion of its original area (20328.67ha) was transformed to other categories. In contrast, remarkable loss was detected in the area of woody shrub land (112,169.69 ha) category while its gain areas (30398.38ha) from other categories did not correspondingly compensate its loss.

In the second period, bare land has continued to increase extensively and gained about 83748.94 ha of land transformed from other categories and the most contributor category to bare land was grass land (62617.165 ha) (Table 6). In turn, an exciting event in the exchange of categories was the gain of remarkable area of grass land

(49,313.81 ha) from bare land, but the balance was still unattractive.

Regarding the rate of change in LULC categories, during the first period of the study bare land and agriculture have been annually expanded by 1.96% and 0.06%, respectively (Table 7). In the second period, the rate of bare land was remarkably decreased to 0.13% while agriculture land has doubled, 0.12%. In contrast, the annual rate of woody shrub land and grass land in the first period were -1.48% and -0.55% respectively whereas in the second period the rates were remarkably decreased to -0.03% and -0.23%, respectively. In general, the overall rate of change of bare land was inversely related to the continuous decline of woody shrub land and grass land categories.

Table 4: Land use/land covers category and area coverage

LULC Categories	1973		1986		2012		Remarks
	Ha	%	Ha	%	Ha	%	
Settlement	2326.3	0.8	3815.46	1.0	5032.53	1.3	Increased
Bare land	86714.0	22.0	187411.6	47.5	200928.98	51.0	Increased
Woody shrub land	118077.5	30.0	42080.1	10.7	40975.29	10.0	Decreased
Grass land	181725.3	46.0	152654.4	38.8	126917.6	32.7	Decreased
Agricultural land	4570.4	1.2	7744.5	2.0	19851.7	5.0	Increased
Total	393706.1		393706.1		393,706.1		

Table 5: LULC Change Matrices of Gode District

Change from LULC 1973 (ha)	LULC Category	Change to LULC 1986 (ha)					
		Settlement	**Bare land**	**Woody shrub land**	**Grass land**	**Agriculture land**	**Total**
	Settlement	**575.40**	301.59	194.05	1228.61	3.25	2302.89
	Bare land	220.53	**65,158.53**	4266.34	15,353.07	488.73	85,487.20
	Woody shrub land	1676.89	65,110.39	**10806.58**	43,922.72	1459.69	122,976.27
	Grass land	1319.99	55,853.72	24879.3	**92,324.48**	4028.92	178,406.41
	Agriculture land	4.06	922.55	1058.69	1062.26	**1485.77**	4533.33
	Total	3796.86	187,346.78	41,204.96	153,891.14	7466.36	**393,706.10**

Table 6: LULC Change Matrices of Gode District

Change from LULC 1986 (ha)	**LULC category**	**Change to LULC 2012 (ha)**					
		Settlement	**Bare land**	**Woody shrub land**	**Grass land**	**Agriculture land**	**Total**
	Settlement	**613.90**	649.64	877.88	1635.87	27.70	3804.99
	Bare land	2575.32	**119,135.31**	10,783.84	49,313.81	5132.28	186,940.56
	Woody shrub land	242.05	18,104.68	**8074.50**	12,659.0	4003.25	43,083.48
	Grass land	1540.11	62,617.17	21,503.23	**59,829.03**	6717.47	152,207.01
	Agricultural land	57.91	2377.45	718.84	1014.34	**3501.53**	7670.07
	Total	5029.29	202,884.25	41,958.28	124,452.05	19,382.23	**393,706.1**

Table 7: Annual rate of changes in land use/land cover

LULC category	**1973-1986**		**1986–2012**		**Overall**	
	ha	**%**	**ha**	**%**	**ha**	**%**
1. Settlement	114.55	0.02	46.81	0.01	69.39	0.01
2. Bare land	7745.97	1.96	519.90	0.13	2928.59	0.74
3. Woody shrub land	-5845.95	-1.48	-42.49	-0.03	-1976.98	-0.51
4. Grass land	-2236.22	-0.55	-989.88	-0.23	-1405.33	-0.34
5. Agriculture land	244.16	0.06	465.66	0.12	391.83	0.10

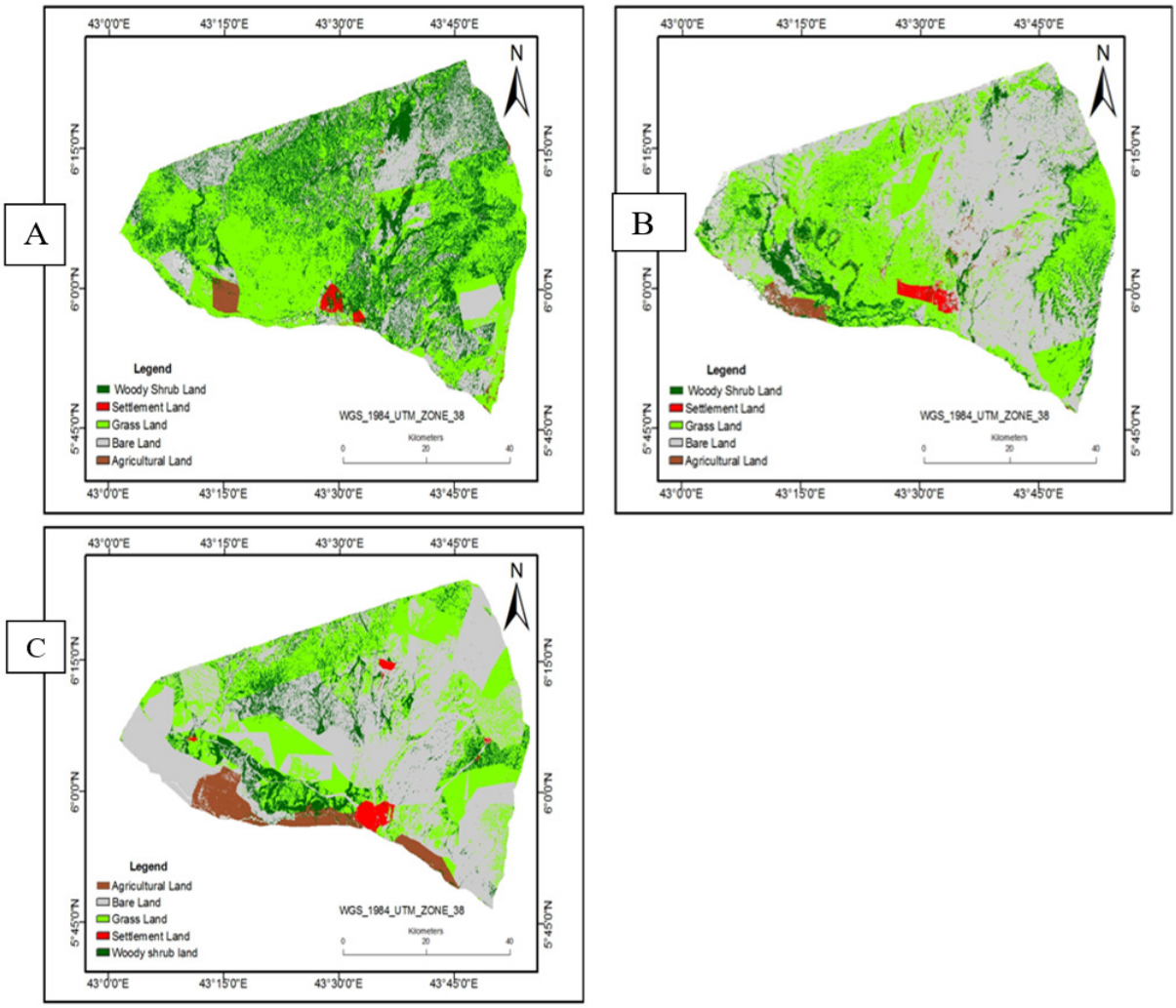

Figure3: Land use/land cover maps of the study area, 1973 (A), 1986 (B) and 2012 (C)

3.2 Socio-economic characteristics and livelihood sources of households

The respondents age was indispensable mainly to look for the trend of land use/land cover change as well the demand for labour in the households. Hence, the mean age was 52.7. The findings also showed 91.2% of sampled households were married while 58.7% of them led polygamous life.

Family size and composition were very important variables, which affect the accessibility of labour for different household activities- crop cultivation, animal herding, and off-farm. The average family size was 7.0. Unfortunately, educational status of sampled households was low, 37.5%andunable to read and write while 40% went for religious and informal education (see Table 8).

Table 8: Sampled households profile by sex, marital status, marital type and educational level (N=80)

Household Profile	Descriptions	Number	%
Sex	Male	63	78.75
	Female	17	21.25
Marital Status	Married	73	91.25
	Divorced	7	8.75
Marital type	Monogamy	47	58.75
	Polygamy	33	41.25
Educational status	Uneducated	30	37.50
	Informal School	5	6.25
	Religious School	35	43.75
	Primary School	7	8.75
	Secondary School	2	2.50
	College	1	1.25

Main livelihood sources of household's in the study area were livestock rearing (39%) and crop productions

(24%) (Table 9). Household's livestock preferences mainly based on their importance to generate adequate income and the capacity of households to retain each type. Thus, cattle was the most preferred one by 31% households followed by goat (27%) and sheep (20%) (Table 12).Whereas, as key informant interviews indicated, agro-pastorals favour to raise diverse livestock species for the benefit of feeding preferences, market value, and resistant to disease and drought.

Maize (41%), sorghum (33%) and sesame (26%) were key crops grown in the area (Table 10)

Table 9: Major household incomes as ranked by the sampled households

Major Household Income	Rank1	Rank2	Rank3	Rank4	Index
Livestock Rearing	73	5	2	-	0.39
Crop production	4	45	6	24	0.24
Labour	1	2	36	41	0.15
Selling Forest Products	2	28	35	15	0.22

Index = [4 for rank 1 + 3 for rank 2 + 2 for rank 3 +1rank 4] divided by sum of [4 for rank 1 + 3 for rank 2 + 2 for rank 3+1 for rank 4].

Table 10: Major crops grown in the study area as ranked by sampled households

Major crop production	Rank1	Rank2	Rank3	Index
Maize	49	20	11	0.41
Sorghum	12	53	15	0.33
Sesame	20	7	53	0.26

Index = [3 for rank 1 + 2 for rank 2 + 1 for rank 3] divided by sum of [3 for rank 1 + 2 for rank 2 + 1 for rank 3]

During the study, constraints towards in the main stay of respondents were identified; these are inadequate rainfall, salinity problem, lack of manure and extreme high temperature in the area (Table 11). The rainfall amount was insufficient to support crop production as stated by 32% of respondents. Salinity also a problem mentioned by 24% of them.

In addition, drought, shortage of water and animal feed together with the prevalence of animal diseases unfavourably contributed to the decreasing trend of the production of crop and livestock in the study area (Table 9).The source of animal feed supply was studded.

Table 11: Limitations in crop production as ranked by the sampled household

Constraints of crop Production	**Rank1**	**Rank2**	**Rank3**	**Rank4**	**Rank5**	**Rank6**	**Index**
Inadequate Rainfall	56	18	5	-	1	-	0.32
Lack of Arable Land	2	2	7	9	7	12	0.04
Extreme-high Temperature	1	7	15	15	15	13	0.13
Soil Erosion	7	7	4	19	9	9	0.13
Lack of Manure	-	10	13	20	15	14	0.14
Salinity Problem	13	36	15	3	8	4	0.24

Index = [6 for rank 1 + 5 for rank 2 + 4 for rank 3 +3rank 4+2rank5+1rank6] divided by sum of [6 for rank 1 + 5 for rank 2 + 4 for rank 3 +3 for rank 4+2 for rank5+1 for rank6]

Table 12: Importance of livestock as prioritized by sampled households

Livestock type	Rank1	Rank2	Rank3	Rank4	Rank5	Index
Cattle	58	13	8	1	-	0.31
Goat	15	57	5	2	1	0.27
Sheep	4	7	61	7	1	0.20
Camel	2	3	5	15	55	0.10
Donkey	1	-	2	54	22	0.12

Index = [5 for rank 1 + 4 for rank 2 + 3 for rank 3 +2 for rank 4+1 for rank5] divided by sum of [5 for rank 1 + 4 for rank 2 + 3 for rank 3 +2 for rank 4+1 for rank5]

3.3 Drivers of land use/land cover change and its implication

Of the interviewed respondents, 36% of them suggested recurrent drought in the study area was the most notable driving force behind the changes in land use/land cover. Others also reported over-grazing (31%), charcoal making (18%) and illegal felling (15%)(Table 13).In turn, these changes in LULC were resulted in the drying of important water points and reduction of vegetation cover that causes severe damage in livestock rearing in the study area.

4. Discussion

4.1. Land use/land cover Change between 1973–2012

Remote sensing data was employed to provide valuable historical patterns to express the temporal land use/land cover changes in Gode district. Land use/land cover change analysis was made over the past 39 years (1973-2012). Maps were produced and scrutinised. High values of accuracy assessments were achieved and this indicated a strong agreement between the classification and geographical data.

The area of woody shrub land and grass land were constantly decreased and mainly transformed to bare land and agriculture. For example, bare land increased throughout the study period and its annual rate of change was 0.13% during the major drought events, which occurred between 1972 and 1974 and between 1984 and 1985 in the area. Following the same trend, the human population in the district was increased considerably. Similar trends were also reported in the country and elsewhere (Gete, 1997; Dregne, 2002; Kahsay, 2004; Netsanet, 2007; Muhidin, 2009; Assen, 2011; Limenih *et al.*,2011; Zeleke and Hurni, 2011;).

The newly resettlement programme by the government have initiated most pastorals to come in to the new crop production system as confirmed by key informants and this resulted in the increment of area in agricultural lands in the expense of woody shrub land and grass land coverage. These substantial decrease in vegetation cover can be linked with human pressure in the study area and other driving forces (local agricultural investments) causing forest land to shrink in space and time. On the hand, the ever increasing human population of the district was the main cause of the increase in the area of agriculture, settlement and bare land. District experts from agricultural office were noted the ever increasing human population enhanced the demand for energy, construction wood, food, fiber and shelter.

4.2. Implications in Land use/land cover change

The woody shrub land and grass land categories in the study area showed a decreasing trend. . The study verified that recurrent drought, over grazing, charcoal making, fuel wood collection, the expansion of crop fields and settlement areas are contributed for the case. Human pressure considered the main issue. Low level of education and polygamous marriages could be some good reasons for rapid human population growth in the study area. This has confirmed by the interviewed households and the output data of remote sensing analysis and secondary data. Lemenih *et al*. (2011), Wondie *et al*.(2011) and Alemu *et al*. (2015) reported similar motives of the decrease in forest resources in North-Western Ethiopia. Key informants also recalled and confirmed that high forests have been burned during the Ethio-Somalia war (1977 to 1978) and major woodland forests in the study area were destroyed. In addition, migrants from Somalia, after the disintegration of the country, have been contributed in the destruction and degradation of woodlands. In turn, the decline of grass land and woody shrub lands currently impacted on the accessibility of animal fodder, fuel wood and construction materials in the study area. And local communities were forced to walk long distances in search of forest products for household consumption and sale. The decline of vegetation cover in the study area also aggravated the desiccation of top soil by wind and sporadic rainfall and the expansion of desertification. Obviously, the household economy mainly built from livestock sources but today not satisfactory as animal fodder and water resources are severely scarce.

In the study area, agriculture is growing gradually under weak professional support and persistent environmental challenges. The trend of crop production, as perceived by the respondents was declined. Similar report was released from Gode district agricultural office (Figure 4).As key informants; the decline trend of crop production in the study area was frustrating and adversely impacting on food security of many households.

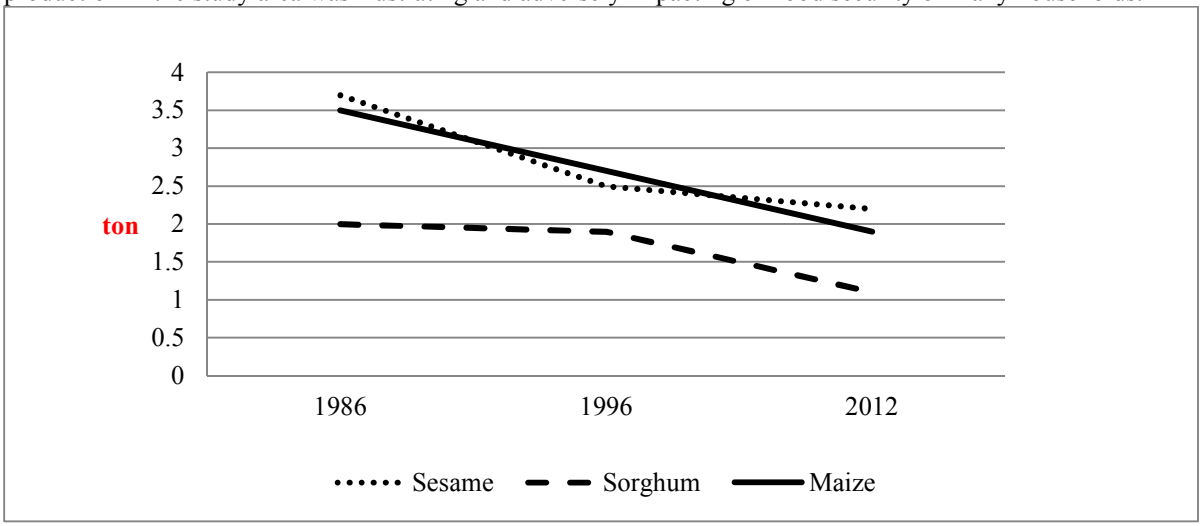

Figure 4: Average Crop Yield in ton/ha (Source by Gode District Agricultural Office, 2014)

Obviously, livestock rearing is an indispensable player of the livelihood of agro-pastoral communities in the study area. They were sources of milk, meat and cash income. Livestock play a significant role in improving food security and combating poverty (Ehui *et al.,* 1998). Moreover, the social status and ethnic intensity of the communities were also determined by the number of cattle owned (Malede, 2013). According to the interviewed households, cattle, goat, sheep, donkey and camel were the major livestock types that have been prioritized, although the raising trend of them has decreased. Drought, shortage of water and forage sources were the major justification as revealed by respondents. Muhidin (2009) in his study also concluded that range land of Gode and vegetation resources have been viciously degraded both in quality and quantity due to over grazing, drought and crop cultivation. Girmay (2003) and Solomon *et al.* (2007) also reported drought, land degradation and lack of fodder resources escalated the reduction of livestock number elsewhere in the country.

Further confirmation with respondents' showed that the average number of cattle per household since 1986 was decreased (Figure 4). According to Gode District agricultural experts and key informants, weak animals and newly born calves have been frequently crashed in association with the recurrent drought, animal disease, and shortage of water and forage. Similar finding was reported from other parts of the country (Desta and Coppock, 2004).

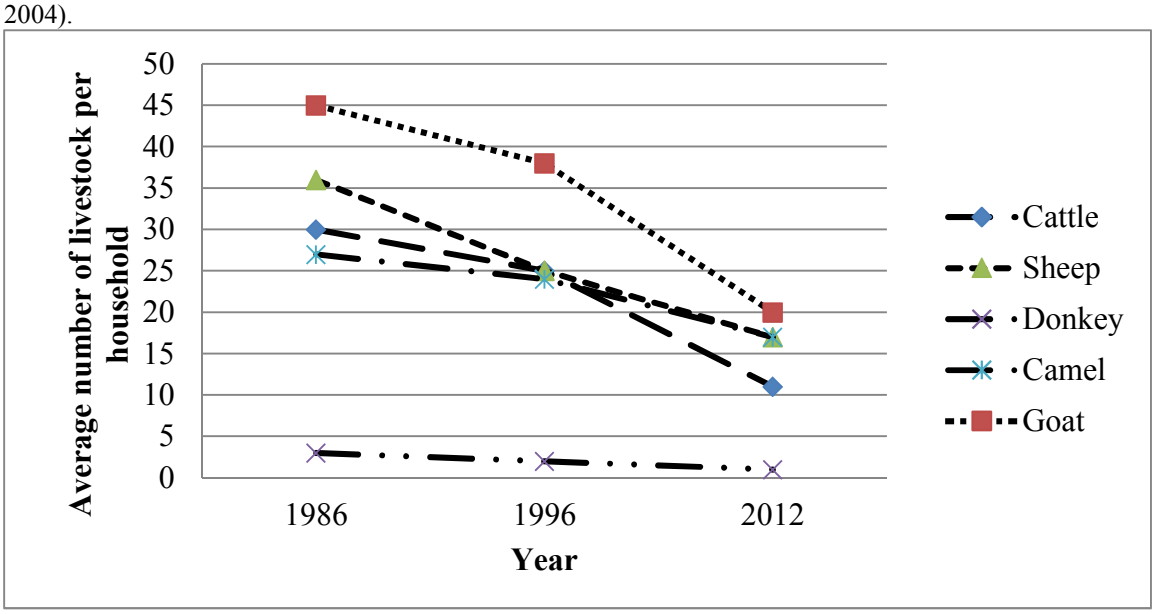

Figure 5: Average Number of Livestock Holding per Household (Source: Gode District Agricultural Office, 2014)

5. Conclusion and Recommendation

Remote sensing data shows uncompromising land use/land cover changes in the last 39 years. Grass land and woody shrub land categoriesregularly coverted to bare land and agriculture.Large human and livestock population number have exerted great pressure on vegetationresources in the form of wood products and pasture.Grass land and woody shrub land were victimized.In contrast, a significant increase in area coverage of bare land was observed in all study period. The net increase was high; drought, removal of vegetation and uncontrolled grazing were the major causes of the increment. This increment implies a clear indicator of expansion of degraded areas, soil erosions, shortage of wood products and the overall reduction of household livelihood security in the study area.

The overall decline of woody shrub and grass land may affect further the fragile environment, livestock and crop production in which agro-pastorals livelihood is relied on both for subsistence and income generation.

Sustainable woodland management like conservation and rehabilitation of natural resources, control grazing (zero grazing), and proper irrigation could help to improve the natural environment and the livelihood of agro-pastorals. Looking for alternative income generation from fishery (Wabeshebelle River) and energy alternative skims are indispensable.

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