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Research Article

Analysis of Land Use Land Cover Change Dynamics by Using GIS and Remote Sensing Techniques: A Case Study of Sensawuha-Gumara Water Shade, Ethiopia

Semegn Gelaye Berie*

Department of Geography and Enviromental Studies, Dilla University, Ethiopia

ABSTRACT

Rapid increases in population, continuing search for a farm land has induced pressure on natural resource. Sensawuha-Gumara watershed is known for its wealth of resources that offer multiple uses and services. The aim of this research is to analysis land use land cover change in the area that contributes for improved natural resource management and conservation programs. With the help of Geographical Information System and Remote Sensing land use land cover change was estimated for three study periods from Landsat satellite image of each year. It was considered that land use and land cover dynamics of Sensawuha-Gumara watershed for the past 31 years revealed that in 1988 more than 21% of the land was covered by cultivation land, forest coverage of the watershed ranges from 14% to 7% in 1988 and 2019 respectively. In 2019 classification year Sensawuha-Gumara watershed covers 46.27%, 22.18%, 7.33%, 14.02% and 10.20% of agriculture, bare land, shrub land grassland and forest land respectively. In order to make there is no responsible organization that is in charge of forest management in the area of densely populated. In order to improve land use management, the relevant natural resource management and planning of an area is essential.

Keywords: Geographical information system; Demographic pressure; Satellite

INTRODUCTION

Background of the study

The land use land cover pattern of a region is an outcome of natural and socio – economic factors and their exploitation by man in time and space. Land is becoming a threatened resource due to massive agricultural and demographic pressure. Hence, information on Land use land cover and possibilities for their ideal use is essential for the selection, planning, implementation and monitoring of land use schemes to meet the increasing demands for basic human needs and welfare. Rates of vegetation clearance are likely to be associated with the size of the human population, developments in technology, and per capita consumption of resources. Shifting cultivation causes vegetation loss in all tropical regions, and accounts for 70% of deforestation in Africa, 50% in Asia and 35% in the Americas.

The long history of agriculture along with high population pressure in the highlands of Ethiopia has depilation of the scarce natural resources. As a consequence, Ethiopia has shown considerable LULC changes during the second half of the 20th century. For instance, the natural high forests that used to cover about 40% of the highlands have been converted to cultivated land and reduced to 2.7% in less than a century [1].

A number of studies indicated that deforestation and encroachment of cultivation into marginal areas were the main causes of land use land cover change and land degradation in the highlands of Ethiopia. Due to population pressure agricultural practices in many parts of Ethiopian highlands have, more recently, expanded to the more difficult terrain such as to steeper slopes and swampy plains and traditionally untapped part of the environment. This has in turn created pressure on land, vegetation and water resources. Consequently, the highlands of the country in particular the Northern highlands are highly degraded and amongst those with high rate of nutrient depletion in sub-Saharan Africa. Such loss and depletion of soils and plant

Correspondence to: Semegn Gelaye Berie, Department of Geography and Enviromental Studies, Dilla University, Ethiopia, E-mail: Semegng@du.edu.et

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biodiversity are recognized to be the two most important forms of environmental degradation in rural Ethiopia. In addition to impact of land use and land cover change in environment, it has a high and continuous impact on crop production which leads to food insecurity. Therefore, Land use and land cover change and dynamics is central issue that requires thorough scientific investigation for sustainable land use planning and development and represents a vibrant and dynamic area of research.

Land clearing, primarily for agriculture, is perhaps the single most important cause of environmental degradation, loss of species, and depletion of ecological communities in worldwide and Ethiopia including Sensawuha-Gumara watershed area. Vegetation loss and degradation are particular problems for conservation biology because vegetations are some of the most species-rich environments on the planet [2].

Remote sensing and Geographical Information Systems (GIS) are powerful tools to derive accurate and timely information on the spatial distribution of land use land cover changes and vegetation analyses over watershed areas [3]. A past and present study conducted by organizations and institutions around the world, mostly, has concentrated on the application of LULC changes. GIS provides a flexible environment for collecting, storing, displaying and analyzing digital data necessary for change detection (Figure 1).

REVIEW OF RELATED LITERATURE

Concepts of land use and land cover change

Land is the major natural resource that economic, social, infrastructure and other human activities are undertaken on. Thus, changes in land-use have occurred at all times in the past, are presently ongoing, and are likely to continue in the future. These changes have beneficial or detrimental impacts, the latter being the principal causes of global concern as they impact on human well-being and safety. For instance, deforestation and agricultural intensification are so pervasive when they aggregate globally and significantly affect key aspects of Earth Systems. According to de Sherbinin, land use is the term that is used to describe human uses of land, or immediate actions modifying or converting land cover. On the other hand, land cover refers to the natural vegetative cover types that characterize a particular area [4].

In the past two centuries, the impact of human activities on land has grown enormously because of population increase, technological development and the requirements thereafter, altering entire landscapes, and ultimately impacting the biodiversity, nutrient and hydrological cycles as well as climate, especially in the developing world. In response to the increasing demands for food production, agricultural lands are expanding at the expense of natural vegetation and grassland. These changes in land use land cover systems have great impact, among others, on agro-biodiversity, soil degradation and sustainability of agricultural production. Throughout the world processes related to urbanization, development of transport infrastructures, industrial constructions, and other built-up areas, are severely influencing the environment, and are often modifying the landscape in an unsustainable way. In many cases land-use activities go hand in hand with substantial modifications of the physical and biological cover of the Earth's surface, resulting in direct effects on energy and matter fluxes between terrestrial ecosystems and the atmosphere. For instance, the conversion of forest to cropland is changing climate relevant surface parameters (e.g.albedo) as well as evapotranspiration processes and carbon flows. In turn, human land-use decisions are also influenced by environmental processes. Changing temperature and precipitation patterns for example are important determinants for location and intensity of agriculture. Due to these close linkages, processes of land-use and related land-cover change should be considered as important components in the construction of Earth System models [5]. The landscape concept used to map and assess LUCC allows us to explain relationships between Land-Use practices and Land-Cover patterns, and considers Land-Cover change as driven largely by Land-Use Types (Table 1).

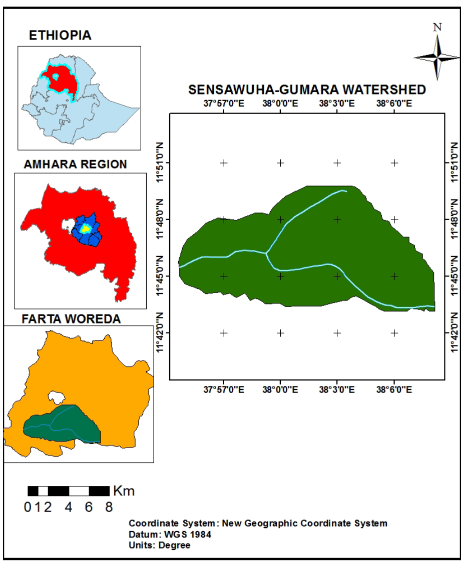

Figure 1: Map of the Study Area. **Note:** (—) Upper Gumara river; (■) Sensawuha-Gumara.

Table 1: Summery of Data and its Sources.

Image Type	Path and Row	Date of Acquisition	Resolution (meter)	Source
Landsat-TM	169/052	02/11/1988	30 × 30	USGS
Landsat-ETM+	169/052	02/04/2000	30 × 30	USGS
Landsat-OLI	169/052	01/03/20219	30*30	USGS
Topo Map			1:50,000	EMA

For different-scale LULC investigations, the landscape methodology is used on the base of remote sensing data of different spatial and temporal resolution, as well as conventional thematic maps and in-field data, to explain relationships between current Land-Use practices and land-Cover patterns.

Major causes of land use land cover change

Land cover changes may occur due to various factors, which may be broadly divided into natural and human induced or anthropogenic causes. United States Environmental Protection Agency (EPA, 1999 report), identified the general causes of land use and land cover changes, which are; natural processes, such as climate and atmospheric changes, direct effects of human activity, such as deforestation and indirect effects of human activity, such as water diversion leading to lowering of the water table. Even though, natural processes may also contribute to changes in land cover, the major driving force is human induced land uses. These human induced causes of land cover change, which are critical and currently increasing in alarming rate; and can be categorized into two broad divisions: Proximate and driving causes. The proximate causes are causes which results immediate land cover change; while driving causes are causes which drives behind the immediate causes [6].

Proximate Causes: The most significant historical change in land cover has been the expansion of agricultural lands. In the past two centuries, the impact of human activities on land has grown enormously because of population increase, technological development and the requirements thereafter, altering entire landscapes, and ultimately affecting the biodiversity, nutrient and hydrological cycles as well as climate. Today close to a third of the earth's land surface is devoted to pastures or cropland, which amounts to approximately one-half of all lands suitable for agriculture. The past century witnessed over half of the worldwide increase in agricultural lands, and in the developing world, half the land cover conversion occurred in just the past 50 years.

A documentation of global patterns of land-use change from 1700 to 2000 is presented and he reports on worldwide changes of land to crops of 136, 412 and 658 Million ha in the periods 1700-1799, 1800-1899 and 1900-1990, respectively. Conversion to pasture was 418, 1013 and 1496 million hectares in the above indicated three periods. Almost all food requirements, people of the world totally depend on land resources, except for only 3% of the food, which is coming from aquatic resources. Therefore, this important resource needs careful management for the sake of sustained ability to feeding the world population. The tropical deforestation in terms of immediate causation by multiple factors rather than single variables [7]. Also he points out that agricultural expansion as the most prominent proximate cause, which is coupled with wood extraction and infrastructure expansion (Figure 2).

In Ethiopia, the proximate causes of land cover change particularly natural forest destruction are agricultural expansion, both through shifting cultivation and the spread of sedentary agriculture; the demand for increasing amounts of construction material, fuel wood and charcoal. Charcoal production is common place in the arid, semi-arid and dry sub humid parts of the country. Using fire to fumigate bees and to facilitate hunting is also very common, which results forest fire and destructs natural forests (Table 2).

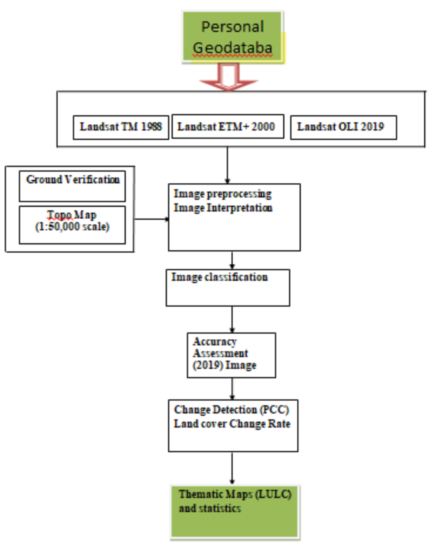

Figure 2: Methodological Flows for Land Use Land Cover Change Analysis.

Table 2: Description of Land Use Land Cover Type in the Study Area.

Land type	Description
Crop Land	Areas allotted to rain fed crop cultivation both annuals and perennials, mostly of cereals in subsistence farming and the scattered rural settlements included within the cultivated fields.
Forests	Areas covered by trees forming closed or nearly closed canopies; Forest; Plantation forest; Dense (50-80% crown cover) predominant species like Equilplus procera.
Bush or Shrub land	Land covered by small trees, bushes, and shrubs, in some cases mixed with grasses; less dense than forests
Grass land	Areas of land where small grasses are the predominant natural vegetation. It also includes land with scattered or patches of trees and it is used for grazing and browsing
Bare Land	Are parts of the land surface which is mainly covered by bare soil and exposed rocks.

Underlying or Driving Causes: The five major factors for driving causes are economics, institutions, technology, culture, and demographic change. Based on the study economic factors are present in 81 percent of all cases, and clearly dominate the underlying causes. Commercialization and the growth of mainly timber markets as well as market failures are frequently reported to drive deforestation. It is striking that combinations of synergetic drivers rather than single drivers at aggregate level are associated with tropical deforestation.

Institutional factors such as policies on land use and economic development, transportation, or subsidies for land-based activities, lack of adequate governance structures, land tenure and property rights issues, issues of open-access resources and squatting by landless farmers are the major driving causes of cover change.

Technological factors in the wood and agriculture sectors, like technological changes in the forestry sector in the form of chain saws and heavy equipment, and in wood processing, agro-technological factors, modification of farming systems through intensification and extensification are playing significant role in cover change (Figure 3).

Cultural factors include attitudes and perceptions such as unconcern for forests due to low morale and frontier mentalities, lack of stewardship values, and disregard for "nature", profit-orientation of actors, traditional or inherited modes of cultivation or land-exploitation, and a commonly expressed sentiment that it is necessary to clear the land to establish an exclusive claim [8].

Demographic factors such as natural increase or immigration is another driving factor. Most of its explanatory power tends to be derived from interlinkages with other underlying forces, especially in the full interplay of all five major drivers. Many cases did not specify beyond broad notions of population pressure and growth, but those that tended to identify immigration more frequently than natural increase.

Land use and land cover change studies in Ethiopia

As 85% of the total population live in rural areas, 85% of the economy is dependent on agriculture with traditional farming (plough), the growth of urban population from time to time, with an increase of migration of rural population to cities for better life and the encouraging land lease policy to investors become important to study land use and land cover changes and its impacts in Ethiopia to design management and monitoring policies.

Researches on land use and land cover change in Ethiopia discussed in different regions and disciplines depending on the availability of data and tools to perform analysis. However, most of the studies have focused on deforestation, river catchments and watersheds, natural ecosystems and forests as well as the associated consequences. The study also investigated a series trend of land degradation resulted due to the expansion of cultivated land on steep slopes at the expense of natural forests. A significant decline in natural vegetation cover, however, there was an increase of plantation in Beressa watershed, in the central highlands of Ethiopia between 1957 and 2000. Also showed a significant decrease of natural woody vegetation of the Koga catchment since 1950 due to deforestation in spite of an increasing trend in eucalyptus tree plantations after the 1980's. A reduction of natural vegetation cover, but an expansion of open grassland, cultivated areas and settlements in Gish Abay watershed, north-western Ethiopia (Table 3).

A significant conversion of natural vegetation cover to cultivated land between 1957 and 1986 in Derekolli catchment of the South Wello Zone of Amhara Region, Ethiopia. Investigated a significantly reduction of natural forest cover and grasslands, but an increase of croplands between 1973 and 2012 in Munessa, Shashemene landscape of the Ethiopian Highlands.

A similar study by Tekle and Hedlund reported an increase of open areas and settlements as the expense of forests and shrub land between 1958 and 1986 in Kalu District, Southern Wello, Ethiopia. The impacts of land use and land cover changes on the hydrological flow regime of the watershed have been reported in many studies. The impact is through altering the balance between rainfall and evaporation and the runoff response. Muluneh and Arnalds reported an increment of a direct runoff Gum-Selassa and Maileba catchments annually from 1964 to 2006 in both catchments due to long-term changes of land use and land cover. It was also reported that land use and land cover changes affected the stream flow of Gilgel Abbay watershed, Ethiopia. His study identified that there was an increase of stream flow by 16.26 m^3/s during wet months and decreased by 5.41 m^3/s from 1986 to 2001 as a consequence of conversion of cultivated land. There was a dramatic expansion of agricultural land followed by bare land however, shrub land, forest land and grass land shows a reduction in aerial coverage. On the other hand in between 1985 to 2003, the same is true for agricultural land, bare land, shrub land and forest land but grass land shows a slight expansion in the aerial coverage due to the conversion of forest and shrub land to grass land in Borena Woreda of South Wollo Highlands of Ethiopia [9].

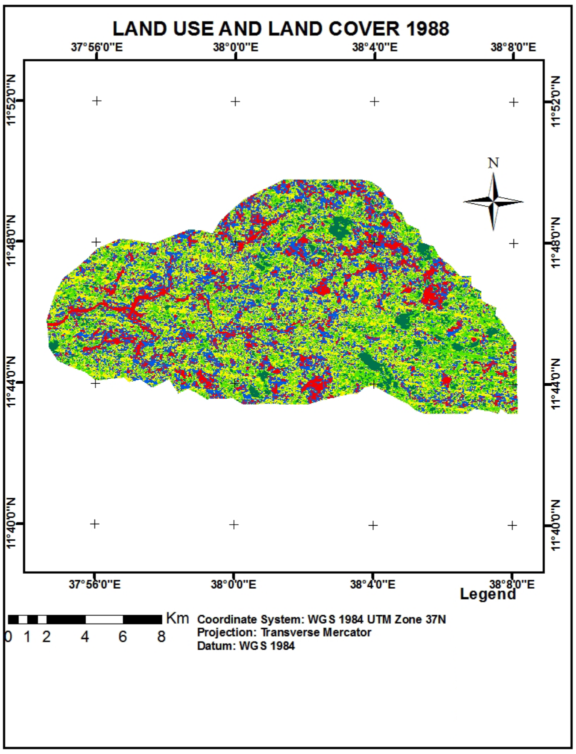

Figure 3: Land Use Land Cover Maps of 1988. **Note:** ( ) Agriculture; ( ) Bare land; ( ) Shurb land; ( ) Grass land; ( ) Forest.

Table 3: Amount of the Land Use Land Cover Classes for the Three Periods.

S.No.	Land cover Class	1988		2000		2019	
		Area (ha)	Percent (%)	Area (ha)	Percent (%)	Area (ha)	Percent (%)
1	Agriculture	4427	21.14	7195	34.37	9690	46.27
2	Bare Land	2381	11.37	4521	21.54	4645	22.18
3	Forest	3043	14.53	2161	10.34	1535	7.33
4	Shrub Land	7251	34.62	4210	20.1	2936	14.02
5	Grass Land	3841	18.34	2856	13.65	2137	10.20
	Total	20943	100.00	20943	100.00	20943	100.00

Major land cover changes have also occurred at the local level for all land types. For instance, a significant increase in cultivated land at the expense of forestland was found to have occurred between 1957 and 1995 in the Dembecha area, northwest Ethiopia. Kebrom and Hedlund reported increases in open area settlements at the expense of shrub lands and forests between 1958 and 1986 in the Kalu area, Northcentral Ethiopia. On the other hand, deforestation trend was reduced through appropriate interventions by promoting planting of local tree species in the Chemoga Watershed, Blue Nile basin, Ethiopia between 1957 and 1998. Similarly, concluded that in the Beressa watershed (central Ethiopia), there were substantial land use changes in the area during the second half of the 20th century.

Moreover, Bezuayehu and Geert reported that the decline of natural forests and grazing lands was due to the conversion to croplands between 1957 and 2001. In this respective period, crop lands increased from 403km^2 in 1957 to 607 km^2 in 2001- a net increase of 51% in Fincha'a watershed. In addition, in Chirokella Micro-watershed of South Eastern Ethiopia, the dense forest covered decreased by over 80%, the moderately forested land was completely transformed into other land use and land cover systems, cultivated and settlement lands increased by 62.8% and bushes and degraded land cover categories showed increasing patterns of 49.9% and 100%, respectively between 1966 and 1996 (Figure 4).

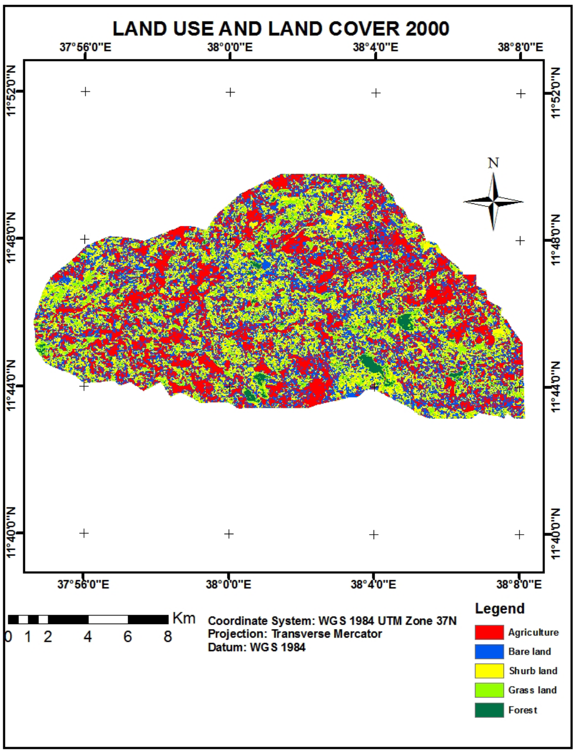

Figure 4: Land Use Land Cover Maps 2000. **Note:** (■) Agriculture; (■) Bare land; (■) Shurb land; (■) Grass land; (■) Forest.

Land use and land cover changes in response to urban growth also reported by some studies that, an expansion of urban areas annually from 1957 to 2009 has been identified by in the urban fringe of Bahir Dar area as a consequence of increasing population. A significantly increase of urban areas from 34% in 1986 to 51% in 2000 in Addis Ababa, Ethiopia by the expense of agricultural land and vegetated areas driven by population growth. A significant urban growth for the last 3 decades as a result of increase in population of Ethiopian highlands. Muluneh and Arnalds cited on Haile that unsustainable growth of population contributed to environmental degradation especially in most populated areas such as in Ethiopian highlands.

From most of these studies it is evident that population pressure is one of the major drivers of land use and land cover changes through destruction of forest and vegetation cover for the purpose of agricultural and urban expansion as discussed. Population growth coupled with migration from rural to cities leads to further expansion of urban areas at the expense of vegetation cover which is commonly practiced in western highlands of Ethiopia according to study.

Use of remote sensing and GIS for land use land cover change

Also the merging of remote sensing, GIS and visualization techniques was applied to demonstrate the potential for realistic computer visualizations depicting the dynamic nature of forested environments. Scientific visualizations can aid in environmental and forest management decision making as a support tool and in landscape ecology to relay the findings of studies. While visualization software and methods have already been developed to recreate natural landscapes, little has been done to investigate the potential for illustrating land cover change through temporal data acquired from the real world. Satellite imagery provides an excellent source of data for performing structural studies of a landscape.

Simple measurements of pattern, such as the number, size and shape of patches, can indicate more about the functionality of a land cover type than the total area of cover alone. When fragmentation statistics are compared across time, they are useful in describing the type of land cover change and indicating the resulting impact on the surrounding habitat. The areas of land cover change between images can also be compared to landscape characteristics to determine if change is more likely to occur in the presence of certain environmental and human induced factors. This level of classification detail presents opportunities for analyzing land cover change patterns at a structural scale (Table 4).

The importance of techniques and methods of using satellite imageries as data sources have been developed and successfully applied for land use classification and change detection in various environments including rural, urban, and urban fringes. Satellite-based remote sensing technology cannot yet be used to monitor land use at the level of accuracy required by developers, engineers and planners interests. The use of remote sensing for biodiversity monitoring through direct and indirect approaches that basis on individual organisms and through reliance on environmental parameters as proxies respectively. Therefore, the use of remote sensing satellite data for land use land cover change detection and monitoring is widely applying throughout the world with the aid of technological improvement that provides high resolution

Table 4: Rate of Land Use Land Cover Change.

Land use Land cover Class	1988-2000		2000-2019		1988-2019	
	Area change (km^2)	Rate of change (km^2/yr)	Area change (km^2)	Rate of change (km^2/yr)	Area change (km^2)	Rate of change (km^2/yr)
Agriculture	27.68	2.3	24.95	1.66	52.6	3.5
Bare Land	21.4	1.78	22.64	1.5	22.64	1.51
Forest	-8.82	-0.74	-15.08	-1	-15.08	-1.01
Grass Land	-52.41	-4.37	-43.15	-2.88	-43.17	-2.88
Shrub Land	-20.07	-1.67	-17.04	-0.11	-17.04	-1.14
Total	-52.22	-2.7	-27.68	-0.83	-0.02	-0.02

images.

Three satellite imagery systems which could supply the required data were the Land sat Multi-Spectral Scanner (MSS); Land sat Thematic Mapper and SPOT MSS. While satellite imagery is a flexible form of data for electronic processing, indicated its two practical difficulties. Firstly, the need for reasonably cloud-free coverage means that a set of images spanning several seasons may be required. A second difficulty arises as a consequence of the first. The boundaries of neighboring scenes, having been captured at different times of year and under different atmospheric conditions, can be difficult to match.

A remote sensing system using electromagnetic radiation has four components: a source, interactions with the Earth's surface, interaction with the atmosphere and a sensor. The amount and characteristics of radiation emitted or reflected from the Earth's surface is dependent and different based upon the characteristics of the objects on the Earth's surface. Therefore, different objects on the Earth interact with radiation at distinct way and knowledge of this interaction is fundamental issue on classification of satellite image. Therefore, based on this reflectance variation of Earth surface objects distinguishing and classification land use land cover is possible.

Classification of a satellite image can be achieved by supervised or unsupervised procedures. A supervised approach relies on the prior specification of training areas by the analyst, in which major land cover types are delimited manually as a key for electronically classifying the image. It needs the knowledge of study area in advance. In contrast, no such visual interpretation is involved in an unsupervised method. It uses automated methods to cluster reflectance values in order to derive a required number of land classes and their associated spectral signatures.

METHODOLOGY

Description of the study area

Location: Sensawuha-Gumara watershed is found in Amhara Region, South Gondar Zone, Farta Woreda about 14 km far from Debre Tabor town. The total area of this watershed is 20943 hectares (209.43 sq.km). All part of the watershed is found in Farta and the watershed has 9 kebeles namely Kualih, Talmido girariys kuskuam, Mahidere mariamena giraria, Meskel Tsion, Huletu Semena, Mindero derem askuma, Huletu Kanat, Shirina Kisnat, Marnat and Siras. The geographical location of Sensawuha-Gumara watershed is 37°55'30" to 38°08'00" East and 11°49'30" to 11°43'30" North.

Research methods and materials

Data and sources: Different researchers have used the satellite imageries for classification of landscapes for different applications. Satellite imageries and ancillary data have been collected in order to identify historical and recent land-use/land cover. The image data used for this study were Landsat TM 1988, ETM+ 2000 and OLI 2019 and Topographic maps at the scale of 1:50,000 were purchased from the Ethiopian Mapping Agency (EMA). Digital Elevation Model (DEM) of the study area, with 30 meter resolution and horizontal and vertical absolute precision of 20 m and 16 m respectively from the Shuttle Radar Topography Mission (SRTM) of NASA. This data were used to observe the relationship between topography, mainly altitude and slope for vegetation change by using DEM and ArcGIS 10.4 software.

Satellite images: Landsat TM satellite data have spatial resolution of 30 meters and includes two middle infrared and one thermal channel. These high-resolution scanners have seven spectral bands and cover a 185/185 km area. For the study area, a single scene path/row 169/052, taken on February 1988 by TM sensor on board was used.

Landsat ETM+: Landsat-7, which carries on the Enhanced Thematic Mapper Plus (ETM+) instrument, was launched on April 15, 1999 as part of the global research program of NASA's Earth Science Enterprise. The sensor has six spectral bands in the visible, near-infrared, and shortwave infrared regions of the electromagnetic spectrum (at 30 m spatial resolution), one thermal infrared band (60 m and 120 m spatial resolution products), and one panchromatic band (at 15 m spatial resolution). For this study a single scene path/row 169/052) was used that had been acquired by this sensor in January 2000 image.

Materials: The materials used during the study include Global Positioning System (GPS) for collection of ground control points in field verification. Different Software has also been used in the study including ArcGIS 10.4 and ERDAS IMAGINE 2014.

RESULTS AND DISCUSSION

The major land use and land cover types shown by the maps of 1988, 2000, and 2019 include agricultural land, grassland, shrub or bush land, forest, and bare land. As indicated the greatest share of land use and land cover from all classes is shrub land, which covers an area of 7,251 hectares (ha), contributes 34.62% of the total area. Agricultural land and grass land cover an aerial size of 4,427 ha (21.14%) and 3,841 ha (18.34%) respectively, whereas the aerial coverage of forest and bare land is 3,043 ha (14.53%) and 2,381 ha (11.37%) from the total area of the Woreda. This shows that 67.49% of the total area of the district was covered by shrub, forest and grass land in 1988 and the remaining 32.51% was covered by agricultural and bare land, which indicates that much of the area was covered by green vegetation in 1988 (Figure 5).

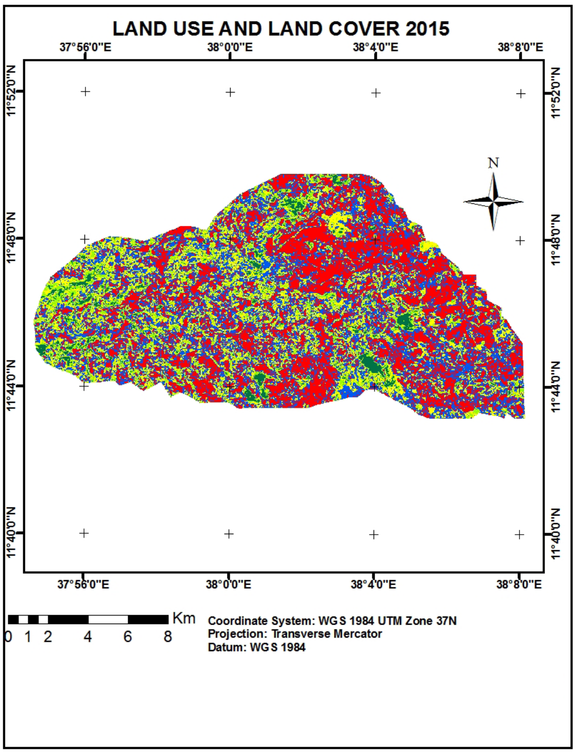

Figure 5: Land Use Land Cover Maps 2019. **Note:** ( ) Agriculture; ( ) Bare land; ( ) Shurb land; ( ) Grass land; ( ) Forest.

In (2000) after 12 years, the Shrub land dramatically declined to 7,1953 ha or 34.37%, forest and grass land also declined to 2,161 ha (10.34%) and 2,856 ha (13.65%) respectively. Despite its relative large size, agricultural land increased to 7,195 ha (34.37%) and bare land has experienced a small increment during this period that is 4,521 ha (21.54%). Relatively the change in the area coverage of the different land use/land cover classes during this period was slow except agriculture and bare land.

After 15 years in (2019), the agricultural land coverage units was about 9,690 ha or 46.27% of the total area and bare land accounts about 4,645 ha or 22.18%. Land category under forest, shrub land and grassland accounted around 1,535(7.33%), 2,936 ha (14.02%) and 2,137 ha (10.20%), respectively.

The results of land-use land cover map show that the area of forest, grass land and shrub land declined in both periods. The rate was greater in the grass land than shrub land and forest. Agriculture and bare land show general trend of increase in both periods. This is just the general impression of land cover dynamics based on comparison of individual land cover maps.

Generally, the following major important changes were observed in the period considered. Firstly, deforestation in all areas especially on the upper slopes has been occurred. Secondly, the forest in the low and mid-highland areas has been converted to other land cover classes particularly to bare land and agricultural land. Thirdly, agricultural land and bare land has been found to be expanded and intensified.

Most studies indicated that in the Northern highlands, where the study area is found, due to high population growth coupled with serious land degradation and low productivity of steep slopes and marginal lands such as water logged plateau and basins were brought under cultivation and vast areas of forest and woodland were cleared. The land-use and land-cover changes and socioeconomic dynamics have a strong relationship; as population increases the need for cultivated land, grazing land, fuel wood; settlement areas also increase to meet the growing demand for food and energy, and livestock population. The results of this study have also found to be consistent with the above findings.

Due to the fact that, expansion of farmlands and intense deforestation were directly linked to population growth observed in the study area. Rise in human population in this period had in turn been the result to get additional land for cultivation and settlement through vegetation degraded. On the other hand, the vegetation had been the source of wood for construction and other domestic uses like fuel.

Accuracy assessment

The fact that accuracy assessment is so important that it tells us to what extent the truth on the ground is represented on the corresponding classified image, More than 184 sample training sites have been collected and it has been here done for 2019 land use land cover classification based on the ground truth taken for each categories. From agriculture, forest, shrub land, grassland and bare land about 59, 20, 34, 36 and 35 respectively. In order to perform classification accuracy assessment, it is necessary to compare two source of information that is the remote sensing driven classification map and what we call reference test information. To assess the classification accuracy, confusion matrix was used. Confusion matrix is strong in that it indicates the nature of classification error (ITC, 2001). Confusion matrix was generated by crossing the two maps generated using the training sets and the independent data.

The confusion matrix was generated by giving the ground truth points from different sources including collected points and topographic map in to the ERDAS IMAGINE 2014 software with interpreter main icon and utilities and finally with accuracy assessment functions.

Finally, overall classification accuracy of 80.9% and overall Kappa statistics of 75.6% was achieved, which is feasible for further application. The reasons for the errors may include the similarity of reflectance of cultivated areas and bare lands. Moreover, there is also an error in the classification of areas covered by forest, shrub land and grass land due to the reflectance proximity. Eventually, the fast land use/land cover dynamic nature of the area may introduce the classification error.

CONCLUSION

An accurate knowledge of analysis land use land cover dynamics is important for effective and sustainable land resource management. Though the Sensawuha-Gumara watershed is potentially rich in natural resource, it is at very high risk due to vegetation degradation caused by continuous unsustainable land use land cover practices aggravated by continuous deforestation and other. Now more than ever, knowledge of the trends of land use land cover change and their factor, and their impact on such fragile environment must be a priority issue in order to devise effective control mechanisms and suitable land management practices.

The finding of the land use land cover change and dynamics in the Sensawuha-Gumara watershed over the last three decades showed that agricultural land at a rate of 3.5 km^2 per annum, bare land at a rate of 1.51 km^2 per annum and settlements have been found to be expanded and intensified at the expense of forests, grassland and shrub lands.

REFERENCES

1. Al-Shalabi MA, Mansor SB, Ahmed NB, Shiriff R. GIS based multicriteria approaches to housing site suitability assessment. InXXIII FIG congress, shaping the change, Munich, Germany. 2006;8-13.
2. Minale AS. Retrospective analysis of land cover and use dynamics in gilgel abbay watershed by using GIS and remote sensing techniques, Northwestern Ethiopia. Int j geosci. 2013; 4(07):1003.
3. Amsalu A, Stroosnijder L, de Graaff J. Long-term dynamics in land resource use and the driving forces in the Beressa watershed, highlands of Ethiopia. J Environ Manage. 2007; 83(4):448-459.
4. Bekele M. Forestry outlook studies in Africa (FOSA). Country Report: Ethiopia. 2001.
5. Bewket W, Abebe S. Land-use and land-cover change and its environmental implications in a tropical highland watershed, Ethiopia. Int J Environ Stud. 2013;70(1):126-139.
6. Brown DG, Walker R, Manson S, Seto K. Modeling land use and land cover change. 2012; 395-409. Springer.
7. Byron N, Arnold M. What futures for the people of the tropical forests? World Dev. 1999;27(5):789-805.
8. Csaplovics E. Methoden der regionalen fernerkundung: Anwendungen im sahel Afrikas. Springer. 2013.
9. Legesse D, Vallet-Coulomb C, Gasse F. Hydrological response of a catchment to climate and land use changes in tropical Africa: case study South Central Ethiopia. J Hydrol. 2003;275(1-2):67-85.