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Land Use Land Cover Change within Kessem watershed, Central Rift Valley of Ethiopia: The Case of Minijar-Shenkora Woreda

Eshetu Teklu[*1] **and Dubale Dagne**[2]

[1] *Department of Geography and Environmental studies, Dilla University, Ethiopia*
[2] *Department of History, Dilla University, Ethiopia*
[*] *Corresponding author, Email: abcdeshetu2019@gmail.com; P.O.Box. 419, Dilla, Ethiopia*

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Abstract

Land-use land covers are not static rather they are dynamic in response to various driving forces. The main objective of this study was to assess land use land cover changes of Minjar-Shenkora Woreda during the three decades (1987–2017). Three different Landsat satellite data sets (Landsat 5 TM, 7 ETM+ and 8 OLI-TIRS) of 1987, 2003 and 2017 were used from the United States Geological Survey (USGS), respectively. The data were processed, and the land use land cover classes were also identified using ERDAS Imagine (ver. 2014) and Arc GIS (Ver.10.3). The study revealed that forest and shrub lands have diminished from 32885 hectaresto 16034 hectaresand 61939 hectaresto 32530 hectares, respectively while agriculture and bare lands have increased from 52524 hectaresto 90859 hectaresand 3018 hectares to7441 hectares, respectively. Moreover, built up areas also have encroached farm lands and bush lands. Over utilization of wood for fuel and construction materials, human induced fire and uncontrolled grazing, population and socio-economic changes are the main causes of the land use land cover changes. On the other hand, people's livelihood vulnerabilities and degradation are the main outcomes of the land use land cover changes. Thus, the concerned bodies of the Woreda along with the communities should discuss and formulate law that can help to protect and preserve natural vegetation, expansion of farm lands to marginal lands as well as prevent invading of farmlands by urban horizontal expansion.

Keywords/Phrases: Land use/land cover classes, land use land cover change, Landsat satellite image, Marginal land and urban horizontal expansion

1 Introduction

Land is the fundamental resource for housing, food production and infrastructure development. It provides substantial economic and social benefits. Land use land cover change is necessary and essential for economic development and social progress. However, it does not come without costs. Conversion of farmland and forests to urban built-up areas, for example, reduces open space, amount of land available for food and timber production (Wu, 2008). That means land use land cover changes are practices and strategies for using natural resources. From the time when humans have controlled fire and domesticated plants and animals, they have cut and cleared forests to meet their basic needs. Deforestation, horticulture expansion and increasing of built-up areas are putting tremendous pressure on the forest resources. Agriculture land has expanded into forests, savannas, and steppes in all parts of the world to meet food and fiber demands. Historically, humans have increased agricultural output mainly through (extensification) by converting woodlands, shrub lands and forests into agriculture lands (Lambin *et al.*, 2003).

Land use land cover changes are root cause for local, national, regional and global level of environmental changes, which can in turn, global cli-

matic change. Desertification, acidification, climate change, sea-level rise, greenhouse effect and biodiversity loss are some major environmental problems resulted from land use land cover changes (Briassoulis, 2000). These environmental problems have significant impacts on food security, human vulnerability, health and safety and even on the viability of the earth. However, the most important thing is that, with few exceptions, it is human practices and not nature which has brought these changes. Deforestation, expansion of urban areas and agricultural lands, and other human activities have substantially changed the Earth's landscape. Such disturbance of the land affects ecosystem processes and services which can have wide–ranging and long–term consequences. Land use and land management practices have an important impact on natural resources including water, soil, air, nutrients, plants, and animals (Wu, 2008). Agricultural expansion, wood extraction, infrastructure expansion and other human activities are causes for the change of the physical state of land use land cover (Geist & Lambin, 2001). Urbanization, expansion of built up areas, expansion of agricultural lands, political as well as socio-cultural factors are also driving forces for land use land cover changes (Haroon & Mohdi, 2012).

Socio-economic changes, technological advancement, demographic changes, political factors like state policies and practices are forces which have created pressure on natural resources such as land, forest and water. In Ethiopia, land use land cover patterns experience drastic change: severe loss of woodlands, grasslands, wetlands and substantial increases farmland and built-up lands (Efrem, 2010; Kefyalew *et al*., 2015). Assessment of land use land cover changes in South Central Ethiopia displayed that the last forty years was a period of agricultural expansion at the expense of forest, woodland, and grassland (Kefyalew *et al*., 2015). On the other hand, rural-urban built-up developments have expended significant amounts of farmland, grassland, woodlands and wetlands (Hualou *et al*., 2008). The expansions of urban and rural settlements have occurred mainly at the expense of farmlands, woodlands and grasslands. Urban-rural built-up area expansion causes for diminishing of agricultural lands. The conversion of agricultural lands to built-up areas occurred mostly at the urban peripheries. With urban horizontal expansion farm households who reside at the fringe of a town have been enforced to miss their farm lands and being relocated to new areas where agricultural lands are available or to change their livelihoods (Gerald & Olufunke, 2011). Hence, the land use/land cover changes have relation with people's livelihood.

Population pressure, declining household farm size, declining household income, deterioration of the remnant forest and worsening land degradation are the major problems prevalent in Kessem watershed, particularly Minjar-Shenkora Woreda. Moreover, the lack of fodder, scarcity of wood for various purpose, loss of forest resources, loss of biodiversity and decline of soil fertility and farm produce related to environmental degradation are prevailing in the study area. Lack of livelihood security has forced farmers to use shrub lands, grasslands, grazing lands for farmlands to cope with recurrent household shocks. Moreover, the rapid urban horizontal expansions due to the rise of population and economic growth have caused the conversion of farm land to built-up areas.

The key fundamentals for the better use of land are acquisition of information on existing land use land cover patterns and change through time. Having information about the present distribution land use land cover proportions and change is required for legislators, planners, state and local government officials for land use policy, for identifying future pressure areas and to predict future demands. However, there is lack of reliable and accurate information about land use land cover change in Ethiopia in general and in my study area in particular. Thus, the main objective of this study is to assess land use land cover changes during the past 30 years (1987 to 2017) within Minjar-Shenkora Woreda.

Therefore, the specific objectives of the study are to:

- generate the patterns of land use land covers of the study area of 1987, 2003 and 2017
- compare the current and the previous land use land covers of the study area
- find out the causes of land use land cover changes of the study area
- identify the impacts of land use land coverc hanges within the study area

2 Materials and Methods

2.1 Location of the Study Area

The study was conducted within Amhara Region, North-Shoa Zone particularly Minjar-Shenkora Woreda. The study area includes urban and rural settlements, farmlands, forests, shrub lands, rivers and road infrastructure. Minjar-Shenkora Woreda borders with the Woreda of Hugeremariam to the north, Boset and Adama Woredas to the south, Fentale Woereda to the east, Ginbichu and Lume Woredas to the west and Berehet Woreda to the northeast. Almost half of its area is situated in the floor and escarpment of the rift valley. Plain and undulating terrain are the dominant topography in the Woreda, which accounts 84%, and 14%, respectively and the rest 2% is mountainous landscape. The total area of the Woreda is about 150993 hectares (1510 square kilometers). Nearly 25%, 70% and 5% of the landscape of the Woreda is classified under Qolla, Woinadega and Dega agro-ecological zones, respectively see figure 1. Based on the 2007 national census conducted by the Central Statistical Agency of Ethiopia (CSA), the Woreda has a total population of 128,879, of whom 66,918 are men and 61,961 women; 12,237 or 9.49

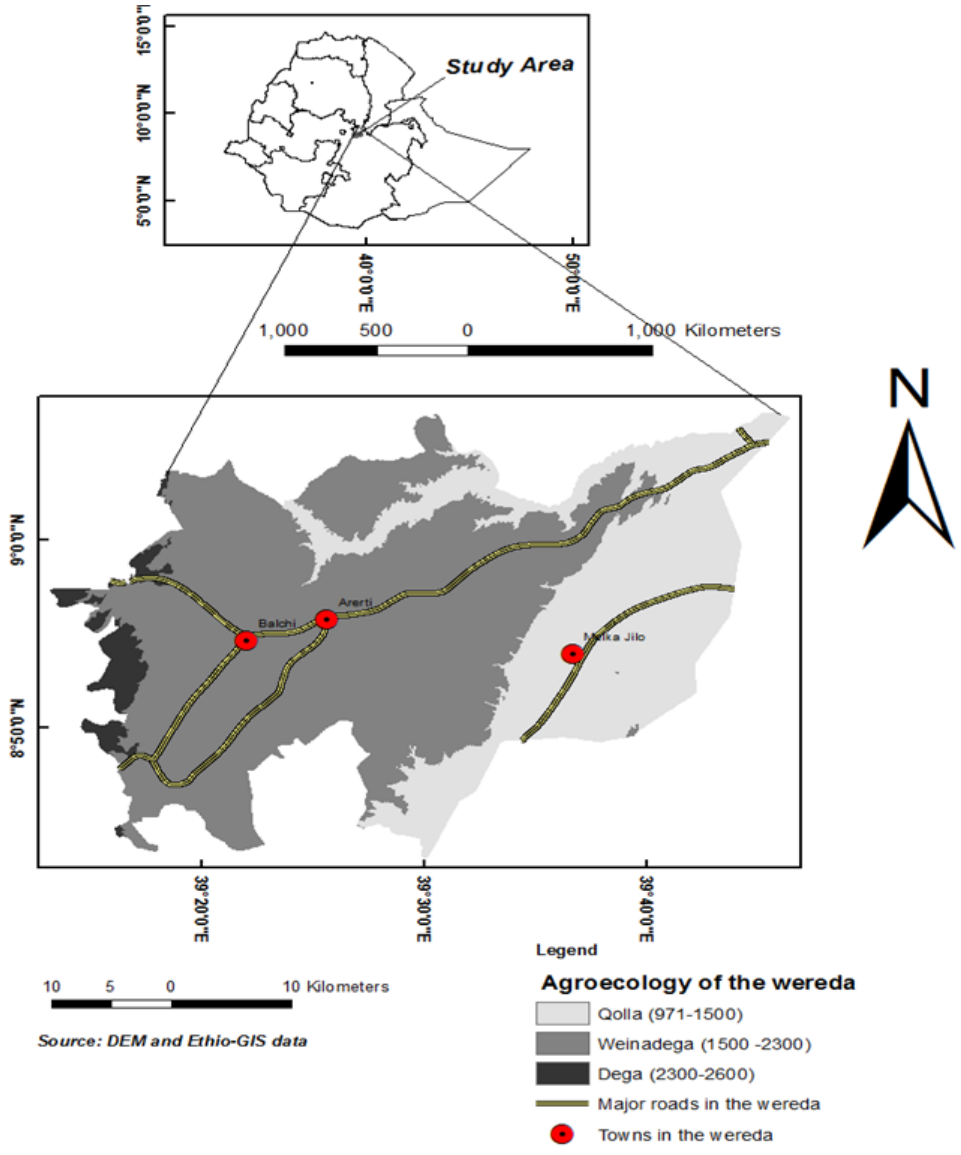

Figure 1. Map of the study area

Agriculture, trade and government employment are the most common economic activity of the rural and urban population, respectively. Mixed farming (both crop production and animal rearing) is dominant rural economic activities. The Woreda is well-known with its grain crop production particularly with *Teff* production. Crop production throughout the Woreda is entirely depended upon rain. The Woreda has a high potential in the production of cereal crops such as *Teff*, wheat, sorghum, chick pea and pea are (Minjar-Shenkora Woreda Agricultural Office, 2017). It also rich in various types of livestock resources such as cattle, goat, sheep, pack animals, camel and poultry.

The Woreda's Capital Arerti Town has interaction with its hinterlands with road transport network which facilitates rural-urban flow of people, goods, information and services. The developments of asphalt, gravel, and dry weather road networks are important to integrate rural and urban areas. Of course, this interaction can have impact on land use land cover change since it promotes supplying agricultural output and forest products to the markets through exploiting natural resources.

2.2 Data Sources

The study follows both quantitative and qualitative approaches and these enable researchers to explore the problem adequately. Thus, the study used both quantitative and qualitative data. The study used widely and freely available Landsat images of the study area having 30m resolution. The study used Landsat TM and ETM+ satellite images of 1987, 2003 and 2017 from the United States Geological Survey (USGS) website as main sources of data. These remotely sensed images are processed and used to detect land use/land cover changes in the study area. The study used images which are taken during the winter season when little or no cereal crops and cloud cover. Landsat satellite images and their characteristics have been presented and summarized in Table 1 below.

Table 1. Satellite Images/Data/ Used in the Study

Sensor type	Path-Row	Spatial resolution	Spectral resolution	Date of acquisition
Landsat (TM) 5	168-054	30*30	8 bands	1987/02/09
Landsat (ETM+)7	168-054	30*30	8 bands	2003/01/12
Landsat (OLI_TIRS)8	168-054	30*30	11 bands	2017/01/26
Google Earth	1987- 2017			
Topographic map (Toposheet)				
Ground observation	2017			

In addition, the study also used ancillary data obtained from primary sources with interview, FGD and secondary data obtained from published and unpublished sources.

2.3 Data Acquisition Methods

The first task in collection of data for the study was the acquisition of images. The study used 1987, 2003 and 2017 Landsat satellite images of Minjar-Shenkora district. These Multi temporal Landsat images are downloaded freely from Earth explorer web server. Multi-temporal data is useful to examine land use/land cover changes since it provides multi dated land cover information. Therefore, the study used Landsat images of 1987, 2003 and 2017 to detect the land use land cover changes during the three decades in the study area.

The study used ERDAS IMAGINE 2014 and Arc GIS 10.3Softwares to process the data and to produce map. The study used ERDAS IMAGINE 2014 software for image processing, enhancement, classification and post classification processes (matrix union and recode). The study also used Arc GIS 10.3 to analysis land-use and land cover data and to produce map. Moreover, the study used Microsoft Word for the final presentation of research output.

Data is also collected for the study using interviews

and focus group discussions. To assess causes and impacts of land use land cover change during the three decades (1987-2017), the study takes three sites from the Woreda (Arerti-zuria kebele, Sekawachona-Dodota and Erarate kebele and (Dire and Amora bet kebeles). The three sites are selected where land use land cover changes are really prevailed. Hence, the study uses purposive sampling for selecting specific sites for focus group discussion and interview. To select participants of the focus group discussion and interview, snow-ball sampling techniques were employed to get participants having better information about land use/land cover change in the study area. The study used 5 focus group discussions (one FGD in each rural kebele) in which 5-8 people were included in each FGD and the participants were selected based on their age and experiences.

Interviews are conducted with the key informants on land use and land covers conditions in the study area. Hence, semi-structured interviews were conducted with local elders and Woreda officials working in various sectors like agriculture, urban planning, and natural resources about causes and impacts of land use land cover changes. Thus, the study used data acquired from remote sensing, Google earth and from people reside in the study area. Moreover, the study used socio-economic data from CSA.

2.4 Digital Image Processing

Band stacking
Once the data in the format geo-tiff is imported and changed into image in ERDAS IMAGINE 2014, band stacking is performed. Band stacking is the process of combing the spectral layers to get a multispectral image. It ties up the spectral layers to comprise an image. The process of band stacking is executed using ERDAS IMAGINE 2014.

Image Enhancement
Remotely sensed images contain noise which makes the image difficult to interpret. Image enhancement is a means which increases the visual distinctions between the features in an image. Objective of image enhancement is to make new image from original image which give more information. This task is performed using image enhancement utility of ERDAS IMAGINE 2014 for all the images 1987, 2003 and 2017 of the study area.

Sub Setting
Sub setting utility is a useful mechanism of extracting area of interest from a large dataset. In case of Minjar-Shenkora Woreda, Landsat satellite one scene preserve an area of 185 km with 185 km, which is relatively larger than our area of interest. Sub setting utility in ERDAS IMAGINE 2014 was executed to get image of Minjar-Shenkora Woreda from a large image dataset of 185 km with 185 km.

Image Classification
Remotely sensed images can be digitally classified through Supervised or Unsupervised approaches. Supervised classification algorithm is used to classify each of the three Landsat images. Various land use land cover classes are identified from the 1987, 2003 and 2017 images. A field visit, topo sheet, Google earth were used as a guide for identifying land cover features of the 1987, 2003 and 2017 images during classifications. Finally, five land use/ land cover classes are identified from 1987 and 2003 Landsat images such as agricultural land, barren land/soil, shrub land, forest and Kessem river (water). At the same time six land use/ land cover classes are identified from the Landsat image of 2017 such as agricultural land, barren land/soil, shrub land, forest, Kessem river (water) and built up area. The study adapts Fish (2007) land use/land cover classification scheme.

2.5 Detection of Land Use /Land Covers Changes

Geospatial technologies have provided essential tools which can be applied in the analysis of land use land cover changes. Time series land use land cover data obtained from digital image processing and classification of 1987, 2003 and 2017 were integrated in GIS data structure and were analyzed. Finally land use land cover change detection was undertaken using area changes of each land use land cover during the three decades.

3 Results and Discussions

3.1 Land use/Land Covers Classes

The major land use/land cover classes of 1987 include forest, bare land, agriculture, bush /shrub lands/ and water. As indicated in the Table 2 the

greatest share of land use/land cover from all classified land use/land cover is bush/shrub lands, which covers an area of 61938.73 hectares (40.97%). Agriculture lands and forest lands cover areal size of 52523.48 hectares (34.7%) and 32884.75 hectares (21.8%), respectively. The least areal coverage is covered by water, which has only 810.68 hectares (0.54%) from the total size of the Woreda. Moreover, the land use/land cover classes of 2003 include forest, bare land, agriculture, bush /shrub lands/ and water. From the land use land cover classes of 2003, agriculture land is the greatest share from all classified land use land cover classes which covers an area of 71665.60 hectares (47.4%). Bush/shrub lands and forest lands cover areal size of 52480.73 hectares (34.72%) and 23029.97 hectares (15.23%), respectively. The least areal coverage still covered by water, which has only 746.44 hectares (0.49%) from the total size of the Woreda.

Furthermore, the land use/land cover classes of 2017 include forest, bare land, agriculture, bush /shrub lands/, water and built-up area. From the land use land cover classes of 2017, agriculture land is the greatest share from all classified land use land cover classes which covers an area of 90859.34 hectares (60.10%) from the total size of the Woreda. Bush/shrub lands and forest lands cover areal size of 32529.53 hectares (21.52%) and 16033.48 hectares (10.60%), respectively. The least areal coverage still covered by water, which has only 1240.85 hectares (0.82%) from the total size of the Woreda. Figure 2, here below depicts the land use land cover classes of the 1987, 2003 and 2017 of the study area (see figure 2).

From 1987 output map, it is noticed that about 40.97%, 34.7% and 21.8% of the land use land covers were bush/shrub lands, agriculture lands and forest lands, respectively. This implies that more than 60% of the Woreda's land use land covers during 1987 were bush lands and forest lands. During the time, agricultural land use land cover size was less than bush /shrub lands. In 2003, the proportion of land use land cover of the 1987 is changed as agriculture 47.4%, bush land 34.72% and forest 15.23%. In 2003, agriculture occupies the greatest land use land cover proportion. On the other hand, the land use/land cover proportions of 2017 were agriculture 60.1%, bush lands 21.52%, forest 10.6%, bare land 4.92% and built up 2.03%.

Built up area land use land covers which was not evident in the land use land cover map of 1987 and 2003 appeared on the map of 2017. This is the indication for the growth and the expansion of built-up areas or settlements from 1987 to 2017 in the study area. These different land use land cover of the study area showed vivid change from 1987 to 2017. It is noticed that the size of agricultural lands, bare lands, built up lands have displayed increment while the size of forest land and bush/shrub lands are diminished significantly in the past three decade (1987 to 2017). Table 2 depicts statistics of multi-temporary image classification of 1987, 2003 and 2017.

Table 2. LUC classe's statistics in 1987, 2003 and 2017 in the Woreda

Land use/ cover class	Area in 1987 (Ha)	Percent (%)	Area in 2003 (Ha)	Percent (%)	Area in 2017 (Ha)	Percent (%)
Bush/shrub land	61938.73	40.97	52480.73	34.72	32529.53	21.52
Agriculture	52523.48	34.7	71665.60	47.4	90859.34	60.10
Forest	32884.75	21.8	23029.97	15.23	16033.48	10.60
Bare land	3017.32	1.99	3252.22	2.15	7441.27	4.92
Water/kessem River	810.68	0.54	746.44	0.49	1240.85	0.82
Built up	-	-	-	-	3070.49	2.03
Total	151174.96	99.99	151174.96	99.99	151174.96	99.99

Source: Landsat image of 1987, 2003 and 2017

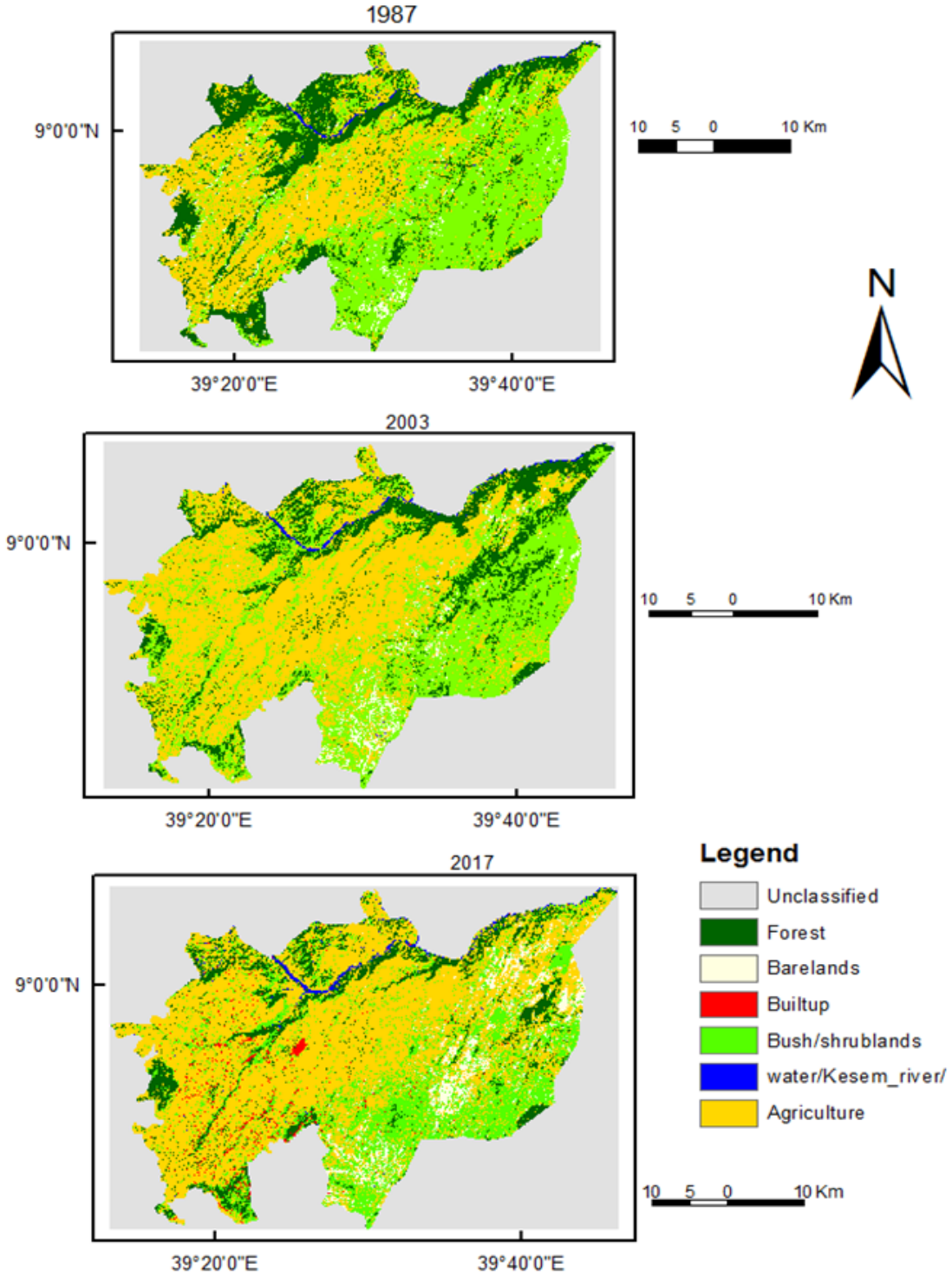

Figure 2. Land use Land cover classes in 1987, 2003 and 2017. (Source: Landsat image of 1987, 2003 and 2017)

3.2 Land Use/ Land Cover Change

Land Use/ Land Cover change (LUCC) simply means (quantitative) changes in the areal extent (increment or decrement) of a given type of land use or land cover, respectively. But in the analysis of land use land cover change, it is crucial to conceptualize the meaning of change to notice it in real world situations. Conversion and modification types of land use land cover changes are documented on the existed literature (Briassoulis, 2000). Conversion involves

a complete replacement of one land use land cover by another while modification involves change of structure or function without a wholesale change from one type to another; it could involve changes in productivity and biomass.

The land use land cover changes of the study Woreda are examined and identified as follow from 1987 to 2017. Through the process of image classification, matrix union and recode, the different land use land cover changes are identified. Land use land cover classes such as agriculture, forest, shrub lands, bare lands, water (Kessem River) and built up areas have displayed significant changes during the three decades. From 1987 to 2003 agricultural land use increased from 52523.48 hectares to 71665.6 hectares. That means agricultural lands augmented by 19142.12 hectares (36.4%) within the specified time. Moreover, bare lands also have increased from 3017.32 hectares to 3252.22 hectares during 1987 to 2003. It means bare lands amplified by 234.9 hectares (7.8%) during the specified time. On the other hand, the sizes of forest and shrub land use land covers diminished by 9854.78 hectares (42.8%) and 9458 hectares (18.02%) from 1987 to 2003, respectively. The least land use land cover change is observed by water/Kessem River, which loss only 64.24 hectares (8.6%) from the total size of 810.68hectares. The reasons for the prevailed land use land cover changes can be population growth, economic change and the improvement of the life of the people. When population size increases, the demands of agricultural lands will rise along with demands of food crops. When the demands of food crops increase, crops producers tend to be encouraged to produce more food crops by increasing the size of their farmlands by clearing forests, shrubs since at the time crops production growth was mainly depend upon farmland extensification rather than intensification. Table 3 depicts area gain vs. loss in land use land cover classes from 1987 to 2003.

Table 3. Area gain vs. loss under land use/land cover classes from 1987 to 2003

Land use/cover class	Area in (Ha) 1987	Area in (Ha) 2003	Gain in Ha (%)	Loss in Ha (%)
Forest	32884.75	23029.97	-	9854.78 (42.8)
Bare land	3017.32	3252.22	234.9 (7.8)	-
Agriculture	52523.48	71665.60	19142.12 (36.4)	-
Bush/shrub land	61938.73	52480.73	-	9458 (18.02)
Water/Kessem River	810.68	746.44	-	64.24 (8.6)
Total	151174.96	151174.96	-	-

Source: Landsat image of 1987 & 2003

Apart from land use/ land cover change from 1987 to 2003; the study also examined land use land cover change of the Woreda from 2003 to 2017. As shown on Table4, from 2003 to 2017 agriculture land increased from 71665.6 hectares to 90859.34 hectares. It implies 19193.74 hectares of forest and bush/shrub lands are converted into agricultural lands. Moreover, bare land also has increased by 4189.05 hectares from 3252.22 hectares to 7441.27 hectares. On the other hand, built up area land use land cover emerged on the map of 2017 which was invisible on the map of 2003. Even if, the type of sensor could be important for the invisibility and visibility of built up area 2003 and 2017, respectively, the size of built up area can also play important role for its visibility on Landsat images. This indicates the growth and expansion of Arerti Town which is the capital Town of the Woreda today.

On the other hand, forest lands have decreased from 23029.97 hectares to 16033.48 hectares while bush/shrub lands have declined from 52480.73 hectares to 32529.53 hectares during the specified time. That means the former decreases by 6996.49 hectares (43.6%) while the later decreases by 19951.2 hectares (61.3%). It implies the amount of shrub lands which is converted into other land use land covers is higher than forest lands.

Table 4. Area gain vs. loss under land use/land cover classes from 2003 to 2017

Land use/land cover classes	Area in (Ha) 2003	Area in (Ha) 2017	Gain in Ha (%)	Loss in Ha (%)
Forest	23029.97	16033.48	-	6996.49 (43.6)
Bare land	3252.22	7441.27	4189.05 (128.8)	-
Agriculture	71665.60	90859.34	19193.74 (26.8)	-
Bush/shrub land	52480.73	32529.53	-	19951.2 (61.3)
Kessem river	746.44	1240.85	494.41 (66.2)	-
Built up	-	3070.49	3070 (100)	
Total	151174.96	151174.96		

Source: Landsat image of 2003 and 2017

The study also has shown a dramatic change of land use/ land cover during the three decades (1987 to 2017). During the past 30 years agriculture land use land covers gained or increased by 38335.81 hectares (72.98%). Moreover, bare land and built-up land use land cover also augmented by 4423.95 hectares (146.62%) and 3070 hectares (100%), respectively. In contrast, forest and shrub land use land cover lost or declined by 16851.3hectares (105.1%) and 29409.2 hectares (90.41%), respectively (see table 5 and figure 3).

Table 5. Area gain vs. loss under land use/land cover classes from 1987 to 2017

Land use/land cover classes	Area in (ha) 1987	Area in (ha) 2017	Gain in ha (%)	Loss in ha (%)
Forest	32884.75	16033.48	-	16851.27 (105.1)
Bare land	3017.32	7441.27	4423.95 (146.62)	-
Agriculture	52523.48	90859.34	38335.81 (72.98)	-
Bush/shrub land	61938.73	32529.53	-	29409.2 (90.41)
Kessem River	810.68	1240.85	430.17 (53.06)	-
Built up	-	3070.49	3070 (100)	-
Total	151174.96	151174.96		

Source: Landsat image of 1987 and 2017

Apart from Table 4, Figure 2 has also displayed the land use land cover changes of the study area during 1987 to 2017. The land use land covers such forest land, shrub land, agriculture land and kesem river course are observed on figure 3A while agriculture, shrub lands, bare lands, forest, built-up land and kesem river course are observed on figure 3B. When Figure 3A is compared with Figure 3B, it can be noticed that forest and shrub lands have decreased while agriculture lands, bare lands and built-up land have increased from 1987 to 2017. As the legend of the Figure 3C to Figure 3H depict, blue color indicates gained, red color specifies loss, cyncolor indicates no change and white color shows other land uses. As shown on Figure 3C and Figure 3G agriculture and bare landuse land cover have gained (increased), respectively while on Figure 3D and Figure 3E shrub land and forest land loss (reduced), respectively during the period 1987 to 2017 (see the figures).

Figure 3 shows the reduction of forest and shrub lands as well as the augmentation of agriculture and bare lands from 1987 to 2017. It has also shown the expansion of built up area and Kesem river course during the same period. Thus, land use land covers such as agriculture land, built up area, bare land and Kesem river course gained or increased while forest and shrub lands lost or diminished during the three decades in the study area. The augmentation of agriculture land use land cover in the study area: it was mainly at the expense of forest land and shrub/bush

lands. Based on the survey conducted, the community Association leaders point out that the agricultural activity has been increasing during recent periods due to population increment and the rise of the price of food crops in the study area. Moreover, they said that the inhabitants are forced by poverty to involve in cutting and clearing forests resources to get income to sustain their lives.

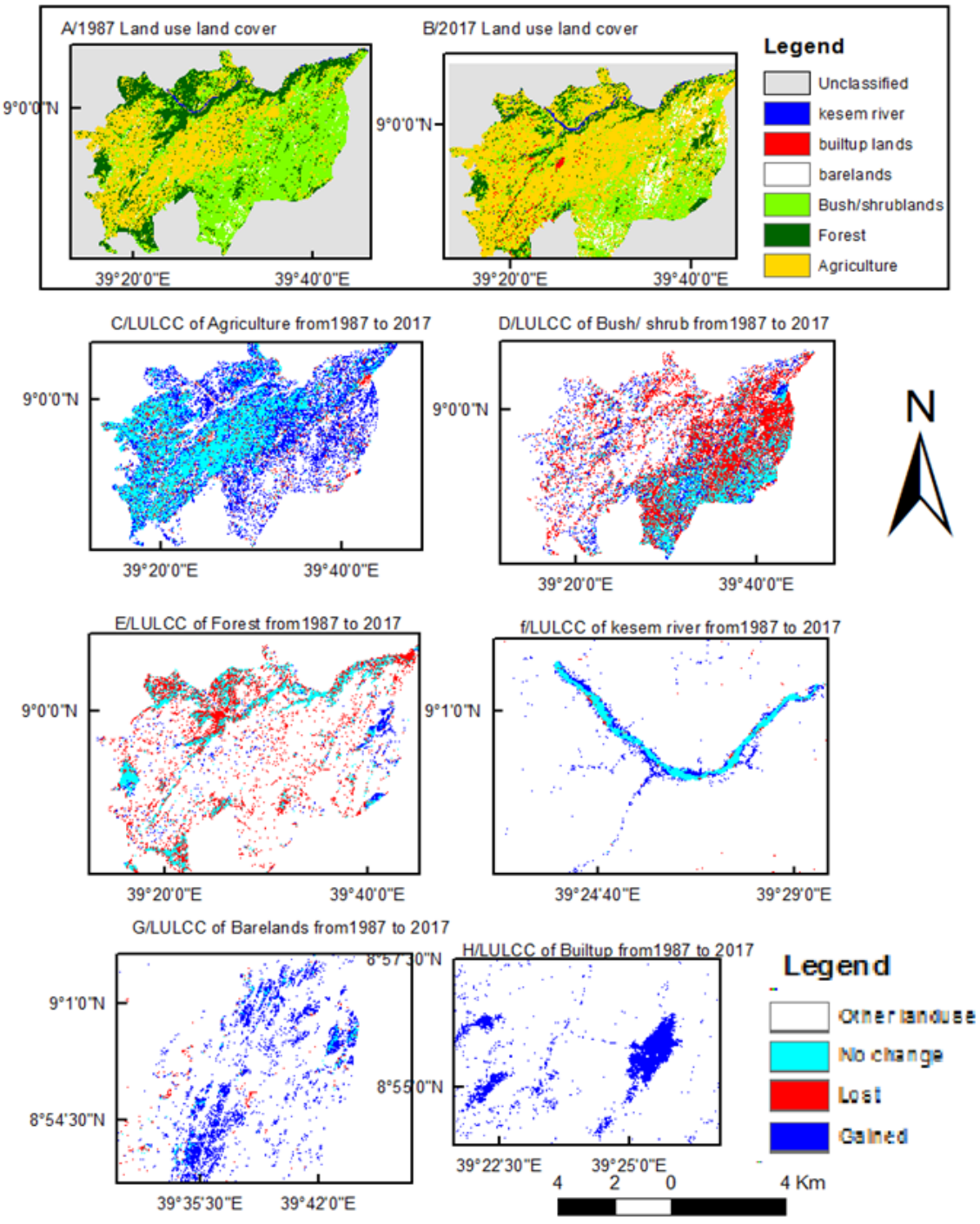

Figure 3. land use land cover change from 1987 to 2017 (Source: Landsat image of 1987and 2017)

3.3 Causes and Consequences of Land Use/ Land Cover Change

Land-use land covers are not static rather they are dynamic in response to various driving forces. Land-use land covers are influenced by multiple interacting factors operating at the different spatial scales of human environment systems. These driving forces of land-use land cover change are classified into two main categories: bio-physical and socio-economic drivers (Turner *et al*., 1994). The bio-physical drivers include characteristics and processes of the natural environment such as weather and climatic variations, landform, topography, and geomorphic processes, volcanic eruptions, plant succession, soil types and processes, drainage patterns and availability of natural resources. The socio-economic factor, on the other hand, comprises demographic, social, economic, political and institutional factors and processes. Hence, population change, industrial structure and change, technology and technological change, family, market, the various public sectors and the related policies and rules, values, community organization and norms are the socio-economic driving forces of land use land cover changes.

The observed land use land cover changes in the study area are the result of the expansion of agricultural land, bare land and built-up areas at the expense of forest and shrub lands. The study has identified major driving factors for land use land cover changes in the study area during the three decades. The data acquired through interviews and FGD have revealed that manifold factors contributed for the land use land cover changes of the study area. In fact, the findings of the study are consistent with the driving factors of LUCC which are identified from secondary sources. Based on the interviews and FGD conducted with community associations' leaders, the rising of rural population size resulting from higher fertility with low mortality, decreasing of infectious disease and malaria is one important cause for the prevailing land use land cover changes in the study area.

The rises of population size have created additional demands of agricultural and residential lands and these lead to cutting and clearing forest and shrub lands and change to farmland and residential land use land covers. The other causes of land use land cover changes are economic and technological growth, improvement of transportation facilities and accessibilities, increasing of standard of living, and improvement of market accessibilities also have played important role for the expansion of farm lands as well as the destruction of forests and shrub lands. When people's income increases, their demands of different basic items also increases. This condition makes people to exploit the nearby natural resources with maximum effort to get more money to satisfy their needs. Moreover, unwise use of forest resource for source of income, construction and housing tools, wood and coal for cooking in rural and urban areas along with absence of keeping and protecting forest from informal cutting and destruction are causes for the depletion of forest and shrub lands.

Climate change and drought are also the other factors for cutting and devastation of forest and shrub resource due to rural livelihood deprivation. During such seasons a large amount of forest and shrubs are devastated with informal cutting and fire to get agricultural lands, grazing lands and honey. The absence of forest owner/ public owner and lack of people's awareness of the impact of the depletion of forest resources are reasons for destruction of these shrubs and forest resources by informal cutting and fire. People's low tradition of planting and protecting trees also contributed for the destruction of forest and shrubs of the study areas. Moreover, livestock rearing like goat, ox, cow, sheep and camel on the same grazing land for long period also aggravated environmental degradation and land use land cover changes of the study area. On the other hand, rural-urban settlement expansion, establishment and expansion of infrastructure consumed a significant amount of farm lands, forest lands, shrub lands and therefore caused for land use land cover changes.

The impacts of land use land cover changes have increasingly thought from significant to threatening extent. Conversions of farm land into rural-urban settlement (built up area) have reduced farmlands necessary for the economic survival of local agricultural economies. This affects the livelihoods of individuals and the ways in which they are organized. This may lead to invading of new shrub and forest lands for farmlands. The change of forest, shrub and grazing land into farm land have caused for soil

erosion, flooding and land degradation. Furthermore, loss of biodiversity, scarcity of livestock fodder, soil erosion and environmental deterioration are largely outcome of land use land cover change. The land use land cover changes in the study area are articulated by loss of biodiversity both plants and animals on the one hand, widespread of crop pests, insects and disease on the other.

For example: wild animals such as impala (Dikula), Deer (Agazen), Tigire (Nebir), Wart hog (Kerkero), Hog (Asama), Jackal (Kebero), Sesi, Midako and Qorke were resided in the study area before 30 years ago out-migrated and disappeared. Due to land use land cover changes of the past three decades, several water sources like streams and rivers have declined such as Kesem River and its tributaries, Shenkora River and Beadle River and even some of them dried up, for example Tebo River is evidence among others. The decline of agricultural output per unit of land from time to time in the study area is also other effects of land use cover changes. This could be due to the deterioration of soil fertility with soil erosion over continuous cultivation and deforestation. The decline of agricultural output can also be the result of widespread of crop pests, insects and climate change which are the outcome of environmental deterioration.

Shortages of wood for construction, agricultural tools, for cooking and grazing land for livestock rearing are also other consequences of land use land cover changes in the study area. The rearing of livestock is being difficult due to shortage of grazing lands and hence benefits which can be acquired from livestock farming like milk, butter, honey, and meat are declined. As population size increases household energy consumption also increases. For the poor in rural areas, wood is not only a source of energy as fuel wood and charcoal, but it is also a means of income generation. Expansion of agricultural lands toward marginal lands, grazing and preserved public lands have resulted for lack of public land for various public services, increased soil erosion, formation of gully erosion and hindered social interaction of the people.

4 Conclusion

This study assessed and quantified land use land cover changes during the past three decades using geographic information system and remote sensing techniques. The study used various data sources, tools, software and techniques. The measure that the study used to detect the land use land cover changes is area variations of the various land use land covers during the three decades (1987 to 2017). The study also collected data with interview and FGD to assess causes and consequences of land use land cover changes.

From the analysis made so far on land use land covers, the results indicate that the study Woreda's land uses land covers are changed considerably during the past three decades (1987 to 2017). Analysis of the study revealed that forest and shrub lands have diminished from 32885 hectares and 61939 hectares to 16034 hectares and 32530 hectares, respectively during 1987 to 2017. During the three-decades 16851 hectares of forest has been changed into bush land, farm land and residential areas mainly in Bichashina-Tafa, Erarati, Seka-wachona Dodota, Kirstos-Semira, Dire, Choba and Amora-bet Kebeles of the Woreda. Moreover, about 29409 hectares of bush land are converted into agriculture, bare lands, built up area in many Kebeles of the Woreda such as Bichashina-Tafa, Erarati, Seka-wachonaDodota, Kirstos-Semira, Dire, Choba, Finanajo and Amora-Bet.

On the other hand, agriculture and bare lands have increased from 52524 hectares and 3018 hectares to 90859 hectares and 7441 hectares, respectively. This implies that 38335 hectares of new farm lands are added on the existed farm lands of the Woreda. Moreover, about 4423 hectares of new bare lands has been created mainly in Finanajo, Chele, Dire and Choba Kebeles of the Woreda during the three decades. Moreover, built up areas also have expanded into farm lands and bush lands in the peripheries of Arerti town, Balchi town and new town is also emerged nearby the famous Yohanse Church and Tsebel in Kirstos-Semira Kebele. Nowadays, built up area expansions have encroached a significant amount of fertile farm lands in the above three areas of the Woreda.

The major causes of land use land cover changes in Minjar-shenkora Woreda include: unwise exploitation of wood for fuel and construction materials, human induced fire and uncontrolled grazing. The absence of public law for protecting and preserving natural vegetation and for controlling illegal cutting and burning of natural vegetation are causes for the deforestation of forest and shrub lands. Moreover, socio-economic changes such as rising of population size, improvement of transport and market accessibility, increasing of people's standards of life and needs, rising of people demands of better housing and clothing enforce people to exploit natural resources more and these can lead to land use/cover changes.

On the other hand, people's livelihood vulnerability and degradation are the main outcome of the land use land cover changes of the study area. Decreasing of forest resources and shrub lands have resulted in the deterioration environmental resources such as water, grazing lands, and streams. Rivers, streams and other water sources have been dried up due to environmental deterioration. The different benefits and opportunities obtained from forest and shrub lands are vanished. Moreover, various insects and pests have appeared and affected crop production while bio-diversities have been impaired. Places name has been disappeared along with the destruction of forest or bigger trees.

The study forwarded the following suggestions based on the findings of the study.

- The concerned body of the Woreda needs to create awareness on the communities about the effects of deforestation and expansion of farmlands into marginal lands. The communities should preserve and protect the natural vegetation from grazing and illegal cutting.
- The people should have information about importance of planting trees to provide wood for housing tools, construction materials, cooking and charcoal production and hence should plant a tree in his/her residential and around farm plot.
- The farm households should have adequate knowledge about the contribution of keeping and preserving natural vegetation for protecting soil erosion, keeping biodiversity, keeping and preserving water sources of streams and rivers.
- Urban areas of the Woreda such as Arerti, Balchi, Yohanse have encroached large amount of fertile farm lands and this has affected the livelihoods of many households. Hence, it must be considered by the concerned bodies and it needs new direction that can reduce consumption of farm lands.
- The communities along with the concerned body should formulate law that can help to protect and preserve natural vegetation and to control illegal cutting of natural vegetation and expansion of farm lands to marginal lands.

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Conflict of Interest

The authors declares that there is no conflict of interest.

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