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Review Article

Impacts of Land Use and Land Cover Change on Vegetation Diversity of Tropical Highland in Ethiopia

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Ethiopia has undergone a substantial shift in land use and land cover (LULC), which is home to the majority of the human and animal population. Land degradation has occurred in the Ethiopian highlands as a result of modifications in LULC caused by poor farming methods, high livestock population, and human pressures. Most researchers identified the many LULC drivers and their impact on floristic composition. All of these manifestations have the potential to have major consequences for land users and individuals whose livelihoods rely on the products of a healthy environment. This change in LULC type, combined with poor land management practices in Ethiopia, puts land in jeopardy of erosion, resulting in accelerated soil degradation. All LULC variables, such as the spread of various agricultural activities, the production of fuelwood and charcoal, cutting trees for construction resources, settlements, and revenue growth, are associated with population increase and resettlement. In Ethiopia, the lack of a relevant forest policy implementation on the ground is recognized as a cause pushing deforestation and other landscape changes. This review paper aimed to compile the effects of land use land cover changes on Ethiopian vegetation.

1. Introduction

The tropical highlands are a biodiversity hotspot that is threatened by global warming and LULC change [1, 2]. Tropical forests are not only important for the biosphere's richness, but they are also centers for human activity, putting them under increasing strain from the world's growing population. Ethiopia is experiencing rapid deforestation, with 150,000–200,000 hectares of forest lost in a single year [3]. As a result, around 6% of the remaining forest in the country is being removed [3]. The most commonly mentioned factors for deforestation in the country are rapid population growth with an increasing need for arable land and wood for construction and fuel, political unrest, forest fires, the insecure land ownership system, inadequate conservation approaches, and a lack of awareness [4, 5].

LULC are two distinct yet intertwined features of the surface of the Earth. The purpose for which humans exploit or take direct action to change or transform the land and its resources is referred to as land use [6–8] also described the possible applications, which include grazing, agriculture, urban development, logging, and mining. The physiological aspect of the land surface of the earth and surrounding subsurface is made up of biodiversity, sediment, elevation, groundwater, and manmade structures, as defined by [7, 8] that defined land cover as, among other things, farming, forest, wetlands, pastures, roadways, and urban areas. LULC change is defined as an alteration in the current land cover or a complete alteration of the land cover (LC) to a new form of cover. In both geographical and chronological change patterns, there is a structural and intricacy of function between both types of LC change [9]. Changes in LC might take the form of conversion or modification. The former is when one sort of cover is completely replaced with another. On the other hand, the latter refers to a change in its composition without affecting its categorization in general [7, 10].

LU changes as a result of human activity for a variety of reasons, such as settlement, farming, infrastructure, conveyance and production, parks, recreational use, mining, and fishing fish, which is known as land use change [11, 12]. Land use changes are related to alterations in land cover, yet land cover can vary without affecting land usage [13]. Changes in the LULC are one of the most critical factors in determining the rate, scope, and spatial range of changes in the surface of the earth and near subsurface as a result of human activity [14]. Changes in LULC caused by humans are as old as humanity itself [15]. The change in the earth's land surface as a result of human activity is unparalleled [16]. It is necessary to comprehend the varied effects of LU changes to comprehend the numerous implications of land cover changes. Different human forces, mediated by the socioeconomic context and influenced by existing environmental conditions, contribute to the planned land use of an existing land cover through soil manipulation [17].

Because of changes in LULC, the deterioration of natural resources, particularly vegetation, is occurring at an alarming rate in Ethiopia [18, 19]. The majority of Ethiopia's forest resources, both highland and lowland, are under severe threat from intensive human land use. Farmers sometimes force to cultivate steeper and steeper slopes of highland areas for arable farming, which can only generate crops for a few years before the soil is washed away [20]. According to recent findings, afroalpine habitats only cover about 10% of their original area [21]. If the current rate of excessive use of vegetative resources continues, the more accessible highlands, which are primarily covered by forests, brush, grassland, and woodland, may vanish shortly [22]. The primary goal of this article review was to synthesize the major causes of altering vegetation patterns and to give information on how LULC continued to influence the spatial arrangements and composition of floral biodiversity in Ethiopia.

2. Methodology

The search engines Google Scholar, Scopus, and Web of Science were used to explore and download the papers used for this review. To search the papers, several statements and keywords related to the review title were used including impacts of land use land and land cover change on vegetation diversity of tropical highland in Ethiopia were used. The downloaded papers were sorted based on the quality of the papers. The quality of the papers was assessed based on the journals on which they were published, if they were peer-reviewed or not, their ability to answer the objective, and clarity of the methodology used. 94 papers were collected and analyzed; most of them are indexed on Scopus and the Web of Science.

3. Scopes of LULC Change

The two interconnected ways of observing the earth's surface are land cover and land use [23]. The land cover depicts the earth's surface's biophysical state and near subsurface, whereas land use depicts how the population of humans manipulates the biophysical aspects of the land, and land usage depicts the function of land use [23, 24]. The association between LU and LC can be summarized as follows: changes in LU can influence and be influenced by changes in LC, but neither is essentially the result of the other. A single LU system can relate to a single LC or include many land covers [25]. A single cover class, on the other hand, may be used for a variety of purposes [1]. Human alteration and transformation of the earth's surface are referred to as LULC [9, 26, 27]. When a change just alters the land cover features rather than producing a total shift from one LULC type to the other, it is called a modification. LULC transformation, on either side, occurs when one LULC type is replaced by another [9, 28].

3.1. LULC Change Drivers. The total land area of the planet is estimated to be 13,340 million hectares [29]. Human activities and natural processes have caused 54 percent of this land surface to be disturbed [25]. At all levels, changes in LULC are linked to a variety of natural and human-induced causes [8]. Climate change, slop, wildfire, soil type, drought, pest infestation, and flood are all-natural causes of LULCC [30, 31]. Human action has both direct (proximate causes) and indirect (secondary) impacts (underlying driving forces) are two types of human-induced driving forces for LULC [32]. In LULC, human-induced causal variables are becoming more well-acknowledged [33]. Agriculture, logging, fire, overgrazing, timber harvest, and urban construction and development all alter each to half of the global land surface [34].

3.1.1. Proximate Causes. Local community immediate actions, which are immediately exerted on land resources as a result of several underlying causes like economic, social, and political factors, are proximate drivers of LULCC [35]. They operate at the community scale to describe just why humans have a direct impact on local land cover and ecosystem function [34]. LULC is mostly caused by agricultural expansion, wood exploitation, and infrastructure expansion. Agricultural growth is the most common proximate cause of LULC [34]. Continuous agriculture (large scale, small scale, and commercial), crop rotation (fire burns), and livestock are all part of agricultural growth (large-scale and small-scale farming). Cropland and pastures are currently among the world's most dominant ecosystems, accounting for more than 35% of the surface of the land being ice-free on the planet [36]. Large areas of Ethiopia that were originally covered in vegetation are being converted to arable land, leaving them vulnerable to soil erosion, and resulting in environmental degradation and substantial land concerns [19].

3.1.2. Underlying Causes. The structural (or systemic) elements that drive the proximate causes are the underlying causes of LULC [9]. They work at the local, regional, provincial, and national levels, as well as at the global level, by addressing one or more urgent problems [13]. They are not controlled at the local level and are external to the local community. LULC is caused by a complex mix of social, policy, and institutional issues, as well as economic, demographic, technical, cultural, and biophysical elements. Minimal local costs, as well as rises in product prices (mostly for crops), are important drivers to LULC, particularly tropical deforestation [35]. Aside from these, changes in land use input and product pricing, taxes, and subsidies, changes in transportation and production costs, and access to capital, markets, and technology all play a role in LULC [9, 13, 35].

Politics, law, economics, and traditional institutions, as well as how they interact with the individual decision, all have an impact on LULCC [9, 25, 37]. LULC institutional issues must be evaluated on a broad scale (international or national level) as well as on a local level [38]. Because large-scale policies are implemented at the local level, and local people's access to land, capital, and technology is affected by the characteristics of both regional and large-scale policy, and knowledge, this is the case [39]. LULC suffers tremendously when local organizations are harmed by large-scale organizations [9, 40]. Technical variables that induce LULC, particularly in tropical locations, include agricultural shifts, such as the use of large-scale mechanized agriculture, intensification, and extensification of farming systems, as well as poor technical applications in the wood industry [9].

Demographic variations in mortality and fertility, changes in family structure, the partition of protracted families into several nuclear families, and factors such as labor availability, migration, and urbanization are the key causes of LULC in most African, Asian, and Latin American countries [13]. Individuals, communities, motivations, communal memories, life stories, emotions, beliefs, attitudes, and perceptions all have a significant impact on land use decisions and land covers [40].

3.2. Ethiopia's LULC Situation. Ethiopia has a total size of around 1.12 million km^2 [41]. The lowlands make up about 55% of the area, while the highlands make up the remaining 45% [41]. In Ethiopia, smallholders who farm for subsistence use the land mostly for mixed farming methods [42, 43]. Environmental damage, unpredictable precipitation, recurring droughts and famines resulting from droughts, the prevalence of HIV/AIDS and malaria, and pervasive poverty are all factors to consider, and weak authority are among the country's many environmental, climatic, and socioeconomic concerns [41]. LULC is linked to the aforementioned issues, either directly or indirectly. Forest cover change is one of Ethiopia's most serious environmental issues [44]. Due to alteration to grazing fields, croplands, open areas, and residential areas, most LULC studies conducted in Ethiopia found the reduction of natural vegetation and grassland, including forests, shrublands, and woodlands. According to this, practically all LULC studies undertaken in Ethiopia share common characteristics, such as the growth of the agricultural area and the damage of natural vegetation as well as biodiversity loss [45].

Agriculture expanded throughout vast expanses of vegetated land, primarily shrubland, woodland, and forest land, in Ethiopia's highlands [46]. Population increase, poor economic conditions, ambiguous land tenure rights, and a variety of other biophysical and sociopolitical issues are all linked to the agricultural land expansion and depletion of vegetation biodiversity in Ethiopia [47]. Population growth was the primary driver of agricultural expansion and vegetation loss [48].

3.3. Ethiopia's Vegetation Cover Extent and Dynamicity Trend. Originally, forests covered around 29% of the land surface of the Ethiopia [49]. Only a fifth of the original has survived untouched as of now [50]. At the turn of the nineteenth century, Ethiopia's woodlands covered 40 percent of the country [51]. Only 2.7 percent of Ethiopia's landmass is currently covered in forest, according to [52], with an annual loss of 150,000–200,000 hectares of natural forest. In 1989, the country's forest cover was 12.9 percent, according to [53]. Only 4.2% of the cover of the forest was estimated a decade later, in 1997 [53]. The pace of deforestation has also been assessed to be variable [54, 55]. The yearly rate of deforestation is believed to be around 40,000 hectares per year [56]. This could be related to the lack of a uniform description of what type of in the various studies, as well as the lack of first-hand data for obtaining these estimations.

The FAO has provided data on Ethiopia's forest cover in May, 2011, which shows that 11.2 percent of the country's land is wooded, or around 12,296,000 hectares. Primary forest covers 4.2 percent of the land (511,000 acres). From 2002 to 2021, Ethiopia lost 80.1 kha of humid primary forest, making up 18% of its total tree cover loss in the same time period. The total area of humid primary forest in Ethiopia decreased by 4.2% in this time period. Ethiopia had planted woodland covering 511,000 hectares. Ethiopia lost an average of 140,900 hectares each year, or 0.94 percent, between 1990 and 2010. Between 1990 and 2010, Ethiopia lost 18.6% of its forest acreage or roughly 2,818,000 hectares. Larger forest areas can now only be found in Ethiopia's south and southwest, where they are extremely remote and inaccessible.

Between 1957 and 1982 (first period), 1982 and 2001 (second period), and 1957 and 2001 (third period), Solomon (2005) discovered a decreasing trend of change in forest cover (four decades substudy). In 1957, forest cover covered 1808.2 hectares (11.8 percent in Sekella woreda), but by 1982, it had dropped to 749.3 ha (4.9 percent) and 423.0 ha (2.8 percent). This loss occurred throughout the different parts of Ethiopia, with the biggest deforestation occurring between 1957 and 1982. In 1957, 58.6% of the total forest area, 1058.9 ha, was removed in the first period. During all of the periods studied, the area under forest decreased by 1383.2 hectares (76.5%), or 9.0 percent of the entire Sekella woreda, from what it was in the base year. In the first, second, and all periods studied, annual forest cover clearance was 40.7, 16.3, and 30.7 ha, respectively. According to [57], the research area's (South Central Ethiopia) deforestation trend is also by the national forest reduction trend.

According to some studies, a rise in forest cover in eucalyptus-growing areas may lead to a modest but steady increase in forest cover [58]. Forest cover in Ankober between 1975 and 1986 [59], land cover dynamics in the Chemoga watershed between 1957 and 1998 [60], and the impact of population on land cover change in west Guraghe land between 1957 and 1982 [61, 62] all showed a slow but steady expansion of forest due to increasing eucalyptus tree cover [63], also discovered that in Yabello, the woody land cover, which is primarily made up of Acacia, Grewia, and Commiphora species, showed an increasing tendency throughout time (1967–2002). Woody vegetation covered 29% (30365 ha) of the total land area in the Yabello area in 1967, 31% (3097 ha) in 1987, and 36% (40177 ha) in 2002; a steady growing tendency throughout the analysis period. In the Yabello area, woody land cover rose by around 2% between 1967 and 1987, 5% between 1987 and 2002, and 7% between 2002 and 1967, for an average annual change of 0.2 percent. This indicated that the most significant alteration in the Yabello occurred between 2002 and 1987.

3.3.1. Ethiopian Forest Dynamism and Its Causes. Despite dwellings and a diverse range of biological resources, Ethiopia's biodiversity is being harmed by human activity [55]. As a result of the increase in agriculture and settlement areas, forests have been degraded on a vast scale [64]. Ethiopia's forest degradation is intimately tied to the country's continual population growth. As the population grows, so does the demand for land for living and agricultural production. As a result of the increased demand for fuelwood and construction timber, the pressure on forest resources grew. Finally, unrestricted logging and the illegal transport of wood stems to cities such as Addis Ababa endanger the country's natural high forests. Due to huge populations of grazing and browsing animals within the forests, spontaneous regeneration of forest resources is challenging [65]. The main driver of vegetation change is agricultural farming activities [48, 66].

3.4. Status of Vegetation Composition across Different LULC in Ethiopia. For different periods, the pace of transition varies. Figure 1 shows that Ethiopia saw a shift in tenure policy, resettlement, villagization, and droughts caused by variability in the climate from 1973 to 1987 [68]. The second period, from 1987 to 2000, was marked by significant agricultural expansion, the construction of a big hydropower dam, and commercial farms and enrichment plantations becoming more common. The Melka Wakena dam has had a significant impact on the terrain as well [69]. Grassland, arable land, and fallow land provide a significant amount of water to rivers and lakes. Such land-to-water conversions have far-reaching ecological repercussions, such as the irreversible loss of wildlife habitat [70]. Deforestation on a large scale, habitat reduction, and the constriction of some types of cover were all noted at this period, in addition to agricultural development. Agriculture's expansion was halted in the third time step, from 2000 to 2008. The Bale fire of 2000 was the most significant occurrence of this period [71].

Except for limited pastoral and pastoral operations, the afroalpine zone of Ethiopia has historically represented highly isolated ecosystems that were less influenced by human effects. Human-made direct and indirect hazards, on the other hand, have recently become increasingly widespread in Ethiopia's afroalpine zone. Increased grazing frequency [72], fires [73], and protracted droughts are some of the consequences [71]. According to archeological data, during climatic heat waves in the past, places at a height of more than 4,000 meters above sea level were cultivated [74]. As a result of global warming and growing human activities, afroalpine ecosystems are anticipated to face significant pressure in the future. Ethiopia's sensitive, fragile habitats are home to numerous endemic animals and plants, making them vital for the fauna and the preservation of endemic alpine plants.

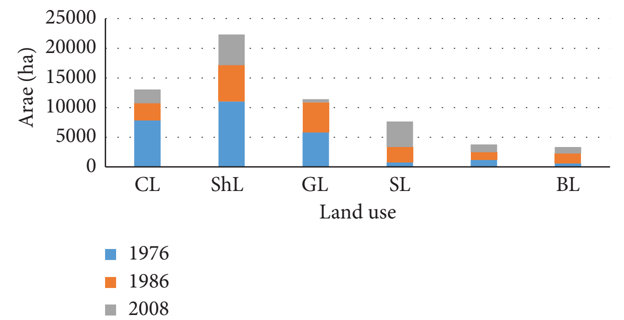

Figure 1: LULC types in the Gilgel Tekeze catchment in 1976, 1986, and 2008 (FL = farm land, ShL = shrub land, CL = cultivated land, settlement land, RR = river bedrock, and BL = bareland). Sources: [67].

Figure 1 illustrates that during the last ten years, forest and bushland areas have expanded by 0.25 and 1.60% each year, respectively, whereas built-up land and settlement area have increased by 1.44 and 0.52 percent per year. The change indicates that as the population and area under settlement grow, the pace of reduction of natural vegetation cover in the watershed accelerates. Forestlands expanded by 2.17 percent from 1986 to 2008, according to [67], when compared to the prior period 1976–1986. During this time, the area was hit by a drought in 1985/86, and there was a big movement in this section of the country to plant trees and build terraces on the hill slopes. Similarly, both land that has been cultivated and settlements exhibited favorable increases. Shrub-bush land and pasture land, on the other hand, declined by 2.72 and 3.9 percent, respectively. During the period 1976–2008, the expansion of cultivated land and settlement took place mostly at the expense of shrub-bush and grazing land. Between 1976 and 2008, the area under shrub-bush land and grazing land decreased by 18.86 and 6.90%, respectively, while cultivated land and settlement increased by 15.50 and 10%, respectively (Figure 2). Shrub-bush land and grazing land fell by 0.6 and 0.21 percent per year, respectively, whereas cultivated land and settlement grew by 0.49 and 0.3 percent per year.

3.5. LULC Change in Central Highlands (1957–2014) of Ethiopia. In the central highlands of Ethiopia, the extension of arable land into pastureland and forest is a long-standing phenomenon [75–77]. Accelerated farmland expansion in the highlands occurred between 1980 and 1995, coinciding

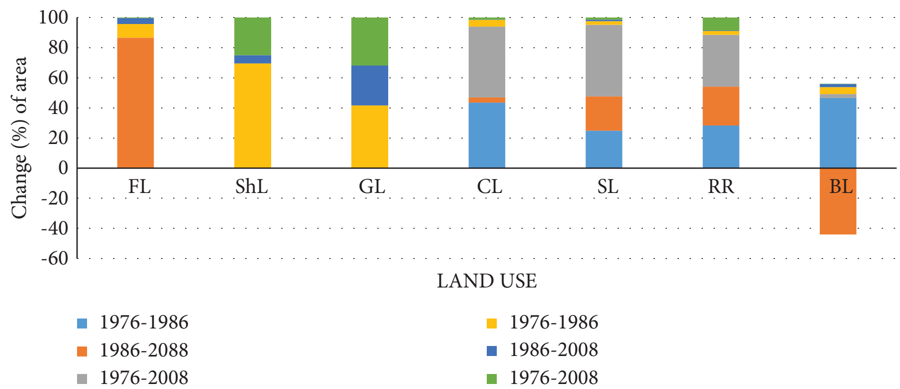

Figure 2: LULC change for periods 1976–1986, 1986–2008, and 1976–2008 (FL = farm land, ShL = shrub land, CL = cultivated land, settlement land, RR = river bedrock, and BL = bareland). Sources: [67].

with rapid population growth (3.2 percent per annum). However, crop agriculture may have been spurred by large disadvantaged classes in the late 1970s and early 1980s, when the country began land reform in 1974 (from feudal arrangements to land to the tillers) (Figure 2). For example, between 1980 and 1995, agriculture expansion into natural ecosystems occupying steep slope areas without sufficient soil and water conservation measures resulted in severe land degradation and feed shortages. Different forest conservation regulations [77] and population pressure are drivers of deforestation in Ethiopia's highlands.

Before 1973, there was a lot of timber production in state-controlled territories [77–79] and after 1973 (after the ban on wood production), deforestation by the local population is critical to the decline in forest resources, especially during transition periods of regime changes. Between 1980 and 1995, however, better state supervision during the socialist Derg administration [30] helped the preservation of forest lands. Following the fall of the socialist Derg in 1991, official control over the forest was diminished once more, and new forest management legislation (1994 and 2007) allowed locals to participate in forest management. [30, 78] Large portions of the Chilimo forest were exposed during this time, and just roughly 2,470 hectares are now forested [80]. Ethiopia's decentralization agenda and rural development initiatives, which involve local communities participating in a win-win approach to nature protection and livelihoods, are regarded to be the ideal fit for a new forest management approach to decentralized forest management [81], but it can also be viewed as a threat. This nutrient is divisive [82, 83]. The technique leads to polarized deforestation under the guise of money generating, but without proper replacement and care of the trees, according to one group [78]. The continued loss of forest land highlights the strategy's ineffectiveness, which requires additional development.

Special attention should be paid to the steady expansion of eucalyptus plantations on agricultural land. Although eucalyptus remains Ethiopia's most divisive tree, its development in the highlands has accelerated since its introduction in 1895 [84]. The claims that eucalyptus uses a lot of water and that other vegetation in the mining industry is displacing racism, which undermines the hydrological balance, depletes soil nutrients, and diminishes biodiversity, are false [85–87]. Most countries, including Ethiopia's Tigray regional government, have formally banned the cultivation of eucalyptus on farmland, around lakes, ponds, and wetlands (Figures 3 and 4). On the other hand, another study reveals that eucalyptus can improve soil chemical qualities, suggesting that the claims may be overblown given its socioeconomic importance [89–91].

3.5.1. Forests. Between 1964 and 2014, the forest cover of the Gelana subbasin decreased gradually; in 1964, the forest cover was 3613 ha. The Gelana watershed, shrank to 749 ha in 1986, losing 14.47 percent of its size (3 percent). It has expanded from 3.0% (749 ha) in 1986 to 5.4 percent (1351 hectares) in 2014. In the first phase (1964–1986), the annual rate of forest destruction was 3.6 percent per year, whereas the annual rate of forest expansion was around 2.87 percent per year (1986–2014). Forest cover decreased by 1.25 percent every year on average throughout the study (1964–2014) (Figure 4).

3.5.2. Shrubland. In 1964, 1986, and 2014, shrubland occupied 10.82 (2703 ha), 18.87 (4713 ha), and 13.41 percent (3348 ha) of the Gelana subwatershed, respectively. Scrubland increased by 74.36 percent during the first period (1964–1986) but fell by 28.96 percent during the second period (1986–2014). 18.67, 31.08, 6.43, and 1.49 percent of shrubland were changed to forest, cultivated and rural settlement, grazing land, and bare land, respectively, during this period. Overall, shrubland rose by 645 hectares over the research period (1964–2014).

3.6. Impacts of Land Cover on Vegetation Pattern in the Bale Mountains. Table 1 provides a summary of the areal extent of the LULC classes for each time step. There were few human disruptions in the early 1970s. Agriculture was not mechanized in 1973. However, mechanical farming's adoption in the 1980s was a major factor in the situation's turn around. This is seen from the agricultural fields' geometric sizes and shapes, which are initially discernible in the

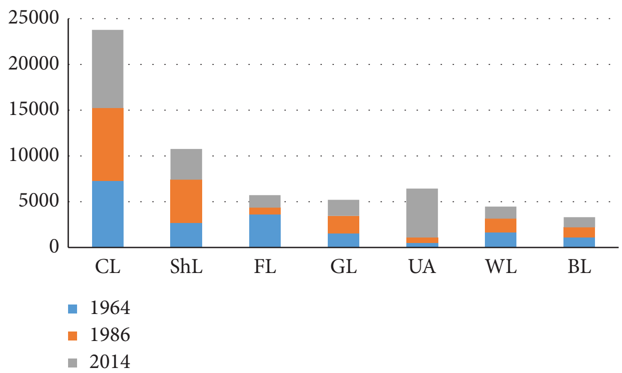

FIGURE 3: LULC type of Gelana subwatershed in 1964, 1986, and 2014 (FL = farm land, ShL = shrub land, CL = cultivated land, settlement land, WL = wetland, UA = urban area, and BL = bareland). Sources: [88].

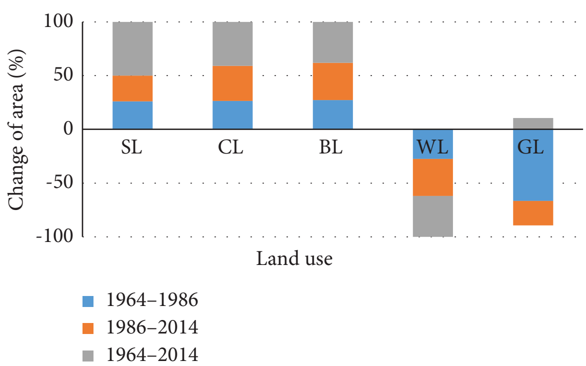

FIGURE 4: Changes in LULC trends in the Gelana subwatershed, Ethiopia's northern highlands (FL = farm land, ShL = shrub land, CL = cultivated land, settlement land, WL = wetland, UA = urban area, and BL = bareland). Sources: [88].

1987 time slice. Similar to this, extensive resettlement and village development activities were carried out in the late 1980s in conjunction with the construction of the Melka Wakena hydropower dam [48].

Afromontane habitats have lost a significant amount of land to agriculture during the course of the 40-year study period. Agricultural land has increased at the expense of afromontane grasslands and afromontane dwarf shrubs and herbaceous formations, growing from 136.39 km^2 (1.71%) in 1973 to 572.19 km^2 (7.19%) in 1987. Agricultural land increased by 1,362.94 km^2 (17.1%) during the second era (from 1987 to 2000), which was a continuation of this expansion. Between 2000 and 2008, the third decade, agricultural land decreased once again to 735.39 km^2. This recent decrease is primarily attributable to the northern section of the study area's major state farms being abandoned or flogged..

During the most recent decades, the size of some LULC classifications, such as upper montane forest, increased significantly (from 641.19 to 1,005.93 km^2). Water bodies rose from 0.08 to 0.79 km^2, afroalpine grasslands (tussock grasslands) increased from 47.89 to 272.25 km^2, and afromontane dwarf shrubs and herbaceous formations increased from 544.3 to 729.28 km^2 [48]. The building of the Melka Wakena dam is to blame for the rise in water bodies over this time period. Concurrently, afroalpine dwarf shrubs and herbaceous formations fell from 414.14 to 123.88 km^2, Erica woodland decreased from 1,193.93 to 984.29 km^2, isolated Erica shrubs marginally decreased from 545.62 to 441.35 km^2, and afromontane grasslands decreased from 1,538 to 697.58 km^2 [48]. Despite some slight variations, the Afromontane rainforest remained very stable in space over the course of the 40-year study period (it was 2,545 km^2 in 1973 and was still 2,527.67 km^2) [48].

Such changes act as a proxy for all relevant changes in biodiversity (such as shifting species composition, distribution, and abundance patterns). The research shows distinct zonation along altitudinal gradients within a given time slice, and as altitude rises, so does vegetation type turnover, leading to compressed biological zones. This is characteristic for tropical highlands [92, 93], and the coexistence of species within a small range probably makes it possible for there to be a high level of biodiversity [94]. Growing sections of the afromontane ecosystems in the Bale Mountains (up to 3,200 m·asl) have been altered and degraded as a result of human activity in recent years [72].

Based on the change detection matrix, researchers discover a consistent yet type-specific transition of LULC types in the various parties of Ethiopia. For each of the reference periods, the rate of transition varies. From 1973 to 1987, the first reference period, a clear shift from grasslands to croplands can be seen. In Ethiopia, this time was marked by a change in the tenure policy, villagization, resettlement, and droughts brought on by climate variability [68]. The construction of a sizable hydroelectric dam, the spread of commercial farms, and enrichment plantations are the defining features of the second period, which runs from 1987 to 2000. The Melka Wakena hydroelectric dam's development had a significant impact on the surroundings as well. Grassland, agricultural land, and deserted areas all contribute significantly to the area of water bodies, respectively. Such changes from land to water have a significant negative influence on ecosystems, such as the permanent loss of wildlife habitat [70]. Overall, during this time, extensive deforestation, habitat simplification, and narrowing of certain cover types were noted in addition to the rise of agriculture. The third time step, from 2000 to 2008, saw a stop in the growth of agriculture. The 2000 Bale fire is the major incident that occurred during this time [73].

The authors of the study analysis also revealed that the afroalpine zone's plant species are more uniform and have relatively constrained ecological ranges. With the exception of a few pastoralist and herding activities, the region's afroalpine zone historically represented highly remote habitats that were less impacted by human activity. Recent times have seen an increase in both direct and indirect hazards in this area that are caused by people. Impacts include more grazing occurring more frequently [72], fires [73], and lengthy droughts [73]. In the past, during periods of climate warmth, places higher than 4,000 m asl may have been cultivated, according to archeological data [74]. Therefore, afroalpine ecosystems are anticipated to under heavy pressure in a future with increased human impact and

Table 1: The different LULC classes with area coverage.

Land use land cover class	*1973*		*1987*		*2000*		*2008*	
	Area (km^2)	Percent	Area (km^2)	Percent	Area (km^2)	Percent	Area (km^2)	Percent
Agricultural land	136.39	1.81	572.19	7.50	1362.94	17.60	735.39	9.52
Afromontane grassland	1538	20.39	1499.12	19.65	539.81	6.97	697.58	9.03
Afromontane rainforest	2545	33.74	2111.8	27.68	2482.47	32.05	2527.67	32.72
Upper montane forest	641.19	8.50	720.9	9.45	1038.93	13.41	1005.93	13.02
Ericaceous forest	1193.93	15.83	1569.06	20.56	747.84	9.65	984.29	12.74
Isolated *Erica* shrub	545.62	7.23	502.3	6.58	250.7	3.24	441.35	5.71
Afromontane dwarf shrub and herbaceous formation	544.3	7.22	353.4	4.63	577.74	7.46	729.28	9.44
Barren and burned area	350.59	4.65	229.16	3.00	648.84	8.38	269.65	3.49
Afroalpine grass land	47.89	0.63	66.08	0.87	80.88	1.04	272.25	3.52
Water bodies	0.8	0.01	5.98	0.08	15.62	0.20	62.78	0.81
Total	7543.71	100	7629.99	100	7745.77	100	7726.17	100

a rising climate. The worst part is that this ecosystem is already compacted at the summit of the mountain and has nowhere else to go [48]. The protection of wildlife and indigenous alpine plants depends significantly on these delicate, fragile habitats, which are home to numerous endemic animals and plants..

It is also anticipated that the numerous ecosystem services the Bale Ranges provide to the nearby valleys and lowlands would be compromised by the increasing levels of resource exploitation in these mountains. People from the highlands and the lowlands of Ethiopia have historically interacted in a variety of geopolitical, socioeconomic, and culturally ways. Therefore, political, economic, and cultural instability in the lowlands is likely to start with ecological instability in the highlands.

4. Conclusion

This review reveal that Ethiopian highland is facing a strong land use and land cover change which is very likely intensified by climate change. Ethiopia has endangered and is threatening the high diversity of endemic plants and animals of the unique massif. Land degradation is exacerbated by changes in land use and cover. Ethiopia's changing land usage and land cover hurt the environment as well as the socioeconomic situation. Human activities can alter or deteriorate forest resources, which are known as susceptibility to forest degradation in Ethiopian highland. Forest resources are damaged not just as a result of human activity but also as a result of other natural forces. Human activities, on the other hand, were considered in this analysis since unplanned behaviors such as illegal logging, exploitation of forest resources for fuelwood and charcoal manufacture, and extension of agricultural areas are the main causes of forest degradation and land use change. As a result of population pressure and inadequate land management, agricultural land expanded dramatically within the stated time frame. In general, significant population growth and relocation initiatives may be linked to the extension of agricultural land in the country. This is due to the conversion of degraded forests to shrublands. However, due to the new settlers' loss of much greenery for infrastructure and firewood, bare land has been progressively increasing. As a result, the land has deteriorated and degraded significantly. The rapidity of the current processes makes it evident that fast action and intervention are required if Ethiopia's unique biodiversity is to be conserved.

Data Availability

The data used to support the findings of the study are included in the paper.

Conflicts of Interest

The author declares that there are no conflicts of interest.

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