Review Article

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The Implication of Land Use Land Cover Change on Biodiversity Conservation: An Overview from Protected Areas in Ethiopia

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ABSTRACT

Conversion of natural habitat to other forms of land use is the main threat to protected areas and biodiversity globally. The continued trend of land use land cover change in protected areas resulted in loss of a large portion of biodiversity, overexploitation by humans, transformation of natural land to human settlement, etc. In Ethiopia, the causes for land use land cover change in many protected areas are farmland expansion, deforestation, unsustainable grazing and settlement expansion, and are leading to loss of biodiversity and negative impacts of ecosystem services. In addition, Ethiopia's protected areas entertain escalating threats and land cover changes due to human population growth, competing claims from the surrounding communities, incompatible investment, lack of environmental law enforcement, absence of complete plan and timely update for protected areas, etc. These have affected protected areas in the country namely the Bale Mountains National Park, Chocke Mountains, Babile Elephant sanctuary, Abijata Shalla Lakes National Park, Awash National Park and others. The continued land use land cover changes are aggravating ecosystem, soil and water resources degradation in mountainous protected areas while they are leading to biodiversity destruction and loss of forest cover in lowland protected areas. In order to halt and reduce the impact of land cover change on biodiversity conservation, undertaking complete land use planning and continuous monitoring of protected areas was found to be important. Similarly, integrating protected areas into the surrounding landscapes and a broader framework of national plans, promoting income generation means for communities surrounding protected areas, promoting biodiversity conservation directly linked to poverty alleviation, involving local communities and stakeholders in land use planning and sustainable management of protected areas, enhancing sound management in vulnerable mountain protected areas and restoring abandoned lands located in and around protected areas are crucial in the proper land use planning and management of protected areas. In addition, enhancing awareness creation and promoting natural resource information of protected areas and enhancing scientific study on land use land cover change pattern of protected areas are vital to undertake effective land use planning and management of protected areas in Ethiopia.

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Abbreviations
FAO: Food and Agricultural Organization
UN: United Nations
LULC: Land Use Land Cover
PAs: Protected areas
PFA: Priority forest areas
EWCO: Ethiopian wildlife conservation organization
BES: Babile Elephant Sanctuary
SMNP: Simien Mountains National Park
ASLNP: Abijata-Shalla Lakes National park
BMNP: Bale Mountains National Park
LANP: Loka Abay National Park
UNESCO: United Nations Educational, Scientific and Cultural Organization
NDVI: Normalized difference vegetation index
IBAs: Important Bird Areas
GSNP: Gibe Sheleko National Park
KSNP: Kefta Sheraro National Park
MNP: Maze National Park.

Introduction
Background
A land use is an indication of the complex human activities on the land and the resulted impact on land surface processes. Land surface is covered by various physical and biological features that make the land vital for various activities [24]. Following the approval of the World Soil Charter in 1981 by FAO (Food and Agricultural Organization) member countries and the convening of the UN (United Nations) Conference on Environment and Development in 1992, land use planning has been given a great emphasis in the appropriate management and sustainable use of land resources [75]. Land-use planning involves a systematic land evaluation procedure for determining the suitability of land for purposes like agriculture, fishery, effective decision making related to land use, management and governance related to land resource, etc [75].

Land cover is the features of land surface and immediate subsurface that comprise biota, soil, topography, surface and groundwater, and human structures [41]. Land Use Land Cover (LULC) is characterized by environmental change features happening on the environment in different places and periods

[72]. When changes occur in land use and land cover, it indicates the relationship between economic development and biodiversity conservation [65]. Mostly, land-use change has been considered as the conversion of natural land cover to cleared forest, subsistence agriculture, urbanization, large commercial agricultural form, and leading to intensive land destruction [29]. This has been the case since the second half of the 20th century with the rapid economic development that resulted in conversion of ~ 24% of the earth's surface into cropland and loss of ~35% of mangroves and ~20% of coral reefs [47]. The intensity and impact of human land use on earth's environment has been considered to increase this century, due to the increasing number of human population and related demand for resources like food and energy [70].

The impact of land use land cover change will also be another problem in many protected areas of the world in the coming decades. It threatens the value and effectiveness of protected areas as a conservation tool [33, 56]. This pressure will be very strong in regions with rapid socio-economic change, high population growth and within areas of intensive land based economic development [10]. As a result, the work of developing countries to achieve conservation goals will be affected by the rapid and large scale landscape degradation in natural conservation areas and ever increasing human induced changes on the areas [50].

Protected areas as land use strategies for biodiversity conservation

Establishing protected areas is one of the most important strategies for achieving conservation [14]. Protected areas (PAs) are sites where conservation of species and management of the natural ecosystem are undertaken. They are cornerstones for conservation of biodiversity and maintenance of environmental services for sustainable development. Effective preservation of protected areas depends on appropriate design and efficient management that incorporates the need of surrounding communities [15]. Currently, over 130,000 protected areas are recognized to exist worldwide covering about 13.9 % of the Earth's land surface and 5.9 % of the territorial marine surface. These areas represent a considerable resource and places for biodiversity conservation and for protection of ecosystem services [15]. Few PAs were mostly uninhabited wildernesses before their designation, but land cover changed over time [55]. Protected areas located in densely populated areas and where employment opportunities low, the reliance of human populations for local resources like food and energy increases and leads to biodiversity destruction [10].

The roles of protected areas extend from the core conservation center to the surrounding environment and beyond. They are crucial in natural protection of organisms, safeguarding and cultivating biodiversity, provision of ecosystem services like pollination and pest control. Terrestrial and aquatic ecosystems existing in protected areas hold biodiversity including fish, plants, seeds, mushrooms, fruits and honey producing insects on which human being is dependent for his diet [19]. Protected areas support conservation and protect biodiversity from indiscriminate destruction by anthropogenic factors [44]. Protected areas also provide ecosystem benefits such as watershed protection, carbon storage, contribution for clean water, reduction of disaster risks, and cultural services such as recreation and spiritual fulfillment [10, 19].

When protected areas preserve biodiversity and maintain their ecosystem values, they face undetectable changes and mislay land covers [44]. Mostly land use change begins to occur outside the administrative boundaries of protected areas and then will spread to main conservation sites of protected areas [10]. Currently,

biodiversity of the Earth is vanishing at rapid rate and will continue similarly unless urgent action is undertaken [15]. Thus, knowledge of land cover changes in different protected areas in the world have been vital to understand the impacts on biodiversity, wildlife and ecosystem services, and is critical to promote conservation efforts in protected areas as well as in policy making [61].

Beyond understanding land cover changes in protected areas, appropriate land use planning is an essential element for effective biodiversity conservation and for sustainable ecosystem services in natural areas. Effective land use planning helps to identify areas of high conservation value, avoid incompatible adjoining land uses, distinguish corridor networks to link protected areas and maintain ecological connectivity, know the early consideration of biodiversity issues, determine the impact of development on biodiversity, etc. As a result, it facilitates biodiversity conservation and ecosystem services provision in adequate manner [53]. Land-use planning which is commonly determined as a top-down planning approach should include the land users notably farmers, herders and fishers, primary land-use planners, those who exploit forest, energy or mineral resources and those who use land for settlements, industry, recreation or tourism in planning processes [75].

Impact of land use land cover change on biodiversity and ecosystems

Land use and land cover change (LULCC) has great negative impacts on ecosystems at local, regional and global scales. For instance, pollutions occurring on water, soil and on air are consequences indicating land use impact on ecosystems [1]. Similarly, protected areas (PAs) which are recognized as strategies for achieving biodiversity conservation and sustainable development are facing great challenges that affect their natural existence [14]. The protected areas of the world are in a rapid destruction due to the changing world. This complicates the conservation and management of biodiversity and the valuable ecosystems of the world. Although there are many issues affecting biodiversity conservation in protected areas, the impact of land use land cover change is the major one because it leads to different consequences including climate change, fragmentation of natural ecosystems, increasing urbanization and introduction of invasive species. The growing number of human population has increased demands of natural resource to meet their needs that in turn led to environmental destruction [15].

Conversion of natural habitat to other forms of land use is the main threat to the global biodiversity. The estimate of the Earth's terrestrial habitat indicates as there have been 39% change of natural environment in to farmland and settlements [61]. The changes to land cover structure affect wildlife resources and their habitats and lead to environmental modifications [73]. This has been indicated in some semi-arid ecosystems of eastern Africa in which changes to land use have impacted wildlife conservation and ecosystem services mainly in and around protected areas [61]. Though many countries in the world are working on environmental protection and management strategies, the intensification of inappropriate land use by humans is resulting in isolation of protected areas, inhibition of landscape and biological connectivity and diminishing of habitat quality in various natural areas [70].

The causes for land use change and factors that affect biodiversity in different ecosystems can be categorized as direct and direct. Direct causes are factors threatening biodiversity conservation within protected area including logging, agriculture, over grazing, etc. While the indirect causes for land use change in conservation

or natural areas comprise socioeconomic, demographic, or biophysical factors that lead to forest-cover loss by human activity and human influence [67]. Managing both direct and indirect factors needs collaborative work with communities as they are actors in environmental modification and land cover change resulting from improper land use in and around protected areas [67]. With the increasing number of human population and related impact on environment, fitting balance between conservation and development activities is required for better maintenance of biodiversity and sustainable benefit of local community [73].

Protected areas of Ethiopia and their challenges
In Ethiopia, there are many protected areas designated as National Parks, Wildlife Reserves, Priority Forest Areas (PFA), Biosphere Reserves and Community Conservation Areas (Fig 1). They are sites for conservation of biodiversity and provide ecosystems services such as regulating temperature, supporting life, facilitating nutrient recycle, etc [74]. Biologically, Ethiopia harbors diverse species of flora and fauna. It has over 6,000 species of vascular plants and of these, 625 are endemic species, and one endemic plant genus. Similarly, the fauna of Ethiopia is characterized by 860 avian species (with 16 endemic species and two endemic genera) and 279 species of mammal (with 35 endemic species and six endemic genera). Moreover, Ethiopia has also different species of reptiles, amphibians, fishes and invertebrates, but adequate data are lacking on these groups [20]. As a result, establishing adequate and representative protected areas in the country was found to be crucial to conserve and manage biodiversity and the different ecosystems in adequate manner.

The protected areas in Ethiopia were began to be established during the late 1960s and 1970s and during this time the EWCO (Ethiopian wildlife conservation organization) played a pivotal role in formulating policies to protect the fauna and flora, designate protected areas, and establishing and managing wildlife conservation areas. The conservation areas of that time were established mainly focusing on large extant assemblages of mammals and remnant populations of endemic and charismatic species. Accordingly, the Simien Mountains National Park was established to protect Walia ibex, Bale Mountains National Park to protect Mountain nyala and the Ethiopian wolf, Yangudi-Rassa National Park to conserve the African wild ass, Awash National Park to preserve the assemblage of Soemmering's gazelles and beisa oryx, Gambella National Park to protect the white-eared kob and Nile lechwe [31]. Similarly, the Babile Elephant Sanctuary, which is part of the Somali-Masai Centre of Endemism was established in 1970 to conserve the unique and viable elephant population in the eastern part of the country [73].

The establishment of new protected areas continued in the subsequent decades across the country. Community conservation areas and participatory Forest Management schemes are also increasing in the country. These types of protected areas help to promote community benefit from the sites and enhance appropriate use and management of forests [66]. However, despite the increasing number of newly established conservation areas, protected areas of Ethiopia are not operating effectively and sustainably. Many parks especially those in remote areas are receiving little support and are not well controlled. As a result, they are experiencing loss of a large portion of biodiversity, over exploitation by people, intensive grazing, illegal human settlement, etc [69]. Land cover change which is the source for land degradation, habitat destruction, loss of biodiversity and change of hydrologic cycle (i.e. erosion, drought) is also a problem in different protected areas in the country. Land degradation occurring in highland

ecosystems leads to increased surface runoff, soil erosion, and affects aquatic life [13]. In Ethiopia, land cover change is mainly caused by unsustainable grazing, illegal harvesting, deforestation, etc and it negatively impacts ecosystem services. The decline of vegetation cover associated with land degradation lowers carbon sequestration and watershed protection [69].
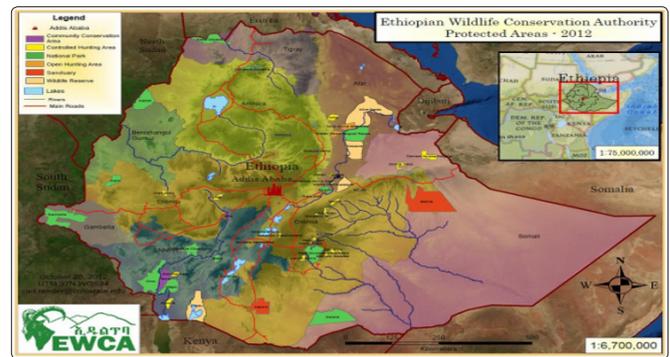

Figure 1: Map of protected areas in Ethiopia [69].

Land use land cover change impact on Ethiopian protected areas and their biodiversity
Land use land cover changes are the major features of the global environment and affect processes and services offered by ecosystems [60]. As part of the globe, land conversion has been a common experience in protected areas of most Eastern African countries [54]. Changes of forest cover to other land use types in East Africa, including Ethiopia were considered as the highest in Africa at a rate of 0.94% (1990-2000) and 0.97% per year (2000-2005) [18]. The increasing number of human population, and associated livelihood activity such as livestock husbandry was the major cause for land cover changes in protected areas of most Eastern African countries [54]. The conversion of natural forest to other land use types such as farmlands, grazing lands, human settlements and urban centers have been increasing factors to loss of biodiversity, deforestation and land degradation in protected areas of the region [43].

As to other nations in East Africa, Ethiopia's protected areas entertain escalating threats due to land use change and related factors. Intensive agriculture, commercial farming, overgrazing, competing claims from the surrounding communities in different protected areas, deforestation and urbanization which are induced due to the growing human population are the major challenges to the protected areas and their biodiversity in Ethiopia [74]. For instance, the study conducted by [61], in Babile Elephant Sanctuary indicted loss of substantial natural habitat (riparian forest, bushland and woodland) during the study period (1977–2017) with an annual average loss rate of 4475 hectare. Agriculture obtained highest land use form at the expense of natural forest compared to other land use types which made agriculture to show expanding trend during the study period. The study conducted in Choke Mountain ranges showed a continuous increment of crop land compared to other land use types during the years between 1986 and 2011. This was due to the expansion of cultivated land in the Choke Mountain ranges at the expense of alpine vegetation. This resulted in 79% decline of Ericaceous forest, 40% decline of grassland and 17% decline of shrub land between 1986 and 2011 [22].

In Ethiopia, the transformation of natural habitats to other land use forms is a common experience in many natural areas [27]. In the highland ecosystems or afroalpine and sub afroalpine areas, this made most of the faunal and floral resources to face high

pressure from intensive human land use [22]. Rapid agricultural expansion and overgrazing are main reasons for ecosystem, soil and water resources degradation in mountainous protected areas in the country [22]. In the lowland ecosystems, land use change is also a problem as identified in many lowland protected areas in Ethiopia. The study undertaken in BES (Babile Elephant Sanctuary, Ethiopia) indicated land use change resulting from settlements and agricultural land expansion as the main drivers of natural habitat loss in the sanctuary [61]. Although the sanctuary was established in 1970 to preserve the viable number of elephant population in the eastern part of the country, about 82% of the available natural area of elephants has been lost since 1970s due to land cover changes occurring in the area [73].

Land use and land cover change is usually related to direct and indirect factors that impact the natural habitat and the overall forest structure in protected areas [67]. These factors lead to ecosystem destruction and affect many protected areas in Ethiopia. The Bale Mountains National Park, which is one of the most important ecosystems and biodiversity resource sites globally, is under increasing land cover change and environmental degradation from a wide range of stress factors [71]. Land use land cover changes associated with shifting of the lifestyle from pastoralism to mixed agriculture (livestock and crop) by the surrounding communities, overgrazing in natural areas, expansion of illegal settlement and increased farming are displacing elephants from most of their previous ranges and are aggravating human-elephant conflict in Babile elephant sanctuary [61]. Similarly, anthropogenic pressures in the last three decades have resulted in conversion of natural vegetation, into cultivated and bare lands, overgrazing of natural grasslands, clearing and loss of forest and natural shrub for the purpose of construction and charcoal making. Furthermore, intensification of upstream agricultural activities has led to overexploitation of terrestrial biodiversity resources of the Abijata-Shalla Lakes National Park [74].

There are different drivers for land use change in protected areas in Ethiopia. Recently, large amount of LULC change has been observed due to socio-economic and biophysical drivers such as population growth, agricultural expansion, development activities, climate and accessibility to resources [60]. In some circumstances, climate change has a great implication in land resource use and needs appropriate land use planning for mitigating and adapting to climate change. To address these challenges, sustainable land resource management that includes various measures adapted to the biophysical and socio-economic context for the protection, conservation and sustainable use of protected areas and the rehabilitation of degraded natural resources and their ecosystem functions is critical [75].

Objective of the review
The general objective for this study was:
To determine the implication of land use land cover changes on biodiversity conservation using Ethiopia's protected areas as a reference.
The specific objectives of the study were:
1. To identify the factors for land use land cover changes in protected areas of Ethiopia
2. To determine LULC changes and their impacts in selected conservation areas of Ethiopia
3. To indicate ways to mitigate LULC change impacts in the Ethiopian protected areas

Methods
This paper was based on studies conducted on different protected areas of Ethiopia notably National Parks, Wildlife sanctuary and (PFA) priority forest areas. Relevant literatures were reviewed on LULC changes of protected areas in different periods. Since LULC change studies of Ethiopia's protected areas are incomplete, only available studies are included to determine the factors for LULC change, trend of changes and the impact on biodiversity conservation in the country. Moreover, articles and documents related to LULC are explored from different internationally published online sources for better description about LULC change and associated biodiversity impacts. This paper followed simple descriptive and quantitative approaches. The qualitative data and scientific findings obtained from different sources were analyzed in the form of description while the quantitative data presented in tables were analyzed using descriptive statistics and narration.

Discussion of findings
Factors for Land Use Land Cover Change in Protected Areas of Ethiopia
Population growth
High population growth has been the root cause for destruction and degradation of natural resources especially in developing countries [22]. In Ethiopia, the northern highlands were the centers of high number of human population and are areas where natural lands have been transformed to cultivated lands for long years. This resulted in reduction of forest cover and destruction to biodiversity and ecosystems in these areas [36]. The increasing number of human population in (SMNP) Simien Mountains National Park resulted in intensification of farmlands and settlements in grassland and original natural forest habitats [30].

Lack of adequate environmental law enforcement
Most protected areas of Ethiopia do not possess legal status, and are characterized by inadequate protection. Even protected areas with legal protection and gazettement such as the Bale Mountains National Park and the Simen Mountains National park are experiencing challenges that can lead them to deterioration [17]. Similarly, the study in (ASLNP) Abijata-Shalla Lakes National park, in Ethiopia indicated absence of adequate environmental law enforcement that aggravated the various threats on the aquatic and terrestrial biodiversity resources of the park [74].

Lack of complete plan and timely update for protected areas
The goal of land use planning is to support land users and decision makers with the clue to select and implement those land uses that will best meet the requirements of community while safeguarding natural resources and ecosystem services for the current and future generations [75]. Incomplete land use plans not considering climate change and ever changing conservation needs affect the future ecosystem condition and sustainability of conservation areas. Absence of monitoring plans in protected area, absence of land use plan updates and absence of ways to address land use changes in conservation areas affect the protection of protected areas and their sustainability [21].

Competing land use between local communities and conservation authorities
Dispute over land use between the local people and biodiversity conservation agencies has been a major problem in developing countries. It is also the case in many protected areas of Ethiopia. In some protected areas of the country, local people continued to utilize the land, water and other resources despite the areas were declared as conservation centers [64].

Incompatible investment

Poor land use zoning and land use controls are the causes for emergence of uncoordinated and conflicting land use approaches [40]. Developmental activities with different goals on the same and nearby areas are known to cause incompatible land use systems that lead to land use land cover changes. This is the case in the Rift Valley areas in Ethiopia where existence of intensive irrigation farming by the horticulture and floriculture project around Ziway Lake, proliferation of the green house floriculture companies and horticulture associations on the banks of Lake Ziway and Bulbula river, conservation of biodiversity and avian fauna in surroundings of Lake Ziway and conservation efforts in and around ASLNP reveal incompatible land use approaches that impact our natural environment in a great manner. The different horticultural and floriculture investments were growing in the past decade as source of employment and generating foreign currency which aggravated land use land cover change in the area [74].

Inadequate involvement of communities in conservation

Although indigenous knowledge is considered to have an important role in biodiversity conservation and protected are management, the incorporation of traditional ecological knowledge and local institutions in protected area management in Ethiopia is insignificant. In the same manner, community participation and their role in conservation is low and limited to few protected areas of Ethiopia compared to its potential [64].

Absence of direct benefits from nearby protected areas

The declines of natural land in protected areas indicate the low-level importance of wildlife conservation in the livelihood of adjacent and local communities. Promoting conservation of wildlife habitat in absence of direct benefits of the wildlife based-tourism industry for near communities is difficult. This results in clearance of natural forest for irrigated farming, human settlement, and infrastructure development at the expense of wildlife and biodiversity conservation [52]. The underperformance of many PAs network in the ecological, economic and social aspect reduces the beneficiary of surrounding communities [42].

Settlement expansion

The ever-increasing local inhabitations in protected areas are the challenges for protected area management and biodiversity conservation. Impoverished resource dependent local populations are increasing in Ethiopia, both within and adjacent areas of national parks with high biodiversity value [64]. For instance, in ASLNP, the movement and involvement of nomads to set up residence with their livestock in the park to meet the various needs for them and for their livestock resulted in destruction of biodiversity and made the protection of the park unsuccessful [74].

Expansion of farming

Expansion of farming in protected areas affects the sustainable existence of biodiversity and natural ecosystems. Intensive farming practice in protected area contradicts with the aim of conservation and leads to land cover change in natural areas. The study in ASLNP indicated the conversion of natural areas to cultivated land area considerably [74]. The settled cultivation within the core park area by migrant communities and resented nearby communities led to increased cultivated land area in 2016. Similarly, the extent of acacia dominated woodland in ASLNP has decreased from 11.1% in 1973 to 2.25% in 2016. The underlying factors for loss of the woodland habitat in the park are related to intensification of cultivation [74]. Expansion of agriculture and inappropriate land plowing reduce vegetation cover, aggravate erosion, and enhance conflict between the park management body and the surrounding local community in different protected areas of Ethiopia [12].

Deforestation

Clearance of forest for the sake of charcoal making and production are the factors for land cover change in ASLNP [74]. The government initially prohibited the use of grazing lands by agro-pastoral populations in the park without proper consultation or compensation. Then, local communities cleared Acacia woodland as a reaction, and much of the forest surrounding Lake Abijata has been removed by communities for purposes like charcoal production [74]. Exploitation of wood for the purpose of fuel and construction materials is one of the main challenges in protected areas such as (BMNP) Bale Mountains National Park and (LANP) Loka Abaya National Parks in Ethiopia. The dependence of local people on park resources to meet their energy demand and construction materials need is leading to intense deforestation and destruction of biodiversity in different national parks in Ethiopia [63, 12].

Overgrazing

The increasing numbers of livestock population in and around protected areas affect protected areas by changing the natural vegetation cover. This is the case in protected areas in Ethiopia where nomadic life style of communities is widely prevalent. In Abijata-Shalla Lakes National Park, this was the challenge affecting the natural forest in the park [74]. Livestock grazing had an adverse impact on birds of Bale Mountains by influencing the habitat of species and altering assemblage composition [6]. Similar study conducted in Loka Abaya National Park indicated expansion of overgrazing due to the involvement of pastoralists whose livelihood is dependent on livestock husbandry. This is leading to conflict between pastoral comminutes and management body of the park in addition to its impact on the park biodiversity and ecosystem [63].

Fire

The occurrence of human induced fire affects many protected areas in Ethiopia. One of such parks that experience fire outbreak is the BMNP that is usually impacted by fire outbreak related environmental consequences [12].

Invasive species

The prevalence of invasive species affect the natural land cover, ecosystem service and feeding of wild animals in protected areas. The replacement of grasslands and woodlands by invasive species like Prosopis in Afar Region in Ethiopia impacted the livelihoods of pastoralist communities and their natural environment in multiple ways [60].

Low government institutional capacity and weak management

Institutional gaps and ineffective strategies are among the factors for improper land use system in protected areas [71]. For instance, Ethiopia established 58 National Forest Priority Areas to conserve the natural forests of Ethiopia and the environment for the genetic resources [59]. However, due to the low level institutional capacity and weak management, the National Forest Priority Areas strategy failed to protect the rights and interests of local communities and conservation of the sites. The communities perceive government management plans as contrary to the interest and rights of the local people [36]. The sustainable conservation of biodiversity and associated ecosystems can be achieved when institution capacity of government develops, management systems are improved and

the major beneficiary of local communities is ensured. Protected area challenges such as habitat destruction, erosion of biodiversity, inefficient livelihoods from biodiversity, etc result from low institutional capacity and weak management, and affect land cover pattern of protected areas [36].

Land Use Land Cover changes in different protected areas and their impacts on biodiversity conservation in Ethiopia
Simien Mountains National Park

Land use land cover change is the problem faced by many protected areas in Ethiopia. Many conservation sites including the SMNP entertain a growing land use land cover changes due to anthropogenic pressures. In Ethiopia, land use land cover change is a pervasive and a common phenomenon derived by conversion of natural areas to agricultural and settlement sites and affect ecosystem services provided by natural landscapes [66]. Although the Simien Mountains National Park has been legally gazetted and enlisted by UNESCO as world heritage site, it still experiences land degradation associated with agriculture and grazing which are the main livelihood forms of the community living in and around the park [45]. Deforestation in favor of farmland expansion and loss of woody vegetation especially in surroundings of Gich and

Chennek camps are anthropogenic problems affecting the park and are major concerns for sustainable management of the SMNP. Similarly, increasing number of livestock has been the source of land degradation in Gich area in the park [32].

The human population pressure is leading to high demand for farm lands, settlements and grazing areas at the expense of habitats for precious wildlife species. For instance, the traditional Walya Ibex habitats were converted into intensive human-used zone in SMNP. The park entertained a decline in Grasslands and forestlands unlike shrubs, farmland and settlements and exposed volcanic rocks and bare ground which increased in their extent in the past 30 years (Table 1). The contributors for shrinkage of forest cover were conversions of the original cover into exposed rocks and bare grounds, and cutting of trees for local energy consumption. In the same manner, the decrease in the extent of grassland area was caused by transforming the open grazing land to cropland and cutting of long grass for the construction of houses. The expansion of settlements in the park forced to acquire lands for farming and livestock husbandry in a great manner [30]. Conversely, in areas gained from farmlands and settlements, expansions of shrubs have been identified in the park [30].

Table 1: Area coverage of LULC classes in SMNP between 1985 and 2015, [30].

Land use and cover types	1985		2000		2015	
	H	%	H	%	H	%
Shrubs	2150.4	9.2	2870.5	12.2	4527.6	19.3
Grassland	8330.2	35.4	6450.3	27.4	4081.7	17.4
Forests	6772.8	28.8	2281.6	9.7	3816.8	16.2
Farm land and settlement	4508.1	19.2	5949.6	25.3	6928.6	29.5
Exposed volcanic rocks and Bare ground	1738.3	7.4	5947.6	25.3	4144.9	17.6

H: hectares, %: Percentage

Choke Mountains

It is one of the highland representative ecosystems in Ethiopia. It has been designated as a protected area for its multipurpose values and holding endemic species of alpine ecosystems in Ethiopia. Despite its different values and attractive nature, the Choke Mountains is facing land cover changes due to population pressure. The study made by [22], indicated the growth of cultivated land in 206% between 1986 and 2011. The crop land has increased by 34% of its original extent in the entire afroalpine region of the Choke Mountains. In contrast to this, the afroalpine vegetation (Ericaceous forest, grasslands and shrublands) have decreased by 79, 40 and 17%, respectively between 1986 and 2011. During these periods, the highest reduction was recorded for Ericaceous forest which is about 13% decline of its original area. In addition, the rate of land use conversion was especially high since 1995 and showed a transformation of large portion of the alpine vegetation to cultivated land (Table 2).

Table 2: Land cover classification for 1986, 1995, 2005 and 2011 [22].

Land cover classes	1986		1995		2005		2011		Relative change
	A(ha)	%	A(ha)	%	A(ha)	%	A(ha)	%	1986-2011 (%)
Crop land	8660	17	13419	26	17770	34	26527	51	206
Ericaceous forest	8513	16	2521	5	1841	4	1807	3	-79
Grassland	22499	43	22685	44	23909	46	13438	26	-40
Shrub land	12466	24	13514	26	8619	17	10367	20	-17
Total area	52139	100	52139	100	52139	100	52139	100	

A (ha): Area in hectare, %: Percentage

Chillimo Forest

Chillimo forest lies within the highlands of Ethiopia. It is typical dry Afromontane forest vegetation with *Juniperus procera*, and harbors different species of birds, mammals, and other biodiversity. It also serves as water source for different rivers including Awash River which is the major important water-way for irrigation of sugar plantations in the Rift Valley. However, the land use land cover feature in the area indicates loss of forestland and an increase in cultivated areas and settlements (Table 3). The harvesting of forest for commercial purpose and cutting of trees for human use were the reasons for loss of the forest. The increasing human population and continued land cover change in the forest affects the livelihood of community and agropastoral production in a great manner [66]. On the contrary, the increasing trend in the extent of shrublands which was identified during study in the area is found to be crucial to serve as buffer zone for the management of the natural Chillimo forest [66].

Table 3: Land use land cover changes of the study landscape, 1973–2015, [66].

LULC Class	Absolute area coverage (ha)				Cover change between periods (%)			
	1973	**1986**	**2001**	**2015**	**1973-1986**	**1986-2001**	**2001-2015**	**1973-2015**
Settlement	5.36	19.89	212.31	341.64	271.1	967.4	60.9	6273.9
Farmland	3202.78	3348.9	3512.07	3493.17	4.56	4.87	-0.54	9.1
Shrub land	216	858.33	1124.19	1161.36	297.4	30.97	3.31	437.7
Bare land	0	212.94	358.65	739.08	212.94	68.4	106.1	739.08
Forest land	4263.12	3247.2	2480.04	1952.01	-23.8	-41.83	-21.3	-54.2
Total	7687.26	7687.26	7687.26	7687.26				

ha: hectare, %: Percentage

Bale Mountains National Park

Ethiopia comprises high mountains and extensive alpine ecosystems that represent ecological islands in a tropical to subtropical lowland matrix. These ecosystems are characterized by differing climate and a remarkable diversity of endemic fauna and flora. The BMNP is one of such areas located in South eastern part of the country [37]. The park is an important place for conservation of biodiversity (i.e endiemic mammals and birds) and in comprising different ecosystems including afroalpine ones. However, land use land cover change due to deforestation and expansion of agriculture has been a major threat to the park. In addition, deforestation, habitat fragmentation, and shrinking of certain cover types are the threats to biodiversity in the park [37].

The landscape level land use land cover change in BMNP is given in (Table 4). During the first period (from 1973 to 1987), deforestation and agricultural expansion were the major threats leading to biodiversity loss and ecosystems destruction in the park. Subsequently, expansion of agricultural lands in the park continued during the second period (from 1987 to 2000). During this time, agriculture expanded in higher altitudes claiming places from Afromontane grassland, Ericaceous forest, Afroalpine dwarf shrubs and herbaceous formations. The study in land cover pattern also revealed the prevalence of Barren and burned areas in the same period. During the third time interval (from 2000 to 2008), agricultural lands were high compared to the original extent in 1973, but were halted from further expansion. In addition, barren and burned areas and afroalpine dwarf shrubs and herbaceous formations were declined compared to the second period. The study on land use land cover in Bale Mountains indicated the rapid change over the last 40 years due to high population growth and resettlement, agricultural expansion and deforestation that exacerbated degradation of the park [37]. Anthropogenic activities such as deforestation, agricultural expansion and grazing are prominent challenges affecting tropical ecosystems [57].

The land cover change in Bale Mountains is affecting biodiversity conservation in different manner. The study by [5], indicated that avian species that are functionally unique to Afromontane forests, especially forest specialist insectivores and canopy layer foragers, are dependent on intact (protected) forests with little human disturbance. They are affected by disturbances on vegetation structure, plant species composition and decrease in the extent of forest. The increasing land covers change in Bale Mountains National park is leading to decrease of forest density and destruction of biodiversity. This has been evidenced by NDVI analysis which showed vegetation reduction in the area [49]. In addition, land cover change due to expansion of settlement in key areas of the park adversely affects the survival of the endemic and endangered species such as Ethiopian Wolf (*Canis seimensis*) and Mt. Nyala (*Traglaphus buxtoni*). This is due to the communities in the area utilize the habitats for farming and livestock grazing. Development of villages inside and in proximity of the park also enhances vegetation (Juniperus, Hypericum, Heather and Lobelia) demand for building material, fuel source that ultimately leads to habitat degradation [12].

Table 4: The 11 landscape level LULC classes and their spatial extent with the observed changes over time [37].

LULC classes	1973		1987		2000		2008	
	Akm²	%	Akm²	%	Akm²	%	Akm²	%
Ag	136.39	1.71	572.19	7.19	1362.94	17.1	735.39	9.24
G	1538	19.3	1499.12	18.84	539.81	6.79	697.58	8.77
Fr	2545	31.98	2111.8	26.54	2482.47	31.2	2527.67	31.77
Fum	641.19	8.06	720.9	9.06	1038.93	13.06	1005.93	12.64
Ef	1193.93	15	1569.06	19.8	747.84	9.4	984.29	12.37
Ei	545.62	6.86	502.3	6.3	250.7	3.15	441.35	5.55
Sdh	544.3	6.84	353.4	4.44	577.74	7.26	729.28	9.17
B	350.59	4.4	229.16	2.88	648.84	8.15	259.65	3.26
Tg	47.89	0.6	66.08	0.83	80.88	1.02	272.25	3.42
Adh	414.14	5.2	327.75	4.12	211.70	2.66	123.88	1.56
W	0.8	0.01	5.98	0.08	15.62	0.2	62.78	0.79
No data	0.00	0.00	0.00	0.00			117.44	1.48
Total	7957.85	100	7957.74	100	7957.47	100	7957.49	100

Akm²: Area in square kilometers, LULC: Land use land cover, %: Percentage, Ag: agricultural lands, G: Afromontane grassland, Fr: Afromontane rainforest, Fum: Uppermontane forest, Ef: Ericaceous forest, Ei: Isolated Erica shrubs, Sdh: Afromontane dwarf shrubs and herbaceous formations, B: Barren and burned areas, Tg: Afroalpine grasslands, Adh: Afroalpine dwarf shrubs and herbaceous formations, W: water bodies.

Babile Elephant Sanctuary
Babile Elephant Sanctuary is one of the sanctuaries in Ethiopia established to conserve the declining elephant population and manage the habitat for sustainable existence of the species. However, due to the continued habitat destruction, the elephant population experienced a great decline over the past 40 years. The increasing anthropogenic pressure and related land cover changes were the factors for frequent occurrence human-wildlife conflict in the area [61]. According to [61], out of the six land cover types identified in the study area only agricultural land, settlements and bareland, showed growth over the 40 years study period. In contrast, the extents of riparian forest and bushland declined, suggesting that land area that was formerly used by elephants was converted into agricultural land, settlements and bareland (Table 5).

Table 5: Area and proportion of land-cover types in BES in 1977, 1997 and 2017 [61].

Land cover classes	1977		1997		2017	
	A(ha)	%	A(ha)	%	A(ha)	%
Riparian forest	74918.97	8.8	54793.17	6.3	27145.17	3.1
Agricultural land	30428.64	3.5	91725.93	10.5	151408.6	17.3
Bare land	2462.94	0.3	11688.39	1.3	32246.91	3.7
Bushland	271496.88	31.1	245813.04	28.1	237617.7	27.2
Settlement	1202.59	0.1	9632.07	1.1	29446.56	3.4
Woodland	493548.57	56.5	460405.44	52.7	396193.9	45.3
Total	874058.6	100	874058.6	100	874058.6	100

ha: hectare, P (%): Proportion in percent

Abijata-Shalla Lakes National Park
As this park has been located in the Central Ethiopian Rift Valley, it entertained significant human intervention in past decades which led to changes in land use land cover pattern and destruction to biodiversity. The park is one of IBAs (Important Bird Areas) which are priority sites for immediate action among the globally threatened species. It is home to different migrant birds including *Aquila heliaca* (a rare passage migrant); *Falco naumanni* (an uncommon passage migrant with a few wintering); *Circus macrourus* (fairly common passage migrant, with a few wintering); and *Acrocephalus griseldis* (status unknown) in IBA. In addition, the park was historically known by its abundant species of Oryx, Swayne's Hartebeest, Buffalo, Water buck, Giraffe, lion, etc but now these species have been exterminated and are no longer seen in the park [74]. The biodiversity of the park (i.e. mammals, birds, fishes, etc) are declining and ecosystem degradations are also intense in the area [39]. The land use land cover change of the park associated with human induced factors is affecting the status of biodiversity in the park [74]. According to this study, cultivated land and grazing land demonstrated significant increase over the last decades while woodland and water ecosystems which are home to wetland and woodland adapted birds are declined compared to their original state (Table 6).

Table 6: Land use land cover change types over time in ASLNP [74].

Land cover classes	1973		1994		2000		2016	
	km²	%	km²	%	km²	%	km²	%
Water bodies	665	37	570	32	699	39	387	22
Wood land	199	11	137	8	81	4	40	2
Cultivated land	199	11	295	16	134	7	466	26
Grazing land	301	17	380	21	458	26	554	31
Bare land	429	24	410	23	420	23	345	19
Total	1793	100	1793	100	1793	100	1793	100

km²: Square kilometer, %: Percentage

Awash National Park
Awash national park makes an important component of the arid ecosystem and tropical savannah ecosystem in Ethiopia. But due to enormous anthropogenic challenges, the park faced different threats. The land use land cover feature of Awash national park is characterized by the drastic reduction of scattered bushland unlike the trend of change in other land cover types. Scattered bushland reduced by 38.5% between 1972 and 1986 and by 29.4% during the entire study period in the park [8]. The park experienced expansion in shrub lands, farmland lands, bare land and grasslands compared to its original state (Table 7). The illegal encroachment of pastoralist communities to undertake agricultural activity and use the park as a grazing site for their livestock increased deterioration of the park and its biodiversity.

Table 7: Land use and land cover change from 1972 to 2006 [7].

LULC types	1972		1986		2006		Change in LULC in %		
	Akm²	%	Akm²	%	Akm²	%	1972-1986	1986-2006	1972-2006
Scatter bushland	289.16	38.6	0.6	0.1	68.8	9.2	-38.5	9.1	-29.4
Shrubland	70.52	9.4	312.2	41.6	148.0	19.7	32.2	-21.9	10.3
Grassland	266.15	35.5	372.6	49.7	345.2	46.0	14.2	-3.6	10.5
Farmland	48.08	6.4	44.6	5.9	75.1	10.0	-0.5	4.1	3.6
Bareland	76.09	10.1	20.1	2.7	112.9	15.1	-7.5	12.4	4.9
Volcanic crater	8.31	1.1	8.9	1.2	9.1	1.2	0.1	0.0	0.1
Total	750	100	750	100	750	100			

Akm²: Area in square kilometers, LULC: Land use land cover, %: Percentage

Gibe Sheleko National Park
Ethiopia is characterized by rapid environmental resource destruction linked to anthropogenic threats in its different protected areas [46]. Gibe Sheleko National Park (GSNP) is a recently designated conservation area found in Gurage Zone and comprises diverse species of flora, fauna and different topography and ecosystems. However, it is facing different anthropogenic threats that affect the land cover pattern and related biological diversity (Table 8). Consequently, identifying information about the land use land cover pattern in the park helps to reduce the challenges and promote conservation measures in the park [28]. Improper land use practices in conservation areas such as deforestation, overgrazing, farmland expansion, settlement, etc alter element of watershed, habitat of wildlife, and vegetation cover especially indigenous tree species [9]. The increasing land use land cover change negatively affects the potential use of an area and leads to land degradation. LULC change reduces of forest cover, increases carbon emission in grasslands and exacerbates global warming [46].

Table 8: Land use land cover change in GSNP in 1990, 1999 and 2016 [28].

LULC types	1990		1999		2016		Amount of change (1990-2016)	
	A (ha)	%	A (ha)	%	A (ha)	%	A (ha)	Mean annual (ha)
Forest land	18600	46.5	12060	30.15	6160	15.4	-12440	478.5
Bush land	12600	31.5	13700	34.25	20600	51.5	+8000	307.75
Farmland	6500	16.25	1800	4.5	5200	13.0	-1300	50
Grazing land	2300	5.75	9000	22.5	5800	14.5	+3500	134.6
Bare land	-	-	3440	8.6	240	5.6	+2240	86.15
Total	400000	100	400000	100	400000	100		

A (ha): Area in hectare, LULC: Land use land cover, %: Percentage

Kefta Sheraro National Park

Kefta Sheraro National Park (KSNP) was formerly known as Shire Lowlands Wildlife Reserve until it was officially established as a park in 2014. The designation of the area as a park was found crucial to conserve the African Elephant population (*Loxodonta africana*) and different wildlife species in northern Ethiopia [16]. Earlier conservation of the park is necessary as highest rate of habitat change recorded in north western Ethiopia, in which 79% woodlands in 1985 reduced to 35.1% woodlands in 2014 [34].

The study by [3], in KSNP indicated the high reduction of woodland area which was 77.8% of the park coverage in 2003 to 38.0% of the park in 2015. Moreover, shrub land coverage increased in 2015 compared to its originals state in 2003 similar to grassland area coverage which increased in the same period. Except for woodlands, larger changes to land cover were recorded between 2003 and 2009 for shrub land and agricultural land compared to the period between 2009 and 2015. Grass land area shown a greater change during the second period between 2009 and 2015 (Table 9).

Table 9: Total area and percentage cover of each land cover class in each of the three years used in this study [3].

Land cover	2003		2009		2015	
	A (km²)	%	A (km²)	%	A (km²)	%
Woodland	1683.9	77.813	1153.5	53.302	821.58	37.97
Shrubland	122.7	5.6699	692.32	31.992	662.17	30.60
Grassland	354.41	16.377	176.47	8.1548	581.22	30.60
Agricultural land	2.86	0.132	138.1	6.3817	70.24	3.25
Bare land	0.16	0.0073	3.66	0.1691	28.81	1.33
Total	2164	100	2164	100	2164	100

A (km²): Area in square kilometers, %: Percentage

Expanding improper land use types and their impact on biodiversity conservation in selected protected areas in Ethiopia

Nech Sar National Park

Nech Sar National Park is one of protected areas located in Southern Part of Ethiopia. Resource dependent livelihood strategies of communities (i.e. crop cultivation, wood and grass collection, livestock grazing, etc) are disturbing the landscape of the park [35]. Expansion of these improper land use types is aggravating environmental destruction, habitat fragmentation and loss of biodiversity. For instance, the mammalian species of the park have been negatively affected due to growing threats in the park. Accordingly, some mammalian species such as the endangered Swayne's hartebeest faced local extinction where as the population of Grant's zebra (*Equus quagga*) has decreased from 6500 individuals in 1985, [38] to 2161 in 2013 count [23]. Moreover, the park is also facing settlement expansion and intensive livestock grazing in its different parts (Fig 2).
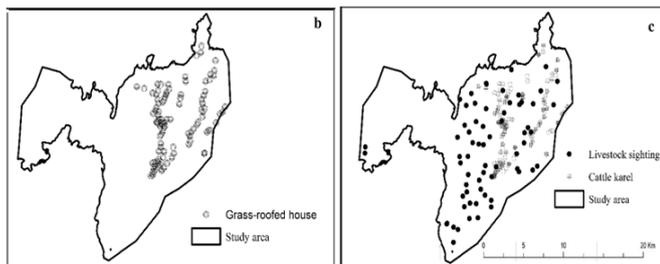

Figure 2: Settlement and overgrazing in Nech Sar National Park [23].

Gambella National Park

Located at the western part of Ethiopia, Gambella National Park is an important center for conservation of biodiversity including the migrant trans-boundary mammalian species white-eared kob. Although the park was 5,700 km2 in the past, it has reduced to 4,350 km² losing about 1,500 km2 or about 25% tropical grassland coverage of its area [11]. In addition, this park has been experiencing anthropogenic threats especially livestock grazing which lead to adverse impact on the ecosystems and biodiversity conservation in the area. The study on human attitudes and conflict with lions (*Panthera leo*) in and around the Park indicated as depredations occur because livestock graze close to (and in) lion habitat. In relation to this, lion killing and declining of the lion population was revealed in and around GNP [25].

The land use land cover changes study in the new boundary of the park indicated expansion of farm land compared to its original state. The extent of farm land was 19 km² and 60 km² in 1987 and 2000 respectively. But, in 2017 the farmland cover decreased to 51 km² (Fig 3). In addition, in 2017 the park comprises an area of 920 km2 under barren or sparsely vegetated land, while 378 km2 under tropical grasslands and 2,970 km² under wetland vegetated areas [11].
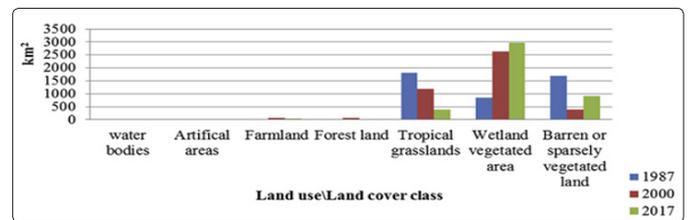
Figure 3: Land Use Land Cover categories in the new boundary of Gambella National Park for (1987, 2000, and 2017) periods [11].

Maze National Park

Land use practices in natural areas determine land cover pattern of protected areas and the resultant changes on biodiversity and ecosystem condition [76]. As one of the conservation sites in Ethiopia, (MNP) Maze National Park harbors significant biodiversity and plays a role in ecosystem conservation. However, in contrast to its goal to maintain biodiversity, the park is facing various land use practices that impact the sustainability of biodiversity and its ecosystems for the future. The study by [2], indicated different threats and land use practices occurring within the park. These include harvesting of trees and grasses for human

use, mass livestock grazing and agricultural expansion (Figure 4). To ensure the sustainability of the park and prevent the ongoing alteration, appropriate and timely management of the park should be in place [2].

a) Tree cutting in MNP   b) Grass trenching and thatching site

c) Livestock grazing   d) Maize and banana cultivation

Figure 4: Anthropogenic threats and land use practices in Maze National Park [2].

Solutions to Reduce the Impact of Land Use Land Cover Change in the Ethiopian Protected Areas
Undertaking complete land use planning and continuous monitoring in conservation areas
Appropriate and complete land-use planning plays a crucial role in the implementation of biodiversity conservation including protection of threatened species and native vegetation. Land use planning made in a holistic manner enables to guide conservation design and helps to avoid and minimize the negative impacts in protected area [53]. Land use land cover change also requires the regular monitoring to identify changes happened to the protected areas. As land use land cover has a direct relationship with ecosystem structure and biodiversity in natural conservation areas, identifying the prime causes of land cover change, monitoring the dynamics and distinguishing the associated resultant impacts are crucial to ensure the sustainability of the environment [26,62]. Undertaking monitoring of Land Use Land Cover changes in a consistent, regular and quantitative basis through remote sensing techniques, aids to evaluate the effectiveness of protected areas in adequate manner [51].

Integrating protected areas into the surrounding landscapes and a broader framework of national plans
Protected areas in the world are facing different threats that undermine their conservation effort [19]. To halt the ever-increasing threats, integration of protected areas with the surrounding landscape and a broader framework of national plans have been found essential. Linking protected areas with the surrounding landscape and managed lands and waters helps to maintain ecological processes, functions and services [15]. Particularly, determining land-use dynamics in adjacent areas of conservation sites that are formally designated as buffer zones,

aids the conservation of biodiversity and reduce the alteration of land cover pattern [67]. Similarly, incorporating protected area into a broader framework of national and regional land-use plans and natural resource laws and policies helps to maximize biodiversity related benefits and mitigate conservation challenges [15]. The management of protected areas should base on innovative and adaptive techniques that help to prevent multiple and interrelated threats in and beyond the boundaries of protected areas [19].

Enhancing awareness creation and promoting natural resource information for effective land use system
Lack of adequate awareness and information on the available resources affects local government decision-making in relation to land use planning. Identifying the effects of human activities on the environment and integrating with information on land use pattern and dynamic is crucial for managing protected areas. Land use planning processes allow existing and future use to be considered by local government, and therefore site specific information on existing land use is required [48]. For instance, Environmental information of protected areas provides a mechanism for management body to conserve biodiversity and promote natural resources protection on core conservation zone [48]. Availability of information for resources helps to plan, implement and improve land cover status of protected areas by the responsible bodies [66].

Promoting income generation means for communities surrounding protected areas
Protected areas differ from highly protected areas with limited human engagement to areas that have intense human involvement where multiple uses of wildlife are permitted. Areas with high protection level show a little land cover change while areas with high human involvement demonstrate a great level of change in their land cover pattern. Wildlife-based land uses in the protected areas enable to generate substantial economic benefits for communities. Protected areas and national parks serve rural communities through introducing new livelihood options (i.e. tourism-related employment and business opportunities), facilitating infrastructural improvement and indirectly promoting economic development [42, 55]. By preventing the conversion of natural habitats, Protected Areas aid the conservation of biodiversity and improve the provision of valued ecosystem services to communities [55, 58].

Promoting biodiversity conservation directly linked to poverty alleviation
Conservation of biodiversity helps reduce poverty by maintaining environmental services and supporting livelihood of rural poor communities. However, in many protected areas, mechanisms to legally benefit communities from the nearby conservation sites are limited [42]. As poor rural communities are mostly dependent natural and wild resources, degradation of the ecological base upon which the rural poor depend diminishes their livelihood [67]. Correspondingly, the livelihood of poor communities is impacted by drought and climate change that leads to reduction of agricultural productivity [74]. The sustainable conservation of protected areas depend on improving the welfare of communities in and around protected areas, guarding local security, enhancing economic gain and supporting developmental activities of the local poor people [67]. This requires sustainable land management plan that aims to meet community needs based on environmental resources, maintain the long-term productive potential of environmental resources and facilitate protection of environmental functions for the wellbeing of rural communities [68].

Involving local communities and stakeholders in land use planning and sustainable management of protected areas

Effective land-use planning is the one that follows an integrated approach and that recognizes the need of communities and stakeholders. Management plans that incorporate communities and stakeholders in the process of land use planning and conserving the natural resources are crucial for long term protection and sustainable management of protected area [58]. Joint management between government and communities is a useful governance solution for protected areas. As local communities possess traditional knowledge useful for protecting the environment, the participation of local people is mostly essential for managing biodiversity in protected areas [19]. Land-use planning of protected areas should involve land users notably farmers, herders, primary land-use planners, those who exploit resources and those who use land for settlements, etc [75]. In relation to this, land evaluation, consensus building and development of laws are components of participatory land use planning processes that should be incorporated in the management and conservation of natural area [75].

Enhancing sound management in vulnerable mountain protected areas

Mountain protected areas provide crucial environmental services such as clean water, disaster risk reduction, harbor biodiversity resources, etc. However, they face rapid changes in land cover and spatial pattern of ecosystems associated with anthropogenic threats such as agricultural expansion, deforestation, fire, grazing, etc [37]. To maintain ecosystem functions in mountains, sound and integrated management of mountain protected areas is essential. Management approach which incorporates the conservation of natural resources and contributes for livelihood improvement of the local communities who are the custodians of the resources is critical in the preservation of mountain protected areas [58]. Management of these areas requires participatory approach in which the needs and experiences of indigenous community is included for better access and conservation of resources. Since mountain ecosystems are mostly prone to challenges such as population growth, climate change, natural disasters, farmland expansion, urbanization, etc that decline their ecosystem benefit, strong management effort in mountain ecosystems and support for poor surrounding mountain communities is very essential [19].

Restoring abandoned lands located in and around protected areas

Species differ in the level and use of habitat requirements such as cover and space which affect their existence in a given environment [29]. Conversion and restoration of abandoned agricultural lands as biodiversity conservation sites is a crucial approach to boost biodiversity and improve habitat of native species. This is because different species relate to their landscape in different ways. The involvement of abandoned farmlands and artificial areas in national parks help the maintenance of ecosystems and support biodiversity conservation in significant manner [11].

Enhancing scientific study on land use land cover change for better management approach

Globally, different changes (i.e. population growth, climate change, urbanization, etc) are happening to our environment and are main challenges in the conservation of protected areas [15]. Scientific studies provide useful clues on land-use specific impacts and the land-use threat mosaic at the landscape level. Species and community assemblages have varying response mechanisms to cope with land-use pressures, depending on land-use type [70]. Distinguishing the changes in land cover pattern and identifying their impact on species and communities aids to reduce biodiversity threats in protected areas [71]. In the same manner, undertaking scientific study on ecosystem structure, landform and dynamic pattern of protected areas helps to promote environmental services offered by these conservation sites [4].

Conclusion

Ethiopia has diverse protected areas designated as National Parks, Wildlife Reserves, Priority Forest Areas, Biosphere Reserves and Community Conservation Areas. They are established for conservation of biodiversity and provision of ecosystem services. However, they entertain improper land uses such as deforestation, livestock grazing, illegal human settlement, agricultural expansion, etc. As a result, changes in land cover pattern of protected areas have been a common experience in many protected areas and are the challenges to maintenance of protected areas in Ethiopia. The drivers for the transformation of natural habitats to other land use forms are associated with socio-economic and biophysical attributes in conservation areas. While the direct factors for land use land cover change in protected areas of Ethiopia include agricultural expansion, illegal settlement, deforestation, overgrazing, etc. Indirect factors such as inadequate community benefits from nearby protected areas, absence of community participation, limited environmental law enforcement, competing land uses between local communities and conservation authorities, etc. To reduce the changes in the trend of land cover pattern of protected areas and associated biodiversity threats, appropriate land use planning and management approach of protected areas should be implemented. This can be achieved though undertaking complete land use planning and continuous monitoring of conservation areas. Similarly, integrating protected areas into the surrounding landscapes and a broader framework of national plans, promoting income generation means for communities surrounding protected areas, promoting biodiversity conservation directly linked to poverty alleviation, involving local communities and stakeholders in land use planning and sustainable management of protected areas, enhancing sound management in vulnerable mountain protected areas and restoring abandoned lands located in and around protected areas are crucial in proper land use planning and management of protected areas. In addition, enhancing awareness creation and promoting natural resource information of protected areas and enhancing scientific study on land use land cover change pattern of protected areas are vital to be undertaken to initiate better management approach of protected areas in Ethiopia.

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