

FOREST DEGRADATION IN ETHIOPIA: EXTENT AND CONSERVATION EFFORTS

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Ethiopia is a mountainous country with a great topographic range from 110m below sea level at Dalol Depression to 4620m above sea level at Mount Ras Dejen. Because of its topographic variation and location in the tropics, Ethiopia has diverse climate conditions and the resulting diverse ecosystems. As a result, the country is well endowed in natural resources. However, resource degradation has gone for centuries. Forests which were 40% of the country's landmass in the beginning of 20th century were reduced into 2.36% in 2000. The causes were agricultural expansion; the increasing demand for construction material, industrial use, fuel wood and charcoal; lack of a forest protection and conservation policy; absence of a strong forest administration system capable of arresting the rapidly increasing rate of deforestation; lack of effort to ensure the participation of communities in forest protection and conservation and the sharing of benefits, and failure to clearly demarcate and enforce the boundaries of natural forest reserves. Currently, the remaining forests were found in South Western Ethiopia in three regions (Oromiya, Southern and Gambela regions). In northern highlands, one couldn't find forests except old-aged Afromontane forests around the Ethiopian Orthodox Tewahido churches and in some inaccessible areas. However, other areas have been completely destroyed and converted to farms and grazing lands. At present there are efforts that the government and local communities are employing. Establishment of protected and forest priority areas, as well as protecting the sacred forest sites are attempts taken to protect forests in the country. Rehabilitation of forests through afforestation, reforestation and area enclosures with participatory forest management practices are another conservation efforts that the government is implementing. Thus, this review aims to demonstrate the extent of forest degradation and indicate conservation measures being taken in response to degradation.

Keywords: Forest, Degradation, Protection, Rehabilitation, Ethiopia

INTRODUCTION

Background

Ethiopia is a country located between 33° and 48° East longitude and 3° and 15° North latitude. Ethiopia has a rugged and mountainous topography with an altitude of up to 4620 m above sea level at Mount Ras Dejen in North Gondar and a low altitude of up to 110 m below sea level at Dalol Depression in the Afar region (EPA, 2003). These diverse topographic features have contributed to the formation of diverse ecosystems characterized by great species diversity. According to WCMC (1994), Ethiopia is one of the top 25 biodiversity rich countries of the World. And has the fifth largest flora in Africa (Anonymous, 1997). The flora of Ethiopia, for instance, is estimated to comprise between 6,000 and 7,000 higher plant and about 10 –12% of these are estimated to be endemic to Ethiopia (Gebre-Egziabher, 1991).

Ethiopia has one of the largest forest resources in the horn of Africa. Ethiopia owns a total of 59.7 million ha covered by woody vegetation among which: 3.56 % are high forest (about 4.07 million ha), 49 % woodland (29.24 million ha) and 44.2 % shrubland or bushland (26.4 million ha) and plantations cover estimated to 955,705 ha (WBISPP, 2004). About 95 % of the total high forest of the country is located in three regions namely Oromiya, SNNP and Gambela regional states (Yitebitu and Eyob, 2014). Oromiya has the highest forest covers (2,547,632 ha) which accounts 63 % of the total forest resource followed by SNNP and Gambela. These states accounts about 19 % (775,393 ha) and 13 % (535,393 ha) of the total forest cover of the country respectively (Srinivasan, 2014). The Ethiopian forests provide

a wide variety of wood and non-wood products such as honey, incense, medicinal plants, bamboo, foodstuffs, etc. They are socially and commercially significant to the livelihoods of rural households.

Despite its significant importance, deforestation is severe and has a long history in Ethiopia, especially in the central and northern highlands where subsistence farming and settlements has been changing landscapes for millennia (Mulugeta and Habtemariam, 2014). Population increases have resulted in extensive forest clearing for agricultural use, overgrazing, and exploitation of existing forests for fuel wood, fodder, and construction materials (Badege, 2001). Currently, the remaining natural high forests of the country are mainly found in the southwest, which was remote and inaccessible until recently (WBISPP, 2004; Mulugeta and Habtemariam, 2014). Northern Ethiopia which was covered by forests is suffering from conditions caused by land degradation (EPA, 1998). In the northern highlands of Ethiopia, patchy remnants of old-aged Afromontane forests are found almost only around the Ethiopian Orthodox Tewahido Churches. Forests in most other areas have been completely destroyed and converted into farms and grazing lands over centuries (Bongers *et al.*, 2006).

Recently, Ethiopia has been taking measures to rehabilitate degraded forests and forest lands (Mulugeta and Habtemariam, 2014). Sacred forest sites are among conservation sites of forest vegetations. These conserved forest patches are found around the world in places of worship are on way of stewardship to protect the forest ecosystem integrity to meet the need of current and future generation. It provides cultural values, in addition to its services as key habitat for diversity of fauna and flora (Wassie *et al.*, 2009). In addition, rehabilitation has been becoming the solution in different vegetation degraded areas to meet the conservation and economic development needs (Tena *et al.*, 2013).

OBJECTIVE

General objective

The main objective of this review is to demonstrate the extent of forest degradation and indicate conservation measures being taken in the country.

Specific objectives:

- To show the distribution of forest in the country
- To assess the extent and trend of forest degradation
- To explain the causes and consequences of forest degradation
- To indicate conservation measures being taken in response to degradation

BASIC CONCEPTS: VEGETATION TYPES OF ETHIOPIA AND DISTRIBUTION

Ethiopia has a complex relief and a variety of climates, and thus diverse habitats with rich flora and fauna. The vegetation of Ethiopia is diverse and ranges from afro-alpine vegetation to desert scrub. The various vegetation types of Ethiopia have been grouped into nine general categories (Anonymous, 1997). These are Afroalpine and Sub-Afroalpine, Dry Evergreen Montane Forest and Grassland Complex, Moist Evergreen Montane Forest, *Acacia-Commiphora* Woodland, *Combretum-Terminalia* Woodland, Lowland Semi-evergreen Forest, Desert and Semi-Desert Scrubland, and Inland Waters (Aquatic Ecosystem). Each of them is described as follows:

Afro-Alpine and Sub-Afroalpine Vegetation

The characteristic plant species in this vegetation type include small trees, giant herbs, shrubs, suffrutescents and herbs: *Erica arborea*, *Philipphia trimera*, *Kniphofia* spp., *Helichrysum* spp., *Bartsia petitiana*, *Alchemilla* spp., *Crassula* spp., and giant *Lobelia* spp.; grasses are mainly species of *Festuca*, *Poa* and *Agrostis*.

The vegetation type consists of areas which are, on the average, higher than 3,200 m a.s.l in highly rugged and dissected mountain peaks of the country. The lower limit of the afroalpine falls at about 3500 m, while subafroalpine areas range between 3200- 3500 m. Two of the most famous parks of Ethiopia – Semien Mountain Park (SMP) in the north and Bale Mountains Park (BMP) in the south – are located here. Livestock grazing and barely cultivation, usually involving fire, are the major human activities, threatening existence of this vegetation.

Dry Evergreen Montane Forest and Montane Grasslands

The characteristic plant species in this vegetation type include *Olea europaea* subsp. *cuspidata*, *Juniperus procera*, *Celtis africana*, *Euphorbia ampliphylla*, *Dracaena* spp., *Carrisa edulis*, *Rosa abyssinica*, *Mimusops kummel*, *Ekebergia capensis*, etc. The vegetation type is associated with highland bamboo (*Arundinaria alpina*) and extensive areas of grassland rich in species including legumes. The most important genera are *Hyparrhenia*, *Eragrostis*, *Panicum*,

Sporobolus, Eleusine, Pennisetum, Trifolium, Eriosaema, Crotalaria. These include a large number of endemics. The vegetation type is found in an altitudinal range of 1500-3400m and has average annual temperature and rainfall of 14-25° C and 500-1500 mm respectively. It is inhabited by the majority of the Ethiopian population and represents a zone of sedentary cereal-based mixed agriculture for centuries. Forests have diminished due to human interference and replaced by bushlands in most areas. Soils have become shallow as a result of soil erosion that has been taking place for centuries. This vegetation type occurs in the Northern, Southern and Eastern highlands of the country.

Evergreen Scrub

This vegetation type can be divided into two sub-types, i.e. montane evergreen thicket and montane evergreen scrub.

Montane Evergreen Thicket

Montane evergreen thicket consists of dense growth of small, evergreen shrubs, lianas and thinly spaced small trees. Shrubs form the dominant part of the vegetation, 2-3m high and some deciduous shrubs and trees could be found among the evergreens. Suffrutescents and perennial grasses are found tangled with shrubs.

Montane Evergreen Scrub

Montane evergreen scrub consists of dense and dominant shrub stratum of evergreen plants, 3-5m tall, and trees project out of this shrub layer. Below the shrub layer, lianas, suffrutescents, herbs and perennial grasses grow.

These two types often form a mosaic on the plateau slopes. The scrub usually occurs at lower altitudes and moister areas. Shrubs occurring in this vegetation type include *Acokanthera schimperi, Carissa edulis, Euclea schimperi, Rhamnus staddo, Myrsine africana, Dodonaea angustifolia, Rhus* spp., *Calpurnia aurea, Jasminum abyssinicum, Osyris quartipartita, Ximenia americana, Protea gaguedi*. The trees include *Teclea nobilis, Croton macrostachyus, Bersama abyssinica, Olea europaea* subsp. *cuspidata, Juniperus procera, Ficus* spp., *Euphorbia abyssinica, E. candelabrum, Dracaena* spp. The dominant liana is *Pterolobium stellatum*. The scrub differs from the thicket in having more and larger trees usually occurring in small clumps. The vegetation type has been expanding at the expense of others. However, it is disappearing from vicinities of towns due to high demand for firewood.

Acacia-Commiphora or Small Leaved Deciduous Woodland

The characteristic plant species in this vegetation type include drought tolerant trees and shrubs: *Acacia tortilis, A. mellifera, Balanites aegyptiaca*, species of *Acalypha, Aerva, Barleria, Capparis, Combretum, Terminalia*, etc. The vegetation type occurs mainly in southern and eastern parts of the country and the Rift Valley with altitudinal range of 900 and 1900 m. Most of the National parks of the country are found in this ecosystem. Extraction of fire wood and charcoal, grazing, expansion of agriculture and exotic and indigenous invasive species such as *Prosopis juliflora* and some *Acacia* species, as well as fire are the major threats to this vegetation.

Moist Evergreen Forest

The characteristic plant species in this vegetation type include the largest and commercially most important trees found in Ethiopia: *Aningeria adolfi-friedericii, Podocarpus falcatus, Trilepisium madagascariense, Albizia gummifera, Celtis africana, Polyscias fulva, Schefflera abyssinica, Bersama abyssinica*. The under-storey contains coffee plants (*Coffea arabica*), some of which are known to be wild populations.

This vegetation type occurs mainly the southwestern part of the Ethiopian highlands at between 800 and 2600m elevation and the Harena Forest on the southern slopes of the Bale Mountains. Uncontrolled exploitation for timber production and coffee production are a treat of this vegetation type.

Lowland Semi-Evergreen Forest

The characteristic plant species in this vegetation type include small trees with leathery persistent leaves: *Acacia mellifera*, species of *Combretum, Terminalia* and various grasses. It occurs only in Gambella, mainly on well drained sandy soils, with altitudinal range of 450 and 600m. It is restricted to the lowlands of the eastern Gambella Region in Abobo and Gog (Gok) districts, and adjacent areas in the Sudan.

Combretum-Terminalia or Broad Leaved Deciduous Woodland

The characteristic plant species in this vegetation type include small trees with fairly large deciduous leaves often with

the lowland bamboo (*Oxythenanthera abyssinica*): species of *Combretum* and *Terminalia*, *Oxythenanthera abyssinica*, *Boswellia papyrifera*, *Lannea schimperi*, *Anogeissus leiocarpa*, *Stereospermum kunthianum*, etc. The understory is a combination of herbs and grasses while in some of the shallow valleys extensive areas of very tall grasses dominated by species of *Cymbopogon*, *Hyparrhenia*, *Echinochloa*, *Sorghum*, *Pennisetum*, etc. are found.

This vegetation type occurs in the north-western, western and south-western parts of the country with altitudinal range of 500 and 1900m. The vegetation has developed under the influence of fire.

Desert and Semi-Desert Scrubland

The characteristic plant species in this vegetation type include highly drought-tolerant shrubs, some succulents and few grasses: species of *Acacia*, *Boscia*, *Cadaba*, *Commiphora*, *Maerua*, *Zizyphus*, *Aloe*, *Commelina*, *Dactyloctenium aegyptium*, *Euphorbia scordifolia*, etc. The areas in which the vegetation type occurs are very dry and vulnerable to wind and water erosion. This vegetation type occurs in the Afar Depression, the Ogaden, around Lake Chew Bahir and the Omo Delta below an altitude of 500 m.

The semi-desert parts are found in the northern western and Northeastern parts of the country (Amhara, Tigray and Afar), Southern (Oromia and Southern Nations and Nationalities and Peoples Region) and the Southeastern and eastern (Somali) parts. The northern parts of Afar and northeastern Tigray are predominantly desert.

Riparian and Swamp Vegetation

The characteristic plant species in this vegetation type include *Celtis africana*, *Ficus sycamorus*, *Mimusops kummel*, *Tamarindus indica*, *Maytenus senegalensis*, *Acacia spp.*, *Kigelia aethiopum*, *Syzygium guineense*, etc. The trees are associated with a wide range of shrubs, herbs and grasses. Swamps are dominated by sedges, grasses and herbs.

FOREST DISTRIBUTION IN ETHIOPIA

Like any other resources forests in Ethiopia is not equally distributed. About 95% is found only in Oromia, SNNP and Gambella regions (Table 1) (WBISPP, 2004), each of them found in South Western Ethiopia. However, northern Ethiopia which was once covered by forest is devoid of vegetation. In the northern highlands of Ethiopia, patchy remnants of old-aged Afromontane forests are found almost only around the Ethiopian Orthodox Tewahido Churches and inaccessible areas. Forests in most other areas have been completely destroyed and converted into farms and grazing lands over centuries (Bongers *et al.*, 2006).

Table 1: Distribution of high forests by region

Region	Total (ha)	%
Oromia	2,547,632	62.5
SNNP	775,393	19
Gambella	535,948	13.2
Amhara	92,744	2.3
Tigray	9,332	0.2
Benishangul-gumuz	68,495	1.7
Afar	39,197	1
Somali	4,257	0.1
Others (Harari, Dire dawa)	216	0
Total	4,073,214	100

Source: WBISPP (2004)

FOREST DEGRADATION

Extent of degradation

In Ethiopia, tree cutting is a common occurrence which has been taking place for centuries (EPA, 1998). As a result, the forest cover has been changed through time. At the beginning of 20th century, forests cover 40% of the country (Badege, 2001). Around the late 1950s, forests cover 16% of Ethiopia's land area (EPA, 2003). During 1973 to 1976, forests cover 6.08 %. While during 1986–1990, some 10 to 15 years later than 1973–1976, it was around 4.75% of the country. In 2000, it reduced to 2.36% (Reusing, 2000). However, forest cover change was very much serious in the highlands of Ethiopia (Figure 1) (Aynalem, 2007). This is mainly because of the conversion of forest lands into cultivable and grazing lands by the increasing population number. Long history of settlement is also another mentioned

reason for the rapid changes besides the history of war and others.

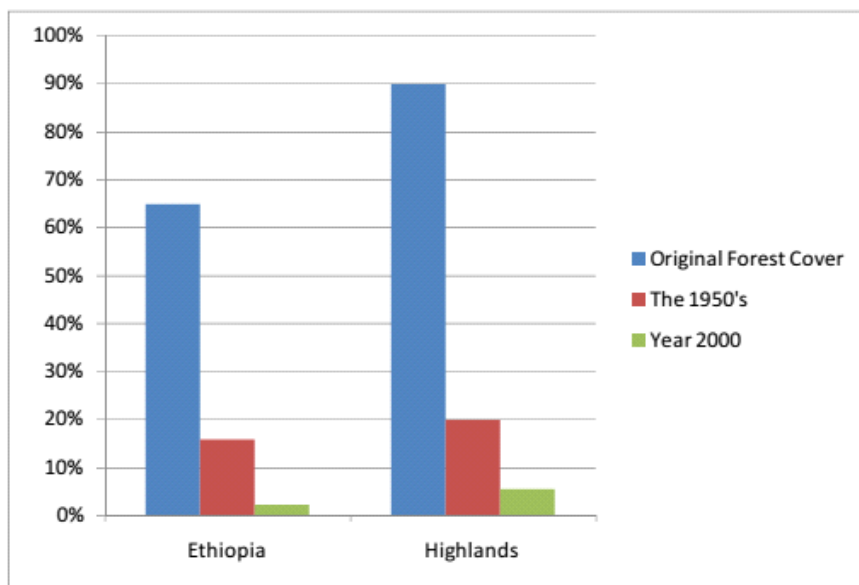


Figure 1: The percentages of original forest cover and the coverage in 1950 and 2000 (Aynalem, 2007)

There is no reliable data on annual deforestation rate in Ethiopia, due to limited and conflicting data sources, partly attributed to varied definitions of forest in the country. The Ethiopian Forestry Action Programme has estimated that 150,000- 200,000 ha of forest is destroyed annually in average yearly deforestation rate of 0.8 percent; among the highest in the world. This is calculated to be 6 percent of the total existing natural forest (EPA, 2003). While, according to Tamirat (1993), the annual rate of deforestation is estimated at 88,000 ha per year. Again, EPA (1997) estimates the annual deforestation in Ethiopia mainly for expansion of rain fed agriculture varies from 80,000 to 200,000 ha per annum. Thus, it is agreed that annual deforestation in Ethiopia ranges between 80,000 - 200,000 ha per year. Similarly with the differences in forest cover changes between the highlands and the country as a whole, forest cover changes also varies among regions. In Oromiya region, the total high forest area was reduced from 8.6% in 1973–1976 to 8.1 % in 1986–1990. While, the reduction in SNNP region was very much drastic, this was from 20% in 1973–1976 to 11.6 % in 1986–1990. In both, Oromiya and Southern regions, the trend of degradation goes from closed and slightly disturbed high forests to heavily disturbed high forests (Azene, 2002). In the northern highlands of Ethiopia, we couldn't find forests except remnants of old-aged Afromontane forests around the Ethiopian Orthodox Tewahido Churches and in inaccessible areas. Forests in most other areas have been completely destroyed and converted into farms and grazing lands (Azene, 2002; Bongers *et al.*, 2006). Similarly, a study by Temesgen *et al.* (2014) in Dera District, Northern Ethiopia and Temesgen and Tigabu (2015) in Hulet Wogedamea *Kebele*, Northern Ethiopia confirmed the reduction of forest land in the study periods (1985 to 2011). It is estimated that if the trend of deforestation continues, all the natural forests in the country will be fully depleted within 15 to 20 years (Azene, 2002; EPA, 2003).

Causes of degradation

There are several reasons for the depletion of forest resources in Ethiopia. However, the major causes include: increases in population and consequent increases in the demand for agricultural land, fuel wood as well as construction and industrial use; settlements around forest areas and forest fires; the expansion of large commercial farms in forest areas; the absence of a forest protection and conservation policy; the absence of a strong forest administration system capable of arresting the rapidly increasing rate of deforestation as well as controlling and preventing the disruption of the various eco-systems; lack of effort to ensure the participation of communities in forest protection and conservation and the sharing of benefits; failure to clearly demarcate and enforce the boundaries of natural forest reserves (EPA, 1998; EPA, 2003; MELCA Mahiber, 2008).

In Ethiopia, forest degradation is closely linked to the ongoing population growth. As commonly known more people lead to an increasing demand on land for living and for agricultural production. This is can be done at the expanse of forest lands. For example, the South-Western part of the Ethiopian highlands at the beginning of this century had still been completely covered by montane rainforests. However, due to human impact almost 70 % of the natural high forests, which still existed in the seventieth got degraded (Figure 2) (Reusing, 2000). To take specific example, the

area between Jima and Gambela which was covered by high forests in the seventies was degraded at present due to human impact (Azene, 2002). However, the cause of forest degradation slightly varies in regions. In the North-West, Gondar area, the major factor of deforestation is land clearing for cultivation and to prevent wild beast from destroying field crops. In addition, cutting of forests for construction and fuel purposes is a common practice. As a result, at present Gondar is not only devoid of forests but also of trees. In almost similar way, in Gambella, one major threat to vegetation cover is the shifting cultivation practice of the Menjengir (EPA, 1998).

In a different way, in the Benshangul and Gumuz areas (Region 6), many human activities result the destruction of forests. Hunters set fire to the forest to force wild animals to flock together and move in the desired direction, where they will be ambushed. Another activity that causes fire in the forest is honey collection. Traditional bee hiving is a common way of life in the area. People set fire when harvesting honey to fumigate the bees and decrease the extent of their attack, and the fire often goes out of hand and destroys the surrounding vegetation. Lightening also causes fire and results in forest destruction (EPA, 1998).

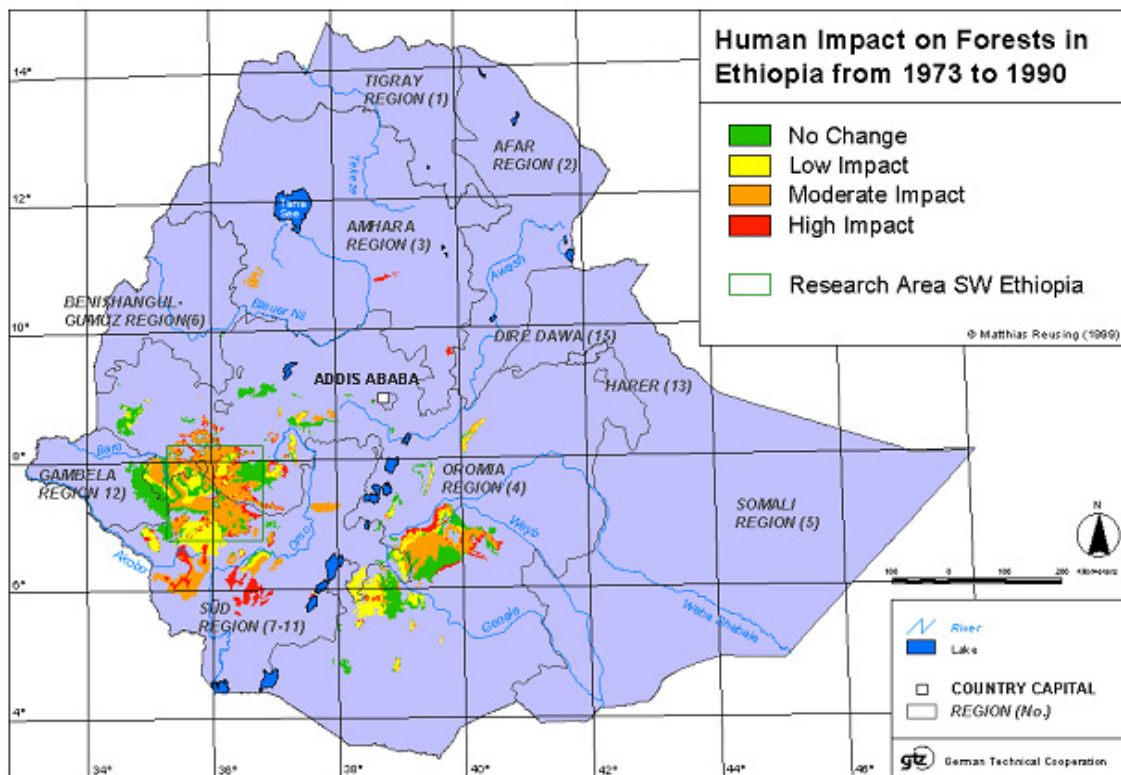


Figure 2: Forest degradation in Ethiopia between 1973 and 1990 (Reusing, 2000)

Consequences of degradation

According to Shibru (2010), deforested land is easily susceptible to erosion; both wind and water, and hence cause a considerable nutrient movement. In Ethiopia, up to 400 tons of fertile soil / hectare is lost annually from lands devoid of vegetative cover as well as from lands where no soil conservation has been carried out (EPA, 2003). In addition, forest and generally biomass degradation lead destruction and erosion of biodiversity of both plants and animals (EPA, 1998). Furthermore, the general loss of vegetation covers puts problems of ecological disturbances (Girmay, 2003).

Generally, forest degradation has a number of environmental impacts on regional and global level. First, degradation of forests and woodlands has impacts on global biodiversity. Second, changes in forest cover have impacting the flow of major rivers. Third, large scale loss of forest cover changes the albedo and air circulation patterns and may affect global climate change. Fourth, soil erosion may cause excessive siltation in rivers and inland lakes, causing reduced water storage capacity in lakes, as well as eutrophication and water quality problems (Project Development Facility, 2007).

FOREST CONSERVATION EFFORTS

In Ethiopia, considerable amount of forest and woodland resources are being managed effectively by local

communities and individuals that are able to use diverse traditional management practices either commonly or privately. Since the last two decades, the involvement of civil society (CSOs and NGOs) in forest management is increasing with considerable multi-dimensional successes such as lobbying for improved policy and introducing and testing new community based forest management schemes (Edwards, 2010).

Ethiopia formulated the first ever comprehensive forest policy in 2007. A forest law enacted with Proclamation No. 94/1994, in 1994 was in use earlier. The main objective of the forest policy is 'to meet the forest product demands of the society and increase the contribution of forest resources to the national economy through appropriate management'. It identified the following six strategies to achieve the stated objective: (i) promoting private forest development and conservation, (ii) promoting forest development technologies, (iii) strengthening forest product markets, (iv) managing state forests, (v) preventing deforestation; and (vi) establishing an up-to-date information database (NSPA, 2012).

Protection efforts

Forest protection is safeguarding natural area by law or custom where species and ecosystems are conserved for current and future generation (Badege, 2001). In Ethiopia, past and present management measures and interventions are directed at preventing further degradation through area enclosures/enclosures, use of protected area and plantation forests as buffers, or at regulating access to forests and harvesting of products through participatory forest management and traditional institutions for forest management, or both (Edwards, 2010). In Ethiopia there are more than 35,000 Orthodox Church communities. Such sacred forest is among the protection effort that contributes to conservation of forest vegetation of the country (Wassie *et al.*, 2009). From ecological point of view the protection of forest maintain the integrity and function of ecosystem in order to improve the ecosystem services. Furthermore, they helps to stabilize the local climate, protect the watershed, and prevent erosion (Badege, 2001).

Rehabilitation efforts

Rehabilitation is defined as process of supporting recovery and management of a degraded ecosystem (both the structure and the function) to a close approximation of its condition prior to disturbance (Mulugeta, 2006). Currently, there is growing recognition that deforestation and forest degradation should be reduced. In the country's document of December 2011, the government identified the forestry sector as one of the pillars of green economy that the country is planning to build by 2030. The following major targets were set for the forestry sectors: afforestation on 2 million ha, reforestation on 1million ha and improved management of 3 million ha of natural forests and woodlands. Through proper management of 5 million ha of forests and woodlands, Ethiopia hopes to achieve 50% its total domestic greenhouse gas (GHG) emissions abatement potential by 2030 (Mulugeta and Habtemariam, 2014). The strategy of greening the economy with the view of considering forests as major targets is one of the efforts that have significant contribution to the rehabilitation of forest and vegetation of the country. In addition, Ethiopia has agro-ecological sites well known for its coffee productivity in South and South Western parts of the country. Thus, coffee based rehabilitation of degraded forest land can improve the diversity and structure of the forest in addition to solving the economic problem of community (Tena *et al.*, 2013).

CONCLUSION AND RECOMMENDATIONS

Conclusion

Ethiopia was very much rich in forest resource. However, the country has experienced serious degradation. The major causes were agricultural expansion; the increasing demand for construction material, industrial use, fuel wood and charcoal; absence of a forest protection and conservation policy; absence of a strong forest administration system; lack of effort to ensure the participation of communities in forest protection and conservation and the sharing of benefits, and failure to clearly demarcate and enforce the boundaries of natural forest reserves. Currently there are several conservation efforts that the government and traditional communities are employing. Establishment of protected and forest priority areas, as well as protecting the sacred forest sites are attempts taken to protect forests. Rehabilitation of forests through afforestation, reforestation and area enclosures with participatory forest management practices are additional conservation efforts that the government is implementing.

Recommendations

Forest resources in Ethiopia have experienced so much pressure due to increasing need for wood products and conversion to agriculture. The trend in Ethiopia today is to protect the remaining forests for their various

social, economic and environmental values. On the other hand, there is increasing demand for wood and wood products. To strike the balance between the two interests, afforestation /reafforestation is very important. It is essential to increase the number of protected area and priority forest area to save the potential forest vegetation of the country from degradation impacts. Also it is considerable to promote the sacred forest site which has great contribution to forest protection.

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