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Original Article

Trend and Current Status of Forest Resources in the Amhara National Regional State, Ethiopia: A Review

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ABSTRACT

Ethiopia is endowed with diverse forest resources. Amhara National Regional State, one of the administrative regions in Ethiopia, has diverse ecology and is endowed with diversified flora and fauna. Forest resources in the region provide various uses and services to the local community. But the forest resources of the region have faced huge devastation due to high human and livestock pressure. As a response, efforts have been made to conserve and develop the forest resources of the region. However, there is a lack of comprehensive information about the current status and trend of forest resources in the region. This review provides the current status and trend of forest resources in the region based on a literature search from different sources. The review showed that the overall forest resource of the region decreased over time, despite the expansion of plantation forests. Most of the natural forest resources of the region disappeared and remnants are found in church compounds and other forest conservation areas. Plantation forests in the region are dominated by exotic tree species, majorly Eucalyptus. Most important non-timber forest products have been neglected, and modern forest development interventions are lacking. This review paper is indispensable for decision-makers, academicians, development, and research institutions to direct their focus toward developing technologies and information for the sustainable development of the forest resources in the region. Appropriate forest management and utilization practices have to be implemented for the sustainability of the forest resources in the region. Since the forest resource in the region is under dynamic change, regularly updating and providing information on its current status is imperative for timely and proper decision-making.

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INTRODUCTION

Amhara National Regional State has diverse ecosystems as a result of contrasting physiographic and climatic features. About 8 broadly categorized ecosystems (Montane grassland, Moist montane forest, Dry evergreen montane forest and evergreen scrub, *Combretum-Terminalia* woodland, *Acacia commiphora* woodland, Wetland and Aquatic ecosystem) based on vegetation characteristics exist in the region (Friis et al., 2010; Gebretsadik, 2016). Location-specific studies in the region indicated that the region is very rich in plant biodiversity. Various non-timber forest products, such as forest coffee, honey, beeswax, spices, and bamboo, also exist in the region (Narita et al., 2017). However, the forest resource of the region is under severe deforestation due to high human and livestock population pressure (Dejene et al., 2013). Forest management practices in Ethiopia in general and in ANRS in particular have been impacted by different human-induced challenges. The loss of forest cover in the region brought wood shortage and environmental problems to the local community (Tadesse et al., 2019).

As a response to forest degradation and deforestation, high-priority forests have been conserved and fast-growing non-native trees have been planted on a wider scale (Bekele, 2011b; Jenbere et al., 2012). While the status of natural vegetation is degrading at an alarming rate (Ewunetu et al., 2021; Reynolds et al., 2017), the plantation forest resource of the region is expanding due to afforestation and re-afforestation activities and other forest rehabilitation activities in the region (Alemneh and Molla, 2022; Ewunetu et al., 2021). These plantations comprise mainly *Eucalyptus* (Alemneh and Molla, 2022) and *Acacia decurrens* species (Nacke and Nacke, 2021; Wondie and Mekuria, 2018). Despite the plantation forests expanding in the region, they are poorly managed and utilized (Tadesse et al., 2019). They are also planted with inappropriate spacing (Alemayehu & Melka, 2022). As a result, the plantation forest in the region has low productivity (Bekele, 2011a).

Comprehensive information on the current status and trend of forest resources in the region is lacking (Walle & Nayak, 2022). Environmental communication in the region is also poor (Zikargae, 2018). Information on the current status and trend of forest resources is a prerequisite for forest resource improvement planning and implementation (Melesse & Abtew, 2016).

Therefore, this review was conducted to provide up-to-date information on the current status and trend of forest resources in the region. The information generated from this review is indispensable for decision-makers, academicians, development, and research institutions to direct their focus toward developing technologies and information for the sustainable development of the forest resources in the region.

METHOD

To collect relevant sources, a literature search was done through (1) a Web of Knowledge search for peer-reviewed scientific papers; (2) an internet search for grey literature; (3) a search for documents from different bureaus in Amhara National Regional State.

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RESULT AND DISCUSSION

Overview of Amhara National Regional State

Amhara region, one of the administrative regions in Ethiopia, is located between 8°45' and 13°45'N latitude and 35°46' and 40°25'E longitude (Ayalew et al., 2012b) in northern, northeastern and central areas of Ethiopia. Due to its diverse ecology, the region is endowed with diversified flora and fauna (Friis et al., 2010; Gebretsadik, 2016). The region is the second largest state in the country, following the Oromia region, which covers an area of about 15.7 million hectares (Belay et al., 2018) and accounts for about 11% of Ethiopia's total area.

Amhara region is divided into three major traditional agroclimatic zones: highland (above 2,300 meters above sea level), midland (1,500 to 2,300 masl) and lowland (below 1,500 masl), accounting for 20%, 44% and 28% of the total land area of the region, respectively (Adenew & Abdi, 2005). Elevation ranges from 700 m to 4,620 masl (Alemu & Bawoke, 2019). The annual mean temperature of the region is between 15 and 21 °C, but in valleys and marginal areas, the temperature exceeds 27 °C (Ayalew et al., 2012a). The long-term mean annual rainfall of the region is 1165.2 mm, and the spatial distribution of this mean annual rainfall ranges from 850 mm to more than 1485 mm (Ayalew et al., 2012b).

State and Trend of Forests in Amhara National Regional State

Natural High Forests

Amhara National Regional State encompasses both natural and plantation forests (Song et al., 2018). In general, the forest resource of the region can be classified as Afroalpine and subafroalpine, Montane dry forest and scrub, *Combretum-Terminalia* woodland, *Acacia-Comiphora* woodland, High and Lowland bamboo, and Plantations (Asefa et al., 2020; Friis et al., 2010; Melesse & Abtew, 2016).

The total forest cover of the region excluding bushlands is about 12,884 km^2 (8.2% of the total land area of the region). If bushlands are included, the forest cover would be about 21,783 km^2 (13.85%). Woodlands, dense natural forests, riverine forests, bushlands, and plantations cover about 740,808 ha, 463 950 ha, 20 653 ha, 889 912 ha, and 62 973 ha, respectively. The majority of natural forests are found in the South Gondar, Central Gondar, North Gondar, Awi, and East Gojjam zones of the region (Melesse & Abtew, 2016).

The natural forests in Amhara National Regional State (ANRS) have diverse ecosystems and are rich in flora. For example, the Semen Mountain National Park consists of the Afro-alpine grassland in the highest areas; ericaceous forest below 3500 m, and on the steep slopes at the top of the gorge, a mixture of tussock-grasses; cliff-hanging herbs and small shrubs on the cliffs; and Montane coniferous forest and grassland at the lowest altitudes. The most conspicuous plants at these high altitudes (all Afro-alpine endemics) are giant *Lobelia* species and *Kniphofia foliosa* (Melese et al., 2018). Likewise, in Lake Tana Watershed, the vegetation is diverse, ranging from Afroalpine to lowland species. About 113 woody species were recorded in the Zegie Peninsula on a 5.28-ha sample area of the forest (Alelign et al., 2007).

Studies conducted in some natural forest systems of the region indicated that the regeneration status of many natural forests is inadequate, and their population structure is not normal (*Table 1*). However, some forests, such as Gelawoldie community forest (West Gojjam), where a higher number of individuals was recorded at the lowest diameter and height classes than in higher classes, indicating healthy regeneration of the forest, though some plant species showed poor regeneration (Mucheye & Yemata, 2020).

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Table 1: Reported problems on some forest resources in Amhara National Regional State

Forest/site	Reported problems	Reference
Yegof forest	11 tree species were found without seedlings, 10 tree species without sapling stage and 6 were without seedlings and sapling stage	(Mohammed & Abraha, 2013)
Menfeskidus Monastery	Some trees species showed abnormal population structure, poor reproduction, and hampered regeneration status	(Negesse & Woldearegay, 2022)
Yemrehane Kirstos church forest	The regeneration of tree species was also not adequate. The vulnerability of young plants to disturbance has also caused slower replacement into tree-size class	(Abunie & Dalle, 2018)
Metema and Abergelle districts	Plant species richness and productivity of woodlands are decreased due to disturbance. The composition of *B. papyrifera* populations declined	(Eshete et al., 2011)
Guassa conservation area	Invaded by *Helichrysum* species	(Girma, 2017)
Fach forest	Poor regeneration status of some tree species	(Zegeye, 2021)
Mahibere Silassie monastery forest	Some species did not have any regenerating plants	(Habtamu, 2017)
Shello Giorgis dry Afromontane Forest	*Celtis africana, Olea europaea, Buddleia polystachya*, and *Premna oligotrricha* did not show seedling density	(Ayalew et al., 2020)
Wieramba forest	Dominated by small-sized trees and shrubs with poor regeneration status	(Teshager et al., 2018)
Lay Agerit Giorgis	*Gardenia ternifolia, Ficus sur, Commiphora africana, and Celtis africana* showed the lowest frequency	(Alemu et al., 2021)

All these studies indicated that the remnant forests and reserve forests in the region are not properly conserved (Mohammed & Abraha, 2013), indicating the importance of implementing appropriate and urgent conservation methods to conserve these forest systems and the tree species in these forest systems.

Woodlands

Most of the woodland in the ANRS is found in lowland areas (500 and 1900 masl) with diverse ecological distribution ranging from semiarid to humid areas (Eshete et al., 2011; Melesse & Abtew, 2016) and cover about 740,808 ha (Melesse & Abtew, 2016). These forest systems harbour economically important tree species such as *B. papyrifera* (Eshete et al., 2011; Friis et al., 2010; Lemenih & Teketay, 2003; Tolera et al., 2021; Worku & Bantihun, 2018) which are known for their commercial products such as frankincense or gum *olibanum*. In the Metema district alone, *B. papyrifera* accounts for 51% of the woody plant density and has a production potential of about 253.5 kg ha^{-1} $year^{-1}$. *Frankincense* is one of the products from *B. papyrifera* that provide economic benefit to the local community and the region (Gidey et al., 2020). It is burnt as incense in temple rituals and is traded as a key commodity for use in the cosmetic and pharmaceutical industries (Negussie et al., 2018). The wood of *B. papyrifera* is used for poles and timber and for industrial manufacturing of matchboxes and boards. The leaves provide dry-season fodder, and the flowers are a good source of nectar for bees. Leaves, barks, and roots are also used in traditional

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medicines. *B. papyrifera* is also recommended for economic development and desertification control (Melesse & Abtew, 2016). Ecologically, *B. Boswellia* is important since it can grow in areas where other trees fail to grow (Ahmed Abdalla & Gessmalla, 2018). Despite the abundance of the resource and growing domestic market demand, the marketed quantities are low, extraction practices are primitive, and both local and national markets are poorly developed (Berhanu et al., 2021).

The lowland forests in the region are under severe pressure and they are decreasing over time (Dejene et al., 2013) in the aftermath of settlement, agricultural investment, forest fire (Lemenih et al., 2014; Yesuf et al., 2015), and disease and pest (Gezahgne et al., 2016; Negussie et al., 2021). Damage by wood boring longhorn beetle accounted for about 8% of frankincense trees loss per year. The loss was higher in unmanaged than in managed *Boswellia* woodlands (Negussie et al., 2018), implying the significance of proper management for the conservation of these forests. Different scholars compared the revenue from frankincense and food crop production in the Metema area and reported that the revenue obtained from frankincense production was intermediate (less than sesame but more than cotton), implying that the continued deforestation of these forests for crop production cannot be explained by lower returns alone, but other factors such as awareness, market access, property right and institutional issues may also play a role to drive deforestation and conversion of dry forests to croplands (Berhanu et al., 2021; Dejene et al., 2013).

Moreover, techniques of gum production from the species in the area are destructive (Asfaw, 2019). *B. payrifera* showed the least regeneration (Wale et al., 2012) and stopped regeneration for the last half century in the area (Feyissa, 2013). Despite awareness creation and law enforcement have been tried to conserve the resource, these interventions did not bring significant impact in conserving the resource.

Bushlands/Shrublands

Bushlands/shrublands are another important forest type in the region. These resources also face huge devastation. Bushland/shrublands is a land on which there is vegetation which is either a remnant of the natural forest or altered but still representative of the structure and floristic of the natural forest (Friis et al., 2010) and covered with bushy type plant species and cover of more than 20% (Melesse & Abtew, 2016).

The area coverage of open bushlands and dense bushlands in ANRS is about 482 643 ha and 407 269 ha, respectively (Melesse & Abtew, 2016). Satellite image analysis of some areas in the region showed that the bushlands/shrublands are decreasing at an alarming rate ranging from 8 to nearly 70% (Table 2) in Lake Tana Basin (Tewabe & Fentahun, 2020), Choke (Fetene et al., 2014), Borena district of South Wollo (Shiferaw, 2011), Fagita Lekoma district (Wondie & Mekuria, 2018), Aba Gerima watershed (Berihun et al., 2019), North Gojjam sub-basin (Ewunetu et al., 2021), Meket district (Tesfaye et al., 2014), Lake Hayq drainage basin (Yesuf et al., 2015) and Derekolli catchment of the South Wollo Zone (Tegegne, 2002) (Table 2) indicating these forest types are under sever pressure that requires urgent conservation actions. However, there are cases where bushlands increased in their area coverage. For example, in Gelana sub-watershed in the Wollo area, bushland increased by 23.9% between 1964 and 2014 (Miheretu & Yimer, 2018).

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Table 2: Case studies of deforestation in some selected areas and forests in the Amhara region, Ethiopia

Location	Land use type	Period	Change (%)	Source
Lake Tana Basin	Forest	1986–2018	-2.3	(Tewabe & Fentahun, 2020)
	Bushland	1986–2018	-9.8	
	Grassland	1986–2018	-10	
Choke	Ericaceous Forest	1986-2011	-79	(Fetene et al., 2014)
	Shrubland	1986-2011	-17	
Borena	Forest	1972-2003	-55.23	(Shiferaw, 2011)
	Shrub land	1972-2003	-49.8	
Metema	Forest land	Before-after settlement	-12.97	(Walle et al., 2011)
Quara	Forest land	Before-after settlement	-4.9	
Andasa	Forest land	1995-2015	-3704.1	(Kerebeh & Shiferaw, 2018)
	Wood and Shrub	1995-2015	-10645.13	
Fagita Lekoma	Forest land	1982-2017	–70.0	(Wondie & Mekuria, 2018)
	Bushland	1982-2017	–49.5	
Aba Gerima	Forest land	1982 – 2016	–65.3	(Berihun et al., 2019)
	Bushland	1982 – 2016	–48.6	
North Gojjam	Forest land	1986-2017	−28.87	(Ewunetu et al., 2021)
	Bush and shrubland	1986-2017	−7.91	
East Gojjam	Forest	1986-2017	-22.3	
Meket	Forest	1976-2008	-4.7	(Tesfaye et al., 2014)
	Shrub-bush land	1976-2008	-56.4	
Gelana	Forest	1964-2014	-62.7	(Miheretu & Yimer, 2018)
	Shrub land	1964-2014	+23.9	
Wof washa	Natural forest	1985-2015	-2	(Tilahun, 2018)
Guassa	Natural and plantation	1986-2015	+102	(Girma, 2017)
Lake Hayq drainage basin	Forestlands	1957-2007	-90	(Yesuf et al., 2015)
	Bushlands	1957-2007	-68.79	
	Shrublands	1957-2007	+136.86	
Derekolli	Shrubland	1957-2000	-84.55	(Tegegne, 2002)
	Shrub-grassland	1957-2000	+53.20	
	Valley-rim vegetation	1957-2000	-37.29	

Bamboo Resource

Two bamboo species exist in Amhara National Sate: highland bamboo (*Oldeania alpina* (K. Schum.) Stapleton (formerly known as *Arundinaria alpina*, *Sinarundinaria alpina*, and *Yushania alpina*) and lowland bamboo (*Oxytenanthera abyssinica* A. Richard) (Plate 1). Lowland bamboo grows in lowland areas of the region at altitude <800 masl in Awi, East Gojjam, and North Gondar zones of the region. The highland bamboo grows in the highlands at altitude >1800 masl (Haile, 2008) in South Gondar, Awi, East Gojjam, West Gojjam, North Shoa, and South Wollo zones of the region. The region has an estimated total area of 0.31 million ha of bamboo stands (INBAR, 2018).

Despite its high potential for the socioeconomic development of the local community, environmental protection, carbon sequestration (Nigatu et al., 2020; Yebeyen et al., 2022) and reclaiming degraded ecosystems (Bystriakova et al., 2004; Peprah et al., 2014; Yang, Wang, Pei, & Hao, 2004) the bamboo resource in the region is underutilized (Nigatu et al., 2021). Highland

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bamboo resources in Ethiopia play a significant role as carbon sinks. A study conducted in southern Ethiopia showed that the carbon storage potential of the species is about 442 Mg ha^{-1} (Yebeyen et al., 2022).

Plate 1: Highland bamboo (*Oldeania alpina* (K. Schum.) Stapleton Lowland bamboo (*Oxytenanthera abyssinica* A. Richard)-

Source: Photo by the Author

Planting bamboo and using it as a source of income has a long history. The farmers in the region, especially in Awi and East Gojjam Zones, are well aware of the local value of the resource where the *O. alpina* is used for house furniture, fencing, construction, and agricultural equipment. The bamboo resource in the region is underutilized (Nigatu et al., 2021) and devastating at an alarming rate due to farmland expansion (MEFCC, 2018). The current size of *O. alpina* resource is expected to be further reduced due to increased pressures. Agricultural land expansion, wildfire, free grazing, lack of regulatory mechanisms, improper harvesting and expansion of settlement areas were reported as the top drivers for the loss of the species (S. Abebe, Minale, & Teketay, 2021).

Church Forests

More than 35,000 Orthodox communities exist in Ethiopia (A. Wassie et al., 2009). About 19 400 church forests were reported in the Ethiopian highlands alone with a total area of 39 000 to 57 000 ha (Aerts et al., 2016). More than 8000 church forests are found in ANRS alone, ranging from <1 ha to >100 ha in size (Reynolds et al., 2017).

Many Ethiopian Orthodox *Tewahido* churches (EOTC) play a significant role in the conservation of forest ecosystems in Ethiopia (Aerts et al., 2016; Wassie et al., 2009). The two modes of protection, '*Gizet*' as a house of God and 'legal protection' as a house of the state, a two-sided blade used to protect church forests (Mekonnen et al., 2019). Church forests have a crucial role in preserving biodiversity by allowing the forests to be used as a source of indigenous tree seeds for local communities and state nurseries (Melesse & Abtew, 2016). Church forests provide a wide range of nature's contributions to the local community in addition to their well-established ecological and conservation value (Sahle et al., 2021). They are also important sources of wild pollinators that are relevant for crop pollination and sustaining the food production system of smallholder farms (Sitotaw et al., 2022).

Despite their ecological and economic significance, church forests in the region are under pressure that faces anthropogenic disturbances such as encroachment of adjacent farms, livestock grazing, the unsanctioned harvest of forest products (Woods et al., 2017), and sanctioned expansion of grave shelters (Klepeis et al., 2016), as well as the planting of non-indigenous tree species such as *Eucalyptus* species (Reynolds et al., 2017). Moreover, most church forests in the region have no clear and documented

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demarcations, which expose them to disturbances. Increasing demand for firewood, construction wood, grazing and agricultural land made conservation of the remnant church forests a challenging task. These factors, together with sedentary farming, led to persistent land exploitation. Thus, the conservation of church forests is becoming beyond the capacity of churches to save them from pressure (Mekonnen et al., 2019). In general, the church forests are under threat, and hence their sustainable conservation and management need due attention.

Plantation Forest

Following the decline of industrial wood production from high natural forests and increasing demand for wood, the importance of plantation forests has grown in ANRS (Tadesse et al., 2019). Plantation forests play an important role in the dynamics of the forest cover in the region. Previous studies indicate that the total area of plantation forests in the region is about 684 000 ha (Tadesse et al., 2019) and showed an increasing trend. Compared with other regions, ANRS has the largest woodlots in the country (Wassie, 2017).

Most of the plantation forests in the region are dominated by exotic tree species. Plantation forests are expanding in the region (MEFCC, 2018; Wubalem Tadesse, 2017). The prominent examples are *Acacia decurrens* in Awi Zone (Plate 2A) and *Eucalyptus camaldulensis* in East Gojjam (Plate 2B), West Gojjam, South Gondar, North Gondar and North Shewa zones (Ewunetu et al., 2021). Expansion of *Eucalyptus globulus* and *E. camaldulensis* in the region is driven by higher demand for the species by the community, a decrease in agricultural productivity, the fast-growing nature of the species, the higher ability of the species to conserve soil, and its non-palatability by animals (Dessie et al., 2019).

Plate 2: Expansion of *Acacia decurrens* in Awi (A) and *Eucalyptus globulus* in East Gojjam (B) Zones of the Amhara National Regional State, Ethiopia

Source: Photo by the Author

In the Awi zone, forest land expanded from 14% in 1995 to 25.6% in 2015 at the expense of cropland (Wondie & Mekuria, 2018). The local community in these areas generate a high amount of income from *Acacia decurrens* plantation and their livelihood is improved (Alemu Mengistu, 2020). Higher crop yields were also obtained when crops were sown on land that was planted with the species due to increased soil fertility. Higher soil organic carbon, total nitrogen, available phosphorus, available sodium, available nitrate, ammonium, potassium, and manganese were found in soils previously planted with this species compared with soil not planted with the species (Beshir et al., 2022). As a result, the species expanded at an alarming rate. In this zone, the area coverage of cropland increased from 1995 to 2000 and decreased thereafter. During the entire study period (1995–2015), cropland declined by 1% per year, while forest land increased by 1.2% per year. Forest cover showed the most significant changes over the 20-year period, mainly due to *A. decurrens;* the area was assumed likely to be covered by plantation forest and grassland in 15 to 20 years after the study period (Wondie & Mekuria, 2018). From 2000 to 2017, plantation cover expanded and increased by 16% in the Awi zone (Worku et al., 2021) along

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roadsides indicating market access is important for commercial plantations (Alemu Mengistu, 2020).

Similarly, Eucalyptus plantation expands at a higher rate in the region. The forest cover in the East Gojjam zone increased from 283.5 ha in 1999 to 984.5 ha in 2017 (Alemneh et al., 2019), mainly due to *Eucalyptus globulus* plantations. In the Mecha district of the west Gojjam zone, *E. camaldulensis* expanded at the expense of croplands, and many people converted their farmlands to *Eucalyptus* plantations (Alebachew et al., 2015). In the Farta district, forest cover increased from 2528.64 ha (3%) in 1999 to 9284.49 ha (11.1%) in 2019 due to the expansion of Eucalyptus (Alemneh & Molla, 2022).

Despite the plantation forest in the region expanding, the resources are not properly managed and utilized. The plantation forest in the region has low productivity (Bekele, 2011a) because of poor management (Tadesse et al., 2019), including inappropriate spacing (Alemayehu & Melka, 2022). Previous studies noted that Eucalyptus woodlots were established with a density of up to 50 000 stems per ha (Bekele, 2011a). Recent studies also indicate that plantations with 62 500 seedlings of *E. camaldulensis* per ha and 81 633 plants of *E. globulus* per ha were reported in some areas of the region. Planting seedlings with closer spacing than the standard spacing reduces production and wood quality (Rais et al., 2020; Rocha et al., 2016). Moreover, the majority of planted seedlings do not receive any silvicultural treatment after planting (Bekele, 2011b; Tadesse et al., 2019). This indicates the need for improving the management of plantation forests in the region to maximize the benefits that accrued from it.

Specific case studies in different parts of the region also indicated that the remnant natural forest resources of the region decreased at a high rate. Considerable amounts of spatial and temporal forest cover change occurred over the past 35 years in the Upper Blue Nile basin (Berihun et al., 2019). For example, in 1982, the dominant land cover classes were forest land in Guder (41%) and Aba Gerima (32%). By 2017, the dominant land use types were plantation in Guder (33.9%) and cultivated land in Aba Gerima (66.5%). Cultivated land remarkably increased in the Aba Gerima and in the Guder watersheds, mainly at the expense of forest cover, grazing, and bushlands. In general, the basin experienced a land use cover change during these years. Similarly, the Wofwasha forest also experienced a continuous expansion of agricultural land and settlement at the expense of forest land (Tilahun, 2018). Changes in forest cover cause both positive and negative socioeconomic and environmental consequences (Berihun et al., 2019). Therefore, an urgent solution is required to reduce the threat and to maintain the forest ecosystem services and functions derived from this forest.

Non-timber Forest Products

Different non-timber forest products (NTFPs) that could significantly improve the livelihood of the local community exist in the region. These resources include forest coffee, honey, beeswax, spices, bamboo (Narita et al., 2017), fodder, firewood, charcoal, farm implements, and climbers. Moreover, thatch, wild meat, wild edible plants, civet musk, silkworm cocoons, dyes and tannins, regulating services, carbon sequestration, pollination, water flow control, soil erosion control, reservoir sedimentation control, cultural and recreational services, protected-area tourism, trophy hunting and other non-use benefits can be obtained from forests (MEFCC, 2016). Forests are also important for honey production (Addi & Bareke, 2021).

The productivity and quality of traditional and modern beehives are influenced by the type, composition, density, and canopy of vegetation (Tolera et al., 2021). NTFPs contribute to food security and maintain rural livelihoods for millions of households (Sheppard et al., 2020). Fodder from forests provides 10% and 60% of the livestock feed in Ethiopia during the wet and dry seasons, respectively. Similarly, many edible wild plants serve as food supplements during times of critical food shortage (Tebkew et al., 2018).

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Amhara region has important NTFPs such as frankincense, bamboo, and others. The region is endowed with gum and resin-bearing species such as *Acacia senegal*, *B. papyrifera* and *Commiphora africana*, and *Sterculia africana*. However, these resources are poorly managed, underutilized and face huge devastation (Eshete et al., 2011; Friis et al., 2010; Mulugeta Lemenih & Teketay, 2003; Tebkew et al., 2018; Tolera et al., 2021; Worku & Bantihun, 2018).

Many medicinal plants that are used to treat various types of diseases exist in Ethiopia (Haile, 2022b). More than 1000 medicinal plants are recorded in the country, and the majority of them are found in the south and southwestern part of the region due to plant species diversity and cultural diversity (Endashaw Bekele, 2007a). Different plant parts such as root, leaves, seed, bark, latex, fruit, stem, tuber, flower, rhizome, thorn, and bulb of various plant species are used to treat different types of diseases (Amsalu et al., 2018; Banchiamlak & Young-dongKim, 2019; Giday et al., 2007; Lulekal et al., 2008; Moges & Moges, 2012). About 200 plant species are used to treat malaria in the southern part of Ethiopia (Alebie et al., 2017). In 2013, the annual pharmaceutical value of Ethiopia's forests and woodlands was estimated at 2.6 billion Birr. The annual harvest and usage of medicinal plants in Ethiopia are estimated to be 56,000 tons (Wassie, 2020), and more are unexplored.

Similarly, several medicinal plants exist in the remnant natural forest systems of the ANRS (Giday et al., 2007). A number of ethnobotanical studies have been conducted in ANRS (Yirgu & Chippaux, 2019). Despite the lower number of medicinal plants existing in the region compared with south and southwestern Ethiopia (Endashaw Bekele, 2007b), a higher number of medicinal plants are recorded in some of the studied natural forests in the region (*Table 3*).

Table 3: Number of Medicinal Plants in Different Forest Systems in ANRS

Study area	No. of medical plants	Reference
Lay Gaynt district	104	(Binor & Seid, 2016)
Gozamin district	93	(Amsalu et al., 2018)
Ankober district	135	(Lulekal et al., 2013)
Ambagiorgis area of Wogera district	23	(Chandrodyam, 2016)
Chiliga district	101	(Mekuanent et al., 2015)
Debrak district	93	(Amde1 et al., 2001)
Dega damot district	54	(Wolde-mariam et al., 2015)
Enarj enawuga district	111	(Birhan et al., 2017)
Gondar town	30	(Birhanu et al., 2015)
Gubalafto district	135	(Chekole, 2017)
Libo kemkem district	163	(Chekole et al., 2015)
Menz gera midir district	155	(Yohannis et al., 2018)
Minjar Shenkora district	118	(Alemayehu et al., 2015)
Raya Kobo district	91	(Osman et al., 2020)
Abergele, Sekota and Lalibela districts	53	(Assefa & Bahiru, 2017)
Sekota district	68	(Adekunle et al., 2009)
Hulet Eju Enese Woreda	80	(Abebe & Teferi, 2021)
Kelala district	82	(Assen et al., 2021)
Dega Damot district	60	(Wubetu et al., 2017)
North Achefer district	74	(Ayalw & Merawi, 2021)
Debre Markos town	55	(Yebirzaf et al. 2019)
Ayehu district	50	(Menberu, 2021)

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Study area	No. of medical plants	Reference
Gozamen district	53	(Reta et al., 2015)
Bahir Dar District	69	(Tadesse et al., 2018)
Enemay district	92	(Birhan et al., 2022)
Basona Werana District	76	(Asfaw et al., 2022)
Bahir Dar zuriya district (Zegie Peninsula)	67	(Teklehaymanot & Giday, 2007)
Mojana district	56	(Haile, 2022a)
Farta district	146	(Amsalu, 2010)
Debark district	126	(E. Abebe, 2011)
Jabitehnan district	82	(Yeshambel Berhanu & Alamnie, 2021)
Yilmanadensa and Quara districts	30	(Alemneh, 2021)
Enemay district	70	(Tafete, 2019)
Dek Island (Lake Tana)	60	(Teklehaymanot, 2009)
Delanta district	113	(Meragiaw et al., 2016)
Raya Kobo	69	(Kalayou & Melese, 2021)

However, medicinal plants are being lost together with the natural forest resources as the majority of them exist in the wild. The major threats to medicinal plants are agricultural land expansion, overgrazing, firewood collection, mining, and cutting down trees for construction and furniture. Therefore, the implementation of appropriate *in-situ* and *ex-situ* conservation measures is important for the sustainable management and conservation of these resources (Amsalu et al., 2018). There is also a lack of documentation on medicinal plants in the region.

DRIVERS AND PRESSURES OF DEFORESTATION AND FOREST DEGRADATION

Deforestation and forest degradation are the major environmental problems in Ethiopia in general (Lay, 2020) and in the ANRS in particular (Walle et al., 2011). The Afroalpine and Sub-Afroalpine vegetation, the high Dry Afromontane forests, bamboo forests, and the woodlands faced remarkable shrink not only in area coverage but also degradation in their structural and species composition (Ewunetu et al., 2021; Reynolds et al., 2017). Almost all natural forests have gone in the highlands except for patches on mountain ridges, inaccessible areas, and sacred places like churches (Reynolds et al., 2017). Currently, the most pressing deforestation is due to agricultural land expansion (Ayele, 2021). The major drivers of deforestation and forest degradation are high human and livestock pressures. Moreover, fuelwood-based Energy sources for the majority of the population, especially in the rural areas of the region, led to high deforestation and forest degradation (Ewunetu et al., 2021).

Human Population

Site-specific studies in the region indicated that the causes of deforestation and forest degradation are agricultural expansion, fuelwood collection, charcoal production, free grazing, illegal logging, settlement expansion, and increasing unemployment (Alemneh & Molla, 2022), which are driven by high human and livestock population pressure.

According to the 2022 report from the plan commission of ANRS, the population of the region in 2022 is about 22,876,999 people, while it was 22,536 999 in 2020 indicating an increase of 1.5% per year. The majority of the regional population lives in rural areas and agriculture is the main source of the economy and biomass is the main energy source (Alemneh & Molla,

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2022). In general, the high population in the region exacerbated forest resource degradation. Subsistence farming and settlement (Alemneh & Molla, 2022; Walle et al., 2011), increasing demand for wood products, agricultural investments (Alemneh & Molla, 2022; Bane et al., 2008), overgrazing pressure, and lack of strong forest policy (Mekonnen et al., 2016), increasing demand for pasture, shelter, urbanization (Alemneh & Molla, 2022; Meseret, 2016; Walle et al., 2011), droughts and fires (Mera, 2018).

Livestock Population

High livestock pressure is one of the major reasons for the destruction of forest resources in the region. The livelihood of the population in the region is more dependent on livestock and their products, basically due to land shortages and a reduction in crop production (Meseret, 2016). The region has been home to about 35% of the total country's livestock population. Based on the 2012/13 agricultural sample survey, the region had a high livestock population density (Leta & Mesele, 2014). Compared with other regions, Amhara stands first in the number of goats and second in cattle, sheep, asses, horses and poultry (Meseret, 2016).

Studies indicated that high livestock pressure significantly contributes to the deterioration of forest resources in the region (Alemneh & Molla, 2022; Amsalu & Addisu, 2014). The rearing of a large number of cattle and the grazing effect retards the growth of newly growing forest seedlings and saplings (Wassie et al., 2009). Livestock trampling also leads to reduced tree species composition (Narantsetseg et al., 2018). Uncontrolled or free grazing and browsing too many livestock for too long a period on land leads to failure in vegetation recovery. Free grazing and overgrazing are the dominant grazing systems in the region (Alemneh & Molla, 2022). Biological conservation practices such as grass strips and tree plantations are also being destroyed or trampled, reducing the chance for establishment and regeneration.

Free grazing is one of the major problems affecting seedling survival and plantation success. Due to the open grazing system in the region, especially during the dry months of the year, all seedlings in communal plantations face grazing, browsing and trampling problems which directly and indirectly affect the survival of planted seedlings (MEFCC, 2018).

Energy Pattern in the Region

The pattern of energy use by the local community affects the forest resources of an area. In the ANRS, there is high energy demand, and the majority of people use fuelwood for cooking (Asres, 2012). It is also indicated that about 94% of the HHs in the region meet their principal energy demand from fuelwood and dung. Without sustainable and affordable technologies of alternative sources of energy, population growth increases the demand for fuelwood, which in turn leads to deforestation and forest degradation. It also contributes to the use of crop residues and dung for fuel which otherwise would be used as sources of organic fertilizer to improve soil fertility and increase crop production. About 60% of the HHs in the region did not use manure on their farmlands because of the diversion of dung and other crop residues for energy purposes. For cooking, most HHs prefer the three-stone open fire, which is believed to be only 10% efficient in overall thermal energy production and use. In recent years, firewood and charcoal have become the most commercialized energy sources for both the rural and urban poor in the region (Ewunetu et al., 2021). In general, the wood-based nature of the energy source of the local community in the region contributes to the destruction of the forest resource, indicating the need for diversifying the energy source of the local community to conserve the natural forest resource of the region.

CONCLUSION

Amhara National Regional State has both natural and plantation forests that are under dynamic change. Location-specific studies in the region showed that the natural forest resource of the region is under pressure, and the deforestation rate

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is very high. The natural forest resource of the region decreased over time, driven by high human and livestock pressure and poor management. As a result, most of the natural forest disappeared, and remnant natural forests remain around and in church compounds.

Efforts have been made to conserve the remnant of natural forests. However, the population structure of these conserved forests is not normal, and the regeneration status of many tree species is inadequate. Woodlands that harbour important non-timber forest products that have economic importance face huge devastation because of agricultural investment. NTFPs in these areas are also not properly managed and utilized. Other important forest resources such as riverine forests, bamboo and church forests have not been given due attention and are under pressure, despite their conservation importance.

Plantation forests, though expanding at a higher rate and playing a significant role in the livelihood improvement of the local people, are poorly managed and dominated by exotic tree species, mainly Eucalyptus spp. Modern Forest development interventions are lacking. Therefore, proper and sustainable forest management and utilization practices have to be implemented both for natural and plantation forests. Enforcement of forest policies, laws and proclamations is also required.

This review provides the current status and trend of forest resources in the region based on a literature search from different sources. This review paper is indispensable for decision-makers, academicians, and development and research institutions to direct their focus toward developing technologies and information for the sustainable development of the forest resources in the region. Since the forest resource in the region is under dynamic change, regularly updating and providing information on its current status is imperative for timely and proper decision-making.

Recommendation

- It is important to establish additional conservation forests by integrating income generation activities such as the collection of non-timber forest products so as to enhance their sustainable conservation.
- Proper management of plantation forests and the use of modern forest development technologies such as clonal forestry are also indispensable to increase the productivity of plantation forests in the region.
- Bamboo species and other fast-growing tree species shall be promoted to reduce pressure on the natural forest resource of the region.
- Church forests have a great conservation role in the region. Therefore, the existing problems in these forests should be solved by devising appropriate conservation strategies
- Scaling up the best plantation forest developments in the region, such as *Acacia decurrens* plantation, should be promoted in other potential areas
- Revising the regional accosting system is required to fully account for the contribution of the regional forest resources to the regional economy.
- Controlled grazing and increasing livestock productivity is important to reduce pressure on the forest resource of the region.
- Forest safety issues such as disease, pest and fire prevention and control need due attention. It is also important to diversify the type of tree species planted in the region.

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Conflict of Interest

The author declares that there is no potential competing interest with the authorship

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