

Review: Church forests—the green spots of Ethiopian highlands

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Abstract. Mekonen AB, Gebreegziabher BG, Wassie WA, Tsegay BA. 2019. Review: Church forests—the green spots of Ethiopian highlands. *Asian J For* 3: 45-53. In the central and northern highlands of Ethiopia, native vegetation is almost restricted to church forests which are the only remnant natural forest in the region. The church forests are sacred because the church is believed to be the house of God and everything in its compound is sacred and respected. However, they are under severe threats by both anthropogenic and a few natural disturbances. This review paper summarizes the role of Ethiopian church forests under the authority of Ethiopian Orthodox Tewahido Churches (EOTC) in biodiversity conservation, source of seed and seedling of native vegetation, ecological importance, ecosystem values and services to the community and to the globe in general. It also emphasizes the main challenges of these forests in terms of human disturbance and natural disturbances. It states the conservation strategies of church forests. We conclude that the EOTCs besides their religious activities played a great role in conserving the forests. However, most church forests have no clear and documented demarcations which expose them to disturbances. The churches are also cultivating fast-growing exotic species to replace native trees for the income of local residents. Finally, we recommend that the head priests should evoke and customize the conservation of sacred groves using religious thought. The government should acknowledge the church for conservation and decide to have a clear boundary for the church forest to minimize further encroachment. Forest genetic resources conservation program (*in-situ*), Participatory Forest Management (PFM), and rehabilitation activities have to be implemented in addition to the church conservation effort using religious thoughts, religious sanctions, and legal protection for the integrity of these remnant sacred groves. Further studies are recommended to fill the gap of sacred groves in addressing the cause of disturbance and to provide possible solutions for better conservation.

Keywords: Conservation practice, disturbance, diversity, ecological values, ecosystem service

INTRODUCTION

Forest resources are one of the natural resources that contribute in many ways as products and services to the wealth of a country in increasing the national income and improving the well-being of the populations. Forestry, besides its direct contribution to the national economy through wood and non-wood products, contributes significantly to various sectors such as energy, agriculture, food, industry, health, environment, tourism and the like. Economically it helps to increase gross domestic product (GDP), employment generation, earning of foreign currency and savings through import substitutions of the country (Senbeta 2011; FAO 2016). Carbon sequestration stored in forest biomass helps to mitigate climate change (UNFCCC 2015). Forest ecosystem also helps to regulate hydrological cycle, conserve soil, and mitigate drought and flood as well as serve as the habitat of biodiversity (FAO 2016). In some areas, forest also has social and cultural significance for local communities.

Tropical forest contains over 75% of the world's biodiversity (Tilman 1999). However, studies show that over the last 200 years there has been a 50% reduction of tropical forests worldwide (Laurance et al. 2009). Agricultural corporations, governmental initiatives, and entrepreneurs together with small farmers led to this vast

deforestation in tropics (Rudel 2007). Land-use change, due to economically driven anthropogenic activities, is the primary driving force for the loss of biodiversity and ecosystem services worldwide (Laurance et al. 2011).

Ethiopia is a country with a land area of 1.12 million square kilometers located in the northeastern highlands of tropical Africa. It has unique characteristics in terms of edaphic, climatic and biological resources. Ethiopian landmass covers a wide altitudinal variation ranging from 110m below sea level to 4620m above sea level. Furthermore, Ethiopia shares more than 50% of the Afromontane regions (above 1500masl) of Africa with 79.7% of the lands above 3000m (Yalden 1983). These geological and climatic diversities have resulted in rich flora and fauna with endemic organisms, making the country an important international center of biodiversity (Yirdaw 2001). For example, the number of species of higher plants in Ethiopia alone is estimated at about 6,500 - 7000, of which nearly 15% are endemic to the country (Teketay 2010).

Many forests in Ethiopia became deforested into remnant small fragment patches. The cause of deforestation is due to the expanding population because of the lack of economic opportunities leading to land conversion for agriculture and grazing, and timber exploitation for firewood and construction (Wassie et al. 2010). FAO

(2015) reported that nearly 141,000ha (0.93%) of the forest cover of Ethiopia was destroyed every year. Considering this problem, urgent actions are imperative not only for the sustainable management of the meager remnant natural forests but also for prompt ecological restoration management in order to preserve the rich biodiversity resources of the country from complete disappearance.

The problem of deforestation and biodiversity loss is more pronounced in the northern and central highlands of Ethiopia, where forests are reduced to patches. As a result, very little natural forest from the northern and central Ethiopian highlands remains today. The deterioration of natural forest resources not only destroys the environment but also undermines the bases of economic growth and long-term prosperity (Boerma 2006; Wassie 2002). The only areas where one can observe natural forests in northern highlands of Ethiopia are in the surroundings of churches ("church forests"). These patches of natural forest have survived as a result of the traditional conservation effort of the Ethiopian Orthodox Tewahido Churches (EOTC) (Wassie et al. 2010). It is one of the earliest churches in the world managing the surrounding forest using its own religious authorities based on holy bibles and religious thought that there are a spiritual bond between tree plantation and conservation.

These forests serve as sanctuaries of many endemic and endangered plant and animal species that have almost disappeared in most parts of northern Ethiopia (Wassie 2002; Bingelli et al. 2003). Thousands of small isolated church forests in Ethiopian highlands have considerable potentials for conservation (Bhagwat and Rutte 2006). The forests are also called sacred groves being kept for the last many hundred years ago through the strong biblical basis, theological thoughts, religious belief and commitment of the communities (Wassie 2002).

This review paper clearly states the importance of church forests to protect biodiversity, and to provide goods and ecological services to the community. It also reviewed the species composition, structure, and biomass production of some of these church forests remnants in the Ethiopian Highlands. It states the impact of humans, animals, altitude and climate change on these forest areas; and finally, this paper compiles the conservation strategies of traditional, religious (EOTC) doctrine and indigenous knowledge for sustainable forest management.

Church forests and their presence in Ethiopia

Sacred groves have been recognized for their major effect on the conservation of natural resources, ecology and climate mitigation in many parts of the world (Bhagwat and Rutte 2006). They have been found in every corner of Africa like, Ethiopia, Ghana, Tanzania, Nigeria, Egypt, and Zimbabwe. Sacred groves have been common in Europe, Northeast and Southeast Asia, Siberia, Korea, Japan, China, and India. These forests have been common in Indonesia, Sri Lanka, and Malaysia (Sibanda 1997). Although their doctrine of religions may vary, eventually their experience of conserving trees in the name of religion is obvious worldwide. Trees have not only met the economic and ecological needs of the people but also for

their culture and spiritual tradition. In Tanzania there are over 600 sacred groves, in Ghana over 2,000 sacred forests, in India over 100,000; and in Japan Shinto and Buddhist shrines, forests cover over 110,000 hectares (Verschuuren 2010). Similarly, in Ethiopia, there are more than 35,000 Orthodox Churches in which most of them own forests (Wassie et al. 2009).

In the northern and central highlands of Ethiopia, patchy remnants of old-aged natural Afromontane forests called sacred groves can be found surrounding Ethiopian Orthodox Tewahido Churches (EOTC). Forests in most other areas have been almost completely destroyed and converted into farms and grazing lands. The local people perceive these forests as holy places in a religious, social and institutional sense. These church forests are the remnant natural forests from the northern highlands of Ethiopia. Hence, if there is a patch of indigenous old-aged trees in the northern highlands of Ethiopia, it can be sure that there is an Orthodox Church in the middle. They are visible from a great distance, with attractive appearance, usually built on small hills "overlooking" the surrounding villages (Figure 1).

The local people call the churches with the surrounding trees as "debr" or "geddam". These places are religiously considered holy places as well as a socially respected and powerful institutions by the followers (Wassie 2007). The people with strong beliefs in the religion that attend the church ensure their sacred groves protection and vigilance rather than formal policing or other community in the region (Tilahun et al. 2015). The forests located around the churches comprise local as well as global hotspots as they are critical conservation areas that provide ecosystem services (Bhagwat 2009). Some of these churches that are established recently have developed a forest around them by rehabilitation processes that are not the natural Afromontane forests. These church forests possess woody indigenous tree species.

The role of Ethiopian church forests

Ethiopia has a total of around 35,000 churches and monasteries, some of which are 1660 years old. The oldest Ethiopian Orthodox Churches date from 4th century. Most of these churches are located in the Northern and Central Highlands of Ethiopia (Wassie 2002; Tilahun et al. 2015). The churches have natural forest vegetation rich in biodiversity of plants and animals. Their vegetation consists not only of trees but also shrubs and herbs, and they constitute important habitats for a variety of animal species (Bingelli et al. 2003). Different plant species provide services to the communities as the spiritual and medicinal values are attached to it (Yeshambel 2013). The local people near to church forest use the plant species as timber and non-timber forest products (NTFPs) includes source of income, agricultural implements, tools, household furniture, folk medicines, washing powder, insecticide, fumigants, aromatic ingredients, gum, ropes, tannery, food, fodder, bee forage and beehives, light, fuel and charcoal, construction, lumber, shade and shelter (Getachew et al. 2010). Generally, the Ethiopian church forests have the following major roles.

Church forests as in-situ biodiversity conservation hot spot

The churches and monasteries of the EOTC are often surrounded by small natural forests characterized by a high floral and faunal diversity with many indigenous and rare species (Wassie 2007; Cardelús et al. 2013). There are two kinds of church forests in Ethiopia of which the churches older than five hundred years are surrounded by primary forests while recently established churches of the last decades are observed with secondary forests and in this case the older church forests are characterized by a high floral and faunal diversity with many indigenous and rare species. These closely located forests have high ecological importance to form corridors and are important for species exchange and the distribution of genetic resources in conservation (Wassie et al. 2010).

Sacred groves are the ideal sites to be chosen for species afforestation programs in their specific localities (*in-situ*) and that could serve as models of sustainable forest management and biodiversity conservation. Many endangered species of flora in Northern Ethiopia are found surrounding churches and monasteries (Tilahun et al. 2015). The EOTC is making a sustained effort to teach and advise the clergy and the people living in the community; highlight the need to protect existing trees; induce the desire to plant and look after newly planted trees, and in particular care of indigenous trees and plants (Wassie 2002).

The church forests are the sanctuary of many indigenous species protected in different agro-ecological/climatic zones, could be used as germplasm for regeneration and then conserve biodiversity (Tilahun et al.

2015). The two tree species, *Juniperus procera*, and *Prunus africana*, which are listed in the IUCN red list, are mostly found in church forests of Ethiopia (WCMC 1996). Sacred groves are often safe places for trees and other biodiversity resources. In other words, church compounds are serving as in situ conservation and hot spot sites for biodiversity resources, including many endemic and endangered species, mainly indigenous trees and shrubs of Ethiopia (Wassie 2002; Dudley et al. 2012).

Church forest for ecosystem services

Church forests provide ecosystem services for pioneer organisms in different landscapes and serve as stepping stones for restoration in long-term forest sustainability, biodiversity conservation, and social benefits. They also provide valuable, often unique, and secured habitats for plants and animals as well as green spaces for people to relieve the stressed mind. Densely forested and well-protected sacred groves give prestige for the religious sites to mean respected and believed to have many blessings from the presence of angels in the compound of such churches (Wassie 2002). Forest restoration and genetic conservation in the degraded high lands of Ethiopia depend on the remnant church forests and a few trees around on farms (Teketay et al. 2010). In addition, these forests provide other essential ecosystem services including non-timber forest products especially, climate change mitigation through carbon sequestration, induce spring water and moisture, spiritual and cultural value (Dudley et al. 2012).



Figure 1. Kulala Meskel; one of the church forests in South Gondar zone, Northern Ethiopia (Picture by Authors)

Table 1. Above and below-ground biomass stock (equivalent carbon dioxide) in each study site (Tura 2011)

| Name of the church | CO ₂ in AGB (t/ha) | CO ₂ in BGB (t/ha) |
|---|-------------------------------|-------------------------------|
| Birhanata Alem Petros Wa Pawulos | 113.43 | 22.72 |
| Geneta Tsige Kidus Giorgis | 685.81 | 137.29 |
| Debre Keraniyo Medihanealem | 187.91 | 37.62 |
| Risa Adibarate Entoto Kidist Mariam | 73.43 | 14.72 |
| Kachane Debre Selam Medihanealem | 566.37 | 113.33 |
| Menbera Tsebaot Kidist Silase cathedral | 1628.54 | 326.01 |
| Yeka Debre Sehil Kidus Micheal | 77.49 | 15.52 |

Ecological values of church forests

Church forests are among the last remnants of Ethiopia's historic Afromontane forests, which date back to the 4th century. They are ecologically important as: (i) the only natural seed source for native Ethiopian trees, (ii) a place hosting birds, insects, reptiles, and vertebrates (a reservoir for biodiversity), (iii) source of freshwater springs including holy water and hydrological services for nearby farmland, and d) a place for soil and water conservation (Wassie 2007; Bhagwat and Palmer 2009; Tilahun et al. 2015). Church forests also harbor pollinator species, including native bees and other insects that add value to outlying crops (Bhagwat and Palmer 2009). These forests also provide food, medicine, construction materials and architectural works as well as other essential human needs for the local community (Wassie 2002; Bhagwat and Palmer 2009). According to Wassie (2002), their disappearance would be a disaster for plants, animals, soil nutrients and moisture resulting in degraded area in northern Ethiopia.

Church forest for carbon sequestration in mitigating climate change

Climate change mitigation can be achieved by reducing greenhouse gas emissions and by sequestering these gases from the atmosphere. Limiting global warming below or close to 1.5 °C from pre-industrial levels would require to decrease net emissions of greenhouse gas by around 45% by 2030 (IPCC 2018). It is required to remove from 100-1000 GtCO₂ over the 21st century to achieve the limit of global warming to 1.5°C (IPCC 2018).

One option for reducing greenhouse gas concentrations in the atmosphere, and thus mitigating climate change, is by increasing the amount of carbon removed and stored in forests (CFI 2012). When trees grow, they sequester carbon in their tissues, and as the amount of tree biomass increases (within a forest or in forest products) the increase in atmospheric CO₂ is mitigated (CFI 2012). The ability of these plantations to sequester carbon has received renewed interest since carbon sequestration projects in developing nations could receive investments from companies and governments wishing to offset their emissions of greenhouse gases through the Kyoto Protocol's Clean Development Mechanism (Fearnside 1999). Church forests

can sink carbon so as to mitigate the greenhouse gas emissions that drive climate change (UNFCCC 2015).

Forests play a significant role in climate change mitigation by sequestering and storing more carbon from the atmosphere than any other terrestrial ecosystem. Church forests, including other sacred places, are relatively more protected than forests in any other place (Tura 2011). According to Tura (2011), the contribution of church forests to the reduction of atmospheric carbon concentration can be estimated by conducting case studies in a few selected churches around Addis Ababa. He found significant amounts of CO₂ stored inside both above and below-ground biomass in seven church forests in Addis Ababa (Table 1).

Church forest for researchers

As a lesson for forest conservation practice

The church has immense religious knowledge of forest conservation in which the church and its believers have developed over generations through experiences. This knowledge enables the church compound to be home to diverse flora and fauna where one can see endemic and indigenous species diversity. However, the remaining forests are currently under threat, due to diminishing areas and extensive grazing by cattle. In such areas, conserving and maintaining plant diversity has been a very challenging task (Wassie and Teketay 2006). According to Wassie and Teketay (2006), the EOTC is believed to play its role in three ways to conserve forest biodiversity: First based upon and rooted in their own understanding of the relationship between humanity and the rest of nature; Second they can teach about the environment and natural systems upon which life depends; Third they can provide active leadership in initiating practical environmental projects.

As field laboratories for practicing scientific ecological studies

Protecting church forest is not only for conservation of natural resource but also for serving researchers and academicians as field laboratories/centres/sites for practical training, research on biology, ecology, forestry, pharmacology, sociology/anthropology, socio-economics, forest history/history, etc. Church forests and monasteries are excellent learning and research centers in general and in particular they are ideal sites for studies on vegetation history, ecology, taxonomy and other fields of biology and forestry (Tilahun et al. 2015). Generally, although the main purpose of churches is as places for worship, burials and meditating religious festivals, they also provide valuable, often unique, and secured habitats for plants and animals, ecological values and green spaces for people. Besides being rich in biodiversity, these spiritually designated forests sequester carbon, help to regulate climate changes, conserve water, reduce soil erosion, and provide shade and natural medicine. They are native seed banks for the future of the given landscape. They also harbor pollinator species, including native bees and other insects that add value to outlying crops (Lori 2015).

Floristic composition and vegetation structure of some church forests

Species and structural composition of church forests in South Gondar Zone

Wassie et al (2010) studied 28 church forests in South Gondar Zone Northern Ethiopia, covering a total of over 500 hectares of remnant forests (range 1.6 to 100 ha). The study confirms 168 woody species of 69 families, of which 160 were indigenous (23 are threatened indigenous tree species) and 8 exotic woody species (100 trees, 51 shrubs, and 17 lianas). The total number of species per church ranged from 15 to 78. The species composition of these church forests is old-growth type where *Juniperus procera*, *Olea europaea*, and *Celtis africana* predominate (Wassie 2007). These groves are not only hosting vegetation but also provide diverse forest products and services. They can also act as sources of genetic materials for the restoration of degraded dry Afromontane forests (Wassie et al. 2009).

Species and structural composition of church forests in North Shewa Zone

Tilahun et al. (2015) studied 6 church forests in 6 districts of North Shewa zone, Amhara regional state Ethiopia with an area ranging from 1.6 ha to 100 ha. The total number of species and families in each of the churches ranged from 17 to 60 and 15 to 39 respectively (Tilahun et al. 2015). There was variation in regeneration status across the height and DBH class distribution. The difference in height and DBH class distributions of individual trees in each studied church forest showed that the forests are at different secondary stages of development. The variation of altitude across each church forest showed the differentiation in tree species type. Results also indicated that the church forests persist because of the commitment of the community, with strong theological thoughts, and biblical basis. The community respects and protects church forests; from these, church forests can be assigned as a central institution and platform for biodiversity conservation (Tilahun et al. 2015).

Species and structural composition of church forests in Addis Ababa

Tura (2011) found the number of tree species in seven studied sites of church forest in Addis Ababa is 22 different tree species with the total tree stems were 1519 and DBH ranging from 10 to 162cm while height ranging from 4 to 44m. The total mean density of trees per hectare from all seven church forests of Addis Ababa is 217 trees ha⁻¹. The DBH ranged from 10 to 162 cm produced a higher mean above-ground biomass 276.29 t ha⁻¹. This suggests that EOTC forests might strongly contribute to conserve woody species diversity in Ethiopia even in highly populated city Addis Ababa.

Benefits of churches from the forests

Forests besides providing grace and prestige to the church, the wood and non-wood products of church forests have several benefits for churches. The main benefits of churches from the forests can be broadly categorized under products and services.

Products

Church forests provide various products for the churches include woods (for the maintenance and construction of the church building, roofs, and walls) firewood, charcoal and other wood products either to use it or sell and earn income for churches collected from church forests (Tilahun et al. 2015). The vegetations of church forests are used to produce sacramental and sacred utensils such as oil, incense, drums, crosses, plates, beads and prayer sticks for church services. The fruits and leaves of some vegetation in churches are used as food for monks, hermits and church students. They used vegetations of church forests for folk medicine. They also used these plants to make ink and dyes for many holy paintings and to decorate churches (Wassie 2007).

Services

Church forests provide a variety of services to churches such as protecting the church building from strong wind, storms and soil erosion. Forests also serve as classrooms for the traditional church school. It creates privacy and calms for hermits and monks to pray. Forests give grace and esteem to churches. Trees give shade to celebrate religious festivals and as platforms for followers meetings outside the church buildings. Forests provide a green and pleasant area for prayers. Forests serve as a place for social gatherings like '*Mahabber and Senbetie*'. The church scholars and followers equate a church without trees to a naked person (Wassie 2007).

The church forests are primarily reserved for the church services as stated above. However, there are some possible forest benefits allowed for the followers under the permission and recognition of the church administrators whereas some benefits have been entirely forbidden. These include the collection of fuelwood, construction wood, fodder, seedlings, honey, recreation, and enjoyment (Wassie (2007). Some other benefits are permitted to be used including seeds, medicine (tree parts), fruits and spiritual contemplation and praying (Wassie 2007).

EOTC and its philosophy in the conservation of forests

The Ethiopian Orthodox Tewahido Church (EOTC) is an ancient native and integral Christian Church of Ethiopia which is one of the oldest Churches in the world and founding member of the World Council of Churches (Wassie 2002). EOTC has a long history of planting and conserving tree species in its yard. The spiritual bond between tree plantation, conservation and protection is based on the holy bibles and the EOTC scholars' thought (Tura et al. 2017). Church compounds are monasteries of trees and other biodiversity resources. Many indigenous trees and shrubs destroyed almost completely over the last century are still found standing in the compounds of rural churches (Tilahun et al. 2015). The area of forest cover preserved by the Ethiopian Orthodox churches in some parts of the country has been declined and found in patches. These patches of forests are used as sources of seeds for raising seedlings in nurseries (Wassie and Teketay 2006).

According to Wassie (2007), church and monastery forests persist since long time ago by the commitment and effort of the holy fathers and mothers and the religious followers. It is obvious that religion, in this case, acts as an effective "social fence" (Bhagwat and Rutte 2006) and also the combination of religious and utilitarian worth that makes them valuable to the community and has thus ensured church forests preservation. According to the prominent church scholars, including the Archbishop and the Holy Scriptures of the church (The Holy Bible, King James Version), the main theological bases and religious perspective in conserving forest resources include the following.

The Church on the earth signifies and symbolizes the new heaven, the holy city, New Jerusalem coming down from God out of heaven, prepared as a bride, adorned for her husband. Thus, it should have the same semblance and appearance as Eden heaven was (Wassie 2002). Therefore, the church like Eden was beautified with many plants, animals and other organisms and the holy water/streams infinitely has been surpassing from these forests that were believed to proceed out of the throne of God.

The trees in the compound are symbolic of the presence of angels guarding the church. On top of this, they are precious heritages passed from many generations with the sacrifice of holy fathers and mothers. They have got blessings of many saints beneath their roots where their holy flesh rested in peace. Therefore, trees in the compound are not to be cut unless for the purpose of the church itself and the land is not to be plowed (Wassie 2002). Clearly, in the holy bible, the Lord God commanded to preserve and conserve forests/trees as described in the following statements: "*You shall not destroy the trees thereof by forcing an ax against them, for you may eat them, and you shall not cut them down. Are trees in the field men that they should be besieged by you...?*" (Deut. 20: 19) (Cited in Wassie 2002).

Churches protect and conserve their forest resources by using two different methods, namely religious sanctions and/or legal protection.

Religious sanctions

The main mode of protection is achieved by creating religious commitment and respect among the followers. As the church is believed to be the house of God, everything in the compound is sacred and respected. Every follower is expected to respect and protect the house of God together with the forest enveloping the church. Cutting a tree in the church compound is considered as denying the presence of God unless it is for the special purpose of the church. It is believed that cutting in and smuggling of trees from the church compound would bring a curse and the one who did it is considered as a person who has violated the Kingdom of God and would be alienated from the church communities. A person that cuts a tree or even a dead branch for personal use would be presented to the church community/church scholars and asked to repent and be committed not to repeat the mistake again. If the person fails to admit his/her mistake voluntarily or makes the same mistake again, he/she would be alienated from the church

community and would not be entitled to services from the church. This sanction is known as '*Gizet*'. Hence, since Orthodox Christians fear '*Gizet*', they do not dare cut trees in church forests (Tilahun et al. 2015).

Legal protections

Since churches and their forest resources are found in a world where there are different attitudes and perspectives of people, they also use guards and civil law to protect their forest resources. At present, the demand for wood is increasing, and religious perspectives are diversified. Therefore, since most of the churches have assigned guards, encroachers and outlaws are caught and brought to the civil courts for the appropriate measures. It was reported that though churches are primarily houses of God, they are also houses looked after by the State, which provides the necessary legal protection to their forest resources (Tilahun et al. 2015).

Forest conservation and religious view

Long-time before the existence of systematically protected areas, people were protecting the sacred area. Faiths have been involved in some of the earliest forms of habitat protection in existence, both through the preservation of particular places as sacred natural sites and through religious-based control systems. This habitat protection method using religious thought resulted in sacred groves with a large sanctuary of biodiversity (Bhagwat 2009). Sacred areas are probably the oldest form of habitat protection conserving natural ecology and biodiversity. From a conservation perspective, sacred natural sites and other places of importance to faith groups exist both inside and outside official "protected areas" as recognized by IUCN. The conservation of sacred natural sites can be integrated into any of the systematic management models that brings a sacred area into a national protected area (UNESCO 2003).

People may value forests for spiritual, economic, aesthetic, cultural and scientific reasons. Ethiopian Orthodox Church perceives the forest and other living things in forest ecosystem as beauty work of God and therefore they give to learn the miracle of the creature, worship, meditate, pray and practice with the trees (Bingeli et al. 2003). The church has owned its forest for centuries based on the fact in the bible that the church forest and its compound are sacred. According to the Holy Bible, God called to Moses out of the burning bush. "*Moses, Moses!*" And he said, from "*Here I am.*" Then He said, "*Come no closer! Remove the sandals your feet, for the place on which you stand is holy ground.*" Exodus (3: 4-5). This shows that everything around us and the earth which stands on it, is created by God and the grounds within the church compound specifically are holy (Cited in Wassie 2002).

Challenges to the church forest

Deforestation due to demographic pressures with increasing demand for firewood, construction wood, grazing and agricultural land made conservation of these remnant church forests a very challenging task. These together with sedentary farming leads to persistent land

exploitation in Ethiopia have made farmers degrade the environment and invade the church forest surrounding (CSA 2013). In some cases, the line that separates the church forest from community agricultural land became blurred (Yirdaw 2001). The church forests' resources have been degraded due to human settlements and utilization (Yitebitu et al. 2010).

Conservation of monastery and church forests is becoming beyond the capacity of churches to save them from the pressure of the local people for agricultural land expansion, grazing, and over-exploitation of timber. The issue of ownership aggravated the rate of deforestation by the surrounding people. The Ethiopian Orthodox Tewahido Church should be entitled to its forests. This increases the recognition of monastery and church forests and can be considered as one of the forest ownership categories by the government (Tilahun et al. 2015). The threats on church forests owned by EOTC include:

Grazing of seedlings and sapling by the domestic animals

Livestock grazing is the major factor limiting seedling establishment, seedling survival, and growth in church forests (Wassie et al. 2009). It also removes the sapling and shrubs of forests, reducing its regeneration. Studies in Ethiopian highlands showed that heavy grazing pressure significantly increased surface runoff and soil loss and reduced infiltration capacity of the soil which in turn undermines suitability of sites for germination (Tilahun et al. 2015).

Anthropogenic encroachment

Encroachment into the church forests by individuals for farmland expansion, settlement, tree cutting and fuelwood collection leads to a decline in the sizes and diversity (richness and evenness) of the forests. The encroachment by the local people is caused by the critical shortage of fuelwood and farmland (Tilahun et al. 2015). The decision to conserve and sustainable use of forest resources by humans is determined by culture. This aspect of conserving biodiversity is referred to as cultural diversity, recognizing the important role of sociological, ethical, religious, and ethnobotanical values in human activities (Wassie 2002).

Substitution of native trees by fast-growing exotic species in church forests

Most of the churches do not have enough income to operate their services and other expenses. Hence, there is a growing tendency of cultivating *Eucalyptus* species replacing indigenous trees inside sacred groves due to its fast growth habit and the high demand of the community is a great threat that may entirely substitute those indigenous tree species by these exotic species for economic use (Tilahun et al. 2015). In the church forests of Northern Ethiopia, *Eucalyptus* is replacing the native species for its fast-growing and cash crop habit to get finance for their administration (Klepeis et al. 2016; Cardelús et al. 2017).

Construction of monuments and improper grave houses in the forests

Many stone and marble made monuments, with an average surface area of 4m², and constructing from small to big grave houses are observed covering considerable segments of the forest areas of churches. Unlike other traditional grave spots, these affect the regeneration potential of the forest. Construction of monuments and houses on graves has never been a tradition of EOTC and still is not accepted by the church scholars (Wassie 2002).

The dominance of some invasive species

According to Tilahun et al. (2015), the destructive impacts of invasive alien species were identified in Kewet, Yifratana Gidim districts towards Afar and Dessie. Among the invasive species, *Lantana camara* was replacing most of the shrub plant species at a very rapid rate. This is intensified to the right of Tarmaber to Menz Guassa plains and terrains from Shewarobit to Ataye, in these areas it quickly takeover indigenous herbs and shrub species (Tilahun et al. 2015; Liang et al. 2016).

Death of many old trees without being substituted

Most of the churches in Northern Ethiopia have been serving for more than a century with their forest resources. Thus, many of the trees are aged and dying without any replacement. This may result in complete losses of valuable indigenous tree species and lead to the decline of species composition of the church forests (Wassie 2002). The other threat is the denying and overlooking of EOTC values, which may increase in the coming generation due to the influence of other religious sects and 'modernity' leading to the overlooking of the EOTC values (Wassie 2002). In spite of the sacred groves' ecological and spiritual benefits, the status of church forests has continued to decline due to a combined effect of economic, environmental, and cultural factors (Aerts et al. 2016).

The major threat of Ethiopian church forests at different time

Historically, most of the church forests were destroyed and burned with the churches and other precious heritages by the anti-Christian expedition led by Ahmed Ibn Ibrahim also called 'Gragh' meaning 'left-handed' at the beginning of the 16th century. After 'Gragh' was eradicated in 1543, most of the churches and monasteries were reconstructed together with their forests (Wassie 2002). In the process of nationalization of private properties during the socialist regime in Ethiopia in 1974, with the central aspect of land reform, adopted the land reform proclamation in 1975 and nationalized all rural land. The EOTC was left without its land holdings, including the forests, which have been preserved for centuries. The fate of those forests was ruthless exploitation and destruction, resulting in the degradation of the area (Tilahun et al. 2015).

Although, the EOTC and its doctrine have a strong initiative to conserve their sacred groves the growth of human population caused to increase in the demand for trees for firewood, construction, income source and gathering. This high population growth accompanied by sedentary agriculture and extensive cattle husbandry compete with the preservation of church forests. Thus the religious followers have threatened the forests inadvertently for agricultural land expansion, grazing, footpaths to churches, firewood, charcoal, and timber production (Yirdaw 2001; Tilahun et al. 2015). In addition, societal requirements of buildings like gathering houses, monuments and cemented graves caused the clearance of trees and resulted in a permanent disturbance. Cultivation of fast-growing exotic species (*Eucalyptus*) and native trees (*Coffea*, *Rhamnus*, etc) for financing the church as a cash crop also disturb the forest critically (Cardelus et al. 2019).

Uniting church philosophy and science for forest conservation

According to UNESCO (2003), sacred natural areas are model sites for management because these sites integrate cultural, social and natural values in a single management system and can act as models for participatory conservation. In legally protected areas with a resident population, the integration of sacred natural sites can improve people's attitude to protected area regulations. The church forest is important for preserving traditional knowledge for applying adapted forest conservation practices often found in sacred natural sites and serve as healing sanctuaries (Bhagwat and Palmer 2009). Traditional ecological knowledge is often applied with regard to their management, thus providing good opportunities for integrating western science and traditional knowledge systems.

According to Dudley et al. (2012) the spiritual faiths, which are followed by most people, have impacts on the natural environment: the interaction can be through the form/s of the sacredness of places and/or influence of faiths. Since the existence of sacred areas within a protected area can create a challenge for managers, decisions whether or not to make a sacred area important to faiths into an officially protected area need to be made on a case-by-case basis.

The Convention on Biological Diversity realized that many areas of the world that contain high levels of biodiversity are anthropogenic landscapes inhabited by indigenous and local communities, requiring that approaches need to be refined to link conservation initiatives with local culture and religious views (Agrawal 2001). A comprehensive understanding of the cultural context (indigenous knowledge in this case) of a given community is necessary for biodiversity conservation activities. Understanding the role that church forests play in the provision of ecosystem services is critical, particularly for soil conservation, freshwater protection, and carbon sequestration. To preserve these forests, and perhaps even expand them multidisciplinary approach that includes all stakeholders from biologists, social scientists, ethnographers, religious leaders, and local people must

collaborate. Understanding the relationship between local peoples and the forest is the way to empower the community to protect and conserve the forest (Cardelus 2012).

According to Terefe (2003), community participation is very crucial to overcome the rate of deforestation. For this purpose Participatory Forest Management (PFM) is adopted and implemented by involving the local community who intimately related to forest resources in order to fulfill the interest, respecting of traditional users, their culture (indigenous knowledge in this case) and religious contribution in saving the forest of the country from small scale to large scale and bottom-up approach which encourage a sense of belongingness to the rural people in general and landless rural youth in particular (Winberg 2010).

Conclusion

The EOTC has strong institutional ability to resist deforestation of the church forests and has customary plans to establish forests in the yards of new churches well ahead of time. 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. Most of the church forests have no clear and documented border demarcations, which encourage encroachment by farmers owning land adjacent to the forests. There is a lack of scientific forest management practices like inventories of the forests resources and forest management plans in the church. The two modes of protection 'Gizet' as a house of God and 'Legal protection' as a house of the state is a two-sided blade to protect the resources. When people inevitably overlook religious values and start to violate those protections or 'Gizet', then he/she will be outcasted by the community from social life and the church from God as he did sin. But, secularism and the view of other religious sects may degrade the value of the church thus for all of these risks legal protection is of paramount importance in addition to the religious sanction.

Recommendation

The participatory forest conservation program will be more successful if the knowledge of the local community, indigenous cultures and religious institutions (particularly of EOTC) with a cooperative effort has been taken into consideration. Researchers have to fill the gap of churches and monasteries in doing scientific forest management practices like inventories of the forests resources and forest management plans to protect them from decline. The government should acknowledge the church for conservation; assure to have a clear boundary for the church forest to minimize further encroachment and should work together in enforcing the legal protection of the forest. Studies should be conducted on the status of conservation, regeneration, and structure of sacred groves ecosystem, and determinant factors affecting them for the better wellbeing of indigenous species to be preserved for the future generation.

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