

THREATS OF WOODY PLANT SPECIES DIVERSITY AND THEIR CONSERVATION TECHNIQUES IN ETHIOPIA

Wondie Mebrat^{1*} and Temesgen Gashaw²

¹Department of Biology, Adigrat University, Ethiopia. Po. Box 50

²Department of Natural Resource Management, Adigrat University, Ethiopia

ABSTRACT: *Forest provides livelihoods for millions of people worldwide, through provision of different products. However, their diversity and area coverage are highly declined through time. Deforestation, invasive species and land degradation are the main threats accelerated plant diversity loss. Like most countries in the Sahelian region Ethiopia is affected by these factors heavily and finally resulted desertification, poverty and natural resource losses. About 75 percent of the countries land mass is estimated to have been affected by the threat of desertification. To overcome these problems efforts has been made to launch afforestation and conservation programs. So, the purpose of this review is to present threats of plant diversity and forest conservation in Ethiopia.*

KEYWORDS: Threats of Forests, Conservation, Deforestation

INTRODUCTION

Ethiopia is a mountainous country with great geographic diversity like rugged mountains, flat topped plateaus and deep gorges incised river valleys and rolling plains (Tewoldeberhan, 1988). These diversified topographic features made the country to be covered by the richest forest cover in tropical Africa (Tolera et al. 2008). These forests are essential for human survival and well-being. They harbor two thirds of all terrestrial animal and plant species. They provide us with food, oxygen, shelter, recreation, and spiritual sustenance, and they are the source for over 5,000 commercially-traded products, ranging from pharmaceuticals to timber and clothing (Murthy et al. 2002; World Bank, 2004; SCBD, 2009). In addition, these resources help to maintain the fertility of agricultural land, used as habitat for wild life, protect water resources and reduce the risk of natural disasters such as land slide and flooding (World Bank, 2004).

Throughout history humans have used the environment resources plants, animals and others to gain great economic rewards; however, many of the methods are now being seen as unsustainable (Abdelfattah, 2009). Forests undergo changes in various ways. Its areas can be reduced either by deforestation or by natural disasters such as volcanic eruptions. As a result, the expanse of forest areas are declining across the globe, partly through logging activities and also due to conversion of habitats to croplands (agricultural expansion) accounts for up to 40 percent of Ethiopian forest losses (Tewoldeberhan, 1988; Pant and Samant, 2007; Tesfaye, 2007; Eyayu et al. 2009; Winberg, 2010). Especially deforestation is high and severe in the northeastern Ethiopia. Because of the disappearance of forests, most of the mountainous sides are bare. Valleys have been gullied, striping and streams, which is used to have water the whole year around are now mainly dry in dry season (Abate, 2003).

Particularly some of the current contributory factors accelerated the decline of woody species diversity in Ethiopia are, the size and distribution pattern of human and domestic animal populations, the level of resource consumption, market factors and policies. In addition, understanding of woody plant species conservation in a narrow sense due to low level of awareness, the attention on woody species conservation and sustainable use has so far been inadequate (Tesfaye, 2007).

To minimize the risk, sustainable forest management has been practiced through applying conservation techniques. Among techniques, protecting forest areas with restricted access for local communities have often been introduced as a solution to tackle deforestation and its effects (Putz, 1994; Winberg, 2010). Especially, advances in plant biotechnology provide new options for multiplication and short- to long-term conservation of plant biodiversity, using in vitro culture techniques. Significant progress has been made for conserving endangered, rare, ornamental, medicinal and the whole plant species, especially vegetative propagated plants of temperate and tropical origin (Cruz-Cruz et al. 2013).

THREATS OF WOODY SPECIES DIVERSITY IN ETHIOPIA

Forests of the mountainous landscapes of Ethiopian highlands were characterized by high woody plant species diversity. However, they have been degraded and fragmented for decades (Tewoldeberhan, 1988). This degradation is the result of population pressure that increases crop cultivation and livestock grazing in marginal areas. Moreover agricultural investment, re-settlement schemes, charcoal, production and relentless expansion of very aggressive invasive alien species are having a profound and determinant effect on the woody plant resource availability. These activities contributed to increased deforestation and soil erosion in the highlands of the country. Particularly, in the North and Central highlands of Ethiopia, forest and woodlands are used to be the only “land banks” that were changed to farmland due to population growth over time (Tewoldeberhan, 1988; Pant and Samant, 2007; Winberg, 2010; FDRE, 2012).

Land Degradation

Land degradation indicates temporary or permanent long-term decline in ecosystem function and productive capacity. Therefore, it is the primary cause of species loss at local, regional and global scales through urban development, road building, recreation, forest fires, agriculture and tree logging. All these destroy and degrade woody plant natural habitats in Ethiopia (Kruger et al., 1997; Scherr and Yadav, 1997; Silva et al. 2008; Laurance, 2010). It is estimated that degradation by human activities is the primary cause of risk for 83% endangered plant species (Turner, 1996; Silva et al. 2008). In addition to these thousands of pollutants are discharged into the environment and their lingering presence threatens plant species diversity by affecting individual species or degrading entire ecosystems (Jalan et al. 2009). Pollutants are the main threats to species diversity especially to water inhabitant species (river, lake, coastal and ocean), that cause the death of flora and also destruction of ecosystems.

Due to these practices woody species diversity is suppressed highly in Ethiopia. These factors accelerate the degradation of natural habitats with many woody plant species at a great extent.

Such practices are leading to the extinction of moisture loving species and promoting the hardy and spiny species having least value for the society. The loss of biodiversity and changing the pattern of woody species has necessitated the assessment of woody species diversity of the region and prioritize habitats, communities and species for conservation (Pant and Samant, 2007; FDRE, 2012).

To minimize the risk, ecological management and land degradation control should be practiced. It is whether promoted as soil conservation or reforestation or some other process, has been an international concern for well over 70 years. Yet there has been a tendency to see land degradation control as a purely technical exercise and self-evidently worthwhile for human society to pursue. Land degradation has been tackled by addressing the degradation itself, rather than its causes and symptoms (Scherr and Yadav, 1997; Gisladottir and Stocking, 2005). In addition to these, awareness creation and continuous training, resettlement program, creating opportunities for alternative means of livelihood and promoting NGOs effort to involve in land rehabilitation practices help solve the problem encountering land degradation problem in Ethiopia (Mesfin, 2010).

Deforestation

Deforestation is the conversion of forested areas to non-forest land use such as arable land, urban use, logged area or wasteland (Tejaswi, 2007). It is a clearance of large expanse of forest for agriculture and other uses, when a forest is removed, the total amount of water and minerals that flow into the streams increase drastically (Alemayehu, 2007). Deforestation in Ethiopia was increasing at alarming rate and the rate of afforestation was very negligible in light of the very high rate of clearing for fuel, expanding agricultural land, for construction, urban development purposes, and also lack of awareness creation for the communities have contribution for deforestation (Mohammed, 2011). This intensive logging practice seriously damages the structure and composition of natural woody plant species and leading to the declining of forest diversity and agricultural yield in Ethiopia. Such activities pose a serious threat to the conservation and regeneration status of biodiversity in general and plant species in particular. Besides to deforestation, livestock-induced disturbances might be among the major factors constraining regeneration and recruitment of woody species. These factors ultimately contribute to the decline of woody species populations in the forests (Alemayehu, 2007).

Deforestation often involves the conversion of landscapes with continuous forest to ones with remnant forest patches set in a matrix of non forest vegetation. This manipulation of tropical environments has consequences for biodiversity at both the landscape and the forest-fragment level. Factors such as fragment size, degree of isolation and time since excision from the continuous forest may directly influence the biodiversity of a fragment and hence, in a complex manner, the biodiversity of the collection of fragments that occupies the landscape (Turner, 1996). One of the consequences of deforestation is that the carbon originally held in forests is released to the atmosphere, either immediately if the trees are burned or more slowly as unburned organic matter decays. Only a small fraction of the biomass initially held in a forest ends up stored in houses or other long-lasting structures. Most of the carbon is released to the atmosphere as carbon dioxide, but small amounts of methane and carbon monoxide may also be released with decomposition or burning (Moutinho and Schwartzman, 2005).

Invasive Species

Invasive alien plant species are not native to Ethiopia and threaten its native plants and biodiversity. It is a growing environmental and economic threat to the country. Conservation biologists have globally ranked invasive alien species as the second most serious threat to plant species at risk (after habitat destruction) (Chenje and Mohamed-Katerere, 2003; Rankin and MES, 2004; Loeb, 2012). It is the other major threat that brings a serious impact on plant species diversity in many part of the world. They are a serious impediment to the conservation and sustainable use of global, regional, and local plant species diversity with significant undesirable impact on the goods and services provided by ecosystems (Lwando and Train, 2005; Obiri, 2011). Among the invasive species *L. camera* L. is one of the most invasive alien species in Ethiopia that severely affects the health and regeneration of the woody plant species in which its distribution is very high. According to Solomon (2010), it is a highly aggressive exotic species or environmental weed in many countries has significantly adverse effect on vegetation biodiversity. It typically forms dense thickets, suppressing native vegetation and seedlings through shading and nutrient competition. It also impact on land resources, and agriculture and livestock production systems, in multiple ways, potentially threatening food security (Goodland et al. 1998; Chenje and Mohamed-Katerere, 2003).

To minimize the risk of invasive species emphasis is placed on the management of alien species in protected areas. Protected area include all areas of natural or semi-natural vegetation in which the conservation of the natural community is a major objective, and it therefore includes areas designated as national parks, nature reserves, and wildlife conservation zones and so on. The management of land outside a protected area can often be crucial to the conservation objectives within it, and to broader conservation goals within a country. Land outside protected areas, and forestry plantations and amenity areas in particular, often act as the main seed source for a number of invasive woody plants. Therefore, control of alien plants outside protected areas can be very important (Goodland et al. 1998).

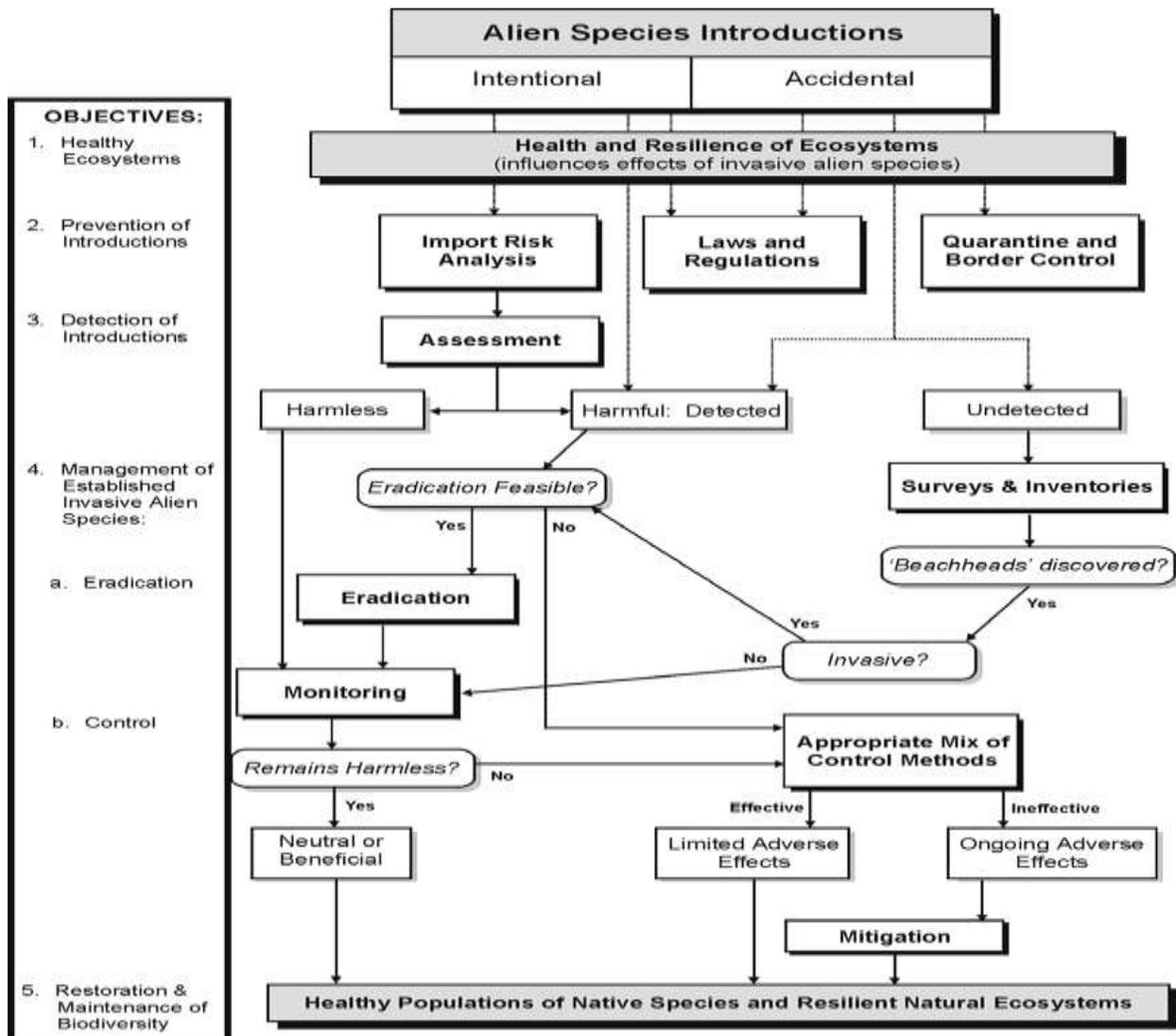


Figure 1: Invasive Alien species management matrix source (Rankin and AMES, 2004)

CONSERVATION OF FOREST RESOURCES

The accelerating pace of species extinction is the greatest challenges facing in most part of Ethiopia. This challenge has lead to the emergence of the practice of conservation in the country. It seeks to learn how to preserve species, communities, and ecosystems and it studies the cause of declines in species richness. To do these two approaches are being used to protect and conserve vegetation diversity. These are the *in situ* and *ex situ* conservation approaches. The *in situ* approach species within their natural habitat while the *ex situ* approach does so outside the habitats of the species by collecting and protecting them in gene bank (FDRE, 2003).

As a result, conservation of woody plant species at the levels of ecosystems, landscapes, community, populations, individuals and genes, is essential to sustain the health and vitality of ecosystems. Conservation practice includes the establishment of protected area as well as

management strategies based on beneficial balance between resource development and satisfaction of human needs (Uhlig, 1988; Tesfahun, 2000). Therefore, ecological assessment of the existing enclosed forests is the base for meaningful planning to rationally utilize the remaining forest resources (Abate, 2007). These study of woody plant species distribution in response to environmental factors helps to generate information for a better understanding of ecological processes and in managing ecosystems.

CONCLUSION

Forests of Ethiopia are highly affected by several natural and anthropogenic factors. Specifically, anthropogenic factors affect forests mostly through expansion of agricultural activity, settlement, deforestation, land fragmentation and invasive species introduction etc. To conserve the remnant forests and for further regeneration, forest management has been practiced through protecting forest areas from human and livestock interference.

REFERENCE

- Abate, A. (2003) A floristic composition and structural analysis of denkoro forest, south wello, MSc thesis presented to the school of graduate studies of Addis Ababa University.
- Abate, Z. (2007) Comparative floristic study on Menagesha Suba state forest on years 1980 and 2006, MSc Thesis Presented to the School of Graduate Studies, Addis Ababa University.
- Abdelfattah, M. A. (2009) Land degradation indicators and management options in the desert environment of currently, soil resources dep., environment agency Abu Dhabi, published in *Soil Surv. Horiz.* 50:3–10.
- Alemayehu, W. (2007) Ethiopian church forests opportunities and challenges for restoration PhD thesis, Wageningen Univeristy, Wageningen, The Netherlands.
- Chenje, M. and Mohamed-Katerere J. (2003) “Invasive alien species are emerging as one of the major threats to sustainable development, on a par with global warming and the destruction of life-support systems, Preston and Williams, working for water programme/south Africa environment outlook.
- Cruz-Cruz, C.M. González-Arno, T. and Engelmann, F. (2013) *Biotechnology and Conservation of Plant Biodiversity*, www.mdpi.com/journal/resources.
- Eyayu, M., Heluf, G. Tekalign, M. and Mohammed, A. (2009) Effects of land use changes on selected soil properties in the Tara Gedam Catchment and Adjacent Agro-Ecosystems, Northwest Ethiopia. *Ethiopian Journal of Natural Resources*, 11(1): 35-62.
- FDRE (Federal Democratic Republic of Ethiopia) (2003) State of environment report for Ethiopia, Published by environmental protection authority, Addis Ababa, Ethiopia.
- FDRE (Federal Democratic Republic of Ethiopia) (2012) National strategy and action plan for the implementation of the great wall institute in Ethiopia.
- Gisladottir, G. and Stocking, M. (2005) Land degradation control and its global environmental benefits, *Land Degrad. Develop.* 16: 99–112.
- Goodland, T.C.R., Healey, J.R. and Binggeli, P. (1998) Control and management of invasive alien woody plants in the tropics, school of agricultural and forest Sciences University of Wales, Bangor, UK Publication Number 14.
- Jalan, D.I., Panjaitan, K. and Timur, J. (2009) 4th National Report the Convention on Biological Diversity, Biodiversity conservation unit ministry of environment publisher.

- Kruger,H, Berhanu Fantew,Yohannes GebreMichael and Kefeni Kejela(1997) Inventory of Indigenous Soil and Water Conservation Measures on Selected Sites in the Ethiopian highlands, University of Bern, Center Development and Environment, Switzerland.
- Laurance, W. F. (2010) Habitat destruction: death by a thousand cuts Oxford University Press.
- Loeb, R.E. (2012) Arboricultural Introductions and Long-Term Changes for Invasive Woody Plants in Remnant Urban Forests, *Forests* 3, 745-763.
- Lwando, C. and Train, R. E. (2005) Effect of *L. Camara* on Plant Diversity, Education for Natural Program EFN news. 6p.
- Mesfin D. (2010) Challenges and Prospects of Land Rehabilitation Practices: A Case of Angacha Woreda, Kambata Tambaro Zone, SNNPR, MSc thesis presented to school of graduate studies of Addis Ababa University.
- Mohammed A. (2011) Perception of Local Community towards Deforestation: the case of Edigetber and Selamber Kebele around Wolkite an MSc thesis presented to school of graduate studies of Addis Ababa University.
- Moutinho, P. and Schwartzman, S. (2005) Tropical Deforestation and Climate Change by Amazon Institute for Environmental Research IPAM - Instituto de Pesquisa Ambiental Amazônia; Washington DC - USA: Environmental Defense.
- Murthy, I. K., Murali, K. S., Hegde, G.T., Bhat, P. R. and Ravindranath, N. H. (2002) Comparative analysis of regeneration in natural forests and joint forest management plantation. *Current Science*, Vol. 83: 1358-1364.
- Obiri, J. F. (2011) Invasive plant species and their disaster effects in dry tropical forests and rangelands of Kenya and Tanzania, *JAMBA: Journal of Disaster Risk Studies*, 3 (2).
- Pant, S. and Samant, S. S. (2007) Assessment of plant diversity and prioritization of communities for conservation in mornaulareserve forests, G.B. plant institute of Himalaya environment and development, Himalaya unit, himachal Pradesh, India.
- Putz, F. E. (1994) Approaches to sustainable forest management center for international forestry research office address J: a lan Gunung Batu 5 Bogor 16001 Indonesia mailing address: working paper no. 4.
- Rankin, C. and MES (Madrone Environmental Services) (2004) Invasive alien species framework for BC: identifying and addressing threats to biodiversity a working document to address issues associated with biodiversity in British Columbia Biodiversity Branch Ministry of Water, Land & Air Protection.
- Scherr, S.J. and Yadav, S. (1997) Land degradation in developing world: issues and policy option for 2020, international food policy research institute 2020 brief 44.
- SCBD (Secretariat of the Convention on Biological Diversity) (2009) Sustainable forest management, biodiversity and livelihoods: a good practice guide, montreal, 47 + iii pages.
- Silva, J., Jones, P., Eldridge, W., Thorpe, J., Campbell, E., and Ohara, M. (2008) Life and endangered plants. Conserving Europe's threatened flora, published by Ethiopian communities. Pp 1-2.
- Solomon, C. (2010) Distribution and effect of *L. camara* on different land uses at Bezawit in Abay Millennium Park, an MSc thesis presented to school of graduate studies of Bahir Dar University.
- Tejaswi G (2007) Strengthening monitoring, assessment and reporting on sustainable forest management in asia (gcp/int/988/jpn) forestry department manual on deforestation, degradation, and fragmentation using remote sensing and gis.

- Temesgen, G., Amare, B. and Hagos, G. (2014) Land Degradation in Ethiopia: Causes, impacts and rehabilitation techniques, *Journal of Environment and Earth Science*. 4 (9): 98-104.
- Tesfahun, F. (2000) Biodiversity conservation and utilization on the basis of farmers' traditional knowledge, Ethiopian experience, Ethiopian science and technology commission, Addis Ababa, Ethiopia.
- Tesfaye, A. (2007) Plant diversity in western Ethiopia: Ecology, Ethno botany and Conservation. University of Oslo Norway, presented for degree of doctor of philosophy.
- Teweldebrhan, G. (1988) Vegetation and environment of the mountains of Ethiopia: implications for utilization and conservation. *Mountain Research and Development*, Vol.8: 211-216.
- Tolera, M., Asfaw, Z., Lemenh, M. and Erik, K. (2008) Woody species diversity in a changing land scape, south-central Ethiopia highlands, *Agriculture Ecosystem and Environment*. 128: 52-58.
- Turner, I.M. (1996) Species loss in fragments of tropical rain forest: a review of the evidence *Journal of Applied Ecology*, 33, 200-209.
- Uhlig, K. (1988) Mountain forest and the upper tree limitation on the south eastern plateau of Ethiopia, *Mountain Research and Development*, Vol.8: 227-234.
- Winberg, E. (2010) Participatory forest management in ethiopia, practices and experiences food and agriculture organization sub regional office for Eastern Africa, Addis Ababa.
- World Bank (2004) International bank for reconstruction and development, the World Bank responsible for the new millennium, Washington, D.C.