

Expansion of Exotic Tree Species and Impacts on Management of the Indigenous Trees; Emphasis on *Eucalyptus* Species in Wolaita, South Ethiopia- A Review

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ABSTRACT

Non-native species cause changes in the ecosystems to which they are introduced. These changes, or some of them, are usually termed impacts as they have both the direct and indirect impacts and they can be manifold and potentially damaging to ecosystems and biodiversity. The direct impact is more of aggressive competition for resources and allelopathic property and the indirect impact is changing the interests of society and making them to neglect the indigenous species on the management aspect, however, the indirect impact seems less recognized by ecologists, environmentalists, and other concerning bodies on the area. Therefore, assessing the impacts of alien species on ecology and/or indigenous species is not as straightforward as considering their economic impacts.

Key words: *Eucalyptus*, Indigenous species, Invasion, Non-native species

1. INTRODUCTION

Invasive Alien Species (IAS); that is non-native species, a species living outside its native distributional range have been introduced both accidentally and intentionally. [1-3] Intentional introductions are, and have been, motivated by economic, environmental and social considerations. In the forest sector, for example, *Pinus*, *Eucalyptus* and *Acacia* species are important sources of pulp, timber and fuel wood, yet at the same time they have placed tremendous strain on water resources and also plant species that invade an alien area and outgrow the native vegetation, establishing and increasing their own territory, often lead to negative economic, environmental, and social impacts. [4]

In Ethiopia, there are about 22 invasive alien species, [5] not all of them pose harm to the environment. Instead, most of them particularly the crop species that were naturalized long time ago in Ethiopia have immense socioeconomic importance. Many exotic tree species become dominant and also enormously supporting development in Ethiopia. Only few were turned invasive by outcompeting for resources.

The exotic species; *Eucalyptus*, *Cupressus* and *Pinus* have been planted since 1900 to counteract the ongoing destruction of natural forest cover from about 20% in 1900 to less than 3% at present in Ethiopia [6] and mainly *Eucalyptus* species are planted to alleviate the shortage of fuel wood and construction

materials specifically around the high lands of Ethiopia initiated to introduce a rather fast growing species of *Eucalyptus*, and others including *Cupressus* and *Pinus* species. [7-12]

In Ethiopia, forest plantations consist of mainly the exotic species, *Eucalyptus*, which is currently expanding its distribution and captured interest of the local people for its fast growth, easily establishment and maximum yield. Due to their high popularity currently, there is rapid expansion of plantations of *Eucalyptus* species in the highlands of Ethiopia. However, despite of the advantages the different studies conducted in different countries and areas reported that, the expansion of *Eucalyptus* seems to cause great concern as various *Eucalyptus* species are claimed to have detrimental effects on indigenous plant communities. [13-16] Also the structure and composition of native plant communities changed with increasing cover of *E. camaldulensis*. [13] The recent studies have showed that non-native forest plantations (NNFP) can cause the extinction of species [17] either by their allelopathic effect, invasion or reducing or weakening the attention of the local people that is given to the native species which are known by their values for food, traditional medicine, enhancement of soil fertility, conservation of soil, regulation of the microclimate and soil moisture. This review tried to raise issues related with the attention given to the expansion of non-native tree species and their impact on the native tree species management.

2. STATUS OF MAJOR INDEGENOUS AND EXOTIC TREE SPECIES IN ETHIOPIA

Indigenous tree species in Ethiopia, namely, *Podocarpus falcatus* (Thunb.) R.Br. ex Mirb., *Celtis africana* Burm.f., *Croton macrostachys* Hochst., *Pouteria adolfi-friederici* (Engl.) A. Meeuse (synonym: *Aningeria adolfi-friederici* (Engl.) Robyns & Gilbert), *Polyscias fulva* (Hiern) Harms, *Prunus africana* (Hook.f.) Kalkman and

Syzygium guineense (Willd.) DC., *Acacia abyssinica*, *Annona senegalensis* (*A. chrysophylla*), *Acacia sieberiana*, *Acacia lahai*, *Acacia abyssinica* subsp. *Abyssinica*, *Ficus sycomorus*, *Millettia ferruginea*, *Acacia sieberiana* (hereafter referred to by their genus or scientific names) having significant ecological and economic importance. [18] The trees are used in the farm land in the form of agroforestry; serving in a multifunction. Conservation of indigenous tree species is crucial for restoration of ecosystems and provision of livelihood support functions among rural communities. [19, 20]

Although farmers have always incorporated trees in their farming systems; but since the onset of technological advancement trees became a neglected factor in agriculture. [21] Widespread use of artificial fertilizers and pesticides combined with mono-cropping, seem to have been the only means of increasing productivity, and currently the expansion of non-native species that are being used for fuelwood and construction materials thus, undermining natural fertilizers from indigenous trees and their role, is one of the major problem affecting the density and diversity of indigenous trees in farming communities in Ethiopia.

Additionally, natural forests and indigenous tree species in Ethiopia are declining rapidly due to their conversion to arable lands coupled with unwise and excessive utilization triggered by increasing population growth. [22] This had and continues to have serious consequences on diversity and density of indigenous trees species in Ethiopia.

On the other hand, about 94%, of Ethiopian population relies on wood-based and biomass fuel for household energy, [23] and for their fast growth and good yield, *Eucalypt* has provided fuelwood, construction material, scaffold, transmission pole, timber and therefore, the species become the popular exotic tree species growing in the rural and urban areas of Ethiopia. The genus was introduced to East

Africa in the late 19th and early 20th century and by the early 1970s the area of eucalypts in Ethiopia, Rwanda, Uganda, Kenya and Sudan had reached 95,684 ha, [24] the largest plantations at that time were in Ethiopia and Rwanda, at 42,300 ha and 23000 ha, respectively. [25]

Ethiopia is one of the 10 important *Eucalyptus*-growing countries in the world, led by Brazil [26] and as to the study conducted by Mulugeta, [27] Eucalypt is preferred over other species in some parts of Ethiopia due to a number of merits that address the need of the farmers. It was stated that Eucalypt species describe as ‘life saviour’, ‘safety net,’ or ‘tree bank’ as it is converted easily and quickly to cash whenever needed. This implies that the value of indigenous trees and their multipurpose benefit is getting off and being replaced by exotic species. On the other hand, about 88% of trees planted by farmers in Sodo Zuria of Wolaita, South Ethiopia are Eucalypt species, [28] which is proofing the preference of the local people and expansion of the species by letting aside the local tree species.

3. ECOLOGICAL ISSUES OF EUCALYPTUS PLANTING

There have been debates on the advantages and disadvantages of Eucalypt species but as to the results generated from different studies in different countries and areas, the species has negative ecological impacts. [26,29-32] Eucalyptus is also known to cause a number of environmental hazards like depletion of groundwater, dominance over other species by allelopathic effects, loss of soil fertility and negative impacts on local food security issues and also the reduction in biodiversity across landscapes, leading to further ecological demises.

Ecological impacts occur when the local biodiversity of the area and/or the ecological processes are altered by the alien species. Alien species affect native biodiversity through a diversity of ecological processes, such as direct predation, competition for resources, such

as nesting sites (for birds), light (for plants) or preferred food or nutrients, habitat alteration, such as shading out native species and freshwater systems, increasing erosion, changing fire regimes, permanently altering nutrient cycles or soil properties, spreading pathogens and parasites and so on. Plants live in association in groups depending upon their ecological requirements; they have generally the same structural and morphological adaptations. [33] Whenever two or more plants occupy the same niche in nature, they compete with each other for various life support requirements that they need for growth and development and when there is negative influence from the neighboring plants; allelopathic effects, that results in the reduction of production, it also influences the existences, hence affects the diversity.

The ecological issue and concern on *Eucalyptus* growing especially on farmlands and near riverbanks is not only due to *Eucalyptus* as an aggressive water and soil nutrient consumer but also due to the high planting density and short rotation. There is no question that both the red and white *Eucalyptus* are heavy and rapid feeders of both water and soil nutrients. [26]

4. NEGATIVE EFFECTS RESULTING FROM THE INVASIVENESS OF EXOTIC TREES ON INDIGENOUS TREE SPECIES

Reports of effects that can be classed as “negative” can be divided into the following categories: hybridization of tree species, economic and social impacts, and environmental impacts. [34] In addition, ignorance of indigenous tree species by the local communities and dominance of IAS over the indigenous/ native tree of the community [8] stated in their study about the disadvantages of impacts of exotic species as the potential impact include: (a) unforeseen risks, such as problems of adaptability and susceptibility of the species to diseases (b) negative impacts on the environment, e.g. undesirable changes in the physical, chemical and biological conditions

of the soil; and (c) undesirable invasion or colonization of arable lands, pastures and native vegetation as well as displacement of the local flora.

IUCN, the World Conservation Union, [35] states that the impacts of alien invasive species are immense, insidious, and usually irreversible. They may be as damaging to native species and ecosystems on a global scale as the loss and degradation of habitats. Hundreds of extinctions have been caused by invasive alien species. The ecological cost is the irretrievable loss of native species and ecosystems.

Non-native species cause changes in the ecosystems to which they are introduced. These changes, or some of them, are usually termed impacts; they can be manifold and potentially damaging to ecosystems and biodiversity. However, the impacts of most non-native species are poorly understood, and a synthesis of available information is being hindered because authors often do not clearly define impact. [36]

5. CONCLUSIONS

The reason for that farmers giving highest relative weights to Eucalypts tree is its coppicing ability, pole quality, fast growth, easily establishment, easy silvicultural management, maximum yield and market demand of trees, Eucalypts tree, which is one of the alien species in Ethiopia is spreading widely in the high lands of the country and it's replaced indigenous tree species, depleting food and shelter sources and therefore affecting animals and birds, dominating the farmland and being used in place of multipurpose trees despite of its debating conditions.

The main drawbacks are its aggressive competition for resources with native flora, depletion of soil water, impoverishment of soil fertility under *Eucalyptus*, and finally its allelopathic property, which excludes and restricts germination and growth of other species and moreover the less recognized impact is the ignorance of indigenous

species by local people for *Eucalyptus* species.

While the initial impacts may be minor and near-invisible, as the alien species population increases over time, the impacts will increase in severity. Assessing the impacts of alien species on ecology and/or indigenous species is not as straightforward as considering their economic impacts. While the costs of solving the problem, control and mitigation measures to restore the endeared ecology impacts can be measured, the actual value of an extinct species or a change to the ecosystem is harder to quantify. Therefore, special attention is needed for the management of indigenous tree species beside to the other impacts when we look for the advantages of the exotic alien species.

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