

Review on Impact of Eucalyptus Plantation on the Soil

Bekele Tona Amenu

Jimma University, P.O.Box, 307, Jimma, Ethiopia

ABSTRACT

This paper takes up a number of issues with the planting eucalyptus trees impacts of on the environment in general and soil in particular. Explains that diversity of eucalyptus, eucalyptus and soil erosion soil nutrient and eucalyptus. Eucalyptus and water cycle, interaction of eucalyptus with other plants and animals allelopathy effect of eucalyptus and to identify the impacts of eucalyptus on crops. Soil nutrients and soil water. It further noted that, eucalyptus species have effects on the germination, radical and growth of a given crop. This adverse effect is motivated by proper management of eucalyptus plantation. Studying the impacts of eucalyptus plantation on the environment is to determine the adverse effect and the use of planting eucalyptus on the ecology of Ethiopia. Many ideas are raised on planting eucalyptus that is planting eucalyptus has arguments for and against because of their adverse effect and use they give for the environment.

Keywords : Soil, Eucalyptus, Allelopathy, Erosion

I. INTRODUCTION

Eucalyptus is a kind of ever green trees, which is indigenous to Australia, Indonesia and Philippines which, is grown to provide paper pulp, wood, gum and oil used in medicines (campinhos, 1999). Eucalyptus has 945 species sub species or varieties among which, 100 species or subspecies or varieties which, are economically important (Fris, 1995).

Eucalyptus still remains as a feature in Ethiopia. After 115 years, ago being introduced to Ethiopia by Emperor Minelik II for the first time. Fast growing nature to card deforestation for wood fuel (Teketay, et al. 2005). As we continue to plant eucalyptus on water shades, we will continue to experience water shortage and it will even become a big problem as climate change hits the earth (Mathal, 2001).

Growing eucalyptus in low rainfall areas may cause adverse environmental impacts due to competition for water with other species and may incidence of allelopathy. Allelopathic effects of eucalyptus, may have implication when other species which grow near eucalyptus trees. This is accusing for crop yield reduction due to nutrient depletion and production of toxic exudates (allelochemicals). Finally, nutrients are

exported out from the plantation of soil system by removing trees for timber sales and fuel wood (Zerfu, 2002).

Those that eucalyptus species which have been used for industrial purpose as well as for agro forestry are often questioned since, their ecology has not been appropriate studies (Bernhard reversat 1999). Eucalyptus seedlings are vulnerable to serve water streets unlike the seedling of indigenous deciduous tree species in Ethiopia (Gindaba et al., 2004). This shows that eucalyptus trees need more water and compete with neighboring plants for the available water in the soil (EI Anib *et al.*, 2001).

On the other hand eucalyptus species released volatile components or compounds such as benzoic, Cinnamic and phenolic acids which inhabited growth of crops and weed growing near it (sasikumar; et al., 2001). Kohlietal, (1998). This is toxic due to allelopathic properties where serve to reduce germination of other plants (Khar et al., 2005; Shiming, 2005). Eucalyptus trees contain allelo chemicals like terpene. These substances will suppress the growth of many other plants by habiting seed germination and seedling growth (Moline 1991; cao and luo, 1996). This will further lead to biodiversity reduction in the eucalyptus Plantation forest. It was

proved that the allelopathy was negatively correlated to the precipitation (Cao and Luo 1996).

Eucalyptus planting is the cause of serving drought. In last decades, the biodiversity and environment have been significantly degrading in eucalyptus Plantation forests (poor and fries, 1995; chem. 2002; yu et al., 2008).

Currently eucalyptus grows at different parts of the world resisting various weather conditions due to its ability to adapt and grow well in area, where there is excess water (Marshy area) and plenty of nutrients drought areas poor soil (un fertile soil), fire attacked areas and on degraded lands (Gindaba, 2006 Pojonen and Pukkala, 1990 Eldridge et al , 1994, Jagger and Pender, 2003). The growth of eucalyptus shows different high at different climatic conditions and it ranges from 457 to 753 centimeters (Chappendal, 1973, Khan and Hassan, 2007) on poor and good site condition respectively.

Planting eucalyptus has a persistence effect on the land use of both temperate and tropical areas by affecting the micro climate condition, decreasing soil fertility attracting seed dispersers and depressing conductive grasses (Lemineh and Teketay, 2005 Lemineh et al., 2004, Lugo, 1997). There are plenty of documents that explain the impact of plantation forestry. (Lemineh et al., 2004, Parrotta et al., 1997) for the recolonization of native tree and shrub species these recolonizations have both negative on the environment and positive effect in social aspects particularly for small scale farmers. But little is known regarding the regeneration process of the indigenous woody species related to planting of different tree species help to solve environmental problems. The use of these fast-growing species rather than indigenous tree species will bring a balance between supply demands (Negash, 1994, Gindaba, 2005). However, to plant exotic species like eucalyptus might be difficult without compromising eucalyptus sensibility. Planting of tree on the bare land, as in areas or an area that is degraded have appositive impact since these lands are waste do not have any functional value both from social and environmental perspectives (Pohjonen and Puk kala, 1990, Jagger and Pender, 2003 Gindaba et al., 2005).

Objective

The **objective** of this paper is to overview the impacts of eucalyptus plantation on the soil and to determine the relationship of eucalyptus with the environment and to know the area favorable for the environmentally friendly establishment of eucalyptus tree species.

II. DIVERSITY OF EUCALYPTUS IN ETHIOPIA

Eucalyptus belongs to family of flowering plants known as "Myrtaceae" (Friis, 1995). It has a gene of more than 500 (Friis, 1995) and (Turaball, 1999) to bee species (FAO, 1998). Mostly in Australia some giant trees have atop high of 90m but in open scrub areas which have allow rainfall dwarf forms of eucalyptus are quite common. A large number of eucalyptus have been planted throughout the tropical zone, but most overseas planting ten species namely eucalyptus camaldulensis, eucalyptus globulus, eucalyptus grandis, eucalyptus maculate, eucalyptus granicalata; eucalyptus robusta eucalyptus saligna, eucalyptus urophylla and eucalyptus viminal (Friis, 1995 cited from Walia, 2008, volume 21).

The other species of eucalyptus which introduced to Ethiopia by Mondon, Vidallet ordered seems of many eucalyptus (eucalyptus amygdalina eucalyptus bicolor, eucalyptus globulus, eucalyptus incrassate, eucalyptus leucolor, eucalyptus melliadra, eucalyptus patens, eucalyptus resinifera, eucalyptus radis, eucalyptus salabris and eucalyptus teretic oronis (Walia, 2000 volume 21).

III. Effects of Eucalyptus on water Cycle

Eucalyptuses are depleting water supply and that on slapping catchment they do not regulate the flow of water as natural vegetation which some time replace. Some of the alleged effects would apply equally to belt trees and to isolated or scattered trees (Walia, 2000 volume).

Eucalyptuses take up a great amount of water from the soil and when grown in plantation they lower the ground water level more than other trees crops. When rain falls, most of the rain drops through the tree canopy to the ground (through fall) but the sun and the wind cause some of the water to eucalyptus bake to the air (evaporation). Some turns down the tree trunk (stem flow) when rain fall reaches the ground. Some may flow

over the surface some evaporates and the remained rinks down in to the sol, parts the water in the soil absorbed by the roots and travels inside the tree to the branches and leaves. Some of it is used by the tree to form new growth, but most of the water passes through the leaves in to the surrounding air (transpiration) and in eucalyptus the rate can reach between 20 and 40 litters, tree each day depending on the size of tree and surface area of laves (poor and fries, 2000).

The plantation of extensive forest of eucalyptus in many deforested catchment will substantially decrease water yield from that catchment the falling of the forest will increase it. The effect of eucalyptus in reducing water yield is improbably less than that of pine and greater than that of other broad leaves species (FAO, 1999). A plant efficiency in relating water depending on its physical characteristic and behavior, most plants are able to close their leaves pores control water loss and in arid climate many have laves that are coated with wax to protect them from drying some eucalyptus have not developed mechanisms for controlling higher rate of transpiration and are likely to suffer from drought stress which limits their ranges of habitats. But majority of eucalyptus species have control rate of transpiration (Davidson, 1998, FAO, 1999).

3.1. Comparisons between Eucalyptus and Other Vegetation

The amounts of rain water used by different type of plant have been studies in wide range of condition. The result is varying according to the site and its climate and incase of forest, the age and size of the tree. Research indicates that eucalyptuses have high water usages per unit time and this is consistent with their high rates of growth. The factor affecting water consumption by tree under natural condition are difficult to measure, and no satisfactory study has yet been made. Eucalyptus had greater water efficiency than several other species, i.e it's consumed less water by units of biomass product (FAO, 1988).

Table 1. Water efficiency or consumption of water per unit of biomass produced

Soy bean	500
Eucalyptus (tree)	510
Albizia	580
Coffee cotton	800
Conifers	1000

Source: FAO (1998). Davidson (1989)

3.2. Water Supply at Lower Depth

In most soils, which are not very shallow, the surplus rain water drains down to level which no more water can be held and there are soil stately saturated. This ground water level rises and falls seasonally (Grele wicz and plichata, 1983).

In swampy area the ground levels is near or at the surface and some species of eucalyptus have been used to drain the water away but draining it up through the tree roots. The opposite effect of many occur when existing trees are removed from areas where the ground water left in the soil lateral spreading and depth penetration of the roots system of eucalyptus vary with species and intensity of water (O lough in 1461, cited in FAO, 1998).

IV. Effects of Eucalyptus on Soil Erosions

When land is not properly managed excessive run off after heavy rainy case soil erosion. Erosion on such that factor as intensity of rainfall soil condition slope and live vegetation and little cover condition should favor the penetration of water in to soil, rather than its flowing across the surface clear weeding such that may be practices in young eucalyptus plantation may make soil susceptible to erosion (Debano, cited in Davidson, 1989). The method has been successfully where a humid climate favored rapid site coverage and production of large volume of wood from eucalyptus species have been recommended for control of erosion in these conditions (FAO corporate document, 2007,).

Tree monoculture of any kind may not be best solution to soil erosion, practically sheet and surface erosion. A eucalyptus globule has a generally good reputation for catchment protection. It has been wide planted for this purpose in country other than Ethiopia. It has good in terms of root system in addition to strong top root.

The problem in Ethiopia, e.g. around Addis Ababa is the degree of human and animal disturbance farmers seems to know better to when it comes to planting eucalyptus on Ethiopia. They plant dense stands and periodical coppice only part of the stand a time to so that there is multilayered canopy and they allow grass to grow beneath. In state forest of clear falling is carried out on steep slopes, when it should be selected stems or strips of rain under tree crown depends on the surface area of individual leaves, large leaves produce large size of drops lets (*E.glabulus*) and small leaves produce small drops (*E. camal dulensis*) (FAO, 1988 and Davidson, 1989).

V. Effects of Eucalyptus on soil nutrients

The situation of soil nutrient use in eucalyptus plantation is regularly harvested. In harvesting eucalyptus stand a major portion of stored nutrient in the above ground biomass is removed (poor and Friis, 1998). In fire wood, scarce regard except for roots below the ground level not rips else is left behind. In such system, there is bound to be a loss of nutrients, which will occur in any tree species, as in agriculture. The difference is only in the proportion of consistent that are reduced (Georg and Misra, cited in walia, 2000).

The better the growth, of the leg is the higher the retention of nutrient in the biomass. The efficient of UN cropped eucalyptus on soil quality have been compared with other species favorably with pine and sal (*Shorea rebusta*). On tree, less sites improved soil fertility through decayed and litter (Fries, 1996). Ethiopia in soil nutrient are different Plantation species, including eucalyptus and the adjacent natural forest (Mielhesen *et. al.*, 1996), Nigatu *et al*, 1996, Bethe, 1998; cited in Teketay, 2000).

5.1. Eucalyptus Utilization and Soil Nutrients

There is an important difference between the nutrients status of a natural forest that of cropped plantation. The type of wood production from eucalyptus plantation depend on local bed sore other market requirements and can be fuel wood, poles, timber or fiber. The nutrients in the products are removed with in a comparatively short period of time because eucalyptuses are usually chosen for fast growth (Teketay, 2000).

The tree main aspects of eucalyptus plantation that affect the nutrient in the soil parts of tree removed the type of management needed to obtain it and the harvesting method used. The total parts of tree are its roots stems, bark, branches, twigs, leaves, flower and fruit all of which included in the term biomass. Nutrients are found in energy part of the tree in differencing proportion and biomass may therefore be used to measure the amount of nutrients removed in cropping (Fries, 1995).

5.2. Nutrient Contents of Eucalyptus Trees

Studies show that on biomass of four year *E.saligna* tree investigation in to some of the elements essential for tree growth (Nitrogen, phosphorus, potassium, calcium and magnesium). These nutrients are stored in the soil as well as in the tree (Teketay, 2000). Nutrients which are stored in various parts of eucalyptus in kg/ha are removed when we are harvested.

Table 2. Nutrient content in the various parts of four years old years' old tree of eucalyptus saligna

Compo nent	Elements				
	Nitro gen	Phosph orus	Potassi um	Calci um	Magnes ium
Leaves	108	7	61	64	17
Branch	30	3	45	69	7
es	13	2	26	57	13
Bark	21	12	42	17	6
Wood	63	3	20	100	15
Litter					

Source, FAO, 1998

VI. Relationship between Eucalyptus and Wild Life

Animals, birds and insects that live in the wild depend on vegetation for their food and shelter. Therefore, when plantations of exotic species replace their natural habitat they are affected. The effect of exotics, including eucalyptus, on certain species of animals, birds and insects have been studies in many countries (Teketay, 2000). If they are suitably managed, eucalyptus can be grown in multi-purpose tree or plantation to provide fuel

and timber and at the same time be habitat that will affect certain species of wild life (Friis, 1995).

Planting eucalyptus in India has increased the number of animals since 1958 grass land in the 11km² game reserve has been progressively reforested with *E. tecticanis* and has resulted in a population increase of species that has almost disappeared (Teketay, 2000).

Planted stands of any tree type generally will certain leaner number of animal's species that more diverse natural forest. Native eucalyptus forest has a rich diversity of wild life which has envied in parallel with them and adopted to them in special ways that none Australian Fallna have not replacing indigenous vegetation with plantation of eucalyptus species almost certain to have an affect an native fauna, but the result are often difficult to predict. In Ethiopia where native forests have been reduced to less than 3% of the land area extensity planted eucalyptuses have high animal population (Davidson, 1998).

VII. Relationship between Eucalyptus and Other Plants

There are documented instance where eucalyptus seedlings are vulnerable to serve water streets unlike the seedling of indigenous, deciduous trees species in Ethiopia (Gindaba et al. 2004). This shows that eucalyptus trees need more water and compete with neighboring plants for available water in the soil EI (animal et al. 2001). Neither an eucalyptus, nor other fast growing tree for that matter is able to cheated biomass without using moisture and nutrient it has to be recognized that some eucalyptus in certain situation of relatively dry climate and nutrient poor soil can be very competitive with other vegetation, including June nihes of some eucalyptus species (Friis I and Amechelsen, 1996).

Forbs and grass was high in all the sites i.e. eucalyptus globules, *J. procera*, *C. cusitanica* and an adjacent natural mantame forest, although their coverage was poor in *C. cusitanica* site. The production of five roots in the top soil was twice as large in the eucalyptus (michelsen et al. 1993). Eucalyptuses are as harmful or under stroyer plants the richness and biomass of herbaceous plant species in plantation of eucalyptus was as high as those of natural forest (Michelsen et al., 1996).

Eucalyptus provide that to faster or catalyze natural regeneration of native woody species there by enhancing biodiversity. Eucalyptus globules, eucalyptus saligna and pinus patuala were the plantation species investigated be in association with adjacent to the natural forest (Fayera and yite betu woody species ranged between 13 and 17 in eucalyptus globules stands (13 to 22 years old) as well as between 18 and 25 in eucalyptus saligna stands (11 to 25 years old) with destinies of ranging between 2300 and 13,400 as well s 3,575 and 18,650 individuals per hectar (FAO, 1999).

7.1. Allelopathic Effects of Eucalyptus

Eucalyptus trees secrete different types of chemicals, from their leaves, stems and roots these chemicals like phenolics terpenoids and their derivatives are potential inhibitors of germination seedling growth fresh weighs and dry weight hero and cao away, (2003), siddiqui and zaman, (2004), siddiqui and zaman, (2005), (Dawar, et al., 2007). Most studies covering alleopathic are laboratory experiments was heavy concentrates (Willis, 1440, cited in david son, 1998).

The potential allelopathic effect of *C. Lusitanica*, eucalyptus Globules, eucalyptus comalduensis, eucalyptus salinan seed germination, radical and seedling growth was investigated was four crops, chichoea , maize, pea and teff (Negate and Michelson, 1993). The result revsed that equals leaf extracts of all the tree species significantly reduced both germination and radical growth of the majority of the crops. If has been show that the shoot and root dry weight increase of the crops was significantly reduced often ten weaks treatments with leaf extracts.

From this crop chik pea and teff were most susceptible with respect to germination and teff with mostly respect to growth. The leaf extract of the four-tree species had been arranged according to increasing alleopathic potential *C. cusitanica*, eucalyptus Globules, eucalyptus Saligna and eucalyptus Camaldulensis so, the authors suggested that the planting of eucalyptus camaldulensis and eucalyptus Saligna should be minimized in integrated land use system. While the use of *Custanica* and eucalyptus Globules was considered as less damaging environmentally (FAO, 1998 and Davidson, 1989).

VIII. CONCLUSION AND RECOMMENDATION

Farmers in Ethiopia plant large amounts of eucalyptus on small areas of land and manage them to yield a variety of products including leaves and ranches for fuel wood and poles and post for house holding and other farm uses, Eucalyptus has ecological effect such as on soil nutrient soil erosion on climate and on water cycle. Eucalyptus tree also have the ability to adapt in harsh climate especially in dry climate where water table is at the last depth, because of these resources it is exotic species in many areas. Many people in Ethiopia are absolutely dependent on eucalyptus as a source of fuel and house building material. It is being the reality the argument for and against planting eucalyptus in Ethiopia is mounting from time to time.

The arguments for planting eucalyptus are because of the benefits eucalyptus has for the environment such as source of fuel wood timber fiber, shade, pole, wind breaks, soil stabilization in short period of time, grown on all site type in all ecological zone etc. Generally, ideas eucalyptus for arguments for and against to planting eucalyptus is good if the government is think over to use or plant on a good management way. Impact is minimized by: -providing choice of species and site as well as the management of the stand at appropriate manner.

8.2. Recommendation

- Since eucalyptuses have negative effect on water cycle, that means it reduce water cycle they should other native species planting recommended.
- Because eucalyptus tree affect soil fertility and nutrient balance the plantation of eucalyptus should not be planted on farm land.
- There are wide ranges of effect of eucalyptus tree on the energy balance and the air currents near the ground and their dust content it should be recommended to planting alternative tree which is complimentary to the nature.
- Because eucalyptus tree has some economic benefits it should be planted far away from some meters from agricultural land.
- Because of eucalyptus tree have competing habit with other native tree species by secreting

different type of chemicals there should not be mixed plantation recommended.

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