Industrial Engineering Journal
ISSN: 0970-2555
Volume : 52, Issue 2, No. 1, February : 2023

EXPANSION OF EUCALYPTUS, ITS ECONOMIC VALUE ANDRELATED ENVIRONMENTAL ISSUES IN INDIA

K.GANGADHARA RAO, Assistant Professor of Environmental Science, Sir C.R.Reddy College of Engineering, ELURU Andhra Pradesh
V.MALLIKHARJUNA RAO, Associate Professor of Environmental Science,
V.K.R, V.N.B & A.G.K College of Engineering, GUDIVADA, Krishna Dist. Andhra Pradesh

Abstract
Eucalypts grow in diverse ecological conditions with some hardy species growing in semi-arid areas, while others are able to grow on marshy and swampy sites. Eucalypts also grow under a variety of soils including fertile loamy soils, infertile sands and heavy clays. It is exotic tree species which has been associated in Indian environment. The population pressure in Indian high lands has led to a change in land use or land cover and establishment of wood lots, so plantation of exotic tree species such as Eucalyptus has long been advocated as strategy for relieving pressure on indigenous forests and wood lands in the Indian high lands. It has provided forester and farmers with valuable resource of fast growing species able to grow under a wide range of conditions depending on the particular species being used. The major factors driving farmers to plant Eucalyptus are; increasing demand for wood products in the market, the un availability of wood on farm, high rate of biomass production, easy to cultivate, and wider adaptability, no palatability to live stock. The species of eucalyptus provides multiple environmental and socio economic benefits such as utilized for fuel wood production (for fire), pole production, house building, medicine (e.g. blue gum used to treat flue, common cold), timber production. In India 5,06,000 hectares of land is believed to be covered by Eucalyptus, this in turn influence the food security of the country. Increasing plantations would create competition between agricultural food crops and Eucalyptus trees for land area and major resources such as water, nutrients and light. This work was intended to review the expansion of Eucalyptus and its socio economic value and environmental issues.

Key Words: environmental issues, eucalyptus, factors, farmers, medicine, plantations, tropical zone

Introduction

The Expansion of Eucalyptus

Among the varies species of Eucalyptus, *E.globulus* and *E.camaldulenesis* are the two dominantly spreading species. In India due to wood product scarcity, the genus was introduced during the region of Emperor Minilik II (1868-1907)in 1894 to full fill the construction and firewood requirements of people in Addis Ababa at the back of deforested native trees around the town. Since then the plant was expanded to all corners of the country and the concerns began to be felt around this time about the possible negative impacts of plantation environment. He was introduced the tree for its fast growing feature. Its cultivation has gradually expanded throughout all India and encouraged by academic research and development institutions. Eucalyptus has increasing in importance globally, because many species of eucalyptus have the ability to improve conditions in treeless areas. In many places, eucalyptus has helped to raise people's living standard by providing several end uses and the many farmers continue to plant and use in many ways such as for building materials, and fuel wood and charcoal making, locally they are also found in shelterbelt, shady groves in and around the village, churches and other dwelling, they also constitute a major source of honey and their leaves as traditional medicine to fight flue and fever.

In other hand, Eucalyptus is often consideredto have undesirable ecological qualities such as depletion of soil water and nutrients, aggressive competition for resources with native flora, unsuitability for erosion control, production of allelopathic chemical that suppress the growth of other plants and provision of inadequate food

and habitat for wildlife.

Adaptive Features of Eucalyptus

Rapid growth rates in eucalypts can be attributed to indefinites shoots (i.e. a growing tip that producespairs of leaves at irregular intervals), and the fact that they do not develop resting buds. Given these characteristics eucalypts can grow both in height and length indefinitely under favorable conditions. Further, when a branch or shoot is damaged the „naked bud" or the growing tip, which can immediately produce a branch of next order, quickly becomes a main bud. As the upper crown increase in height the lower parts of the trunk are built up very rapidly producing large volumes of wood per hectares [8]. Eucalyptus growing in India is mostly confined to the high lands where thereare suitable moisture and temperature. India is amongst the leading top five countries (Brazil, India, South Africa, and China) that grow Eucalyptus trees. Eucalyptus growing in India is largely confined to the high lands (1500-3200m.a.s.l) where moisture and temperature are suitable for tree growing. The two eucalyptus species are normally altitude based with red Eucalyptus (*E.camaldulenesis*) being for lower (warmer) altitudes, that is the upper Kolla and Woina Dega Zones, and the white eucalyptus *(E.globulus*) for the cooler (higher), Dega and Wurch Zones. Eucalyptusis one of the most successful trees, it adapts to a variety of habitats and it has an evolutionary adaptive features such as tolerance of sever periodic moisture stress through xeromorphic leaves, stomata close when water potential deficits, in the leaf is high wax coting, hairy juvenile leaves (some of the species), volatile leaf oils, deciduous in dry season (few species), tolerance of low soil fertility through adaptive capacity to soil with low nitrogen and phosphorus content.

The species have specialized nutrient up take system of eco-and endo-mycorrhizae that increase phosphorus up take mainly but also zinc, copper, ammonium, tolerance of fire damage through lignotubers (underground organs) thick barks, dormant bud system, indeterminate crown ,and tolerance of insect damage by oils and phenolic compounds. Rotations of the Eucalyptus are usually between 5-25 years. Since the Indian highlands are suffering from severe deforestation and biomass fuel crises, *E.globulus* is the prominent tree in government and community estate plantations because of its fast growing ability through coppicing, resistance to browsing by livestock, and through simple sawing and potted seedling propagation. Tending of Eucalyptus coppices is done to bring up second and subsequent generations of Eucalyptus. Coppices form from dormant buds on the cambium of cut trees. Coppice shoots, which are dominant and have the best form and good attachment to the stump, should be selected for retention.

The selected shoots should also be as low down the stump as possible and as wide apart as practicable. Shoots on the windward side should be preferred. The root crowns of some Eucalyptus species are lingo tuberous, which enhances coppice production. Lignotubers are swellings at the stem base that consist of a mass of tissue which assist the tree to sprout in case the main stem dies. However, there are two valuable timber species, *E.delegatensis* and *E. regnans* that hardly regenerate from coppices [18]. Despite its greater importance and the potential for Eucalyptus to improve rural livelihoods and national development initiatives, *E.globulus* are undermined by several scientists and communities related to the belief that "there are significant negative environmental externalities associated with Eucalyptus trees". Most criticisms are based on a range of technical, ecological and socio-economic arguments. For example in India, *E.globulus* has usually been harvested at 5- 7 years for pole and construction wood while maximum wood production is commonly attained at 18 years.

Socio Economic Value of Eucalyptus

In the country where 85% of the population is depending on subsistence agriculture which is mainly backward farming, poverty reduction and food security is major concern and target for policy makers and government in general. Eucalyptus significantly contributes to the household income improvement that leads to poverty reduction. In Eucalyptus planted areas, it is the largest nonagricultural source of household income. The income from Eucalyptus contributes up to 72% of total household annual cash income for poor household in central highland of India. In India Eucalypts trees have many peculiar characteristics than other indigenous trees which are preferred by small land holders. Farmers grow eucalyptus trees to fulfill shortage of fuel wood and construction materials. The socio economic importance of the tee can be vividly seen all the way from the

capital city Amaravati throughout country side. the varies construction sites in big cities of the country ,the house hold energy demand of the most Indians income generation ,source of the building materials for small homes to large one[20]. With a large proportion of the world population in general, and of developing countries such as India in particular depending on wood for cooking and heating, the economic importance of Eucalyptus is immense.

Eucalyptus plantation have acted as a buffer against financial crisis for many poor farmers on land un suited to sustainable agriculture and in many developing countries the area of private planting was much greater than that planted by government departments or industries. Furthermore the plantations have increased job opportunities both in the plantations and processing industries. Eucalyptus species have many uses which have made them economically important tree species. Initially eucalyptus species were planted for curiosity in botanic gardens , arboreta (tree collection), parks and for amenity .Later on ,they were found to be use full for fuel wood ,charcoal, timber, poles, posts, mine props ,poly wood, paper pulp, fiber board, tanning, oil, shade and shelter, ornamental purpose & as a source of nectar for honey production. The Eucalyptus species has a ready market niche which gives it a competitive edge over other tree species and contributes to the growth of national economy .

Importance of Eucalyptus in Agro-forestry

Agro-forestry is an approach to land use based on integrating trees and shrubs into crop and livestock production systems. Agro-forestry systems provide a wide range of environmental and socio- economic benefits. Thus, Eucalyptus species can be used in agro-forestry systems, i.e. they can be planted in homesteads, farm boundaries, farm woodlots and roadsides. Eucalyptus plantation stands provide wood for various purposes, conserve soil and water, rehabilitate degraded lands and provide amenities such as recreational areas. Although Eucalyptus species do not provide fodder or add nitrogen to the soil like some species of Acacia and Leucaena, they provide various benefits, particularly fuel wood and construction material, and thereby make an important contribution to improved rural living.

Water Use Efficiency of Eucalyptus

There is limited evidence regarding the impacts of Eucalyptus on water. Water scarcity is an increasingly severe problem across the developing world, with many countries in East Africa already experiencing severe water scarcity. Certain trees that are integrated into agricultural systems can increase the efficiency of water use, while plantations of fast-growing trees like Eucalyptus trees can exacerbate the problem of water shortages. It is claimed that Eucalyptus trees absorb more water from the soil than any other tree species. The results of research on the water use and water balance effects of trees in Kenya shows that, Eucalyptus consumes more water, especially during its early growing stages compared to pines species.

Table1. *Water use efficiency of some plants per unit of biomass*

Plants	Liters of water /kg of biomass produced
Eucalyptus tree	510
Albizialebbek tree	580
Potato	600
Sun flower	600
Field pea	600
Conifers	1000
Pongamia	1300

Source: *FAO (1988)*

Soil Degradation

Land degradation has become an increasingly serious problem, especially in the tropics and subtropics, where many soils are inherently poor in nutrients and at high risk of degradation due to erosion [15]. The main causes for land degradation include improper land use, poor agricultural practices, deforestation and overgrazing, among others. Soil erosion is among the most important surface processes that result in severe land

degradation in the tropics. Trees influence soil erosion mainly through intercepting of rainfall which dissipates its kinetic energy to detach the soil particles. However, the rain drops that are intercepted eventually drop to the soil surface with different erosive energy, which depends on the size and orientation of the leaves. Large leaves produce larger size droplets which have greater impact energy on the ground. Eucalyptus is blamed for heavy use of soil moisture, leaf litter and soil humus, consumption of soil nutrients, less soil conservative, no fodder and habitat. A lot of studies argued that, Eucalyptus decreases soil nutrients within 20 m distance from the trees and the comparison study of Eucalyptus with mixed plantation has revealed that Eucalyptus has three times more fine root biomass in surface soil which indicated that planting crops in association and adjacent to Eucalyptus should be avoided. However, Eucalyptus species exceptionally can extend the nutrient cycling deep to ground soil where other trees and crop could not access that much depth. The wetland conversion study has indicated that there is significant deference between wetlands and converted land to dominantly Eucalyptus by reducing major nutrients from the converted land which is Eucalyptus .

Shading on Crops

Since they are fast growing, plantations of exotics are usually taller than other plants of equal age, and their shade may affect nearby crops by reducing the sunlight needed for growth. Because of shading and competition for water, the yields from agricultural crops close to Eucalyptus plantations are sometimes not as good as they are further away from the edge. Eucalyptus trees may reduce crop yields on plots adjacent to wood lots or rows of trees and the allopathic effects of eucalyptus and competition for nutrients when planted adjacent to food crops or intercrops with cereals or vegetables may lead to loss in food crop production that may affect house hold food security and income. Allelopathy is the release of chemicals from leaves or litters that inhibit the germination or growth of other plant species and consequently reduce the output of crops.

Table2. *Some ecological effects of Eucalyptus*

Effects	**Positive effects**	**Negative effects**
Biomass production	Planting fast growing eucalyptus may be one of thebest short term options for the provision of critically required biomass.	Land scarcity may be a constraint to wide scale planting.
Effects onsoil, nutrient depletion and top soil retention	On degraded hillsides and wastelands the net soil nutrient contribution of Eucalyptus through leaf litter is likely to be positive.	Eucalyptus trees deplete soil nutrients needed by agricultural crops, however the spatial magnitude of depletion is not known.
	Good potential for topsoil retention on degraded hillside.	The ability of Eucalyptus to provide organic matter is questionable.
Allelopathiceffects	Rainfall may decrease or negate the allelopathiceffects of trees on crop.	Allelochemicals negatively influence agricultural production and are a more significant factor in dry regions.
Hydrological impact	In regions with erratic and severe rainfall the ability to take up large quantities of water may reduce runoff, flooding and water logging.	Eucalyptus may complete water away from agricultural crops decreasing agricultural output as far as 10 meters away from where trees are planted.
	On previously barren slopes, tree cover may reduce erosion and gully formation caused by rain fall.	Wide scale hydrological impacts are uncertain.

Source: *Jigger and Pender, 2000*

Conclusion

It is known that natural forests supply a wide variety of benefits that can be very important to the local communities in the long term, but plantation may supply greater quantities of material within a short period of time. Eucalypts provide multiple benefits ranging from industrial wood, poles, timber, fuel wood, bee forage, essential oils and many environmental services such as windbreaks, erosion control, buffer to natural forests, flood control and climate change mitigation. Eucalyptus is also currently widely used in construction, joinery and furniture. So, planting Eucalyptus has great benefits for the society in terms of improving their economy and stabilizing the climate condition of the country. Eucalyptus species are tolerant to sever periodic moisture stress, low soil fertility and fire and insect damage.

References

[1] Amare, G.(2002). Eucalyptus farming in India: The case of Eucalyptus woodlots in the Amhara Region. In: Natural Resources Degradation and Environmental concerns in the Amhara National Regional state, India: Impact on Food security, proceeding, Bahar Dar, India.
[2] Daba Writu (1998). The economics of growing *Eucalyptus globulus* (Labill). On the Highland of Oromia, India with special reference to Intoto and chancho Areas, Indian Msc.Thesis.
[3] Boland, D. J., Brooker, M. I. H., Chippendale, G. M., Hall, N. Hyland, B. P. M. and Johnson, R. D. (2006). Forest trees of Australia. Melbourne, CSIRO, Australia
[4] Davson ,J. (1989). The Eucalyptus Dilemma, Arguments For and Against Euclyptus planting in India. Forestry research center seminar notes, series 1, Adiss Ababa.
[5] Demel Teketay (2000). Facts and experience on eucalyptus in India and elsewhere: ground for making wise and informed decision. Workshop on Eucalyptus Dilemma, 15 Nov. 2000.
[6] Derba, B. (2016) .Socio economic importance of selected Indigenous and Exotic Tree Species used in Dabat district, North Gonder ,India.
[7] Dye PJ, Bosch JM. (2000). Sustained water yield in afforested catchments – the South African experience. In: von Gadow K, Pukkala T, Tomé M (eds) Sustainable forest management Kluwer academic publishers, Dordrecht, pp 99-120.
[8] FAO (1979) .Eucalyptus for planting .FAO forestry and forest product study NO.11.679PP. FAO,Rome.
[9] FAO (1985). The ecological effect of Eucalyptus. FAO. Forestry paper NO.59.FAO. Rome.
[10] FAO. (1988). The Eucalyptus dilemma. No.26 pp. Rome, Italy.
[11] Gessesse, D. Tekilu,E. (2011). Eucalyptus in east Africa, socio-culturalic and environmental Issue, planted forest Tree Working paper 46/E Forest Management Team,FAO, Rome.
[12] Getachew Admassu (2016). The impact of Eucalyptus expansion on food security In Bambasi woreda. Benishngul Gumuz regional state, western India.
[13] Gindaba J.2003. Water and nutrient relations of selected tree species of India. PhD dissertation. University of Stellenbosch, South Africa. 2003; 190. 63.
[14] Haileab Zegeye (2010) .Environmental socio economic implications of Eucalyptus in India ,INGil,L, Wubalem Tadesse,Tolosana, E. and Lopez, R. Processing the conference on Eucalyptus species management, History, status and trends in India pp184 -205.EIAR. Adiss Ababa.
[15] Jagger, P. Pender.J, (2000). The role of trees for sustainable management of less favored land the cause of Eucalyptus in India, EPTD Discussion paper No.65.
[16] Jaleta D, Mbilinyi B. Mahoo H, Lemenih M., (2016). Eucalyptus Expansion as Relieving and ProvocativeTree in India. JAERI, 6(3): 1-12, www.sciencedomain.org.
[17] Kaumi, S.Y.S. (1983). Four rotations of Eucalyptus yield trial. Commonwealth Forestry Review 62: 19 –24.
[18] Konuche, P. K. A. (1989). Results of Eucalyptus species trial at Londiani.KEFRI Technical Note No 6.
[19] Louppe D. and Denis D. (2010). Expansion, research and development of the Eucalyptus in Africa Wood production, livelihoods and environmental issues: an unlikely reconciliation? (A communication given
[20] Mekonnen, Z., Kassa, H., Lemenh, M., and Campbell, B.M. (2007). The role and management ofEucalyptus in Lode Hetosa district, central India. Forest, Trees and Livelihood vol 17, 309-323.
[21] Mekonnen T, Aticho A (2011). The driving forces of Boye wetland degradation and its bird speciescomposition, Jimma, Southwestern.Journal of Ecology and the Natural Environment. 3:365–369. 58.
[22] Pohjonen, V. and Pukkala, T. (1990) Eucalyptus globulus in Indian forestry. Forest Ecology andMnagement 36, 19-31.
[23] Silenat Birhanu & Fikadu Kumsa, "Review on Expansion of Eucalyptus, Its Economic Value and Related Environmental Issues in India" International Journal of Research in Environmental Science, vol. 4, no. 3, p. 41-46, 2018. http://dx.doi.org/ 10.20431/2454-9444.0403005
[24] Tesfaye Teshome, (2009.Is Eucalyptus ecologically hazardous tree species? Indian Journal for researchand innovation foresight, vol.1,No.1;pp128-134.
[25] Turnbull JW (1999). Eucalypt plantations. New Forests 17, 37-52.
[26] Zenebe Mekonen (2009). Community opinion, Marketing and current debates on Eucalyptus in Huruta District, Arsi Zone of Oromia Region, India.
[27] Zewdie, M. (2008). Temporal Changes of Biomass Production, Soil Properties and Ground Flora in Eucalyptus globulus Plantations in the Central Highlands of India. Doctoral Thesis, Swedish University of Agricultural Sciences, Uppsala, Sweden.