International Invention Journal of Agricultural and Soil Science (ISSN: 2408-7254) Vol. 3(4) pp. 47-51, October, 2015
Available online http://internationalinventjournals.org/journals/IIJAS

Review

Ecological impacts of Eucalyptus plantation in Eza Wereda, Ethiopia

Belay Zerga

Department of Natural Resources Management at Wolkite University, Ethiopia.
Corresponding Email: belayzerga@Gmail.com

Abstract

In Ethiopia farm forestry practice is becoming widespread particularly in population pressure-prone areas. Rapidly increasing population pressure has led to vast change in land use/land cover pattern. Land use changes affected the whole system of food crop production in the study area, Eza wereda, which is found in West Gurageland. Eucalyptus tree in this regard dominated the landscape of the region without planned land use in such diminutive land holding size. Land use competition between eucalyptus tree plantation and other food crops became a common feature of the study area. The study assessed perceived negative ecological impacts in three selected KPAs (Kebele Peasant Administrations) namely, Zigba Boto (kolla), Shebraden (woinadega) and Koter Gedra (dega). Purposive systematic sampling procedure was used to select the three agro-ecological areas of the wereda. In each selected KPAs 180 households were selected by using purposive systematic sampling techniques. Direct observations, discussions with key informants and focus groups were undertaken by the researcher. The required data were also collected using schedule through structured open and close-ended questionnaires. The study revealed that households in the study area are benefiting from eucalyptus tree plantation. Fuel wood, construction, and financial benefits are the main reasons of farmers in engaging with this farming activity. Thus 3% and 60% of the surveyed farmers have ranked eucalyptus tree as first and second source of their income respectively. Hence eucalyptus tree has dominated all other food crops, chat and coffee next to enset. The effects of eucalyptus tree plantation in ecology particularly in competition, undergrowth suppression, soil nutrient and water depletion, shadow and litter fall effect, and presence of birds and wild animals is well understood by farmers. However, land diminution they faced due to population pressure and valuable income earned from the sale of eucalyptus over shadowed their opportunity to plant the tree in ideal site. Therefore, to keep the food security situation of the area, land use competition (particularly with farmlands) and ecological externalities in sustainable manner; the concerned bodies *should assist the farming practices of eucalyptus plantation by applying bottom-top and top-bottom interventions.*

Keywords: Eucalyptus, Land use competition, Farmers' perception, Households, Ecological impact.

INTRODUCTION

There are high and increasing demands for wood for industrial uses and fuel needs, especially in developing countries of the tropics with their increasing populations. To cope with this situation, people often opt to planting fast growing, highly utilizable, exotic tree species. Such popularity may be justified by more than 80 countries that have shown interest in eucalyptus and have planted more than 4 million hectares worldwide outside the natural range of Australia, S E. Asia, and the Pacific (Poore and Fries, 1985).

Population pressure in the Ethiopian highlands has led to a change in land use/ land cover. Establishment of wood lots and plantations with exotic tree species (such as Eucalyptus) has long been advocated as a strategy for relieving pressure on indigenous forests and wood lands in the Ethiopian highlands. Nevertheless, tree planting at the scale that satisfies the biomass energy demand alone would occupy 6% of the total utilizable land area in Ethiopia by 2014, requiring a major land use shift (Bojo and Cassells, 1995).

Given the urgency of food security in the country, plantations with exotic trees underscore the importance

of integrating trees into more intensive tree crop production systems wherever the environment is conducive. Traditional agroforestry practices in Ethiopia involve planting of trees in various spatial patterns to meet wood, fuel wood and fodder requirements. In recent years, however, single rows of Eucalyptus globules trees planted along crop field borders have become a dominant feature of the central highland landscape (Selamyihun, 2004). The greater availability of fuel wood may replace the dung fuel, which currently accounts for more than 81% of the biomass energy consumption of rural households in favor of its use as fertilizer. In addition, preservation of indigenous woodland and biodiversity may be achieved when substitutes for indigenous forest products for fuel wood are available (EFAP, 1993).

Ethiopia is amongst the leading top five countries (Brazil, India, South Africa and China) that grow eucalyptus trees. Eucalyptus growing in Ethiopia is largely confined to the highlands (1500-3200 m.a.m.s.l.) where moisture and temperatures are suitable for tree growing. The two eucalyptus species are normally altitude-based with red eucalyptus(E. camaldulensis) being for lower (warmer) altitudes, that is the upper kolla and woina dega zones, and the white eucalyptus(E.globules) for the cooler (higher), dega and wurch zones. Good growth and thus high level of income from large biomass yield in very short period only comes if eucalyptus is given good planting site, good husbandry during establishment, much like that given to agricultural crops (Amare, 2002).

Undergrowth is patchy consisting either of a dense shrub layer of young native trees and some true shrubs or of a grassy herb layer dominated by panacea species. Moses and epiphytes, common in natural stand, are completely absent, mushrooms have almost disappeared. The most specialized plants are replaced by tolerant weeds. The litter is thicker and mainly composed of intact eucalyptus leaves. As clearly observed by the researcher, undergrowths in eucalyptus woodlots are too dwarf or totally absent in all the surveyed KPAs (Kebele Peasant Administrations). In addition to this, the existences of birds, wild animals, soil erosion, and shade effect have increased.

In the study area, farmers' perception towards ecological effects of eucalyptus is good but land diminution due to population pressure shadowed their opportunity to plant the tree in ideal site. To reduce the allelopathic effect, as told by key informant from Shebraden KPA, thinning of seedlings is practiced. Another solution is using the litters (leaves) for fuel wood. Eucalyptus woodlot accelerated soil depth and gully width particularly when it is planted in rugged and previously leached areas. This is clearly observed in Yehyegibe locality (Shebraden KPA); and western and southern margin of Koter Gedra forest in Koter Gedra KPA. The water depletion capacity of eucalyptus is also unquestionable.

Farmers' perception on Ecological impacts of Eucalyptus plantation

Soil Erosion and Gully Formation

Eucalyptus is not good tree for erosion control. Under dry condition ground vegetation is suppressed by root competition. In sample KPAs soil erosion and gully formation, as well observed by the researcher are more serious in Koter Gedra (dega) and Shebraden (woinadega) than Zigba Boto (kolla). This is because Zigba Boto has flat topography compared with the other two KPAs except inside of Wabe River gorge. In areas where eucalyptus tree are inter cropped with other trees, the problem is minimal and absent, whereas in areas covered with only eucalyptus woodlots there is more soil erosion and gully formation. Typical example for this is observed in Yehyegibe and Lay Sham localities found in Shebraden KPA. There are also areas at the western and southern margin of Koter Gedra community forest with similar condition in Koter Gedra KPA. These areas have deep gorges and widened gullies because of deforestation of indigenous trees and soil depletion effect of eucalyptus.

As shown in Table 1, all the respondents ranked 2 (which mean major increase) for soil erosion, gully formation, negative effect on under growth and presence of wild animals and birds. However, gully formation ranked 1 (which means minor increase) in respondents of Zigba Boto. This may be due to the flat nature of the topography of this area.

As indicated in Table 2, 38%, 39% and 23% of the sample KPAs' respondents planted in steep, gentle and flat areas respectively. The higher portion of practicing eucalyptus plantation in flat and gentle than the steep surface indicates that, the soil erosion capacity of eucalyptus tree is relatively in a better condition. NGO's such as World Vision practiced some soil conservation activities in woinadega areas of the wereda. This NGO; Agriculture and Rural Development Office of the wereda together interrupt eucalyptus seedling distribution due to its serious land use competition and degradation effect.

Existence of birds and Wild Animals

In areas of eucalyptus plantation, there are many birds and wild animals which are damaging crops. Farmers' response in this regard revealed that the presence of birds and wild animals increased proportionally with the increase in eucalyptus tree farming. Such conditions threat more in the areas of eucalyptus plantation which are located around rivers and other forests or bush lands. Hence, wild animals after crossing the forests or bushes directly enter to eucalyptus woodlots. Thus eucalyptus woodlots are used for hiding some wild animals that destroy some crops. Such wild animals include monkeys, apes, and wild pigs. Some

Table 1. *Households' fear on the expansion of eucalyptus to farmlands in the near future*

Expected fears	Number of Respondents with rank (Multiple response)						Total	%
	Zigba Boto	%	Shebraden	%	Koter Gedra	%		
Soil erosion	2(50)	100	2(55)	100	2(75)	100	180	25
Gully formation	1(50)	100	2(55)	100	2(75)	100	180	25
Negative effect on under growth	2(50)	100	2(55)	100	2(75)	100	180	25
Presence of wild animals and birds	2(50)	100	2(55)	100	2(75)	100	180	25
Total	200	28	220	30	300	42	720	100

Rank (-2 =Major decrease, - 1= Miner decrease, 0= no change, 1= Minor increase, and 2= Major increase)
Source: Household Survey (2008)

Table 2. *Slope of the surveyed households' eucalyptus plantation sites*

Slope	Number of Respondents (Multiple response)						Total	%
	Zigba Boto	%	Shebraden	%	Koter Gedra	%		
Steep	8	16	15	27	45	60	68	38
gentle	20	40	27	49	23	31	70	39
flat	22	44	13	24	7	9	42	23
Total	50	100	55	100	75	100	180	100

Source: Household Survey (2008)

respondents in Shebraden reported that monkeys sometimes even enter to farmers' house and take away food stuffs. This is due to the attraction (pulling factor) of homestead eucalyptus plantations. Thus, birds and wild animals threat the land cover, which has economic and ecological advantages.

Undergrowth and Soil moisture Conditions

Needless to say, undergrowths of eucalyptus plantation are very few or absent. This is partly, true on lands where eucalyptus farming is not inter-cropped with other indigenous trees. The dominant litter fall (leaves) prohibited the growth of other plants under eucalyptus woodlots due to its allelopathic effect. This chemical reduces the soil nutrients that are necessary for undergrowths. Hence, the soil will be degraded through enhanced erosion, nutrient and water depletion. The establishment of plantation not only suppresses undergrowths but also affects the performance of cultivated crops adjacent to the woodlot. Farmers know all these effects well through experience. The long and widening nature of eucalyptus tree roots have also great effects on water and soil nutrients. One informant from Shebraden (Ato Kifetew) reported that species inside of eucalyptus woodlots appears like *"yasheshibet",* meaning *cleaned house*. Therefore, farmers have to inter-crop indigenous trees like *juniperus procera* within eucalyptus woodlots since such trees can compete and survive unlike grasses, shrubs, and bushes.

Water Availability in the Stream

Eucalyptus appear to use less water per unit weight of biomass produced than other kinds of trees and many agricultural crops, but their potentially high biomass production under low rainfall conditions may reduce stream flow more than slower growing kinds of trees. Water consumption by eucalyptus can be reduced by planting trees farther apart or by thinning existing plantation. Farmers in the three sample KPAs reported that eucalyptus trees dry up streams and swampy areas particularly in dry seasons. The marshy area in Zigba Boto is a typical example in this case as reported by respondents and observed by the researcher. However, because of the ability of forests including eucalyptus woodlots in bringing rain, the availability of water that was lost during dry seasons reaches at its field capacity at rainy periods.

Shadow and Litter fall Effect

Shadow effect of eucalyptus plantation to the surrounding areas' food crops is clearly observed by the researcher during data collection. Such effect is more

Figure 1. Litter fall Effect that degraded the grazing land (Shebraden area)
Source: Photo by Author, 2008

common in dega (Koter Gedra) KPA, because here crop production (cereals and pluses) and vegetable are more common than woinadega (Shebraden KPA) and kolla (Zigba Boto). In the latter cases, it has adverse effect particularly on fruits, chat, cereals, pulses, vegetables, and the like.

As farmers indicated, effects of shadow (absence of sunlight to the ground due to big eucalyptus woodlots coverage) is more serious when woodlots are planted north-south direction since the sun rises in the east. Crop lands get sunlight directly when the sun is at overhead (at noon). The copping strategy by farmers is cutting the trees in young stage at areas of sun direction.

Leaf fall has also effects on croplands of the nearby areas. Needless to say eucalyptus litters (leaves) dry up the grounds due to its allelopathic effect. Farmers indicated this in their expression "*Beharzaf afer yaterk*", meaning *eucalyptus dry up the ground (the soil).* The leaf fall effect would have been reduced had it be palatable by animals. The copping strategy of farmers, as mentioned by key informants during discussion, is collecting or cleaning the fallen leaves when it is accumulated at large amount for fuel wood particularly in dega areas to reduce litter fall effect.

This is because the fact that collecting eucalyptus leaves for the purpose of fuel wood in dega areas is a common experience in most households than the woina dega and kolla areas. Such experience seems attributable for shortage of firewood during the past years, i.e. the first periods of eucalyptus tree adoption. Indigenous copping strategy, as reported by farmers, is cutting the elongated branches for fuel wood. In such cases, both shadow and leaf fall effect can be reduced considerably. Figure 1.

Farmers, therefore, have to practice using litters as source of fuel wood to minimize shadow and litter fall (allelopathy) effect in the surrounding croplands. However as mentioned before this is not the case is woina dega and kolla areas of the area of study. There should be intervention and promotion of DAs (Development Agents) in this regard in all the agro climatic areas of the wereda to manage eucalyptus plantation and the farmland in appropriate and sustainable way.

Crop Yield in the Surrounding area of Eucalyptus woodlots

All the above stated ecological effects directly or indirectly have negative impact on crop yield of the nearby areas of eucalyptus woodlots. As noted earlier, the effect of litter (leaf) fall and its high water consumption by long and horizontally spreading roots is well recognized by farmers. In dega areas, for example in Koter Gedra KPA, which is more known for better production of cereals, pulses and vegetables; eucalyptus woodlots is affecting crop yield than woina dega and kolla areas. To reduce such effects as mentioned in previous discussions, farmers in the study area cut elongated branches towards croplands and collect the leaves (litters) fall for household fuel wood consumption.

CONCLUSION AND RECOMMENDATIONS

The role eucalyptus tree play in stabilizing peasant livelihoods' income diversification is immense. Cost-profit analysis of the product compared with other food crops and cash crops such as chat and coffee is much better. Thus, farmers should use their lands in appropriate and sustainable way in order to create multipurpose production in different seasons and years. Farmland plantation in Kolla and dega regions of the study area is very common. Multidimensional negative ecological impacts of eucalyptus are very serious particularly in these areas. Farmers therefore have to allot these areas to food crops and the rugged areas to eucalyptus since land use transformation totally might be occurred without guarantee to food security in such

enset culture area. This is because the capacity of eucalyptus tree to replace enset production seems very week in such accelerating population pressure area. Government intervention in this regard also should be applied otherwise the unplanned land use/land cover change might result in economic, social and cultural damage. The negative ecological impact happened as a result of land use competition between eucalyptus and other food crops threatened the whole farming under takings particularly in dega areas. The wereda Agricultural personnel have to intervene in depth so as to consult farmers in copping strategy in addition to their indigenous knowledge. Local representatives of households should get training on scientific eucalyptus tree plantation from the concerned government offices or NGOs that are engaged in environmental management areas.

Eucalyptus plantation is becoming a dominant cash crop in the region. All the drawbacks of the species are overshadowed by its immediate financial return particularly for those of small landholders. Agriculture and Rural Development Office of the Wereda/ Zone has to diversify alternative income generations from horticultures such as apples, avocados and mangos to each households of the region based on soil and climate suitability. Using modern and indigenous technologies towards fuel energy consumption have their own impact in order to use eucalyptus tree as source of fuel wood in sustainable way. The other indirect advantage in this regard is combating serious eucalyptus expansion-prone land use competition and transformation. Thus, households have to use technologies like *mirt midija (*'modern stove'*)* and others. Agriculture extension workers and local administrators should give awareness on this regard. Eucalyptus litter fall and crop residues are used as source of fuel wood mainly in dega part of the study area. Farmers have to use in woinadega and kolla areas since such practices have their own advantage in reducing litter fall effect (allelopathic effect) and unwise expansion of the tree. However, using animal dung as source of fuel wood should be discouraged since its advantage to fertilize land is better relatively.

As a result of eucalyptus expansion, the presence of birds and wild animals threatened croplands. To combat this condition the wereda agricultural personnel and representative farmers have to discuss on the possible solutions without damaging the ecology. Finally, to overcome the problems of serious land use competition between eucalyptus tree plantation and food crops, and prolonged land degradation; in-depth community participatory research is needed.

REFERENCES

Amare G (2002). Eucalyptus farming in Ethiopia: The case of Eucalyptus woodlots in the Amhara Region**.** In: Natural Resources Degradation and Environmental concerns in the Amhara National Regional state, Ethiopia: Impact on Food security, proceeding, 2003, Bahar Dar, Ethiopia.

Bojo J, Lassells D (1995). Land degradation and Rehabilitation in Ethiopia**.** A reassement**.** AFTES working paper **7** Washington, D.C World Bank.

EFAP (1993). The Challenge for Development. V.II Ministry of Natural Resource Government of Ethiopia. Addis Ababa.

Poor MED, Fries C (1985). The Ecological Effects or Eucalypts, Forestry paper **59.** Rome, Italy.

Selamyihun Kidanu (2004). Using Eucalyptus for soil and water conservation in the Highland Vertisols of Ethiopia. PhD Dissertation Wageningen, The Netherlands.

How to cite this article: Zerga B (2015). Ecological impacts of Eucalyptus plantation in Eza Wereda, Ethiopia. Int. Inv. J. Agric. Soil Sci. Vol. 3(4): 47-51