INDONESIAN JOURNAL OF SOCIAL AND ENVIRONMENTAL ISSUES (IJSEI)
Journal Homepage: https://ojs.literacyinstitute.org/index.php/ijsei
ISSN: 2722-1369 (Online)
Research Article

Volume 3	Issue 3	December (2022)	DOI: 10.47540/ijsei.v3i3.710	Page: 289 – 299

Analysis of Factors Affecting Local Household Income Derived from Eucalyptus Woodlot in Jamma District, Ethiopia

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ARTICLE INFO

Keywords: Environmental Impact; *Eucalyptus* Woodlot; Household Income; Sustainable Production.

Received : 05 November 2022
Revised : 19 December 2022
Accepted : 21 December 2022

ABSTRACT

A woodlot is a piece of woodland that is a privately owned farm for tree plantation. It has become a common activity among local households in Ethiopia. Currently, local households in Jamma District, Ethiopia predominantly plant eucalyptus woodlot as their alternative income source. However, there is no empirical evidence on the factors that affect driving maximum income from Eucalyptus woodlot. This study investigated the factors affecting income from Eucalyptus woodlots in the Jamma district. Data were collected and organized by the household survey, key informant interview, field observation, and focus group discussion. Qualitative and quantitative data were used from primary and secondary sources. A total of 150 randomly selected households were interviewed from *Eucalyptus* woodlot owners. Multiple linear regression analysis was applied to determine the significant variables affecting the income amount derived from eucalyptus woodlot. The results described the socioeconomic characteristics of households, and investigate the determinants of *Eucalyptus* woodlot income level. Age, family size, distance from the market, and household experience are the major factors that determine the income of households derived from *Eucalyptus* woodlot production. Household income derived from eucalyptus woodlot was negatively and significantly affected by the distance where their woodland was located from the market and their experience in planting *Eucalyptus* as the regression analysis showed. The result of this study suggests that technical manuals should be implemented to minimize its negative impacts on the environment to made the households better benefited from their *Eucalyptus* woodlot products and for sustainable production.

INTRODUCTION

Woodlot in Ethiopia is a strait area of woodland where trees are planted on the farmland. Usually, it was owned in private as a source of fuel, pols, and lumber with a size of 0.1 hectares (Birara et al., 2019). Natural forests and woodlands are declining on the one hand and population and wood demands are dramatically growing on the other hand of the country. A well-known action to solve a such problem has been plantations of fast-rotation age tree species (Tadesse et al., 2019). Hence, *Eucalyptus* species were introduced which is the key species for fast-growing (Lemenih and Bongers, 2010; Tefera and Kassa, 2017).

With rapid growth, *eucalyptus* is important to suck up carbon dioxide from the atmosphere and return oxygen to the atmosphere (Tadesse and Tafere, 2017). Hence, with the growing interest in tree planting for climate change mitigation, it has a great role to neutralize the effect of greenhouse gases responsible for global warming (Mersha et al., 2022). However, *Eucalyptus* has negative environmental impacts due to the lack of a proper plantation management system (Yitaferu et al., 2013; Daba, 2016).

On the other hand, *Eucalyptus* tree planting is an integral component of most agricultural systems in the tropics which plays a vital role in the livelihood of both rural and urban populations (Admasu, 2016). It has created various income-generating activities for local households (Dessie et al, 2019). For instance, people are relying on different wood-based products for subsistence and cash income such as firewood, construction

materials, industrial uses, medicine, and food (Wabwiel et al., 2016; Amena, 2016). According to Zerga and Berta (2016), *Eucalyptus* plantation species in Ethiopia it is widely contributing to the national consumption of construction poles (92%) followed by farm implements wood sources (91%), firewood (85%), posts (83%), timber (74%), and charcoal (40%).

Hence, due to their economic potential croplands were converted to *Eucalyptus* woodlot (Yitaferu et al., 2013; Lemenih and Kassa, 2014; Tadesseet al., 2015). This indicates the popular acceptance of eucalyptus production as an impressive business for small-scale farmers in the country (Alemayehu and Melka, 2022). It produces wood within a short time to satisfy different needs of society, and also helps to conserve native tree species. In addition, *Eucalyptus* trees are more profitable and able to harvest in a short time and require little labor force on the land during this period (Eshetu et al, 2018). It can be cultivated in areas of low fertile land and does not demand plenty of nutrients and agricultural chemicals when compared to other crops.

Particularly in the Jamma district, there is an expansion of the city which causes the increasing demand for wood products for construction materials and fuelwood; hence woodlot owner households support their income by selling their woodlot. On the other hand, infrastructures like roads and education have key roles in the values of woodlot products.

The focus of the study objective is to investigate and analyze the determinants that affect the income level of households derived from *Eucalyptus* woodlot in Jamma District, Ethiopia. The study aimed to point out the factors which affect the income level of local households derived from eucalyptus woodlot and find out the drawback of *Eucalyptus* woodlot production depending on the household's perception. Therefore, this study provides a comprehensive analysis and valuable recommendations for sustainable and profitable *Eucalyptus* woodlot production in the study area. As a result, this study aimed to determine the factors influencing the level of income obtained from eucalyptus forest products, and household perceptions of the impact of eucalyptus forest production on the environment in the study area.

MATERIALS AND METHODS

Study Area

The study was conducted in the Jamma Districts of Amhara National Regional State of Ethiopia. Jamma is one of the administrative districts in South Wollo Zone, Ethiopia. Its capital town is called "Degolo", which is about 260 km away from Addis Ababa and 110 km far from the zonal city of South Wollo Zone, Dessie. Geographically, the district is located between 10°23'0" and 10°27'0"N latitude and between 39°07'0" and 39°24'0"E longitude. It has an altitude range from 1600 to 2776 m above sea level. The district's total area is 129,281.25 ha. Jamma Woreda has two climatic zones, temperate and sub-temperate which are called locally Kolla and Woyna Dega respectively. The majority (77%) of its population lives in Woyna Dega.

Sampling Techniques

In this study, multistage sampling techniques were employed. First, *eucalyptus* potential woredas were selected from the South Wollo zone purposively. Second, Jamma woreda was selected among *Eucalyptus* potential woredas using a simple random sampling method. In the third stage, *eucalyptus* potential kebeles were identified from the selected woreda based on *Eucalyptus* woodlot potential and the current fast trend of expansion and location close to urban centers where there is a growing demand for wood products. Then, three potential kebeles were selected among *eucalyptus*-producing kebeles by using a random sampling method. The selected kebeles were Gomenty, Yejerty, and Micha. Finally, 150 eucalyptus woodlot owner households were selected using simple random sampling methods from selected sample kebeles of 240 households. The sampled households have been selected based on the baseline information documented by Jamma district agricultural office from the target kebeles. This was simply done with the guidance of district experts following the methods used by (Fikir et al., 2016). The total sample size was determined by the popular sample size determination formula of Yamane at a 5% precision level cited by Assefa (2021).

$$n = \frac{N}{1+Ne^2}$$

Where:

n = sample size

N= total population of household

e = precision level

Thus, the result of the sample size calculation 240/ $(1+240*(0.05)^2)$ was 150. Then, it was equally allocated to each target of the three villages.

Data Collection Methods

The data were collected from primary and secondary sources. Secondary data was collected from relevant sources of published and unpublished documents to gain a general insight into the issue. The primary data was collected from a household survey, key informant interview, and focus group discussion. The sampled households who participated in the data collection were the owner of *Eucalyptus* woodlots.

The household survey collection was carried out by using a semi-structured questionnaire aimed at capturing both quantitative and qualitative information, following the methods of (Fikir, et al., 2016). This semi-structured questionnaire is mainly focused on the major factors affecting *Eucalyptus* woodlot income and the socioeconomic characteristics of sampled households in the study area. The questionnaires were administered using a personal interview approach, which is recommended to avoid non-responsive bias (Akhter, 2022).

Data Analysis Method

The collected data were analyzed using both qualitative and quantitative approaches. The quantitative data were analyzed through descriptive statices and the linear regression model. Descriptive statices were used as an analysis of frequencies, percentages, mean, and standard deviation as well as results were presented in the form of tables and graphs. Weighted Mean was also used to know the major impacts of *Eucalyptus* plantations on the environment regarding households' perception. In addition, the factors affecting the level of household income generated from *Eucalyptus* were analyzed using a multiple linear regression model. On the other hand, qualitative data were analyzed through a summary of texts. The weighted mean score and multiple regression model are presented below:

$$WMS = \sum s_i f_{i/n}$$

s_i = score of the i^{th} item,

f_i = frequency of the respondents for the i^{th} item,

i = 5,4,3, 2, 1 value for highly important, moderately important and important, less important and least important respectively n = total number of respondents.

Multiple leaner regression model was used to analyze the factors affecting household income derived from *Eucalyptus* woodlot. The model was used because of its simplicity and compatibility with this study for analyzing the data. It described the effects of the independent variables on the dependent variable by controlling the other factors constant. Independent variables used for analysis such; as age, landholding size, family size, distance from the market, and experience of household in *Eucalyptus* production. The definitions of the variables included in the model are stated below;

$$y= \beta 0 + \beta 1X1 + \beta 2X2 + \beta 3X3 + \beta 4X4 + \beta 5X5 + ... + \beta kXn + \varepsilon k$$

Where:

y = dependent variable explained by different explanatory variable, Xn = independent variable used to explain dependent variable, $\beta 0$ is an intercept of the regression model, βk = parameters associated with the explanatory variable, and $\varepsilon \kappa$ = Stochastic error term.

Table 1. Description of linear variables and their expected sign used in multiple linear regression model

Variables Description	Description	Measurements	Expected Sign
Dependent variable			
Income from *Eucalyptus* woodlot (EWI)	Income in Ethiopian Birr (ETB)	Continuous	
Independent variables			
Age	Age in years	Continuous	-
Household experience	Experience in years.	Continuous	+

Variables Description	Description	Measurements	Expected Sign
landholding size	Landholding in hectare	Continuous	+
Family size	Family size in number	Continuous	-
Distance from the market	Distance in kilometer	Continuous	-

Were;

EWI – Income derived from *Eucalyptus* woodlot production

$\beta_1 \dots \beta_5$– the parameter which measures the change in woodlot income concerning the variables.

Assumptions of the Multiple Regression Model

Before, the analysis of multiple linear regression results, five assumptions were checked to keep the requirements of these assumptions. Based on this, there were no multicollinearity, linearity, homoscedasticity, autocorrelation, and normality problem to meet the assumptions of multiple regressions.

RESULTS AND DISCUSSION

Socioeconomic Characteristics of Sampled Households

The purpose of this study was to reflect on what factors influence driving maximum income from households' woodlot production in the study area. Structured and semi-structured questionnaires along with a survey were used to collect qualitative and quantitative data from rural households. Descriptive statistics and an econometric model were used to analyze the overview of *Eucalyptus* at the farmer level and to investigate the challenges of the household to obtain income from Eucalyptus plantation.

Different socio-economic characteristics of the sampled household were analyzed through descriptive statistics. Variables such as age, gender, educational status, family size, and main income source of households were considered in the analysis (Table 2). The result shows that the majority (82.67%) of the respondents were men and the remaining 17.33% were women. This is indicated that male households are more engaged in *Eucalyptus* production than female households in the study area.

The educational level of the household was categorized into four groups; namely elementary whose educational level is below nine years of education, and secondary school whose educational level is nine up to twelve years of education. The education level result shows that 55.33% of respondents attended elementary school followed by illiterate (28.67%) and attended secondary school (16%). The educational level of households has been one of the main factors in the development and growth of their incomes.

Table 2. Categorical socio-economic characteristics of sampled households

Variables	Categories of variables	Freq.	Percent
Educational Status	Elementary School	83	55.33
	Illiterate	43	28.67
	Secondary School	24	16.00
Gender	Female	26	17.33
	Male	124	82.67

The continuous socio-economic characteristics were presented in (Table 3). The result indicated that the mean age of the household was 46.7 with a minimum age of 30 years old and maximum age of 65 years old. The mean landholding size of the household was 2.54 ha with a standard deviation 0.75. The minimum and maximum landholding were 1 ha and 6.5 ha, respectively. The result also shows that the total family size of the sample households ranged between 2 and 14 members with a standard deviation of 3.01. The average woodlot distance of the household from the market was 6.99 with a maximum of 13 km and a minimum of 3 km (Table 3).

Table 3. Continuous socioeconomic characteristics of sample households

Variable	Mean	Std. Dev.	Min	Max
Age	46.73	9.85	30	65
Landholding size	2.54	.75	1	6.5
Family size	6.45	3.01	2	13
Eucalyptus woodlot distance from the market	6.99	3.46	3	13
Household farm experience	23.61	6.77	10	38
Number of observations = 150				

The Source of Energy in the Study Area

Table 4. Major energy sources in the study area

Major energy source	Proportion (%)
Firewood	67.60
Charcoal	1.30
Animal dug	29.10
Other	2.00

The energy sources for lighting, cooking, and heating are firewood, charcoal, animal dug, and others like crop residues. Firewood is the most important source of energy for cooking and heating as more than half (68%) of the respondents confirmed (Table 4). The FGD participants stated that firewood is mainly derived from *Eucalyptus*. The finding is supported by related studies (Edesa, 2021) which stated that firewood from eucalyptus was a primary source of energy for lighting, cooking, and heating in the Chelila district of Oromia. Animal dug, charcoal and others are also sources of energy in the study area that contributes about 29%,1%, and 2%, respectively.

Major *Eucalyptus* Woodlot Products and Proportion in the Study Area

Table 5. Major *Eucalyptus* woodlot products

Types *Eucalyptus* products	Proportion (%)
Construction	83
Fuelwood	77
Furniture	48
Pole	44
Charcoal	25

Due to population growth, the demand for firewood and building materials uses has increased substantially. The result showed that construction materials were the most important products of *Eucalyptus* as the majority (83%) of respondents confirmed followed by fuelwood (77%) in the study area (Table 5). Furthermore, the study shows that *Eucalyptus* contributes to furniture production (48%), pole (44%), and charcoal (25%). This result is supported by FGD and KII participants who reported that Eucalyptus uses as a source of wood fuel and construction materials for subsistence uses as well as generate cash income. According to FGD participants' responses, construction wood is classified locally into Worage and Mager based on the wood's diameter used for construction purposes. The bigger diameter construction round wood is called worage and the smaller diameter construction wood is named that mager in the study area. Split wood is also the other most important type of product, which is mainly used for house construction at vertical positions in all rounds. Evidence showed that in most developing countries such as Ethiopia the rapid and significant forest conversion and degradation together with the rise in population, has created a gap between supply and demand for wood products including construction and fuelwood (Lemenih and Kassa, 2014; Kisegu et al., 2019; Bayle, 2019). The establishment of fast-growing tree species has been the common response to such a problem in many countries (Kisegu et al., 2019; Bayle, 2019).

Income Derived from *Eucalyptus* Woodlot Production

Table 6. Annual income derived from *Eucalyptus* woodlot production

Variables	Total cash income	Mean	Std. Dev.
Selling for fuel wood	620,400	4136	1875.139
Selling for construction	660,200	4401.333	1265.706
Stumpage price	2,193,400	14622.667	4804.558
Total income	3,474,000	2313.333	
Number of observations = 150			

The total cash income derived from major eucalyptus wood lot products in the study area were presented in the above table. The result indicated that the mean cash income the household received through selling stands of eucalyptus trees was 14622.66 birr. The mean income from selling for construction purposes and selling for fuel wood were 4401.33 and 4136 birrs respectively (Table 6). This finding is supported by other studies that found that Eucalyptus contributes to the local communities for different socio-economic needs mainly for cash income (Getnet et al., 2022). The studies of other many researchers have found that the income generated from *eucalyptus* trees is much higher than income from agricultural crops which is why farmers are shifting their agricultural land to *eucalyptus* plantations (Bekele, 2015; Jaleta *et al.*, 2016).

Table 7**.** The proportion of income gained from different *Eucalyptus* products

Income generating activities	Proportion (%)
Selling for fuelwood	17.9
Selling for construction wood	19.0
Stumpage price	63.1

The proportion of income from selling fuelwood, construction wood, and tree stand of *Eucalyptus* was presented in (Table 7). The result indicated that income from the tree stand of *Eucalyptus* contributes a high proportion to the total income which accounts for 63.1% (Table 7). Furthermore, the proportion of income from selling fuelwood and construction wood contributes equivalently about 19% and 17.9%, respectively. The income generation contribution of Eucalyptus is the motive of farmers for planting *Eucalyptus* (Tesfaw et al., 2021).

Perceptions of Households on *Eucalyptus* Woodlot Plantation

Table 8. Households' perception of the impacts of *Eucalyptus* plantation

Impacts	Highly important	Moderately Important	Important	less Important	Least Important	total	Weighted mean	Rank
Allelopathic	42	60	33	10	5	150	3.83	1
High water consumption	32	33	40	36	9	150	3.29	2
Make the land infertile	12	25	45	36	32	150	2.66	3

The household survey, FGD and KII results show that local communities have adequate knowledge of the environmental impacts of eucalypts as they experienced a long time using them for many needs. The FGD and KII participants pointed out that after the *Eucalyptus* plantation, the crop yield around the plantation area declined due to its effect on soil fertility, allelopathic effect, and high-water consumption behavior. The household survey result shows that households perceived that the allelopathic effect of *Eucalyptus* has become a serious problem, resulting in reduced crop yield and they put this impact in the first rank followed by soil infertility and high-water uptake (Table 8). Previous studies also showed that despite its economic potential, *Eucalyptus* has diverse environmental impacts regarding soil nutrient content, water consumption, and its allelopathic effect (Tadesse and Tafere, 2017; Nega and Bedasa, 2019; Bayu, 2020; Zerga et al., 2021). The findings

of this study also agreed with other related studies (Chane and Belay, 2021) which found that farmers well understood the water stress effect and its impact on the surrounding cropland from its allelopathic effect of *Eucalyptus*.

Determinants of Income Derived from *Eucalyptus* Woodlot Using Multiple Linear Regression Model

Table 9. Multiple linear regression results of factors affecting household income derived from *eucalyptus* woodlot

Eucalyptus income	Coef.	St.Err.	T	P>|t|
Age (years)	44.599	178.314	0.25	0.003***
Landholding size (ha)	270.925	553.117	0.49	0.004***
Family size (number)	-129.78	124.977	-1.04	0.301
Eucalyptus woodlot distance from the market (km)	-209.165	18.777	-11.14	0.000***
Household experience on *Eucalyptus* woodlot production (year)	-46.954	179.746	-0.26	0.034**
_Cons	46656.068	4041.015	11.55	0.000
Number of obs. =150.000				
R-squared = 0.559				
Adj R-squared =0.5375				
Prob > F = 0.000				

**** and ** present 1% and 5% level of significance*

The multiple linear regression model was used to analyze the factors affecting household income derived from *Eucalyptus* woodlot production (Table 9). This model was significant at (P = 0.0000) with a higher value of R^2 (0.559/55.9%) which indicates that the larger proportion of the variation of eucalyptus woodlot products income is explained by the explanatory variables used in the model (Gujarati, 2021). In the model, five variables were included of those two variables were found to be highly significant factors that influenced the income level derived from *Eucalyptus* woodlot products; namely age of the household, landholding size, the experience of the household, distance from the market at the P-value of 0.003, 0.004,0.034 and 0.000, respectively (Table 9). Landholding size and age of household were significantly and positively associated with *Eucalyptus* income, while the experience of the household and distance from the market had a significant and negative relationship with the income derived from *Eucalyptus* woodlot (Table 9).

The age of the household was significant at a 1% level of significance (P<0.01). The positive sign indicated that an increase in each unit of household age will have an increase in the income level derived from *Eucalyptus* woodlot products. The reason for this result could be the less labor-intensive nature of eucalyptus for production make the older aged household engaged in eucalyptus woodlot production compared to younger households. Older households do have not enough labor for labor-intensive activities such as producing crops (cereals). Another probable reason could be resource availability such as land.

Consequently, an older household has a higher possibility of allocating their lands for eucalyptus woodlot production because eucalyptus required less labor and less cost to produce than crop production. Many studies also indicated that it is difficult for older households to perform agricultural tasks as it needs more labor. Therefore, they turn to resource collection activities that need less physical labor, such as harvesting and providing income from woodlot products. The result agreed with related studies that found that household age had a positive association with the income derived from Eucalyptus woodlot products (Dessie et al., 2019). The result is in line with another study that found that *Eucalyptus* activities are the best alternatives for older people younger people (Edesa, 2021).

Experience of the local household in eucalyptus woodlot production was statistically significant and associated negatively. This means the more experienced households in *Eucalyptus* woodlot production gain minimum incomes from their eucalyptus woodlots. The reason for this could be the old age of *Eucalyptus* coppice stands may affect the quality of the products. When the age of the coppice rounds increases, the coppicing ability and the product quality of coppice stands are going to be low. This is related to (Munialo, 2020; Dessie et al., 2019) who found that the association between the woodlot owner households' experience and the yield of production was negative.

The association between the variables' landholding size and the income level derived from *Eucalyptus* woodlot products was significant and positive. The possible reason for this result is that as the landholding size increases the amount of production also increases because they had a chance of allocating land for *Eucalyptus* production. So, the income level gained from eucalyptus woodlots was increased. Hence local households who have large land sizes can generate a high level of income through produce and selling high amounts of *Eucalyptus* woodlot products. This implies local households who have large land sizes would plant more trees on their farm. Related studies (Edesa, 2021) found a positive contribution of farm woodlots to the income of rural households. In addition, other studies (Gizachew, 2017; Gizachew, 2017; Derbe, 2018) indicated that the total land holding size of the local households had significant and positive effects on the income derived from *Eucalypts* woodlot of their farmlands. The result further agreed with related studies that found that landholding size had a positive relationship with the income derived from woodlot products (Dessie et al., 2019; Asefa, 2021).

The distance coefficient shows a negative and significant association with *Eucalyptus* income. This means that an increase in the distance of the eucalyptus farm which is far from the market reduced household income from *Eucalyptus* woodlot products by 209.165 birr (Table 9). When *Eucalyptus* woodlot production was far, transportation costs from the farm to market increased, hence they earn minimum income from Eucalyptus woodlot products. Literature showed that distance from the market affects the decision of smallholders involved in Eucalyptus plantation and generates income from it (Abebaw and Dea, 2016; Addis et al., 2016).

CONCLUSION

Eucalyptus woodlot productions are an important alternative income source for local farmers in the study area. Income was generated from *Eucalyptus* woodlots through the selling of stands, selling of fuelwood, and selling for construction. The result indicated; *Eucalyptus* producer households were generating more cash income through selling their eucalyptus sands compared to other activities. Households' perception of eucalyptus production on its properties like water consumption, and allelopathic effect on the surrounding crops. They perceive that eucalyptus consumes lots of water than most crops, but with good management, eucalypt planting supports the protection and conservation of biodiversity. The income level derived from *the Eucalyptus* woodlot was affected by different parameters, it was negatively affected by the experience of planting *Eucalypt* trees and distance from the market. On the other hand, the age and landholding size of the households had a significant and positive effect on the economic value of *Eucalyptus* woodlot production.

Generally, the contribution of *Eucalypt* trees to the sustainable development of Ethiopia is significant owing to their economic profitability and their role in household food security. On the other hand, it has been seriously challenged by the lack of infrastructures like roads, watering facilitates, and lack of awareness on how to manage it for deriving the maximum income from their woodlot also, marketing and value chain support is not linked to woodlot owners' households to the existing wood-based industries in an organized manner to make households benefited from their *Eucalyptus* woodlot. Depending on this, the evidence from this study suggests that the government should be focused on road construction to minimize transportation costs and make the households better benefit from their *Eucalyptus* woodlot products and also technical manuals about eucalyptus management and utilization.

REFERENCES

Abebaw, S., Dea, M. (2016). Determinants of farmers' decision-making for planting Eucalyptus trees in Meket District, North Wollo, and Ethiopia. *Res. Human. Soc. Sci*. 6 (13), 62–70.

Addis, F., Melak, S., Tefera, B., & Kassa, H. (2016). Impacts of smallholder tree plantation in Amhara Region of Ethiopia: the case of Lay Gayint and FagtaLocuma Districts. *Ethiopian Journal of Economics*, 25 (1), 35-58.

Admasu, G. (2016). *The impact of Eucalyptus plantation expansion on food security in Bambasi Woreda*. Benishangul Gumuz regional state, Western Ethiopia.

Akhter, S. (2022). Key Informants' Interviews. In *Principles of Social Research Methodology*. Springer, Singapore.

Alemayehu, A. and Melka, Y. (2022). Small scale eucalyptus cultivation and its socio-economic impacts in Ethiopia: a review of practices and conditions. *Trees, Forests and People*, 100269.

Amena, E.M. (2016). *Economic Contribution of Participatory Forest Management Approach and its Major Implementation Challenges in the case of Bale Zone*. Oromia Region, Ethiopia.

Assefa, G.A. (2021). *Estimating Land Expectation Value of Smallholder Farmers' Eucalyptus Woodlot Products in Wogera District*, Northern Ethiopia.

Bayle, G.K. (2019). Ecological and Social impacts of Eucalyptus tree plantation on the environment. *J. Biodiverse. Conserv. Bioresour. Manag*. 5 (1), 93.

Bayu, B. (2020). Existing dilemma of the impact of eucalyptus species on crop yield and soil nutrients in Ethiopia: review paper. *J. Nat. Sci. Res*. 11 (17).

Bekele, T. (2015). Integrated Utilization of Eucalyptus globulus grown on the Ethiopian Highlands and its Contribution to Rural Livelihood: A Case Study of Oromia, Amhara and Southern Nations Nationalities and People's Regional State Ethiopia. *International Journal of Basic and Applied Sciences*, *4*(2), 80-87.

Birara, A., Alemu, A., and Koye, AD. (2019). Determinants of the production and commercial values of eucalyptus woodlot products in Wogera District, Northern Ethiopia. *Environmental Systems Research*, 8 (1), 1-10.

Chane, A. and Belay, T. (2021). The effect of eucalyptus globulus woodlots spacing on Physico-chemical properties of soil in smallholder farmers, Sidama region, south-central Ethiopia. *GSJ*, 9(11).

Daba, M. (2016). The Eucalyptus Dilemma: The Pursuit for socio-economic benefit versus environmental impacts of Eucalyptus in Ethiopia. *Journal of Natural Sciences Research*, 6 (19), 127-137.

Derbe, T. (2018). *Factors Influencing Smallholder Farmers' Adoption of Eucalyptus Woodlot in Wogera District, North Gondar Zone*, Amhara Regional State of Ethiopia.

Dessie, A.B., Abtew, A.A. and Koye, A.D. (2019). Determinants of the production and commercial values of Eucalyptus woodlot products in Wogera District, Northern Ethiopia. *Environmental Systems Research*, 8(1), 1-10.

Edessa, D.Y. (2021). Economic Contribution of Eucalyptus globulus to the Livelihoods of Local Communities in Chelia District, Oromia, Ethiopia. *European Business & Management*, 7(6), 159-167.

Eshetu, S.B., Pretzsch, J. and Mekonnen, T.B. (2018). Financial Analysis of Smallholder Farmers Woodlot and Homestead Agroforestry Systems and its Implications for Household Income Improvement, the Case of Hawassa Zuria District, Southern Ethiopia. *J Agri Sci Food Res*, 9(236), 2.

Fikir, D., Tadesse, W. and Gure, A. (2016). Economic contribution to local livelihoods and households' dependency on dry land

forest products in Hammer District, Southeastern Ethiopia. *International Journal of Forestry Research*, 2016.

Getnet, M.T., Ketema, M., Alemu, B. and Demilew, G. (2022). An Assessment on Socio-Economic Impacts of Smallholder Eucalyptus Tree Plantation in the case of Northwest Ethiopia. *European Online Journal of Natural and Social Sciences*, 11 (1), 250.

Gizachew, K. (2017). Expansion of eucalypt woodlot and its factors in Cheha District, Southern Ethiopia. *World Scientific News*, 66, 63-180.

Gujarati, D.N. (2021). *Essentials of econometrics*. SAGE Publications.

Jaleta, D., Mbilinyi, B., Mahoo, H. and Lemenih, Mulgeta. (2016). Eucalyptus expansion as relieving and provocative tree in Ethiopia. *Journal of Agriculture and Ecology Research International*, 1-12.

Kisegu, D., Kagaham, D., Whitney, C., Tabuti, J.R.S. (2019). *Contribution of Smallholder Tree Growers to Increasing Tree Cover in Kaliro District. Agriculture and Ecosystem Resilience in Sub Saharan Africa, Climate Change Management*. Springer Nature Switzerland.

Lemenih, M. and Bongers, F. (2010). The role of plantation forests in fostering ecological restoration: experiences from East Africa. In *Degraded forests in eastern Africa*. Routledge.

Lemenih, M. and Kassa, H. (2014). Re-greening Ethiopia: history, challenges, and lessons. *Forests*, 5(7), 1717-1730.

Mersha, M., Alamirew, B. and Ayele, L. (2022). Factors determining farmers' decision and level of participation in terracing as a response to land degradation in Dejen Woreda, North-West Ethiopia. *Cogent Social Sciences*, 8(1), 2126080.

Munialo, S. (2020). *Factors influencing Maize yield Gaps on Smallholder farms in Vihiga and Kakamega Counties of Western Kenya* (Doctoral dissertation, University of Nairobi).

Nega, F., Bedasa.T. (2019). Allelopathic Effect of Eucalyptus globulus Labill. On Seed Germination and Seedling Growth of Highland Teff (Eragrostis tef (Zuccagni) Trotter)) and Barely (Hordeum vulgare L. *Journal of Experimental Agriculture International*, 1-12.

Tadesse, S.A. and Tafere, S.M. (2017). Local people's knowledge of the adverse impacts and their attitudes towards growing Eucalyptus woodlot in Gudo Beret Kebele, Basona Worena district, Ethiopia. *Ecological Processes*, 6(1), 1-13.

Tadesse, W., Gezahegne, A., Tesema, T., Shibabaw, B., Tefera, B., Kassa, H. (2015) Enhancing the role of forestry in building climate resilient green economy in Ethiopia. Strategy for scaling up effective forest management practices in Amahara regional state with particular emphasis on smallholder plantations. *CIFOR*. Addis Ababa.

Tadesse, W., Gezahgne, A., Tesema, T., Shibabaw, B., Tefera, B., & Kassa, H. (2019). Plantation forests in Amhara region: challenges and best measures for future improvements. *World J. Agric. Res*, *7*(4), 149-157.

Tefera, B., Kassa, H. (2017). Trends and Driving Forces Of Eucalyptus Plantation By Smallholders In The Lake Tana Watershed of Ethiopia. In *Social And Ecological System Dynamics*. Springer, Cham.

Tesfaw, A., Senbeta, F., Alemu, D., Teferi, E. (2021). Value Chain Analysis of Eucalyptus Wood Products in the Blue Nile Highlands of North-western Ethiopia. *Sustainability*, 13, 12819.

Wabwile, V.K., Ingasia, O.A. and Langat, J.K. (2016). *Effect of the improved sweet potato varieties on household food security: empirical evidence from Kenya* (No. 310-2016-5492).

Yitaferu, B., Abewa, A. and Amare, T. (2013).

Expansion of eucalyptus woodlots in the fertile soils of the highlands of Ethiopia: could it be a treat on future cropland use? *Journal of Agricultural Science*, 5(8), 97.

Zerga, B. and Berta, A. (2016). Preference, purpose, and pattern of Eucalyptus tree farming in Eza Wereda, Ethiopia. *International Journal of Research and Innovation in Earth Sciences*, 3(2), 30-38.

Zerga, B., Warkineh, B., Teketay, D. and Woldetsadik, M. (2021). *Perceptions on Impacts of Competition of Eucalypt Plantations with Other Land Uses on the Rural Livelihood in the Western Gurage Watersheds*, Central-South Ethiopia.