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Economic Contribution of *Eucalyptus globulus* to the Livelihoods of Local Communities in Chelia District, Oromia, Ethiopia

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Abstract: *Eucalyptus globulus* is the most economically important and the most commonly cultivated exotic tree species in the Chelia District. However, we have limited knowledge on quantitative estimation of *Eucalyptus* contribution to the communities' livelihoods, and perception of factors currently drives its expansion. The main objectives of the present research were to measure the quantitative economic contribution of *Eucalyptus* to the communities' livelihoods and to investigate factors that currently contribute to its expansion. We used a mixed-method approach, combining both quantitative and qualitative techniques. Data were collected using semi-structured survey questionnaires. A multiple linear regression model was used. The weighted mean score was used to analyze the perceptions of factors that currently contribute to *Eucalyptus* expansion. We surveyed the contribution of *E.globulus* to local communities; perception of factors that contributes to its expansion; the reason why respondents preferred *Eucalyptus* to other tree species, and respondents' points of view on the current and future potential *Eucalyptus* expansion. Our results show that *Eucalyptus* income makes up 87% of the total households' income, while agricultural income makes up 13%. The results also reveal that income source is the most factor that currently contributes to *Eucalyptus* expansion. Our analysis explained that the reason why respondents preferred *Eucalyptus* to other tree species are high-income return, suitable for building and firewood, short-rotation, and requires less management. We have confirmed that most of the livelihood's income was generated from *Eucalyptus* income, and local communities are highly dependent on *Eucalyptus* activity. The findings of our research have important implications for managers and policymakers.

Keywords: Economic Contribution, *Eucalyptus globulus*, Livelihood, Local Community, Chelia District

1. Introduction

Eucalyptus globulus is the most economically important species in the temperate regions of the world, and nowadays, it is the backbone of the hardwood forest industries in Australia, Chile, Ecuador, Ethiopia, Portugal, Spain, Uruguay, and China [1-3]. *Eucalyptus globulus* is the most cultivated tree native to Australia and is commonly called Tasmanian blue gum [4-7]. Having great economic importance reported that in 2004 more than 2.5 million hectares of *E.globulus* were cultivated worldwide [3]. The study conducted in northern Spain shows that the area occupied by *E.globulus* has increased by 4.6 times greater than 50 years before [4]. It has been suggested that the reason for the widespread *subspecies globulus* may have been the bitterness of its juvenile leaves and seldom eat by animals where fencing does not need [8].

Eucalyptus globulus has been introduced into Ethiopia along with other *Eucalyptus* species to supplement firewood and building materials in the nineteenth century. In the nineteenth century, natural forests in Ethiopia are significantly reduced because of human pressure on natural forests for farmland expansion and settlements. Consequently, the problem of building materials and firewood is becoming a great challenge, especially for urban dwellers. Then *Eucalyptus* species were introduced into Ethiopia, which can solve these challenges. Fuelwood and construction materials demand are some of the principal causes of deforestation in Ethiopia [9].

Eucalyptus species were introduced into Ethiopia in 1895 as a potential solution for building materials and firewood [10]. Among the introduced *Eucalyptus* species into Ethiopia, *E.globulus* is the most widely adapted and grown species in highland areas. *Eucalyptus globulus* and *E.camaldulensis* are the most common species and the most preferred by farmers [11-14]. The current opportunities and the most important topic of *Eucalyptus* development in Ethiopia are a source of income, energy sources, building materials, and urban development. The introduction of *Eucalyptus* species is not only mitigated the problem of firewood and building materials but has also contributed to the diversification of human dependence on natural forests [15, 16].

In many parts of Ethiopia, *Eucalyptus* is the most commonly grown species in the community for farm implements, home furniture, building materials, and firewood [17]. In addition, selling *Eucalyptus* poles and timber products could increase farm incomes, reduce poverty, increase food security and diversify smallholder-farming systems in many areas. *Eucalyptus* income contributes 72% of total household income yearly in Central Highland of Ethiopia [18]. Furthermore, *Eucalyptus* plays an important role for people living in urban and rural areas. In Ethiopia, there are huge gaps between the demand and supply of wood because of the depletion of natural resources. Thus, the use of fast-growing tree species that produce large amounts of biomass, such as *Eucalyptus* is increasing from time to time each year.

Eucalyptus has spread over large parts of Ethiopia and becoming part of the Ethiopian agricultural systems [10, 19]. During prolonged periods of private forestry initiation at the beginning of the 1900s, which lasted until the revolution of 1974-1975, around 90,000 ha of *Eucalyptus* was planted in the surroundings of Finfinne (Addis Ababa) and other cities [20]. In 1985, more than 250,000 ha of *Eucalyptus* were planted [21]. The local community grows *Eucalyptus* along their agricultural croplands as an integral component of productive agriculture. *Eucalyptus* uses as an agroforestry tree species [22]. In many places in Ethiopia, *Eucalyptus* has contributed to raising people's standard of living by providing several uses and financially more profitable compared to alternative crops [23-25].

Eucalyptus provides job opportunities (directly or indirectly) for those who are unemployed. Directly to a person employed as day-to-day work in the collection, loading onto and unload from the vehicle during harvesting and transporting. It also creates short-term employment for those jobless at the time of splitting *Eucalyptus* poles for building, fencing, and firewood purpose. In particular, for poor women living around the city, *Eucalyptus* provides them with the opportunity to generate income by collecting and selling *Eucalyptus* leaves and barks. Because of the expansion of current urbanization in Ethiopia, building materials are highly demanding, and therefore the demand for *Eucalyptus* poles for construction is rapidly increasing in urban areas.

Eucalyptus globulus is recognized as being the most important exotic tree species at the community level. The main fundamental characteristics of *E.globulus* are: fast-growth, yield high biomass, suitable for building materials and firewood, coppicing ability, and short rotation compared to the other indigenous and exotic tree species. Several studies have been conducted on the *Eucalyptus* plantation in Ethiopia [10-12, 17-19, 21, 23-27].

Although *E.globulus* provides multi-function to communities' livelihoods, there is a gap of knowledge, information, literature, and document regarding the quantitative economic contribution of *Eucalyptus* in the Chelia District. Previous researches have a lack of quantitative estimation of the economic contribution of *E.globulus* to local communities' livelihoods. To date, no study has been focused on the economic effect of *E.globulus* on livelihoods using a quantitative economic model. In addition, the current perception of factors that contributes to the expansion of *E.globulus* has not been studied.

Therefore, our study remedies these gaps by analyzing both quantitative and qualitative economic analysis. The significance of the study provides new insights into the economic contribution of *E.globulus* to the livelihoods of local communities in Chelia District. Furthermore, the results of our study are expected to provide general information on *Eucalyptus* and its contribution to the livelihoods of communities in the Chelia District. Our research provides a roadmap for researchers, managers, environmentalists, policymakers, communities, industrials, and stakeholders about the *Eucalyptus* development in Ethiopia.

Our research aimed to further current knowledge of the quantitative economic contribution of *Eucalyptus* and perceptions of factors currently contribute to its expansion in Chelia District. Our main objectives of the present study were (1) to measure the economic contribution of *E.globulus* to the livelihoods of local communities; (2) to investigate factors that contribute to *E.globulus* expansion; (3) to investigate why respondents preferred *E.globulus* to other tree species; and (4) to identify respondents' points of view on the present and future *E.globulus* plantations. The study was conducted by providing the following research questions: (1) what are the economic and social contributions of *E.globulus*? (2) what are factors contributing to *E.globulus* development in the study area? (3) how important is *E.globulus* to local communities' livelihoods? (4) why are local communities preferred *E.globulus* to other tree species? (5) what are the respondents' points of view on the present and future development of *E.globulus*? (6) what are the major income sources, energy, and building materials in the study area?

2. Materials and Methods

2.1. Study Area

The study was conducted in the Chelia District (Figure 1). Three villages (Tulu Kosoru, Ale Hula Dabi, and Wegidi Kortu) were chosen, considering their potential *E.globulus* growth among the other villages. The geographical location lies between latitude 8°-9°N and longitude 37°-38°E with an elevation ranging from 1700 to 3060 m.a.s.l. The average

yearly minimum and maximum temperatures are 8°C to 25°C with average temperatures of 16°C. The average annual rainfall is from 750 to 1000 mm (Chelia Agricultural Office, 2014). The main economic activities of the respondents are mixed agricultural systems (i.e. crop and livestock production) and *E.globulus* cultivation. The major crops are wheat, barley, teff, beans, peas, potatoes, and vegetables. Livestock assets are cattle, sheep, goats, donkeys, mule, and horses. *Eucalyptus globulus* is the most commonly cultivated exotic tree species in the study sites.

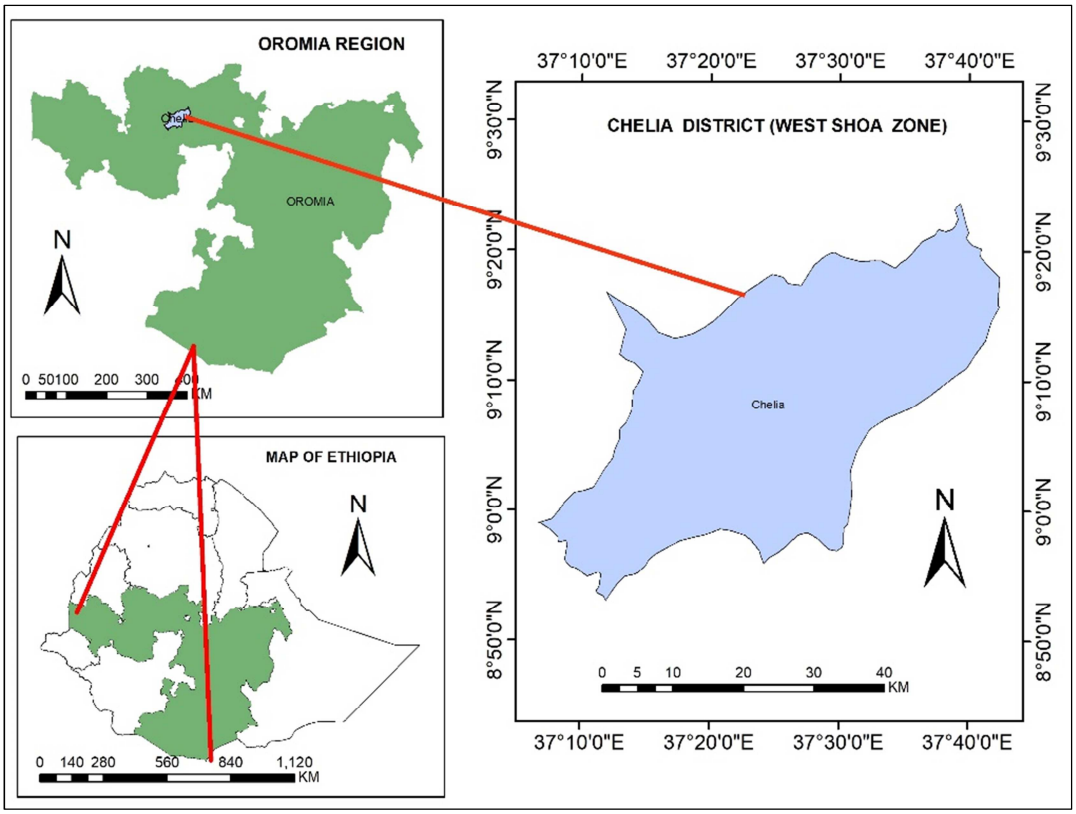

Figure 1. *Map of the study area.*

2.2. Sample Size

Total sampling households were 240. The sample size was calculated at a 95% confidence interval and 5% precision level according to [28].

$$n = \frac{N}{1+N(e)^2} \quad (1)$$

Where n = sample size; N= total population of household; e = precision level

2.3. Data Collection

In our study, we used *Eucalyptus globulus* (*E.globulus* Labill.) as the study material. The study was undertaken from December 2018 to February 2019. First, we have discussed with the district's experts and village development agents to identify the village in which *E.globulus is* potentially growing, and then three villages were identified. Second, fifty respondents were selected randomly from each village. Finally, a total of 150 respondents were recruited for interviews using [28]. The simple random sampling technique was used in selecting the respondents for the interviews. Respondents first provided informed consent about the objectives and significance of the study before data collection. For our research, we used primary data collected through face-to-face in-depth interviews.

The study was conducted using a mixed-method approach, combining both quantitative and qualitative techniques. Data were collected using semi-structured questionnaires (open and close-ended) from key informants, focus groups, and respondents. Respondents' and experts' points of view about the perception of factors currently contributing to the development of *E.globulus* were collected. After the factors have been identified, the weighted mean score and the average rank were applied. Respondents' preference *E.globulus* to other indigenous and exotic tree species was also assessed. All socio-economic statuses of the respondents were collected, such as sex, age, marital status, education, income sources, landholding size, energy sources, and building materials.

The two main sources of respondents' income are agriculture (i.e. crop and livestock production) and *E.globulus*. Total income is the sum of agricultural income and *Eucalyptus* income. Income from crop production is the sum of the total crop yield obtained from sales and home consumption annually. Income from livestock production is the total income obtained from sales as well as subsistence livestock and livestock products annually. Income from *Eucalyptus* is the total of the *Eucalyptus* trees per hectare sold as well as home use. All quantities of products were

multiplied by the local market price. Income was calculated in the currency of Ethiopian Birr (ETB). The exchange rate in June 2019, 1US$ is equal to 29.29 ETB.

2.4. Data Analysis

The quantitative and qualitative data collected during the interviews and observations were analyzed. The quantitative data were analyzed using descriptive statistics, such as average, percentages, frequencies, and standard deviation. The qualitative data were summarized through text analysis. The software application we used to analyze the data was STATA version 13 and Microsoft Excel 2013.

Weighted mean score (WMS) was used to predict the perceptions of factors currently contribute to *E.globulus* expansion. The weighted mean score and the mean rank for each factor were calculated and obtained by multiplying the frequencies with their respective scores, added them up, and divided by the total number of respondents according to [29]. The results were presented in the form of tables and figures.

To analyze the economic contribution of *E.globulus* to the livelihoods of local communities, we used multiple linear regression analysis to predict the relationship between the economic contribution effect of *E.globulus* and its impact on livelihoods, age, education, gender, marital status, income sources, and land size. The multiple linear regression model was estimated using the ordinary least squares (OLS) estimation technique. The income generated from *E.globulus* was regressed as a function of agricultural income and respondents' characteristics. In our model, we included household income (i.e. agricultural income) to see how alternative income diversification affects the *Eucalyptus* contribution. The econometric model is as follows:

$$Euincome = \beta_0 + \beta_1 Agrincome_{\ 1} + \beta_2 Lhs_2 + \beta_3 Aep_3 + \beta_4 Educ_4 + \beta_5 Age_5 + \beta_6 Male_6 + \beta_7 Married_7 + \mu \quad (2)$$

Where, *Euincome* = the income derived from *E.globulus*, β_0 is the intercept, $\beta_{1...}\beta_7$ = the regression coefficients, *Agrincome* (income derived from agriculture), *Lhs* (landholding size), *Aep* (area eucalyptus planted), *Educ* (years of education), *Age* (birth year), *Male* (an indicator for gender), *Married* (marital status), and μ is the error term.

3. Results

3.1. Demographic Characteristics of Respondents

The respondents' characteristics are presented in Table 1. Data were collected from sampled respondents using questionnaires and interviews. One hundred and forty-eight interviews were conducted with males and with two females, in a total of 150 respondents. Of that, the gender distribution of the respondents shows that 98.7% were male and 96.7% were married. The age of the respondents was distributed as follows: (19-35 years), (35-60 years), and over 60 years are 22%, 75.3%, and 2.7%, respectively. Regarding the education level, 10.7% of respondents were illiterate, 58% attended primary school, 17.3% high school, and 14% college and above. The minimum and maximum landholding sizes of the respondents were 0.25 and 9 hectares, respectively, with a mean value of 2.87. The minimum and maximum area of *Eucalyptus* planted were 0.13 and 3 hectares, respectively, and with a mean value of 0.64.

Table 1. *Characteristics of the respondents.*

Household Characteristic		Frequency	Percentage (%)
Gender	Male	148	98.7
	Female	2	1.3
	19-35	33	22
Age	35-60	113	75.3
	over 60	4	2.7
(Mean =43.48; Standard deviation = 9.79; Minimum = 19; Maximum = 75)			
Marital status	Married	145	96.7
	Unmarried	5	3.3
	Illiterate	16	10.7
	Primary school	87	58
Education	High school	26	17.3
	College and above	21	14
Landholding size (Mean =2.87; Standard deviation = 1.16; Minimum = 0.25; Maximum = 9)			
Area eucalyptus planted (Mean =0.64; Standard deviation = 0.62; Minimum = 0.13; Maximum = 3)			

3.2. Comparison of Income Groups

At the study site, we compared two income groups of household income. *Eucalyptus* income makes up 87% of the total household income than agricultural income (Table 2).

Table 2. *Mean household income (in ETB) and income shares by income source per year.*

Income source	Mean income Year^{-1} respondent^{-1}	SD	Min	Max	Income Shares (%)
Eucalyptus income	790,077	810,957.3	49,500	4,800,000	87%
Agricultural income (Crop + Livestock)	113,128.2	159,624	0	1,754,100	13%
Total income	903,205.2	970,581.3	49,500	6,554,100	100%

Note: June 2019, 1US$ = 29.29 ETB; SD = Standard Deviation

3.3. Contribution of Eucalyptus globulus Products to Local Communities

As forest ecosystem services contribute to the socio-economic benefits to local communities, *Eucalyptus* also contributes to communities' livelihoods. The energy sources and building materials used by respondents are mainly from wood and wood products (Figure 2). The energy sources of respondents used for lighting, cooking, and heating are firewood, charcoal, electricity, and others. Firewood from *E.globulus* is the primary source of energy for cooking and heating, which accounts for 95.7%. At the study sites, the building materials used for households are mostly from *E.globulus* poles, which account for 96%.

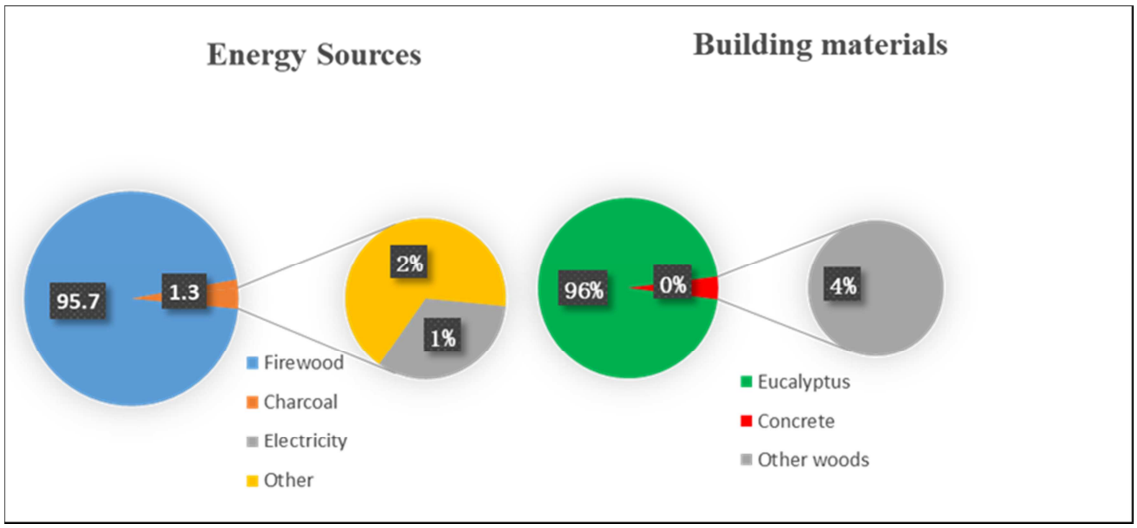

Figure 2. *Energy sources and building materials at the study place.*

3.4. Perceptions of Factors Currently Contribute to Eucalyptus Expansion

Income source is the most factor that currently contributes to the *E.globulus* expansion, followed by building materials and firewood (Table 3). A recent development in income generation from *Eucalyptus* has led to its current expansion throughout the country.

$$\text{Weighted Mean Score (WMS)} = \frac{\sum s_i f_i}{n} \quad (3)$$

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

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

i= 3, 2, 1 value for highly, moderately and least important, respectively

n = total number of respondents.

Because of population growth and the expansion of farmland, deforestation has been a major problem in Ethiopia for a long time, particularly in the 19th century. These conditions had put natural forests under pressure. Consequently, the demand for firewood and building materials uses has also increased substantially. Today, natural forests in Ethiopia are legally prohibited from human disturbance. This condition encouraged people to pay more attention to plant a fast-growing tree species on their land.

The income from fuelwood sales is often used to supplement the income from agricultural production, especially at the time of crop failures [17]. The other factors that contribute to the expansion of *E.globulus* are its fast growth, farm tools, and home furniture. Our findings are consistent with previous results [15, 16].

Table 3. *Perceptions of factors that contribute to Eucalyptus's expansion.*

	Perceptions				
Factors	**Highly important**	**Moderately important**	**Least important**	**WMS**	**Mean rank**
Firewood	140(93.3)	10(6.67)	0(0.00)	2.93	3
Income source	150(100)	0(0.00)	0(0.00)	3.00	1
Building material	145(96.67)	5(3.33)	0(0.00)	2.97	2
Fast growth	130(86.67)	20(13.33)	0(0.00)	2.87	4
Charcoal	0(0.00)	3(2.00)	147(98.00)	1.02	8
Farm tools	120(80.00)	20(13.33)	10(6.67)	2.73	5
Home furniture	50(33.33)	15(10.00)	85(56.67)	1.77	6
Soil acidity	10(6.67)	40(26.67)	100(66.67)	1.40	7

Figures in the parentheses indicate percentages

3.5. Respondents' Perspectives on the Current and Future Eucalyptus Development

The fast growth of *E.globulus*, together with its coppicing ability and wood properties, has promoted the use of this species by the local community in the Chelia District. Respondents revealed that they are highly interested in *E.globulus* planting in the future because the energy sources for rural people living in Ethiopia are still 100% dependent on firewood for cooking and heating as well as building materials for rural communities in their daily lives. *Eucalyptus* is praised for the potential to raise farm income, reduce poverty, increase food security, and diversify smallholder-farming systems in less favored areas [17].

Furthermore, the expansion of the *Eucalyptus* plantation in Ethiopia creates job opportunities for those landless and the poor. They purchase *Eucalyptus* and sell it to places where firewood and construction materials are highly demanding,

particularly in urban areas.

All respondents revealed that *E.globulus* is the most important because of increasing their total household income, improves their livelihoods, and guarantees their lives as food security at risk-time, when their crops and livestock are suddenly damaged by disasters, such as floods, heavy rains, and epidemics.

Eucalyptus globulus requires less management and short rotation than indigenous and exotic tree species. Other reasons respondents noted that the loss of soil fertility and changing soil into acidity causes crop production and productivity reduction from time to time. As a result, farmers' inability to purchase inorganic fertilizers. Consequently, this has provoked farmers to shift their farmland into *Eucalyptus* plantations, which they see as a source of income and for other uses.

3.6. Descriptive Statistics of Eucalyptus Income Against Socio-economic Variables

Regression results of the model data are presented in Table 4. The model revealed that 79% of the variance on *Eucalyptus* income. The area of *Eucalyptus* planted was statistically significant at (1%), while age was statistically significant at (10%).

The regression results show that landholding size, area of *Eucalyptus* planted, education, age, gender, and marital status were positively correlated, while agricultural income was negatively correlated with *Eucalyptus* income. Not all of the variables were statistically significant at any significance level with *Eucalyptus* income, except for the area of *Eucalyptus* planted and age. These indicate that no significant effects on *Eucalyptus* dependency.

Table 4. *OLS regression of Eucalyptus income against socio-economic variables.*

Variable	Coefficient	t-value	P>|t|
Agricultural income	-0.26949 (0.213)	-1.26	0.208
Landholding size	41269.7 (40411)	1.02	0.309
Area of eucalyptus planted	1,214,019***(72,231.38)	16.81	0.000
Education	1,466.157 (8,732.266)	0.17	0.867
Age	7,642.733* (4,287.525)	1.78	0.077
Gender = 1 if male, 0 otherwise	-14,843.89 (270,999.4)	0.05	0.956
Marital status = 1 if married, 0 otherwise	4,216.424 (191,960.2)	-0.02	0.983
Constant	-1,880,02.5 (348,478.3)	-0.54	0.590
Number of observations	150		
Prob > F	0.0000		
R-squared	0.792		
Adj- R-squared	0.782		

Note: Standard errors in parentheses; * p<0.05, ** p<0.01, *** p<0.001

4. Discussion

4.1. Contribution of Eucalyptus Globulus to Local Communities

Eucalyptus globulus has received much attention recently for its multi-function providing a potential socio-economic contribution to communities. *Eucalyptus globulus* plantation plays an important role in both social and economic values because it provides a high-income return, creates job opportunities, food security and poverty reduction, building and firewood, and produces a high rate of biomass. Eucalyptus plantation has a potential socio-economic benefit to the local community [30].

4.1.1. Social Contribution of Eucalyptus globulus

Eucalyptus products provide multi-function to communities' livelihoods in their daily lives. Eucalyptus provides the communities with timber, which is critical for the provision of building materials, energy sources, home furniture, and farm implements. The disproportion between population growth, economic, and natural resource demands such as firewood and building are some of the substantial challenges. Eucalyptus has the potential to reverse these challenges. Eucalyptus product contributes to 96% of building materials and 95.7% of energy sources. *Eucalyptus globulus* achieves a mean annual increment of $30m^3ha^{-1}yr^{-1}$ in Ethiopia [19, 31].

As firewood and building materials are the main reason for the introduction of Eucalyptus into Ethiopia in the nineteenth century, today, it is also the main factor that contributing to the Eucalyptus expansion across the country. Directly or indirectly, Eucalyptus underpins the majority of the day-to-day jobless in their economic growth. Eucalyptus products can enhance both economic and social benefits to improve the livelihoods of agriculture-dependent people.

4.1.2. Economic Contribution of Eucalyptus Globulus to Communities' Livelihoods

Products from *E.globulus* can be a vital income source for local communities and the poor for both subsistence and cash income. The Eucalyptus income shares up 87% of the total household income accounted for the largest share, while agriculture income shares up 13%. We found a much higher value for Eucalyptus income (87%) than those that eucalyptus income shares up 72% of the total household income [18]. Our findings show that Eucalyptus' income contribution is greater than what non-timber forest products (NTFPs) contribute to the rural household's economy. According to [32-34] found that NTFPs make up 79%, 39%, and 27% of the total household income, respectively. The study conducted in southeast Australia shows that the financial return from *E.globulus* was greater than livestock grazing [35].

Eucalyptus improves communities' livelihoods through economic growth, ensures food security, eradicating poverty, and contributes to sustainable development. Eucalyptus products either alone, or in combination with agricultural products, help to improve livelihood resilience by reducing their vulnerability to climate-related harsh events and other economic, social, and environmental impacts and disasters.

4.2. General Panorama of Eucalyptus globulus at the Study Site

Income source has become a critical issue in developing countries because of natural resources degradation, deforestation, and climate change. Consequently, declining of agricultural products from time to time. These conditions put communities' livelihoods under pressure and lead to poverty and food insecurity. To resilient these challenges, using alternative income sources is mandatory to improve livelihoods and living standards. Eucalyptus cultivation plays a vital role in lifting the communities' livelihoods and their living standards. The income sources generate from Eucalyptus products are used to cover all family expenses both for subsistence and cash income, while agricultural products are used mostly for subsistence. Eucalyptus plays an important role in communities to improve their socio-economic status, such as economic growth, reducing poverty, ensuring food security, and contributes to sustainable development that could serve as a safety net.

Respondents were asked, "what are the factors that currently contribute to Eucalyptus expansion?" their responses were income sources (100%), building (96%), firewood (93%), and fast growth (86%) are the key drivers. Respondents were asked, "the reason why they preferred *E.globulus* to other indigenous and exotic tree species?" all of the respondents (100%) commented that *E.globulus* provides multi-function and its characteristics, such as high-income return, job opportunities, suitable for building and firewood, adaptability to wide environmental conditions, short rotation, requires less management and effort. Our results agree with [17]. The short rotation allows a larger wood production and supplies wood for several other activities, helping to preserve the native forests from logging.

When the respondents were asked about their perspectives on the future potential expansion of *E.globulus*, all of the respondents (100%) commented that they preferred to continue to grow if there are no choices that will substitute Eucalyptus species.

4.3. Dependence on Eucalyptus globulus

In the study sites, most of the people's livelihoods were dependent on agriculture for their subsistence. The two major livelihood activities in the study sites were agriculture and Eucalyptus products. Eucalyptus was the major income source, and most of the local communities were dependent on it for subsistence and cash [36, 37]. The major provisioning services of the Eucalyptus are timber, firewood for energy sources, and building materials, which are important for both subsistence and cash for communities' economic growth. The income 87% of the total household income was generated by selling the Eucalyptus poles. At the study sites, the average annual household income from Eucalyptus products per year was 790,077 ETB (approximately US$ 26,974.292). Agricultural income estimated about 13% of total household income on average annual household income per year was 113,128.2 ETB (nearly US$ 3,862.348). This means that local communities' income is generated from the Eucalyptus income than from agricultural income.

4.4. Factors Influencing Eucalyptus globulus Dependency

The Eucalyptus dependence level of local communities was calculated using the relative Eucalyptus income as a share of total household income derived from the consumption and sale of Eucalyptus poles. The level of dependence at the study site (the ratio of Eucalyptus income from the total household income) was 87% on average. Thus, local communities in the study sites are mainly generated their income from Eucalyptus to improve their livelihoods and living standards. To test the socio-economic variables that influence the Eucalyptus dependency, we ran ordinary least square (OLS).

Agricultural income was negatively correlated with Eucalyptus income. This means that having an additional income diversification will reduce the dependency on Eucalyptus activities. The greater the possibility to make use of different available income sources, the likely lowers the share of Eucalyptus income activity in the total household economy. Landholding size was positively correlated with Eucalyptus income. Having more landholding size, the household income increases relatively. Our results agree with that an increase in landholding size proportionally household income also increases [38].

Education level was positively correlated with Eucalyptus dependence. Our findings contrast with previous results found that more educated households are slightly enhanced the propensity to establish additional Eucalyptus woodlot [15]. People respond to incentives to make decisions in their lives to maximize both utility and profit by comparing marginal benefits and marginal costs. Thus, either educated or not, people need more income to improve their livelihoods and living standards.

The age of respondents was positively correlated with Eucalyptus income. Unlike other agricultural activities, Eucalyptus activities require less management and effort. Thus increasing in age means does not hinder Eucalyptus cultivation. In brief, one of the main characteristics of Eucalyptus is required less management and effort. This is may not true in agricultural activities because as getting older age the ability to participate in agricultural activities is less. This condition forced older people into contracts with their agricultural land or sharecropping. Thus, Eucalyptus activities are the best alternatives for older people instead of agricultural activities.

5. Conclusions

To sum up, our work has led us to conclude that *E.globulus* plays a vital role in communities' livelihood and living

standards. The evidence from our study suggests that *E.globulus* plays a vital role in the economic growth of communities' livelihoods. Our research has highlighted the importance of *E.globulus* in the Chelia District. These findings add to a growing body of literature and substantially to our understanding of *Eucalyptus*' contribution to livelihoods. Although there is a limitation of sample size because of budget, we believe that our work could be a framework for future research and decision-makers. Our study has gone some way towards enhancing our understanding of current knowledge of the quantitative economic contribution of *Eucalyptus* in the Chelia District. Our research suggests that it is important for policymakers to encourage stakeholders to debate about the present development of *Eucalyptus* in Ethiopia and have important managerial implications. We believe that our research will serve as a base for future studies on *Eucalyptus* development in Ethiopia. Further data collection is required to determine exactly how *Eucalyptus* activity affects individual's livelihoods. Our findings suggest the following directions for future research: the role of *Eucalyptus* in sustainable biodiversity conservation, how much contribute to the country's GDP, and how much unemployed dependent on *Eucalyptus* products.

Author Contributions

For research, conceptualization, methodology, formal analysis and investigation, writing original draft preparation, review and editing, resources [Dese Yadeta Edesa].

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Conflicts of Interest

The authors declare that they have no conflict of interests.

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