

Review Article

Annual Income Contribution of Wood Fuel Production from Small-scale Plantation Forest Experience from Farmers in Fagta Lekoma, Awi zone, Amhara, Ethiopia

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Abstract: This study aims to examine the annual income contribution of wood fuel production from small - scale plantation forestry in Fagta Lekoma district of Amhara region, Ethiopia. Household surveys were conducted by following the snowball-sampling technique. The data analyzed by using STATA software and multiple linear regression model also employed to evaluate the contribution of wood fuel annual income from the total annual income of the households. About 9000 Ethiopian Birr (ETB) and (1 USD = 36.8 ETB) household income comes from charcoal selling which is the highest average annual income. The result of multiple linear regression analysis indicates that an increase in one unit (ETB) income from charcoal making leads to an increase in total annual income by 0.972 units (ETB). Annual income contribution of wood fuel production is the largest amount of income recorded followed by annual income from crop production. Plantation forestry plays a significant role not only economically but also by the provision of alternative livelihood options for households. Plantation forestry used as a means of soil reclamation as well as means of households' income. Inaction and implementation of policies supporting plantation forestry sustain rural livelihood by increasing their adaptive potential for shock and stress by creating alternative means of livelihood.

Keywords: Households Livelihood Options, Small-scale Plantation Forest, Means of Household Income, Sustainable Development

1. Introduction

Small scale plantation forests play a significant role in contributing to household income as well as poverty reduction for community level [1]. Small-scale plantation forests for commercial wood fuel production play a significant role in supporting the livelihoods of farmers. Despite the potential of wood fuel contribution for households income generation limited study was conducted. Thus, this study aims to quantify the role of wood fuel production from a small-scale plantation in the Awi zone of Fagta Lecoma district, which found in the Amhara region Ethiopia with the rapid expansion of *Acacia decurrens* and eucalyptus plantation at an alarming rate, especially in recent years.

The contribution of wood fuel production is not only restricted to the provision of energy sources but also provides important income generation options for rural farmers in sub – Saharan

African country which is true for Ethiopian farmers who live in the northern highland of the country [2]. Plantation of trees increasing at an alarming rate worldwide for instance from 1990 to 2000 plantation forest land estimated to be 143.4 million hectares which have a drastic change in terms of expansion estimated from 1980 to 1990 which is only about 25.8 million hectares. The expansion of plantation associated with the cause of social conflicts [3]. Eucalyptus is not only the most planted tree species in the world but also it is the dominant plantation tree in east Africa by covering a total area of 524 million hectares of land [4]. Eucalyptus is mostly preferred species by Ethiopian farmers due to its nature of fast growth, relatively easy management, and the ability to coppice [5]. More than 92000 hectares of eucalyptus plantation were recorded of which about 67% planted by smallholder farmers [6].

The expansion of smallholder's commercial plantation

needs trade-off agricultural crop production land [7]. The production of small scale plantation by farmers fuelled not only by demand for wood fuel from nearby cities but also to reclaim degrade soil and to raise soil fertility which upturns the yield of crop produced [8] especially *acacia decurrense* trees Fagta Lakoma district, Awi zone North-western Ethiopia. Planting of Eucalyptus tree also preferred by a farmer than the production of the crop in the study area due to numerous reasons such as low productivity of crop aggravated by fast-growing demand for wood and wood products as well as fast growth characteristics of the species [9].

Despite the argument of the adverse impact of eucalyptus species on the ecological balance and negative allopathic impact farmers intensively skewed to planting eucalyptus trees on their farmland which creates disputes with agricultural extension agents and local experts [9]. The dispute aggravated by the expansion of tree plantation on productive cropland of which is strongly unsupported by local agricultural experts. The expansion of tree planting on cropland creates a conflict of interest between cropland and tree plantation land [10] so this study tries to seek solutions for harmonizing conflict of interest between farmers and development agents by providing scientific information.

In Ethiopia agricultural land degradation is a series problem that reduces crop production [11]. Loss of cropland productivity push farmers to reclaim their farmland while to bust agricultural production form their land thus farmers decide to expand *Acacia decurrense* planation to their cropland which is the main source of conflict and disagreement between farmers and local agricultural expert in the study area. Forest degradation and intensive farming aggravate the salinity of agricultural land in the study site afforestation and small scale commercial plantation expansion on farmland not only increase soil fertility but also diversify

means of livelihood. On the other hand, a study conducted in Arisi Negele indicates that more than 11% of farmers convert their cropland into eucalypt plantation [5] and states planation woodlots increase at the expense of cropland. To resolve the disputes between farmers and agricultural experts as well as to suggest appropriate innervation conducting this study plays a significant role.

2. Methodology

To examine the role of plantation forest in reducing poverty purposive sampling technique used. Wood fuel producers were identified with local development agents and listed purposively to select 99 respondents from 3 potential Kebeles by following snowball-sampling techniques the study site was selected based on its potential of wood fuel production from small scale commercial plantation. The collected survey data subjected to statistical analysis by using STATA 14 statistical software. To evaluate the economic contribution of wood fuel production for annual income form plantation for a household a multiple regression was used and the result discussed by using descriptive statics such as frequency, percentage mean and standard deviation the result presented by using tables and graphs.

2.1. Description of the Study Site

The study was conducted in the Fagta Lekoma district, which is characterized, by the expansion of small-scale commercial plantation wood lot. The district found 1800 to 2800 m.a.l range of altitudinal variation about 19.5 % of the district covered by forest the mean annual rainfall ranges between 1500 mm to 2500 mm and the mean annual temperature is between 12°C to 22°C which makes the district suitable for tree plantation [8].

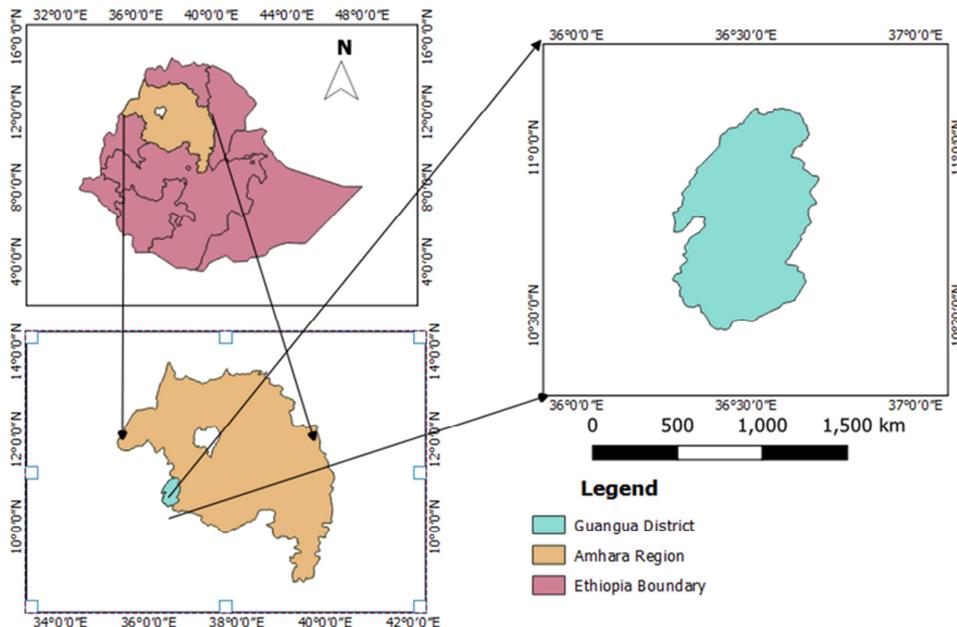


Figure 1. Map of the study area.

2.2. Data Collection and Sampling Methods

To evaluate the contribution of annual income from wood fuel production a combination of purposive and snowball sampling methods was carried out. Based on the potential of wood fuel production three kebeles were selected then following referral sampling method 99 households were selected.

2.3. Model Specification and Variable Description

A multiple linear regression model was used to evaluate the contribution of wood fuel production income for the total annual income of households' and the model specified as follows

$$TAI = B_0 + B_1ICHM + B_2IFWS + B_3IACS + B_4ILVS + B_5INTFP + U \quad (1)$$

Where

TAI = Total annual income

ICHM = Annual income from charcoal making

IFWS = Annual income from firewood selling

IACS = Annual income from crop selling

ILVS = Annual income from livestock selling

INTFP = Annual income from other non-timber forest product selling

B_0 = constant term

B_1 - B_5 = unknown parameter

U = Error term

3. Results

3.1. Summary of Respondents Socio-economic Status

Description of target households was described by using descriptive statistics from a total of 99 households about 93 respondents were male and the rest 6 respondents were female. 89 respondents were married 8 and 2 respondents were unmarried and windowed respectively.

The wealth status of the respondents indicates that about 66 respondents categorized as rich while 32 respondents as medium wealth class only 1 respondent found in rich class. The age of respondents ranges from 19 to 87 years old, which encompass a wide range of age class. Land size ownership varied from 0 to 6 ha. The minimum family size was about 1 while 6 people per household were the maximum family size. The experience of respondents in the year also other variables. The minimum years of experience were about 1 year whereas the maximum year of experience was about 5 year.

Table 1. Description of respondents' socioeconomic status.

category variables	frequency	max	min
sex of respondents			
male	93		
female	6		
marital status			
married	89		
unmarried	8		
windowed	2		
wealth status			
rich	1		
medium	66		
poor	32		
Education status			
Illiterate	33		
primary education	35		
secondary education	26		
Bachelor degree	1		
Informal education	4		
Continues variables			
Age of respondents		19	87
Landholding in ha		0	6
family size		1	11
Permanent residence in years		1	5
Experience in wood fuel production		1	5

Sources survey data (2017)

3.2. Estimation of Wood Fuel Contribution for Households Annual Income

The contribution of wood fuel production for annual income estimated by using multiple linear regression and the result discussed as follow. The result of multiple linear

regression analysis indicates that an increase in one unit (ETB) income from charcoal making leads to an increase in total annual income by 0.972 unit (ETB).

Income from charcoal production is statistically significant sources of income for households in the study area ($p = 0.000$). Firewood selling also another important source of income

which is statistically significant ($p = 0.000$) wood fuel comprises both charcoal production and firewood production

for the generation of income for households from commercial small-scale plantation.

Table 2. Contribution of wood fuel production from the small-scale plantation for household income.

Total annual income	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
Income from annual crop selling	0.9696	0.134	7.26	0.000***	.7042445 1.23498
Income from livestock selling	0.9588	0.264	3.64	0.000***	.4352181 1.482368
Income from bamboo selling	0.9631	0.100	9.63	0.000***	.7644679 1.161696
Income from Fire wood selling	0.8802	0.242	3.64	0.000***	.3999588 1.360407
Income from Charcoal selling	0.9719	0.0592	16.43	0.000***	.8544281 1.089435
_cons	2889.248	1013.356	2.85	0.005	876.923 4901.572
Number of obs = 99					
Prob > F = 0.0000					
R-squared = 0.8499					
Adj R-squared = 0.8418					

*** Significant at 0.01 significant level Source survey data (2017)

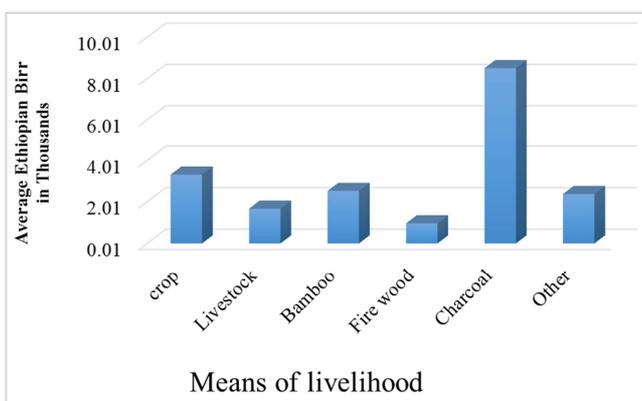


Figure 2. Household income contribution from different livelihood option.

Comparison of Livelihood Contribution for Household Annual Income

Annual income contribution of wood fuel production is the largest amount of income recorded followed by annual income from crop production while the thread rank occupied by income from bamboo livestock and firewood play important

role in generating annual income. The average annual income of households indicates that about 9000 Ethiopian Birr (ETB) comes from charcoal selling which is the highest average annual income. Cereal crop selling contributes about 3000 ETB, selling of bamboo and livestock generate 2000 ETB and 1000 ETB respectively.

3.3. Order of Livelihood Contribution for Household Annual Income

Charcoal making is the most important source of livelihood income from small-scale plantation forests. The second most important source of income for households from their plantation is firewood selling while bamboo is the third important plantation forest means of income. The order of importance for the contribution of plantation forest for households' livelihood indicates Charcoal production and selling account major annual household income. Plantation forests account for a significant portion of livelihood means in the study area.

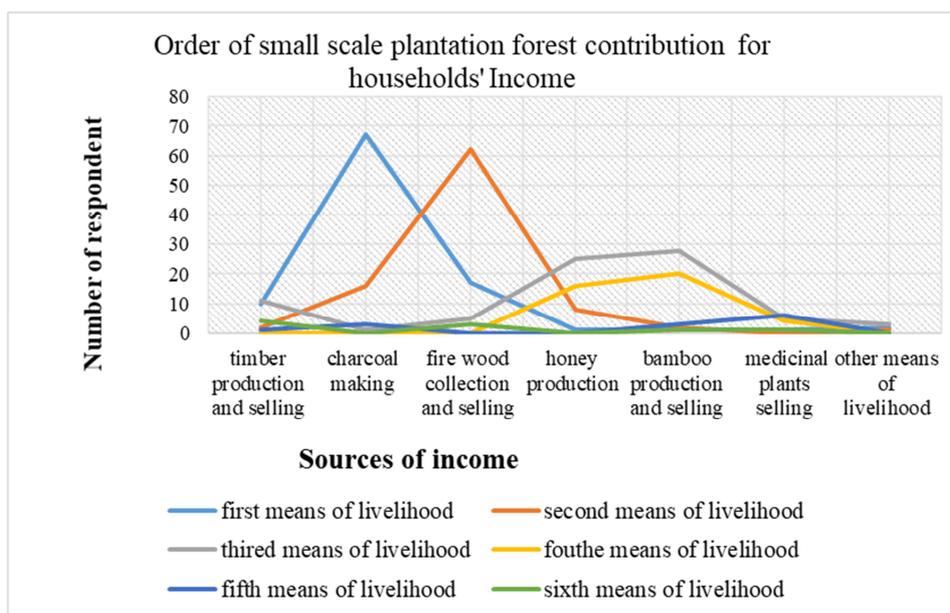


Figure 3. Order of small-scale plantation contribution for annual household income.

4. Discussion

Generally the role of small-scale plantation forest for households' income significantly important in reducing poverty. Besides reclamation potentials of forest plantation, it diversifies livelihood options for farmers to increase resilience from risk and shock caused by climate change. Soil salinity is a major problem challenging crop productivity thus farmers innovate *acacia decurrens* to reclaim their farmland intercropping also the farming system used by farmers to boost land productivities. Even if a large number of farmers establish their livelihood on crop production but the average annual income from wood fuel production and selling is larger than average annual income from crop production that shows small-scale plantation forestry play important role in reducing poverty. Promoting specialization in the production of wood fuel specifically and plantation forestry at large helps to build green economy development.

5. Conclusions

Due to the misconception of local agricultural experts about the economic contribution of plantation forestry the disfavor farmers to expend tree plantation on their farmland. The study also found that charcoal production and firewood production for markets provide higher average annual income for households than other non-crop means of income. Modernizing the process of wood fuel production system reduces environmental pollution while decreasing the risk of wood fuel production. More study needed to reduce the damage due to disease and pest in the plantation sector while diversifying the number of fast-growing tree species [10]. Households engage in crop production, wood fuel production, livestock production, bamboo production, and formal employment as their sources of livelihood in the study area. Participation in plantation forestry diversify means of household income while creating shock resilient society.

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Conflicts of Interest

The authors declare that they have no competing interests.

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