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An Assessment on Socio-Economic Impacts of Smallholder *Eucalyptus* Tree Plantation in the case of Northwest Ethiopia

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Abstract

The availability of forest products determines the possibilities for forest-based livelihood options. Plantation forest is a widespread economic activity in highland areas of Amhara regional state, owing primarily to degradation and limited access to natural forests. As a result, tree plantation has become one of the rural livelihood options in the area. Therefore, given the increasing importance of smallholder plantation in highland areas of Amhara Regional States, the aim of this research was to evaluate the extent of smallholder plantation and its socio-economic impact. To address the above-mentioned research, a sequential embedded mixed research design was employed. This qualitative and quantitative information was gathered from both primary and secondary sources. Primary data were collected from 385 sample households, which were chosen using a three-stage, multi-stage sampling method based on the Cochran sample size formula. Both descriptive and inferential statistics were used to analyze the data. Smallholder eucalyptus plantations in the study area were discovered to be common, and they are now part of the livelihood portfolio for meeting both household wood consumption and generating cash income. According to the PSM model's ATT results, income from selling farm forest products certainly contributes more to household total income, farm expenditure per cultivated land, and education spending than non-planter households. As a result, the government must strengthen plantation practices by prioritizing specific intervention areas while implementing measures to counteract the plantation's inequality-increasing effect through a variety of means, including progressive taxation.

Keywords: Smallholder Plantation, *Eucalyptus*, Propensity Score Matching, Average Treatment Effect and Income

Introduction

The livelihood system is the integrated whole of arrangements and activities carried out by households to achieve their intended goal of food security and welfare. Adanch et al. (2013) describe how rural households across developing countries rely on diversified sources of income, and forest resources play an important role in this regard. Forests are important sources of livelihood for millions of people and contribute to the national economic development of many countries. Forests in Africa, such as plants and bushmeat, are frequently used in daily life, providing essential resources for local lives where the state provides no other social protection. According to Isaac et al. (2017), almost two-thirds of Africa's 600 million people rely on forests for their livelihoods, including food security, both directly and indirectly. At least 70% of African families utilize wood as their major source of energy.

Despite their critical importance in livelihood and climate regulation, forest resources are under enormous pressure all over the world, resulting in deforestation and degradation. The pressure is escalating as a result of urbanization, industrialization and, above all, human population growth. Likewise, Ethiopia, with a land area of about 110 million ha, is one of the largest countries in SSA. Historical sources indicate that forest land was the dominant LULC class, accounting for about 35% of Ethiopia's land (EFAP, 1994) and 85% of the highland areas over 1500 masl (Conn,1991). However, recent forest history reveals the conversion of a large amount of forested land to agricultural land.Due to mass deforestation and distraction, for instance, from 1982 to 2016/2017 forest land decreased by about 70% (Mulatu et al., 2019 and Maitima et al., 2009). Rapid population growth, which leads to an increase in the demand for crop and grazing land, wood for fuel and construction, were the major driving forces for the observed LULC changes in Ethiopia (Mulatuet a., 2019). Consequently, the gap between supply and demand is expanding. The intense forest destruction and degradation in Ethiopia and its devastating economic, ecological, and socio-cultural consequences have been repeatedly reported.

As a result, there is a growing awareness that deforestation and forest degradation must be reduced. Plantation forests have frequently been viewed as a "quick fix" solution to the long-standing problem of over-exploitation of natural forest resources. Tree-planting campaigns have a long history in Ethiopia. According to historical records, afforestation began on King Zera-(1434–1468) Yakob's orders in the early 1400s, but modern tree planting using introduced tree species (Australian Eucalyptus) began when Emperor Menillik II (1889–1913) looked into ways to alleviate a shortage of firewood and construction wood in Addis Ababa (Amogne, 2013). Currently, in Ethiopia, these practices mainly comprise three forms: industrial plantation, peri-urban energy forestry, and small-scale plantations (Lemenih and Kassa, 2014). In Ethiopia, small-scale plantations supply the largest volume of wood products used in the construction sector (such as poles and posts) and a significant portion of the biomass fuel consumed in the country. It also covers an estimated area of 754,900 ha out of 972,000 ha of plantation forest in the country (Wondie and Mekuria, 2018). Likewise, as indicated in Wondie and Mekuria (2018), the total area of plantation forests in the Amhara region is estimated at 684,000 ha, of which industrial plantations are 44,600 ha and non-industrial small-scale private plantations are 639,400 ha.

The availability of forest products determines the prospects for forest-based livelihood options. In highland areas of Amhara regional state, plantation forest is a wide-spreading economic activity, mainly attributed to the degradation and limited access to the natural forests (Mulatu et al., 2019, Bekele 2011, BoEPLAU 2015, and Wubalem et al., 2015). In most areas, the plantation is produced not only to fulfill household wood demand but also for its cash value (Sirawdink et al., 2011; Tilashwork et al., 2013). Thus, tree plantation has become one of the forms of on-farm diversification towards agricultural secondary activity. "Agricultural Secondary Activities" are activities mainly related to activities other than agricultural commodities production but that are connected with them (Eurostar, 2013). In the region, the overall forest resources have shown a slight increase in area coverage for the last 15 years. Smallholder plantations supply the largest volume (Lemenih and Kassa, 2014). *Eucalyptus Camaldulensis and Eucalyptus* Globulus are among the preferred species for plantation in Ethiopia (Sultan et al., 2018).

People in the area rely on wood for a variety of things, including firewood, construction materials, medicine, and food (Langat et al., 2016). The economic potential of exotic tree species has led to the expansion of plantations not only on marginal lands but also the conversion of crop lands to woodlots (Yitaferu et al. 2013; Lemeneh and Kassa, 2014; Tadesse et al. 2015). Thus, the current trend of small-scale plantation expansions in the region indicates the popular acceptance of forest plantations as an attractive business for smallholder farmers in the region (Bekele, 2011; BoEPLAU, 2015; Wubalem et al., 2015). Though smallholder plantation is an important strategy by which rural people work to achieve sustainable livelihoods, it is one that generally operates in combination with other livelihood strategies that also contribute to the formation of sustainable livelihoods. Therefore, given the increasing importance of smallholder plantation in the highland areas of Amhara Regional States, the central question about plantation is whether and under what conditions diversification increases or decreases overall rural development. Despite the rapid expansion of smallholder plantations and the debate over the ecological impact of eucalyptus plantations in the region (Gil et al., 2010; Okia, 2009; and Zegeye, 2010), only a limited attempt has been made to assess the socioeconomic impact of smallholder tree plantations on the livelihood system.

Hence, from all the above backgrounds, it is essential in this research to evaluate the extent of smallholder plantation and its socio-economic impact. For this, both descriptive and inferential statistics and new data from selected districts in ANRS were used. The findings of this study will provide a clear picture of the extent of small-scale plantation and its impact on policymakers, allowing them to make appropriate policy interventions and possibly diverting policy focus.

Methodology

The current study used a sequential embedded mixed method where qualitative data was used as a supportive data set. The supportive data set can be gathered before and after data collection and analysis of the primary data type of a specific study using the sequential embedded mixed method. The supportive data set (e.g., qualitative data) is typically used first to understand the research context and participants, as well as to develop survey instruments. They are then used to follow up on and explain quantitative results. The quantitative data for this dissertation was based on a "single-round cross-sectional survey" with some retrospective questioning. Qualitative information was collected using FGDs and KIIs. The intention to gain a deeper understanding of the consequences of farm household livelihood strategies necessitated a focus on selected sample districts. Thus, the study was conducted in three districts of northwest Ethiopia. The respective administrative districts in the zone are selected purposefully with a set of criteria such as the prevalence and expansion of smallholder tree plantations, access to the market, and socioeconomic conditions.

Primary data was collected from 385 sample households. To determine the size of the sample for the survey, the Cochran formula was used for its potential to allow calculating an ideal sample size given a desired level of precision, desired confidence level, and the estimated proportion of the attribute present in the population (Cochran, 1977). The formula is:

$$n_0 = \frac{Z^2\, p * q}{e^2} = \frac{(1.96)^2\ (.5)(.5)}{.05^2} = 385\ households$$

Where; e is the desired level of precision (i.e. the margin of error), p is the (estimated) proportion of the population which has the attribute in question and q is 1 – p.

Methods of Data Analysis

To analyze both qualitative and quantitative data in this study, descriptive and inferential statistics were used. The study used an econometric model to determine the socio-economic impact of smallholder plantations. It assesses the effect of smallholder tree plantations on farm household income, income distribution, use of improved farm inputs, and education. The study assumed that tree planting is a program intervention, where households that participate in tree planting are treated while households that do not are not controlled. The main challenge of an impact evaluation is determining what would have happened to the program's beneficiaries if it had not existed (Khandker et al., 2010). Thus, in PSM, to evaluate the impact of a program on the population, it is possible to compute the average treatment effect (ATE) as:

$$ATE = E[\tau] = E(Y1 - Y0)$$

$$ATT = E(\tau/D = 1) = E[(Y1 - Y0)/D = 1] = E(Y1/D = 1) - E(Y0/D = 1)$$

Where *E (Y1/ D=1)* is the average outcome of those households who participated in non-farm employment/tree plantation and *E (Y0/D=1)* is the average outcome of those households if they were not participated in non-farm employment and tree plantation.

Table 1. Covariates, outcome and treatment variables included in PSM model

VARIABLE NAME	SYMBOL	DEFINITION OF THE VARIABLE AND ITS MEASUREMENT
SELECTION VARIABLE		
Participation in small-holder plantation	PPWOOD_OWN	Binary, 1 if the Household having planted trees; and 0 otherwise
OUTCOME VARIABLES		
Household Income	HH_INCOME	Continuous, amount of annual household income which is generated from different income generat-ing activities
Improved Agricultural Input Use	AGRI_INPUT	Continuous, amount of annual household's spend-ing in birr for the purchase of improved agricultural input (fertilizers, improved seeds, and pesticides and insecticides).
Education spending	EDU_SPEN	Continuous, annual amount of birr spent for educat-ing household members who are currently enrolled in education.
COVARIATE VARIABLES		
Age of household head	AGE_HH	Continuous, Age of household head in years
Family size	FAM_SIZE	Continuous, Total sizes of household member takes the value of 1, 2, 3….
Sex of Household Head	SEX_HH	Binary, 1 if the household head is male and 0 if household head are female
Household head Edu-cation status	HH_EDU	Binary, 1 if the household head is literate and 0 if household head is illiterate
Farm Size	FARM_SIZE	Continuous, Land size holding of the household in hectare
Soil Quality of Land	INFER_LAND	Continuous, Proportion of landholdings perceived as "infertile in quality"
Livestock ownership	LIV_OWN	Continuous, Total livestock ownership in tropical Livestock unit (TLU)
Credit Access	CREDIT_ACC	Binary, 1 if households were access credit within the last 5 years and 0 otherwise
Exposure to Drought	EX_DROUG	Binary, 1 if households were exposed within the last 5 years and 0 otherwise

VARIABLE NAME	SYMBOL	DEFINITION OF THE VARIABLE AND ITS MEASUREMENT
Exposure to flood	EX_FLOOD	Binary, 1 if households were exposed within the last 5 years and 0 otherwise
Occurrence of insect and pest side	INS_PEST	Binary, 1 if Insect and pest are perceived as problems and 0 otherwise
Land irrigation	RISK_OCC	Binary, 1 if households own land of any size which have potential for irrigation; and 0 otherwise
Road access	ROAD_DIS	Continuous, amount of walking time to all-weathered roads (walking/ minute)
Participation in non-farm employment	PPNON_FARM	Binary, 1 if the household participate in any non-farm employment (NFE); and 0 otherwise

Results and Discussion

One of the most important long-term cash crops planted on the farm in the study area is the eucalyptus tree crop. It was discovered that almost all households in the study area plant eucalyptus trees for their own consumption as well as for the market in the form of boundary trees or woodlot plantations. Growing and planting Eucalyptus trees on farmlands in the form of woodlots has become common practice in the study area, and it is now part of the livelihood portfolio for meeting both household wood consumption and generating cash income. Tree plantation is widely regarded as a transition from traditionally grown less profitable crops to more profitable crops. It was discovered that 52.5 percent of the households in the study own woodlot plantations of at least 0.125 hectares or half-Timada (Figure 1). As can be seen in Figure 1, highland areas had a higher proportion of woodlot planters (85.6 percent) than midland areas (27 percent). *Eucalyptus Camaldulens* is grown in the midlands, whereas *Eucalyptus Globulus* is mostly found in the highlands. In 2017, Kebede (2017) discovered similar findings in his assessment of the expansion of eucalyptus woodlots and their factors in southern Ethiopia, where he found 58 percent of eucalyptus woodlot planters. As a consequence of its economic value, eucalyptus tree plantations have become one of the dominant types of crop in the study area. Similar findings were also revealed by Abebe (2019), Duguma (2013), and Hailemicael (2012).

Households in the study area established their eucalyptus woodlots primarily by converting other land-use types. Approximately 81.5 percent of households had converted their cropland to woodlot plantation.

Econometric Results

Livelihood outcomes are the goals that households want to achieve as a result of pursuing livelihood strategies. This section is devoted to the econometric analysis of the variables used for the estimation of the socio-economic impacts of smallholders’ plantations. After the assumptions were tested, there were four major tasks to complete before presenting the impact of smallholder tree plantations. First, propensity scores for all households should be calculated. It is to predict the propensity score of characteristics that are not affected by the treatment variable. Secondly, a common support condition should be imposed on the propensity score distributions of adopters and non-adopter households. This includes discarding observations whose predicted propensity scores fall outside the range of the common support region. Third, an appropriate matching estimator was chosen and before assessing the impacts of adoption, the quality of matches was tested in order to check for the fulfillment of common support conditions and ensure that the distribution of the variables between treated and controlled is balanced.

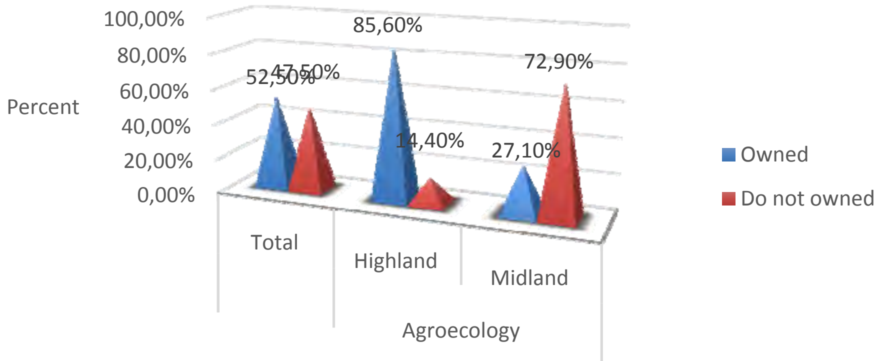

Figure 1. Smallholder Eucalyptus woodlot ownership

Estimating the Propensity score

The Probit model results calculated individual propensity scores that were used to match households engaged in smallholder plantations with those who do not. The covariates are depicted in Table 1. After selecting covariates, the "pscore" command in STATA software was used to estimate the propensity score. The result of the Probit regression is depicted in Table 2. The result shows that the probit regression fits our data well, which is chi2 (14) = 357.57, Prob > chi2 = p 0.001 and Pseudo R2 = 0.6711. This in general suggests that the PSM model fits the observed data well. However, a parameter estimate of the model is not a big concern in propensity score estimation (Khandker et al., 2010).

Table 2 Result of Probit regression model

Variable	Coefficient	Std.Err.	P>Z
Constant	1.220	0.831	0.142
SEX_HH	-1.165***	0.373	0.002
HH_EDU	0.072	0.269	0.789
CRE_ACCSS	-0.707**	0.233	0.002
AGE_HH	0.177	0.141	0.208
AD_FAMSIZE	-0.468***	0.069	≤ 0.001
ADU_LR	-0.000	0.004	0.993
FARM_SIZE	2.256***	0.252	≤ 0.001
INFER_LAND	0.011**	0.004	0.010
ROAD_DIS	-0.021***	0.006	≤ 0.001
FLOOD_OCC	0.307	0.430	0.475
DROU_OCC	-0.383	0.292	0.191
LAND_IRR	0.234	0.299	0.433
PPNON_FARM	2.215***	0.389	≤0.001
INS_PES_OCC	-0.430	0.300	0.151
Number of Observation = 385 LR chi2(14) = 357.57 Prob > chi2 = ≤ 0.001 Log likelihood = -87.606966 Pseudo R2 = 0.6711			

Overlapping or Presence of Common Support conditions

ATT is only defined in the region of common support. Checking the overlap and the region of common support between treatment and comparison groups is an important step. The minimum and maximum comparisons were made for setting the common support conditions (Caliendo & Kopeinig, 2008). Thus, the regions of common support are those within the range of the lowest and highest estimated values for households in the treatment group. Accordingly, the common support area is occupied (Endeshaw, 2016). The recognized region of common support was between 0.026 and 0.983. Additionally, visual analysis of the density distribution of the propensity score is a straight-forward and easy way to identify whether there is a presence of overlap. Thus, **the "ps-graph"** command was run in STATA to see the density distribution of estimated propensity scores for the two groups of farmers. As demonstrated in Figure 2, the condition for common support is fulfilled because of substantial overlap in the propensity score distributions for the two groups depicted. This means that the covariates observed in the treated group are also observed in the non-treated group.

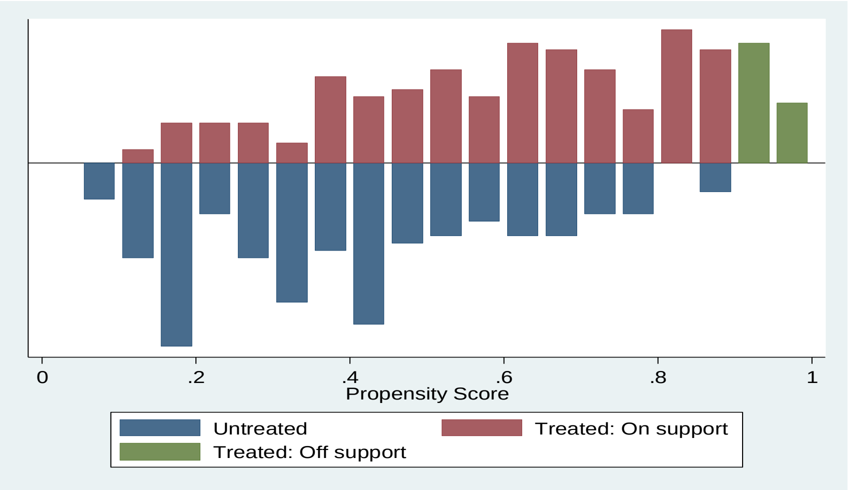

Figure 2 Common support graph (psgraph)

Selecting and Evaluating Quality

Once a balanced propensity score has been created, the next issue is selecting appropriate matching strategies. The choice of the best matching algorithm was from among the three best matching algorithms: (1) Nearest Neighbor matching, (2) Kernel Matching, and (3) Caliper Matching. In this research, following the work of Tolemariam (2010), Caliendo and Kopeinig (2008), and Stuart (2010), joint significance, low pseudo-R2 values, and large matched sample size (number of covariates with no statistically significant mean difference between planter and non-planter) were found. Hence, for the model specified to evaluate the impact of smallholder tree plantation nearest neighbor matching algorithm, which provides an insignificant mean difference among all explanatory variables after matching between treated and control groups, a large matched sample (338 samples) is chosen as the best matching estimator. Moreover, to test the robustness of the matching technique, "**pstest/t-test**" and "joint significance test" were used to check the matching quality. As previously stated, the final number of blocks used to investigate the impact of plantation was 5.The result ensures that the mean propensity score is not different for planters and non-planters in each of the five (5) blocks (see Table 3).

Table 3. Test of propensity score balance in each block

Block of the pscore	Smallholder Tree Plantation			
	Comparison group (n)	**Treatment group (n)**	**Total**	t-test for matches
Block 1	88	13	101	0.2552
Block 2	28	10	38	0.9794
Block 3	29	13	42	0.8576
Block 4	11	18	29	0.3863
Block 5	27	101	128	0.8374
Total (n)	183	155	338	

Note: the last column in this table indicated p value of the mean propensity score for each block.

ATT Estimation of impact of smallholder tree plantation and non-farm employment (socio-economic impacts)

Propensity score matching was used in order to compare the mean difference between treated and control households. The ATT (average treatment on the treated) difference between planter and non-planter groups, as well as households engaged in non-farm employment versus those not, was then calculated. Hence, Table 4 depicted the impact of a smallholder's tree plantation on household total income and household agricultural and educational expenditure. As discussed above, the average treatment effect on treated (ATT) was calculated using nearest neighbor (NN) matching.

Table 4. Result of ATT on socio-economic impact of smallholder tree plantation

Intervention	Outcome Indicator	Average		Impact	S.E	T-Test
		Treated	**Controls**			
Smallholder tree plantation	Income	66866.68	38147.95	28718.73	10795.97	2.66**
	Purchase of agricultural inputs	3057.10	2152.03	905.06	1264.28	3.51***
	Educational expenditure	1868.20	1041.41	826.79	235.64	3.27**

Note: S.E does not take into account the propensity score estimation; * and ** means significant at 1% and 5% probability levels, respectively.

Plantations help local economies and rural livelihoods in many mountainous regions, where poverty and environmental degradation are frequently linked. The ATT result depicted in Table 4 shows that farm households engaged in tree plantation have higher household total income, farm expenditure per cultivated land, and education spending than non-planter households, which is consistent with the researcher's expectations and the descriptive analysis. The average annual income of tree plantation households is 66,866.6 ETB, which is 42.9 percent (difference value/treated value)* 100) higher than that of non-planter households. The mean difference was significant at 5% p-values. This indicates that smallholder tree plantations have a significant impact on household income. The average annual income of non-planter households is 38,147.9 ETB. This leads to the viable proposition that households participating in plantations set a prior aim of generating cash income. This finding is consistent with those of Kebede (2017) and Shibire and Jürgen (2017). Perhaps it is because tree plantations provide more financial benefits to households than crop farming (Lemenih and Kassa 2014; Kebede 2017, Duguma 2013). *Eucalyptus plantations have become the* *most profitable cash crop* .This is the main reason that a small-scale plantation at a farm level in the form of a woodlot has become popular among rural households and has become one major component of their livelihood portfolio both for meeting household wood consumption and generating cash income (Kebede 2017, Tegegne et al. 2018 and Abebe et al. 2019). Consequently, lots of farmers have also converted their farms to eucalyptus and diversified their income sources.

Furthermore, as described in the previous section's descriptive analysis, households select farming practices based on a variety of criteria. Among these, the household's land size, an available resource like capital, and labor are the decisive factors. As a result, because tree plantation is a long-term investment, rich households with enough land to cultivate and other sources of income such as non-farm employment and remittance allocate more land for tree plantation from the start. It is because farmers who have small landholdings and have no other sources of income may be exposed to temporary poverty if the land they own is small enough to produce annual crops for consumption. Woodlot adoption was related to household wealth class (Eshetu, 2018).Households in a better-off category often own more land as compared to the poor, which helps them decide to allocate part of their land for woodlot. In addition to a household's wood needs, the better-off households want to diversify their income (Shibire and Jürgen, 2017 and Mamo et al., 2007).

The ATT result in Table 4 shows that farm households engaged in tree plantation have higher family expenditure per cultivated land than non-planter households. Agricultural productivity is the leading component and it is a prime pre-requisite for the growth of developing countries. Modern agricultural input use, which is measured in terms of monetary spending on the purchase of such inputs (for example, fertilizer, improved seeds, insecticides, and so forth), is the only means to augment agricultural productivity in Ethiopia. On average, tree planter households spend 3,057.10 ETB per hectare of cultivated land, whereas non-planter households spend only 2,152 ETB. Thus, households engaged in tree plantation spent 29.6% more money on new farm inputs per hectare of crop land, which is significant at a p-value of 1%.

Thus, it was discovered in this study that households with woodlot plantations use more improved farm inputs than households without plantations. It means that the sale of Eucalyptus poles and other products has the potential to raise farm incomes, which may be used to buy agricultural inputs. Moreover, key informants argued that the tree stand itself helps the farmer access credit to buy farm implements from formal and informal sources. Furthermore, tree plantation increases the marginal productivity of land. As a result, farm households strive to intensify their land so that the land covered by annual crops is as productive as the land covered by tree plantations. It is also important for farmers because it can be used to make farm implements and fences for crop-covered land. This finding, however, contradicts the findings of Fentahun et al. (2016). They conducted an analysis of the impact of plantation on household farm spending and discovered that as the level of plantation increased, household farm spending decreased. The possible justifications were that planter households may spend more of their plantation income on consumption, particularly manufactured consumer goods, which are highly income elastic, as well as the purchase of other asset-bearing activities such as livestock, house construction, and the like.

The accumulation of human capital has been shown to be crucial for economic growth and poverty reduction. Education is one of the most basic services that allow people to improve their skills and knowledge, thereby boosting economic growth and reducing poverty. Individuals and society benefit from higher educational achievements. Individuals may benefit financially as well as contribute to societal well-being from these benefits. Planter households spend approximately 826.79 birr (44.2 percent) more on education than non-planter households. At a 5% p-value, the impact is significant. The reason could be that planter households have earned more money, particularly from plantations. Although the government funds the majority of education investments in Ethiopia, most families contribute to their children's education on their own dime. According to Bhalotra and Heady (2003), education expenditures are determined by the income level of the household.

Furthermore, as described in the preceding section, a plantation requires fewer laborers, allowing school-aged household members to attend school, and educational spending rises in proportion to the number of students enrolled. This could be because, as Ranjan (2001) observes, in rural areas, the decision to send a child to school is heavily influenced by the direct and indirect costs to the household and their ability to afford them. Clothing, books, transportation, and school fees are examples of direct costs. Indirect costs include lost wages for children if schooling competes with paid work, as well as lost unpaid labor on the family farm or doing housework. Furthermore, plantations are a cash crop that produces more liquid and divisible assets than other assets, making it easier for households to access funds for education and other related costs. BLlanden et al. (2002) and Fentahunet al. (2016) observed comparable findings.

Conclusion and recommendation

The purpose of this research is to look into the socioeconomic effects of smallholder plantations on a rural household livelihood system in Ethiopia's Amhara region. Smallholder eucalyptus plantations in the study area were discovered to be common, and they are now part of the livelihood portfolio for meeting both household wood consumption and generating cash income. For many households, it has become an important land-use option. Tree plantations are widely regarded as a transition from traditionally grown, less profitable crops to more profitable crops. According to the ATT results of the PSM model, income from selling farm forest products contributes significantly to household total income, farm expenditure per cultivated land, and education spending. Households on tree plantations earn 42.9 percent more per year than non-planter households.Farm households that plant trees spend more per acre of land than non-planter households. Households in tree plantations spent 29.6 percent more on new farm inputs per hectare of crop land.Furthermore, planter households spend 826.79 birr (44.2%) more on education than non-planter households.

Thus, while farm forest plantation is not a cure-all for rural poverty, households' decisions to adopt such land-use can undoubtedly help them cope with emergencies while also preventing them from falling further into poverty by increasing household annual income, on-farm investment, and enhancing their efforts to build human capital. According to the findings, plantations have a positive impact on household income, agriculture, and education investment. As a result, the government must strengthen plantation practices by prioritizing specific areas of intervention in the sector through the development of policies, programs, and projects for effective rural development. Nevertheless, at the same time, efforts must be made to overcome the inequality-increasing effect of plantations through a variety of methods, including progressive taxation.

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