Impact Factor (SJIF): 3.484 E-ISSN: 2583-7206

International Journal of All Subject Research

Received: 05/November/2023 IJASR: 2023; 2(6):22-29 Accepted: 03/December/2023

Factors Influencing Farmers Decision for Plantation of Eucalyptus Woodlot and Its Status in North Mecha District North-West Ethiopia

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Abstract

The major objective of this study was analyzing factors influencing farmers decision for plantation of eucalyptus woodlot and its status in North Mecha district. Multi-stage sampling technique was employed for household survey. Household survey of 166 farmers, key informants and FGD were employed to collect primary data. Descriptive statistics, inferential statistics and binary logistic regression were used as data analysis methods. The results confirm that, the average area was changed 41%, 4% and 6%, from annual crop land, grazing land and perennial crop land to eucalyptus woodlot, respectively. Further different socioeconomic factors that contributed or hindered for eucalyptus expansion were; parcel number, family size and total land holding. These three factors had positive significant impacts on farmers decision whereas, frequency of extension contact, family labor and sex had negatively significant. The study concludes that due to the existence of the above factors & lack of awareness about eucalyptus plantation, the farmers' plantation expansion continues. Therefore, it is recommended that the ministry of agriculture should develop and implement awareness and education program aimed at educating farmers on benefits and problems associated with Eucalyptus planting and introduction of high productive and market value agricultural technology.

Keywords: Binary logistic, Decision, Factors, North Mecha, Woodlot

Introduction

Eucalyptus is the species most widely introduced overseas and is a long and evergreen woodlot from the Myrtaceae family [1]. Eucalyptus, a genus of more than 800 species, has become the most planted genus of woodlots in the world [2]. The most eucalyptus growing countries are China, India and Brazil (170, 2.5 and 3.7 million ha) [3, 4, 5, 6, 7]. In Africa, South Africa is the largest growing country under eucalyptus plantation about 515000 ha [8].

In Ethiopia eucalyptus was introduced during Emperor Menelik II (1868-1907) from Australia to Ethiopia for construction and firewood requirement of people in Addis Abeba at the back of deforested native woodlots around the town. The common eucalyptus species *are: Eucalyptus globulus* locally known as *Nech-Baharzaf* and *Eucalyptus camaldulensis* locally known as *Key-Baharzaf*. However, *Eucalyptus grandis, Eucalyptus saligna, Eucalyptus veminalis, Eucalyptus citiodora and Eucalyptus bicostata* are also wide spread popular species in the country [9]. Currently, Ethiopia has wide area of eucalyptus plantation (506000 ha) in East Africa [10].

Agricultural diversification and monoculture of eucalyptus woodlot plantation have their own advantages and disadvantages. In one hand, the current scenario of eucalyptus plantation influences adjacent food crops that make it to become the crops yield; which could be due to the competition soil wetness and nutrients and shade effect of the fruit tree [9]. On the other hand, agricultural diversification is one of the most likely paths to advertise the development of agriculture in Ethiopia [11]. Also transforming from monoculture to diversified agricultural practices not only generate employment resource, but also makes bridge market efficiency gaps [12]. Despite of these facts, farmers in Ethiopia convert the farm land from ecologically and economically diversified agrobiodiversity into monoculture eucalyptus woodlot plantation stands, which in turn affects the animal fodder and human nutrition security of the community in the study area. It makes the land poorer and poorer, that other plants and crops cannot survive in this zone [13].

In the northern district of *Mecha*, eucalyptus has been grown by farmers on large scale, converting the fertile farmland from time to time [14]. In this regard, even if the area has the potential for vegetable cultivation, cereal crops and edible fruit trees with rain fed and irrigation are highly suitable for the study area, fertile land has been converted to monoculture eucalyptus woodlot planting [14].

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Numerous factors that affect the decision to plant eucalyptus trees are identified by the results of a long-running literature review on the adoption of eucalyptus woodlots. For instance, Berihun and Habtemariam [15] note that some of the primary reasons for the decision to establish a eucalyptus plantation include, among others; an increase in the current market demand for domestic and export wood products; increased housing construction from time to time as a result of urbanization; and high input price (notably, improved seed, chemical fertilizers, insecticides, herbicide and disease). Similarly, Setiye and Mulatu, [16] socioeconomic, institutional, and demographic factors are how farmers decide whether to plant eucalyptus woodlots.

Considerable studies have been conducted on the driving forces and impact of Eucalyptus tree in different parts of the world as well as in our country Ethiopia, and most significantly on identifying determinants of the adoption of eucalyptus tree.

However, most of the literatures were based on a its determinants (mostly the reasons to plant) than the current status of eucalyptus woodlot plantation. Specifically in the study area where the current study was conducted, no empirical research on the factors influencing farmers decision of eucalyptus plantation and its status have been conducted. Thus, with the pursuit of filling the gaps identified in the above problem statements, the current study on analyzes factors that influence farmers' decisions and the status of eucalyptus woodlot plantation in the study area.

The conceptual framework of the study focused on linking the relationship between socio-economic, demographic, institutional and their implications on planting eucalyptus woodlot decision.

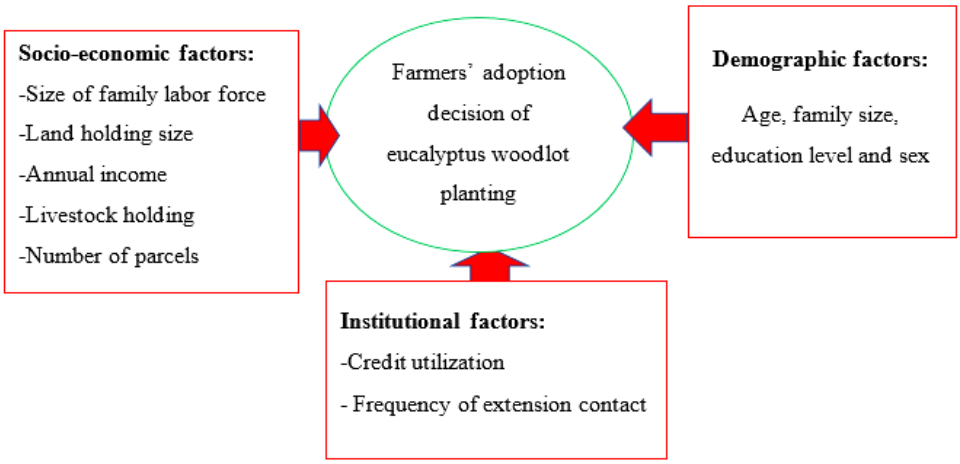


Fig 1: Factors influencing farmers decision for eucalyptus plantation (Enriched) [16, 17].

Materials and Methods

The study was carried out in North Mecha District which is located 34 km far from Bahir Dar and 525 from Addis Ababa [14]. It is in the middle of the highway between Bahir Dar and Injibara.

The research design used to achieve the objectives of this study was a cross-sectional survey employing both qualitative and quantitative comparative approaches; whereby the whole data collection processes complement each other. Cross-sectional survey was considered appropriate because it is effective in providing a snapshot of the current behavior, attitude and belief in a population and has an advantage of providing data relatively quickly and the data collected from the selected individual at a single point in time (Creswell, 2012; Gay *et al*., 2009) as cited by [16]. Multi-stage sampling procedure was employed to generate primary data. First, north *Mecha* district was selected purposively due to its experience on large coverage of eucalyptus plantation and the experience of the author in knowing the area. Second, the 33 *kebeles* of the district were classified into two groups based on the eucalyptus woodlot cover that have high eucalyptus cover (17 *kebeles*) and low eucalyptus cover (16 *kebeles*) by using stratified probability sampling within the guidance of the district expert and professional observation. Then, the two *kebeles* were chosen from the 17 *kebeles* that have high eucalyptus woodlot cover and two *kebeles* were chosen from 16 that have low eucalyptus woodlot cover by using simple random sampling. Finally, as the household was considered as basic sampling unit, 166 households (58 household heads from Tekledib, 33 household heads from Midre-genet, 21 household heads from Enamirt and 53 household heads from Enashenifalen) kebeles were selected using systematic sampling techniques proportional to the population.

In order to collect reliable and representative sample out of the targeted population the sample size was determined by applying the scientific formula [18] as shown below. The possible justification for preferring this scientific formula was to reduce bias and maximize accuracy.

$$n=\frac{Nz^2PQ}{d^2(N-1)+z^2PQ} \quad (1)$$

According to the formula the sample size was determined with some degree of precision for the general population. Since the rural households' homogeneity character and distance of village to village was ensured, takes error term 0.07.

$$n=\frac{5011*(1.81)^2*0.5*0.5}{(0.07)^2*5010+(1.81)^2*0.5*0.5}=\frac{4104}{25}=166$$

Where: n = sample size of housing units (household head); P= probability of success (eucalyptus grower in terms of percentage); Q=probability of failure (non-grower eucalyptus woodlot in terms of percentage) =1-P; N=Total number of housing units; Z=standardized normal variable and its value that corresponds to 93% confidence interval equals 1.81; d = precision error (0.07).

According to data obtained from the district administration office, there were 4175 housing units (N) in the four *kebeles*. From these about 50% (P) were of eucalyptus woodlot grower and the rest 50% (Q) eucalyptus woodlot non-grower.

Therefore, n = 166 is the minimum sample size of housing units or household head. By taking the list of farmers in each *kebele* from the local administration, 166 farmers were selected through the procedure of systematic random sampling.

This study attempted to integrate the quantitative and qualitative data. Generally, information has been collected from secondary and primary sources. Various documents (published and unpublished) were reviewed to collect secondary data. Different websites were browsed to obtain secondary data and ideas related to the issues under investigation. In addition, relevant theoretical literatures and empirical studies done in the country and in other developing countries were reviewed. While, primary data were collected from household survey structure questionnaire, FGD, and key informant interview.

Structured interview schedule was used to collect quantitative and qualitative data from farm households that were used to assess the determinants that influence the farmers whether decide or not to decide eucalyptus woodlots plantation. Questions include socio-economic characteristics, institutional and other enabling factors. A sum of 166 farmers were considered in the household survey. Firstly, the questionnaire was prepared in English and later it was translated into Amharic (local language), to prepare the question simple, readable and understandable to the respondents. In addition, enumerators were oriented to have a common understanding regarding the data collection instrument. The household survey was conducted through a door-to-door interview between the farmers and the interviewer at the holy days.

The data collected through tablet-based data collection with the help of kobo toolbox data collection software. This is a data management tool, which helps for the data made reliable, save time and resource. Pre-trial was taken before the household survey. This assisted the author to know whether there was a need to change the questionnaire based on the feedback from the pre-trial. As a result of pre-test, it was found that rewording of difficult terms and modification of questions.

Descriptive statistics such as mean, percent and standard deviation were used to examine demographic, socioeconomic and institutional characteristics. Inferential statistics such as chi-square test was used to identify the relationship between adopter and the non-adopter of dummy and categorical variables and t-test was used to compare the means of continuous variables as method data analysis using SPSS and STATA software.

Specification of Econometric Models

An econometric model, in particular, binary logit regression was used to examine the effect of different socio-economic and institutional factors on the farmers' decision of eucalyptus woodlot plantation. According to Gujarati [19], binary logistic regression is used to identify determinants of the dependent variable; because it represents a close approximation to the cumulative normal distribution, fitted probabilities are between zero and one.

Therefore, in estimating the binary logit model, the dependent variable was adoption decision of eucalyptus woodlot plantation which took a value of 1 if the household had a eucalyptus woodlot and 0 otherwise.

According to Gujarati [19], the functional form of the logit model is presented as follows:

$$Li = \ln\left(\frac{Pi}{1-Pi}\right) = Zi = \beta+\beta1x1+ \beta2x2+ \beta3x3+ \beta4x4\ldots \beta nxn \quad (1)$$

Where; Pi = the probability practicing eucalyptus woodlot plantation ranges from 0 to 1

L=the natural log of the odds ratio or logit

$$Zi = \beta0+\beta1x1+ \beta2x2+ \beta3x3+ \beta4x4\ldots \beta nxn \quad (2)$$

$\beta0$ = the intercept. It is the value of the log odd ratio, $\left(\frac{Pi}{1-Pi}\right)$ when X is zero.

$\beta = \beta1+ \beta2+ \beta3+ \beta4\ldots \beta n$ the slope, measures the change in L for a unit change in X;

Thus, if the disturbance term (Ui) is taken into account the logit model becomes

$Li = \beta0 +\beta1\ X\ i +U\ i$

Many determinants in the study area were hypothesized that influence the adoption decision of eucalyptus woodlot planting. Based on theoretical analysis and empirical evidences, the selection of explanatory variables was carried out.

The explanatory variables were tested for the presence of multicollinearity, heteroscedasticity and normality issues prior to running the logistic regression model.

Multi-collinearity is a situation whereby there exist strong linear relationships among independent variables is more than 75 percent [19]. If at least one of the independent variables is a linear combination of the others, the problem occurs. The presence of multicollinearity could cause the calculated coefficients of regression to have the wrong signs and smaller t-ratios that could lead to incorrect conclusions.

The model variables were tested for multi-collinearity using collinearity statistics variance inflation factor (VIF) and contingency coefficient (CC). Accordingly, variance inflation factor was used to detect the problem of multicollinearity between continuous variables and contingency coefficient was employed to check the presence of multicollinearity problems between categorical and dummy variables [19]. The VIF computed as follows,

$$VIF = \frac{1}{1-R^2}$$

Where VIF is the variance of an inflation factor

R^2= is the multiple correlation coefficients between explanatory variables

According to Gujarati [19], if the value of VIF is exceed 10, this indicated that there is strong multicollinearity problem between continuous variables. Based on the study result, the value of VIF have shown that there is no multicollinearity problem between all independent continuous variables.

Similarly, the contingency coefficient computed as follows.

$$C = \sqrt{\frac{X^2}{N+X^2}}$$

Where, C= contingency coefficient

χ^2= chi-square random variable

N= Total sample size

The decision rule of contingency coefficient when the value greater than 0.75, there is strong multicollinearity problem between dummy and categorical variables, as the result value of contingency coefficients have shown that all value less than 0.75; this implies there is no multicollinearity problem between all dummy and categorical variables.

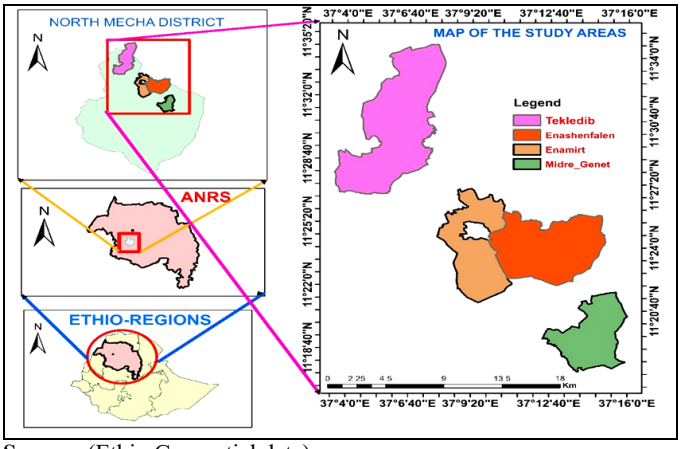
In general, data were found to have no serious multicollinearity problem based on the VIF and contingency coefficient results and thus ten continuous and three discrete explanatory variables were retained in the model.

Heteroscedasticity is identified as a common problem with typical cross-section data. The established procedure for the correction of heteroscedasticity is to estimate the models using robust standard errors. Therefore, the model is estimated using robust standard errors to correct for heteroscedasticity.

Normality problem is common on continuous and discrete variables which reflects outliers and failure of normality. The main solution to correct normality problem is data transformation. In this study, annual income and age of household head were transformed to log10 and age square root, respectively in order to reduce skewness of the data.

Both SPSS and Stata version 20 and 14 was used to estimate the magnitude and effects of factors that determine probability farmers' adoption decision farmers of eucalyptus woodlot plantation.

Determinants of farmers' decision of eucalyptus woodlot plantation was estimated by binary logit model and presented in Table 17. The Wald chi-square value of 41.83 is statistically significant at 1% indicating that the explanatory variables in model explain the probability of adoption decision of eucalyptus woodlot plantation. The goodness of fit the model was measured by using Pseudo-R2. The Pseudo-R2 was computed Pseudo R-square is 0.912. Converting the model's final ratio Pseudo-R2 in to percentage showed that 91.2% of the variance dependent variable was explained by explanatory variables.



Source: (Ethio Geospatial data)

Fig 2: Location map of North Mecha District

Definition of Dependent Variable

The dependent variable of the logit model takes a dichotomous value depending on the farmers decision of eucalyptus woodlot plantation either to adopt or not to adopt the eucalyptus woodlot. Thus, the farmer planting eucalyptus woodlot at least one plot of land will have the value of one otherwise, zero.

Adopters: Farmers who were growing eucalyptus woodlot with minimum demonstration size of woodlot is 0.125 hectare or 0.5 *Kada* land practices on their farm land in three or more years.

Non-Adopters: Farmers who were not growing eucalyptus woodlot in their farm land.

Table 1: Definition of dependent variable

No	Variable	Operational Definition of the Variables
1	Adoption decision	of eucalyptus woodlot plantation, takes the value 1 if the farmer plant eucalyptus woodlot otherwise, 0

Definition of Explanatory Variables

Based on literature review, the following explanatory variables were hypothesized that influence adoption decision of eucalyptus woodlot plantation.

Table 2: Operational definition of explanatory variables

Variables' name	Variable type	Measurement	Exp. Sig
Age	Discrete	Completed year	+
Education level	Categorical	1=Cannot read and write, 2= can read and write, 3=1-4 grade, 4=5-8 grade, 5=9-12 completed grade, 6= above 12 completed grade	(-,+)
Family size	Discrete	Number of households live together	-
Family labor	Discrete	Active labor member in the household (15-64) years	-
Livestock holding	Continuous	TLU	+
Parcel number	Continuous	Parcel number	+
Sex	Dummy	1= Male 0 = Female	(-,+)
Credit utilization	Dummy	0=utilizer, 1=non-utilizer	(-,+)
Extension contact	Continuous	Number of days per year	-
Farmers risk perception	Categorical	1= Very low risky, 2= Low risky, 3= No risky, 4= Moderate risky, 5= Very high risky	+
Total land holding	Continuous	Hectare	+
Annual income	Continuous	ETB	+

Results and Discussion

Demographic and Socioeconomic Characteristics

Establishment of eucalyptus woodlot plantation is a common practice for rural families in Ethiopia in general and in North Mecha District in particular.

Among the total sample household survey of 123(74%) were adopter and 43 (26%) non-adopters of monoculture of eucalyptus woodlot planation.

About 81(65.9)% were male and adopter of eucalyptus woodlot plantation and 41(95%) were male and non-adopter of eucalyptus woodlot plantation while, 42(34.1%) were female and adopter of eucalyptus woodlot plantation and 2(44.7%) were non-adopter of eucalyptus woodlot plantation.

Of the total sample household, about 12(9.8%) were credit user and eucalyptus woodlot adopters and 111(90.2%) were respondents' non-user of credit with eucalyptus woodlot adopter and about 42(97.7%) were user with non-adopter of eucalyptus woodlot and 1(2.3%) were non user with eucalyptus woodlot non-adopter. This implies that when the farmers were access and utilize credit, they could purchase or reduce input constraints so, they transform for cultivation of diversified crops rather than planting monoculture of eucalyptus woodlot Educational level of the sample household heads was about 118(95.9% were cannot read and write with adopter of eucalyptus woodlot and 5(11.6%) were

cannot read and write with non-adopter of eucalyptus woodlot. Of the sample household head 3(2.4%) were attended informal education and included persons that can write and read with adopter of eucalyptus woodlot and 15(34.9%) can read and write with non-adopter of eucalyptus woodlot. 2(1.6% were attended education in grade 1-4 with adopter of eucalyptus woodlot and 11(25.6%) were non-adopter of eucalyptus woodlot, 0(0%) were attended education in grade 5-8 with adopter of eucalyptus woodlot and 7(16.3) were attended 5-8 grade with non-adopter of eucalyptus woodlot, 0(0%) were attended education in grade 9-12 with adoption of eucalyptus woodlot and 3(7%) were non adopter of eucalyptus woodlot, while the remaining 0(0%) were above grade 12 with adopter of eucalyptus woodlot, and 2(4.7%) non-adopter of eucalyptus woodlot plantation.

The χ^2 test analysis showed that, credit utilization, sex and education level have significant association with farmers' adoption decision of eucalyptus woodlot plantation.

Based on the result, the average parcel number was 4.20 adopter and 2.42 non-adopter and it varies between adoption decision, the average annual income varied among adoption decision, 4.75, adopter and 4.99, non-adopter, respectively. While, family size and family labor were not significant in adoption decision.

Livestock were also other important assets of farm households in the study area. The average number of livestock in the sample households estimated to be 2.21 for adopters and 3.60 for non-adopters, respectively in terms of tropical livestock unit.

The average land holding sizes of sample households varied between adoption decision of eucalyptus woodlot, being for adopter 1.72 ha and non-adopter 0.72 ha.

In general, non-adopters were slightly younger, own more resources (mainly livestock), earn more income than the adopters. Moreover, there was a significant difference between adopters and non-adopters with regard to TLU, frequency of extension contacts, age, annual income, parcel number and total land holding at 1% significance level.

Table 3: Household and socioeconomic characteristics

Variables	Category	Adopter (N=123) (%=74)		Non-adopter(N=43) (%=26)		χ 2	p-value
		Frequency	Percent	Frequency	Percent		
Sex	Male	81	65.9	41	95.3	16.809***	.000
	Female	42	34.1	2	4.7		
Credit utilization	User	12	9.8	42	97.7	24.142***	.000
	Non user	111	90.2	1	2.3		
Education level	Cannot read and write	118	95.9	5	11.6	119.16***	.000
	Can read and write	3	2.4	15	34.9		
	1-4 grade	2	1.6	11	25.6		
	5-8 grade		0	7	16.3		
	9-12 grad	0	0	3	7.0		
	Above grade 12	0	0	2	4.7		

Variables	Adopter		Non-adopter		t-value	Sig.
	Mean	Standard dev.	Mean	Standard dev.		
Parcel number (#)	4.20	1.40	2.42	1.18	-7.44***	.000
Age (years)	53.54	11.51	38.56	13.27	-7.06***	.000
Livestock holding (TLU)	2.21	2.22	3.60	2.16	3.57***	.000
Labor force (15-64)	2.84	1.48	2.79	1.19	-.19^{NS}	.852
Family size	4.65	2.24	4.30	1.83	-.92 ^{NS}	.361
Annual income	4.75	.15	4.99	.31	6.94***	.000
Frequency of extension contact	4.07	2.67	11.21	3.36	14.06***	.000
Total land holding	1.72	.54	.73	.39	-11.05***	.000

Note: *** indicate the significance level of continuous variable at 1%
Source: authors' own computation.

Current Status of Eucalyptus Plantation

The research area's predominant woodlot species is eucalyptus. According to survey results based on the total amount of land owned by eucalyptus adopter farmers (202.63 ha, or 100% of the land), 6%t of the land was perennial crops like coffee, gesho, and guava, and 41% of the land was cropland. These results show that eucalyptus is rapidly spreading in the study area at the expense of arable, perennial, and grazing land, which negatively impacts agricultural productivity and yield. due to the study area's growing eucalyptus market demand and declining wood resource.

As a result, crop land was the primary source of the additional eucalyptus planation coverage, which was then followed by other perennial crop areas. Similar to this, a study by (Dereje *et al.*) [20] found that 11% of the field crop area in south central Ethiopia had been turned into a eucalyptus woodlot. The FGD verified that clearance of fruit trees and field crops had occurred in the north Mecha district as a result of eucalyptus planting. However, it was suggested that highlands and dry areas were the best places to plant eucalyptus. According to the district expert and key informant interviews, eucalyptus production in the study area of Ethiopia began under Haile Selassie (1915-1974), but the fast expansion rate

occurred between 1991 and 2007 due to its quick growth, high market demand, and cash flow. Eucalyptus is the species of woodlot that is most frequently planted on the Koga watershed, according to (Tilashwork *et al*) [21]. This suggests that instead of spending money on irrigated agriculture land, the farmers can plant eucalyptus trees in the proper location, according to the district and Kebele informants (KII).

Table 4: Average area cover with eucalyptus woodlot

	Sum	Mean	Std. Deviation	%
Annual crop land cover with eucalyptus	82.75	.4985	.49734	41
Grazing land with eucalyptus	8.65	.0521	.11205	4
Perennial crop with eucalyptus	12.58	.0758	.18374	6
Total land cover with eucalyptus	103.98	.6264	.44832	51
Total land size of eucalyptus adopter	202.63	1.4683	.66853	100

Source: Authors' own computation.

Factors influencing Farmers Decision for Plantation of Eucalyptus Woodlot

The decision of eucalyptus woodlot plantation is significantly determined by six of the 13 explanatory variables. The results of the binary logit model indicate that, frequency of extension contact, parcel number, sex, family size, labor force and total land holding are the significant determinants.

The frequency of extension contact (measured by number of days) was include as separate explanatory variable in the model. The coefficient is statistically significant (0.084) and has a negative effect on the probability of farmers' decision of eucalyptus woodlot plantation. keeping all other factors constant, the frequency of extension contact increased a unit, the farmers who were in contact with extension agent is 72% less likely making the decision eucalyptus woodlot plantation. This result is similar with the study of [17] showed that the farmers who contact with extension worker is less probably decide for plantation of eucalyptus woodlot. This implies that, farmers who have more contact with extension agents had less probability of planting eucalyptus woodlot.

The number of parcels over the distributed land of the household was significant (0.002) and positively associated with the adoption decision of farmers of eucalyptus woodlot plantation. The odd ratio of parcel number showed that if the influence of all other factors remained constant, the parcel number of farm land increased by one unit the probability of deciding of eucalyptus woodlot plantation increased by a factor of 4.2. The result implies that farmer with more dispersed pieces of land is positively connected to the decision to plant eucalyptus woodlot than a diversified agricultural practice. Because, it is difficult for farm technology such as farm machinery and other labor-saving farm technologies when the land is divided into small pieces or dispersed in different locations, so the farmers are not economical for crop farming and they choose to plant eucalyptus woodlot.

Family size was significant (0.024) and positively influenced the decision of farmers of eucalyptus woodlot plantation. If keeping the influence of all other factors constant, as the family size increased by one unit, the odd ratio of farmers with adoption decision of eucalyptus woodlot plantation would increase by a factor of 6.5. This result is in line with [16]. Conversely, this result contradicts the finding that family sizes of the farmers have a negative impact on the decision of eucalyptus woodlot plantation [22]. The results imply that the farmers who have large family size have higher probability to decide of eucalyptus woodlot plantation. This is due to that; large family size does not mean large active labor rather there would be having large dependency ratio and to feed their large family is through renting of farm lands.

Family labor force (Labor force member between age 15 and 64) as hypothesized, similarly to prior predicted, the family labor force was significant (0.038) and negatively affected the adoption decision of farmers to plant eucalyptus woodlot. The farmers who had labor force are 95% less likely making the decision of eucalyptus woodlot than those who did not have labor force.

However, this contradicts with finding of Setiye and Mulatu [16] indicate that, farmers who own high dependency ratio were less likely to adopt eucalyptus woodlot than those with low dependency ratio. High dependency ratio means that, the age between 0-14 and above 65 years than the number of family age between 15-64 years. This implies that farmers who have more active labor have less probability to decide of eucalyptus woodlot plantation and intend to diversify their agricultural practice than those who have no active labor. Because, low dependency ratio or active labor among the grower farmers mean that the needed labor force to cultivate and manage the diversified crop has been sufficient and there was no problem of shortage of active labor force the household.

Thus, the farmers who have more labor or less dependency ratio preferred to cultivate diverse of food crops rather than planting monoculture eucalyptus woodlot.

The results show that, sex was statically significant (0.002) and negatively related with adoption decision of farmers to plant eucalyptus woodlot. If keeping other variables held constant, the farmers who are male household head are 99% less likely making the decision of eucalyptus woodlot than the farmers who are female headed household. However, this is contrary with findings of Zeleke [17] indicate that, female household headed was less likely to grow woodlot than male household headed. The results imply that men have lower probability to decide on eucalyptus woodlot plantation than females. This is because a man is more familiar with day-to-day agricultural activities and better exchange of information with male to male. The male household head in the sample had better literacy and male labor than female household head and also, male headed household is practical experienced farm ploughing for cultivation of crop on their farmland. The conventional method of agricultural extension in sub-Saharan Africa is traditionally geared towards male farmers [23]. They note that, the delivery of extension services biased against women. Generally, this experience was common in Ethiopia [17]. The extension agents had limited contact with women household head throughout the country.

The total land holding was significant and positive effect with adoption decision of farmers of eucalyptus woodlot plantation. The regression result showed that, if all other variables were held constant, as total land holding increased by one unit, the probability of farmers' adoption decision of eucalyptus woodlot plantation increased by a factor of 65. Nevertheless, this finding in the agreement with [16] and [17]. This implies that farmers who have large farm size have higher probability to decide the plantation of eucalyptus woodlot. This could be attributed when the farmers hold small farm land, they prefer to cultivate different crops and

vegetable as well as fruits instead of planting monoculture of eucalyptus woodlot.

Table 5: Estimates of binary regression model for farmers decision of eucalyptus woodlot plantation

Explanatory variables	coef.	Robust std. Err.	p-value	Odds ratio
Frequency of extension contact	-1.2715*	0.20604	0.084	0.2804
Education level	0.0169NS	0.3272	0.958	1.0170
Credit utilization	-2.0405NS	0.368393	0.472	0.1299
TLU	-0.8059NS	0.2438	0.14	0.4466
Parcel number	1.445722***	2.0004	0.002	4.2449
Family size	1.865715**	5.3585	0.024	6.4605
Labor force b/n age 15 and 64	-2.85121**	0.0793504	0.038	0.0577
Age	-1.2664NS	0.2914005	0.221	0.2818
Sex (male=1)	-7.1678***	0.0017842	0.002	0.001
Total land holding	4.1748***	73.70152	0.000	65.0305
Age square	18.8915NS	2.30e+09	0.189	1.60e+08
Logofincome	-4.3739NS	0.0551218	0.317	0.01260
Number of obs = 166 Pseudo R2 = 0.912 Wald chi2(13) = 41.83 Prob > chi2 = 0.0000 Log likelihood =-8.3148044				

Note: *, ** and *** refer to significance at 10% (p<0.1), 5% (p<0.05) and 1% (p<0.01), respectively.
Source: Authors' own computation.

Conclusion and Recommendation

The overall results of binary logistic regression presented that the factors influencing the farmers decision of eucalyptus woodlot plantation were parcel number, family size and total landholding which had a positive and important determination of the adoption decision of farmers to establish eucalyptus woodlot plantations, while the frequency of extension contact, family active labor and sex had a negative and important determination of the adoption decision of farmers of eucalyptus woodlot. The results indicated that the eucalyptus plantation status in the study area was; 51 percent of the surveyed farmers land were covered by eucalyptus woodlot. Of this, 47 percent, 6 percent and 4 percent of surveyed farmers land was occupied by annual crops, perennial crops and grazing land to eucalyptus woodlot plantation with excessive competent productive land uses. The farmers did not realize the impacts of eucalyptus woodlot plantation on ecological components concerning crop production and natural resources. From this, it is possible to conclude that farmers prefer to decide on eucalyptus woodlot plantation by institutional, socioeconomic and demographic factors.

The study is restricted to the factors that led farmers in the north Mecha district to switch from varied farming to eucalyptus monoculture, rather than the relative merits of eucalyptus over other crops and woodlots. It was not possible to cover all of the kebeles that are present in the district because to constraints with regard to money, time, and human resources. The research was limited to a manageable size in terms of the problem's breadth and geographic area. Therefore, it is advised that researchers compare the costs and benefits of eucalyptus plantations to those of other edible crops.

The ministry of agriculture, the agricultural office of the Amhara region and other stakeholder bodies should develop and implement crop diversification strategy that guides the farmers on high market prices, a high value of crops and cluster the scattered farm plots to reduce small pieces of the parcel to increase farmers' participation in the diversification of crops.

Since the farmers are extremely expanding the eucalyptus tree on their farm land and expected to continue, until getting the replacement tree for eucalyptus woodlot, the government in collaboration with Non-Governmental Organization (NGO) and other partners should identify and provide the alternative tree species which might be better substituted eucalyptus woodlot.

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Government put in place appropriate policy, legal and institutional framework and mechanism for land use and planning that integrate woodlot and tree plantation establishment and management, Eucalyptus inclusive.

Data Availability

The survey data used to support the findings of this study are included within the supplementary information file(s).

The authors received no funding for this research.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

Acknowledgments

I am grateful to Bahir Dar University of Ethiopia for providing me the educational opportunity.

This manuscript was developed based on a master's thesis written for a partial fulfillment of the MSc. Degree in rural development management.

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