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Determinants of Farmers Decision Making for Plant Eucalyptus Trees in Market District, North Willow, Ethiopia

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Abstract
Eucalyptus is one of the non-native species grown in Ethiopia. In the study area eucalyptus tree is expanding and the species specific adoption decision analysis is needed. The main objective of the study was to identify determinants of the farmers Decision making for Plant Eucalyptus Trees in Market District, North Willow, Ethiopia. Multistage sampling techniques were employed. A total of 192 household head was surveyed that were selected through systematic random sampling. For the data collection, qualitative (focus group discussion and key informant interviews) and quantitative approach (household survey though questionnaires) were instrumental. Data were analyzed through descriptive statistics, correlation and binary logit regression analysis. The paper concludes that farm size, loan and credit facility; per capita income, age of the farmers, land ownership of the farmers, availability of non-agricultural land was positive significantly affecting the farmer's adoption decisions. The dependency ratio and risk perception of farmers determine negatively. Proper site selection, land use planning and approval of land ownership of the farmers, substitution and enhancement of other means of income and material sources also forward as a recommendation.
Keywords: Adoption, Decision Making, Eucalyptus Tree, Farmers, Agro forestry, Policy, Plantation

1. INTRODUCTION

Tree plantations provide the benefits and purposes that are gathered from the natural forests (Ashraf et al., 2014). In the tropics over 10 million ha of eucalyptus plantations at the close of 1990 (FAO, 1993). Ethiopia has the greatest area of eucalyptus plantations in the east Africa and it is one of the 10 pioneer countries that stuck in the eucalyptus. At the moment, Ethiopia has the largest area of eucalyptus plantations (more than 0.5 million ha) (Amare Getahun, 2010). Meket woreda is one of the rural woreda which is found in the Amhara state, Ethiopia. In the study area, in that location is a wonderful enlargement of the eucalyptus trees. But, the distribution of eucalyptus trees in the study area is also uneven among the smallholder farmers (adopters and non-adopters) and their determination is likewise struck by the different agents. In general, farmers decision making in tree planting are influenced by socioeconomic characteristics of the farmers, institutional and policy characteristics, biophysical factors, resource endowment and psychological factors.

The wide range of theoretical paradigm of factors influencing householders' planting of trees and adoption of agroforestry[1] has been conducted. However, the analysis are not species specific and it is difficult to infer results of tree planting or agroforestry adoption decisions for specific species like eucalyptus tree. Because, an agroforestry systems and different tree woodlots have their basic features and purpose. For instance, Agroforestry has multiple shared outputs and numerous economic characters and tree planting have different purpose like to enhance the productivity of other food crops, fruits for the family, Supply of fuel and other forest product. But, exotic species like Eucalyptus are not founded to enhance the productivity of food crops, edible fruit to the household, or to supply fodder for livestock.

Referable to the above different characterizations, it is vital and better to undergo species-specific. Therefore, how the socioeconomic characteristic, resource endowment, institutional characteristics and physiological factors affect the farmer's decision to plant or not to plant eucalyptus is still unclear. Thus, this study aims to analyze factors affecting the farmer's decision to plant or not to plant eucalyptus trees. The major objective of this study was to identify the determinants of farmer's decision making on planting eucalyptus trees in Meket District, North Wello, and Ethiopia.

2. CONCEPTUAL FRAMEWORK

The conceptual framework of the study focused on linking between the interaction of farmer's socioeconomic characteristics, personal-demographic situation, resource endowments, institutional and policy framework, Psychological factor, other supportive factors and their implication in the decision-making process of farmers.

[1] A collective name for land use systems and technologies where woody perennials are deliberately used on the same land management units as agricultural crops and/or animals, in some form of spatial arrangement or temporal sequence (World Agroforestry Center, 2003).

Adoption of tree planting by farmers is a gradual procedure that calls for the processing of information and decision-making to optimize the usage of household productive assets (Faham et al., 2008).

Land-owners tried different stages of trial and reflection to increase their understanding of the positive and negative aspects of the eucalyptus planting and ultimately decide on at a final decision on whether or not to adopt. Other elements that are relevant are land quality, a distance of the farmland to the market and road, and also external factors, including product prices, and even government policies for land tenure and harvest rights (Place et al., 2012). The institutional and policy factor also affect the farmers decision of eucalyptus adoption. Other factors like social, economic, Psychological factor and asset endowment factors also determine adoption decision. Such factors affect the farmer's decision on eucalyptus tree planting positively or negatively.

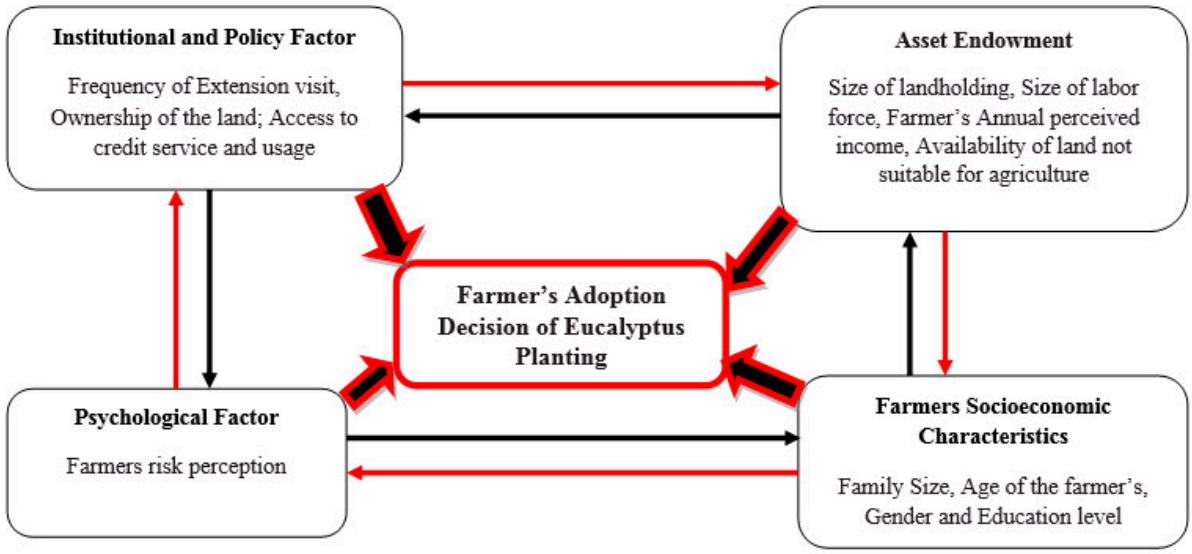

Figure 1: Conceptual framework of factors influencing the farmers Adoption decision on eucalyptus planting (Note: The study focuses on the bold Arrows only).

3. MATERIALS AND METHODS

3.1. Research Design

The research design used in this study was a cross-sectional survey employing both qualitative and quantitative approaches whereby the whole data collection processes complement each other. Because, Cross-sectional survey 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).

3.2. Data Source and Type

The data accumulated from various sources depending on the aim of the work and the type of information to be examined. These let in both primary and secondary information sources. The primary data collected through key informant interviews, focus group discussions and household survey through questionnaires whereas secondary data was obtained from research journals and articles, different reports, proceedings and books, the written document of rural development office and environment and land administration Office of the districts. Quantitative and qualitative data were compiled from different sources through several methods.

3.3. Sampling procedure, Technique and Sample Size

For this study, multistage sampling procedure were instrumental. First, Meket woreda was selected purposively due to its experience on large coverage of eucalyptus and experience of researcher in knowing the area. The woreda has 45 rural and 2 urban kebele. Second, the study area is stratified into two groups based on the eucalyptus tree cover (that have high eucalyptus cover (19 kebeles) and insignificant eucalyptus cover (28 kebele) within the guidance of the word expert with professional observation. Thirdly, the five kebeles were randomly chosen from the 19 kebeles that have significant eucalyptus tree cover.

Sample size determination was undertaken through statistical technique, which was prepared by (Cochran, 1977 as cited by Ashenafi Haile, 2011). According to the formula the sample size is determined with some degree of precision for the general population was used.

$$n = \frac{NZ^2PQ}{d^2(N-1) + Z^2PQ}$$

Where: n = sample size of housing units (household head); P= Housing unit variable (residential houses in terms of percentage); Q= Nonresidential houses (different sectoral offices, schools, etc. in terms of percentage) = 1-P; N= Total number of housing units; Z= Standardized normal variable and its value that corresponds to 95 % confidence interval equals 1.96; d = Allowable error (0.05).

According to data obtained from the Woreda administration office, there are 8194 housing units (N) in the five kebele. From these about 85% (P) are of residents and the rest 15% (Q) area of nonresidential.

$$n = \frac{NZ^2PQ}{d^2(N-1)+Z^2PQ} = \frac{8194 * (1.96)^2 * 0.85 * 0.15}{(0.05)^2(8193)+(1.96)^2 * (0.85) * (0.15)} = \frac{4014}{20.96} = 192$$

Therefore, n = 192 is the minimum sample size of housing units or household head. The sample size per kebele will be determined in proportion to the total number of farmers in each sample kebele. By taking the list farmers in each kebele from the local administration, 192 farmers were selected through the procedure of systematic random sampling.

Table 1: Sample size by kebele

Kebele	Population size	Number of Farmers	Targeted population
Weketa	6323	1265	29
Agrit	9505	1901	44
Berekeza	7029	1406	34
Debre Zebit	10430	2086	49
Werkaye	7678	1536	36
Total	**40965**	**8194**	**192**

Source: construct by researcher

3.4. Data Collection Methods

This research has attempted to integrate the use of qualitative and quantitative data collection approach.

3.4.1. Qualitative data collection tools

Key Informant Interview: were conducted with different individuals (i.e. One word agricultural office experts, three Kabul elder and the five Kabul extension agents). Checklists were developed and used to guide the interview.

Focus Group Discussions (FGDs): was conducted with each selected five kebele having five–seven members in order generate additional information. There was a total of five FGDs (one in each Kebele). To supervise and guide the conversation with the FGD members, checklists are prepared based on the research matter. The FGD members were selected based on their knowledge about the community and nominated by the kebele administration officers.

3.4.2. Quantitative data collection tool

Household surveys through questionnaires': A household survey was conducted using semi-structured questionnaires (open and closed ended). The household surveys are conducted to obtain quantitative data that were used to identify the factors that influence the farmer's decision making to plant or not to plant eucalyptus trees. Questions include socioeconomic characteristics, resource endowment, institutional and other enabling factor. A sum of 192 farmers takes apart in the household survey. Firstly, the questionnaire was prepared in English, but it is translated into Amharic (local language), to prepare the question simple, readable and understandable to the answer. Household survey was conducted through door to door interview between the farmers and the interviewer at the *taboo* days. Pre-trial was taken prior to the household survey. This assists the researcher to know whether there is a need to change the questionnaire based on the feedback from the pre-trial.

3.5. Data Analysis tools

The type of data analysis to be conducted depends on the type of data collected (i.e. qualitative or quantitative data and/or both). Both qualitative and quantitative methods of analysis were employed to examine the study information. The SPSS version 20 and MS-excel was used for data analysis. Descriptive statistics such as mean, percent, and standard deviation is used to characterize the farming system of the study area from the socioeconomic data. The Tables, graphs and charts as well as bar graph also used to present the data's. The comparability of different farmer's characteristics was done using t-test and $\chi 2$-test. The information's collected during focus group discussion and key informant interviews also analyzed using the qualitative analysis techniques such as narration.

3.5.1.1. Regression analysis

The aim of the survey is to identify the factor that determine the farmer's decision making on planting of eucalyptus tree. In this case the response (regress and) variable is binary or dichotomous variable taking on two values (0 and 1). Therefore, Binary logistic regression was instrumental to examine the influence of independent variables on a dependent variable (i.e. Farmer's decision on the planting of eucalyptus tree).

The socioeconomic, institutional and policy related, resource endowment, Psychological factor that affects eucalyptus planting decision was examined by logistic regression analysis. Because logit has an advantage that in the analysis of a dichotomous outcome variable it is extremely flexible and easily used function (model) from a mathematical point of view and meaningful interpretation (Amemiya, 1981). The E (Yi | X) in the linear probability models measures the conditional probability of the event Y occurring given X, it must necessarily lie between 0 and 1. This holds true in the probt and logit model. Simply, this is the actual problem with the OLS estimation of the LPM (Gujarati, 2004). The data obtained from all respondents (192 from the five kebele, including both eucalyptus growers and non-eucalyptus-growers) was considered in the model.

The dependent variable for the present case is the farmer's decision on planting of eucalyptus trees, and by attributing a value of 1 if a farmer takes in or grow eucalyptus tree and the value 0 otherwise.

$$Li = ln\left[\frac{Pi}{1-Pi}\right] = Zi = \beta o + \beta^1 X^1 + \beta^2 X^2 + \beta^3 X^3 + \beta^4 X^4 \dots\dots\dots \beta nXn \quad \dots\dots (1)$$

Where Pi = is a probability of being an adopter of eucalyptus tree ranges from 0 to 1

Zi = is a function of "n" explanatory variables (regressors) (x) which is also expressed as

$$Zi = \beta o + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 \dots\dots\dots\dots\dots\dots\dots \beta nXn \quad \dots\dots\dots\dots\dots\dots (2)$$

βo = is an intercept

$\beta_1, \beta_2, \beta_3, \beta_4 \dots\dots \beta n$ = are the slopes of the equation in the model

Li = is the log of the odds ratio, which is not only linear in Xi but also linear in the parameters.

Xi = is the vector of relevant farmer characteristics

If the error term (Ui) is brought in, the Logit model becomes

$$Zi = \beta o + \beta^1 * \text{familysize} + \beta^2 * \text{education level} + \beta^3 * \text{farm size} + \beta^4 * \text{loan or credit facility} + \beta^5 * frequecy\ of\ extesion\ visit + \beta^6 * \text{Income per capita} + \beta^7 * \text{Age} + \beta^8 * \text{land ownership} + \beta^9 * \text{Risk perception} + \beta^{10} * \text{dependecy ratio} + \beta^{11} * \text{Gender} + +\beta^{12} * \text{availabilityof land not suitable for agriculture} + Ui \quad \dots (8).$$

The above explanatory variables (X) included in the model are taken based on the published literature on tropical forestry as well as based on the various agricultural decision-making premises and the innovation diffusion theory (the foundation of this study) (Ashraf et al. 2014; Bebbington ,1996; Belay Zerga, 2008; Cossalter and Pye-Smith, 2003; Enters and Durst, 2004; Evans 1992; Mercer et al., 2004; Negussie Achalu et al, ND; Nsiah, 2010; Nibbering, 1999; Summers et al., 2004; Scherr, 2004; Simmons et al. 2002; Song et al., 2004; Thacher et al. ,1997; Walker and Homma,1996 , Zenebe Gebreegziabher, et al., 2010)

4. RESULTS AND DISCUSSION

4.1. Demographic and Socioeconomic Characteristics of Sample Farmers

The 77.1% of the surveyed household was male-headed household. The 64.04% of household with eucalyptus trees and 21.35% of non-adopters of eucalyptus trees are married. The majority are Orthodox in the survey area. The 66.1% of the household are illiterate. The chi-square test result also indicate that the land ownership ($\chi 2$=15. 82***), the availability of land not suitable for agriculture ($\chi 2$= 21.11***), frequency of extension visits ($\chi 2$=9.14**) and availability of loan and credit facility(X^2 =20.13***) have significance association with the decision of the farmers .

Table 2: The independent sample t-test of the continuous variable of the Characteristic of the surveyed farmers

Characteristics of the respondent farmers	Mean		Tests
	Adopters	Non adopters	
Household size	5.49	4.29	t-value =5.744***
Dependency ratio	0.72	1.41	t-value =7.294***
Age of the farmer	50.37	40.28	t-value =5.94***
Land size	0.94	0.59	t-value =5.10***
Number of livestock	5.29	3.02	t-value =-5.19***
Income of the household	20,422.95	14,729.20	t-value=5.07***

Note: **, *** indicates the significance of the continuous variable at 5% and 1% of level of significance

4.2. Analytical Modeling of Factor Determining Farmers Decision Making on Planting of Eucalyptus Tree Planting

Before estimation of the parameters of the example, it is essential to attend to the problem of multicollinearity among the selected explanatory variable. There are two steps that are frequently recommended to examine the presence of multicollinearity. These are Variance Inflation Factor (VIF) and Contingency coefficients. Variance

inflation factors or tolerance was computed and used to test for the presence of an association between continuous explanatory variable (Guajarati, 1995; Gujarati, 2004). To avert the problem of multicollinearity, it is quite essential to omit the variable have VIF values that exceed 10. VIFs exceeding 10 are signs of serious multicollinearity. Thus, (Appendix 1) indicates that there was no explanatory variable that has the VIF value more than 10 shown that all the continuous explanatory variables have no serious multicollinearity problem (see Appendix 1).

Literally, in order to see the degree of association between dummy variable Contingency coefficients were computed. Agreeing to the Healy (1984), contingency coefficient is the chi-square-based measure of association where a value of 0.75 or above indicates that a strong relationship between explanatory variable. In the same manner, the degree of association between the each categorical variable was calculated using the contingency coefficient. Nevertheless, the Table in the (See Appendix 2) indicates that there were no-multicollinearity and problems associated with sets of dummy variables included in the model.

The value of the Pearson chi - square indicates the goodness of the fit for the fitted model. The likelihood test ration statistics indicate by the chi-square statistics is extremely significant (sig. = 0.001) suggesting the strong explanatory power of the model. Therefore, the log-likelihood value was highly significant at 1% of the level of significance.

The model result shows that the logistic regression model correctly predicted 90.1% of the total sample household, 95.1 % of the eucalyptus tree adopter's household and 76.0 % of the non-adopters household. Thus, the overall percentage of correct value is 90.1 %, which is suggesting that the model is likely to be reliable for prediction purpose (i.e. Categorizing individual household in the eucalyptus tree adopters and non-adopters). The Cox and Snell R^2 index, as well as a Nagelkerke R^2 index, suggest that between the 52.5 % and 76.9 % of the variation in the dependent variable is explained by the set of explanatory variable included in the model. This result from all these indicators clearly shows that the model fits well to the data.

On the other hand, the value of close to one of the Nagelkerke R^2 and the high p-value (p-value =0.819) of the Hosmer and Lemeshow Goodness of the fit test showed the goodness of fit of the model. In another term the Hosmer–Lemeshow statistic indicated a good fit of the data to the estimated model because the significance value was greater than 0.05. Also, the value of the log-likelihood ratio of the model was highly significant (p-value= 0.001), indicating that the selected variables had a significant effect on the predictive ability of the model.

4.3. Factors Affecting Farmers Decision Making of Eucalyptus Tree Planting

Table 3: The maximum likelihood Estimates of the Logit model

Parameters		B	S.E.	Sig.	Odd ration
Family size		1.391	0.357	0.000***	4.018
Farm size		3.239	1.165	0.005***	25.501
Laon and credit facility and availability		2.104	0.708	0.003***	8.202
Income per capita		0.000	0.000	0.041**	1.000
Age of farmers		0.093	0.042	0.026**	1.098
Land ownership		2.927	0.959	0.002***	18.670
Risk perception index		-6.158	2.738	0.024***	0.002
Dependency ration		-1.108	0.713	0.120^{NS}	0.330
Land not suitable for agriculture		1.910	0.751	0.011**	6.751
Frequency of visit	Occasionally(Ref.)			0.426 ^{NS}	
	Mostly	0.333	0.892	0.709 ^{NS}	1.395
	Regularly	1.648	1.293	0.202 ^{NS}	5.199
Gender		-0.279	0.691	0.686 ^{NS}	0.756
Education level		1.179	0.822	0.152 ^{NS}	3.250
Constant		-13.123	3.955	0.001***	0.000

Model Chi-Square =142.927***
Overall Correct Prediction$^{@}$ =90.1%; sensitivity =95.1%; specificity=76.0%
Cox and Snell R^2 =0.525; Nagelkerke R^2 = 0.769
-2 Log likelihood=77.295***
Hosmer and Lemeshow Goodness-of-Fit Test = 4.429(p = 0.819)

Note: *, **, and *** indicate statistical significance at 0.1, 0.05, and 0.001 levels,
^{NS}=not significance.

4.3.1. Family size and Dependency Ratio

The probability of the farmer's decision in adopting eucalyptus was positive and significantly influenced by the household size. This variable was significant at 0.000 level of significance. Everyone increase in the household size increases the odds ratio of the farmers decision in the planting of eucalyptus tree versus the decisions of the household not to adopt eucalyptus tree by the factor of 4.018. However, this finding contradicts the finding that

holding place in India that family sizes of the farmers have a negative impact on the decision to adopt eucalyptus (Ashraf et al., (2014). Yet, the study directed by Dereje Jenbere, et al., (2012) indicate that the total family size had no significant effect.

The large family size and low dependency ratio among the adopter's farmers mean that the needed labor force to plant and manage eucalyptus tree was sufficient and there was no problem of shortage of active labor force the household. The regression model results revealed that the dependency ratio is negatively and statistically insignificant factor in the decision of the farmers in planting or adopting of the eucalyptus tree. The farmers who owns a high dependency ratio less likely adopting eucalyptus tree than the farmers who have less dependency ration. High dependency ration means that the number of the family who have the aged 0-14 and over the age of 65 is greater than the family number having the age between 15-64 years.

The odd ratio of the model output is 0.330. Other studies like summers, et al., (2004) and Nsiah, (2010) confirm that a large number of working age positively affects that household decision of tree planting. According the study takes place in Rwanda by Ndayambaje et al., (2012) indicate that the number of adult members in households had significant positive effects on the presence of trees on farms. But, the active labor force in the family affects the decision of household negatively and significantly at ($P<0.05$) (Dereje Jenbere, et al., 2012).

4.3.2. Size of Land holding (Ha)

The size of the land plays an important role in adoption decision of farmers in establishing or planting of a eucalyptus tree. This section of the analysis concentrates on the landholding characteristics of the study households and its implication on their decision to establish eucalyptus tree. The regression result shows that farm size of the farmers has positive and significant at the 0.005 level of significance. If all other factors are kept constant, the likelihood/odds of a farmers to use his/her land to plant eucalyptus tree will increase if the farmers have enough land to produce food to feed his family as compared to a farmers that owns small landholding and the odd ration also increase by the factor of 25.501.

The farmers who has small land holding are preferring to produce crops and another purpose like growing of fruits and vegetable than the tree growing like a eucalyptus tree. The family who have enough land holding using their land for diversifying the source of income like growing crops, fruit, tree planting, vegetable and animal raising. Thus, the size of farmland owned by farmers appears to be an important agent that determines the farmer's decision in the planting of the eucalyptus tree. This is in agreement with results from several studies (e.g. Shifa et al., 2015; Ewnetu Zeleke, 2009; Zenebe Gebreegziabher, et al., 2010; Nsiah, 2010 and Dereje Jenbere, et al., 2012; Etongo et al., 2015).

4.3.3. Availability of Loan or Credit Facility

The analysis indicates a statistical important relationship between the availability of loan and credit facility for the farmers and the eucalyptus tree adoption decision of the farmers at 0.05 level of significance. The accessibility of loan and credit facility increase the tendency of the farmers to induce a decision in adopting a eucalyptus tree. The odd ratio value is 8.202. The farmers who have credit and loan from the different institution are more likely adopting eucalyptus tree on their land than the farmers who receive no credit and loan facility by the agents of 8.202. Mulugata Lemenih, (2010) also indicate that loan and credit facility is a critical issue in future tree planting.

4.3.4. Income Per Capita

Family income is one of the important ingredients in determining the farmer's decision in taking up or planting of the eucalyptus tree. An increment in the income per capita significantly increased the odds of the household's decision to use the land to plant eucalyptus trees versus the decision not to plant eucalyptus tree trees by a factor of 1.000. This study also parallels with the study of Ashraf, et al., (2014) report that the monthly income of the farmers is significant for the tree adoption of the farmers.

4.3.5. Ownership Land of the farmers

The binary logit regression result shows that land ownership is positively and statistically significant effect on the farmer's decision in the planting of the eucalyptus tree. Land ownership is an important socioeconomic characteristic. In the study area land where the mainland ownership being own land, land through rent, lease and share-cropping. The land which the farmers managed through lease, rent or share-cropping most of the time does not use for the tree planting purpose rather for crop production. The farmers who owns his own land is more likely making decisions on adopting of the eucalyptus tree than who manage the land through rent, lease and share cropping by a factor of 18.670.

The farmers who owns his own land adopts a eucalyptus tree than others. Hence, share-cropping users and land renters may be, in most instances, prevented by landowners from using such land for establishing eucalyptus tree. The establishment of the eucalyptus tree is therefore mostly done on lands either purchased outright or acquired through family lineage or own land. This study is confirmed by study undergo in Burkina Faso that those who perceive their land tenure to be insecure are more likely to plant only fruit trees and not wood producing trees (Etongo et al., 2015).

4.3.6. Age of the Surveyed Farmers

Age of the farmers in the estimated model was positive and significantly linked to an adoption decision of farmers in the planting of the eucalyptus tree. Preventing the other factors constant, the adoption decision of farmers for the planting of eucalyptus tree increase with the increase in the age of the farmers by the factor value of 1.098. The likelihood is higher with increasing the age of the farmers. The elder has less ability to harvest crops, fruit and vegetable, instead, the elder prefer to grow on the eucalyptus tree. The youngster most the time use their soil for crop production rather than tree planting. The youngster is much eager to adopt new technologies rather than growing eucalyptus. According to Ashraf et al., (2014), adoption of tree planting decreases with the increase in the age of head of household because younger people have a longer planning horizon and are more willing to take risks, compared to older people. This is in agreement with results from several studies (e.g. Simmons et al., 2002; Zenebe Gebreegziabher, et al., 2010; Etongo et al., 2015 and Abrham Abiyu, et al., 2012). Yet, a study conducted by Dereje Jenbere, et al., (2012) indicate that the respondent's age had no significant effect.

4.3.7. Risk perception of the farmers

The farmers risk perception about the eucalyptus tree effects on the crop productivity and ecological components like water, land, biodiversity was included in the example because it was found important to prove the risk perception of the farmers in adoption decision of household in tree planting. The risk perception farmers plays an important role in adoption decision of farmers in establishing or planting of the eucalyptus tree. The regression result shows that risk perception of the farmers a negative and significant effect in eucalyptus tree planting decisions of the family. The farmers who perceived the risk of the eucalyptus tree planting is less likely making a decision in adopting of the eucalyptus tree than those who don't perceive as risky. Holding other variable constant, the increment in the risk perception of the effects of growing of eucalyptus the probability of adopting eucalyptus tree would decrease by the odd factor of 0.002. The farmers who did not perceive planting of eucalyptus tree as the risk of the crop, water, soil, and biodiversity is 99.98% more likely making the decision in the planting of eucalyptus tree than those who perceived as hazardous. The finding indicates that the non-adopter farmers is more probable to hold a high-risk perception toward to the effects of the eucalyptus tree planting on the on crop productivity, soil moisture, water status and biodiversity than those adopter's farmers.

4.3.8. Availability of land not suitable for agriculture

The analysis indicates a highly statistically significant relationship between the availability of land considered unsuitable for agriculture and the decision to take on a eucalyptus tree ($p<0.05$). The availability of non-agricultural land, therefore, increases the farmers' propensity to adopt a eucalyptus tree on their land. The farmer's that takes in poor quality of state or non-farming land was most likely making a decision in adopting of the eucalyptus tree than the farmers who haven't the land not suitable for agriculture by the factor of 6.751. This finding agree with the finding reported by Nsiah, (2010) availability of land not suitable for agriculture is positively and significantly (0.001 level of significance) affects the farmers tree planting decision.

5. CONCLUSION AND RECOMMENDATION

The majority of the surveyed farmers was illiterate, the flower of orthodox Christianity and married. The result of the binary logit regression result confirms that farm size hold by the farmers, loan and credit facility, per capita income, age of the farmer's, land ownership by the farmers and availability of land not suitable for agriculture was positive and significantly determine the farmers eucalyptus tree planting adoption decision; but, the risk perception of farmer's also affects the adoption decision of the farmers negatively and significantly. Likewise, the gender of the surveyed farmers, education level and frequency of extension visit was hypothesized to positively affect the decisions of the farmers, but it is not the case for this study. The land ownership of the farmers should be granted by the government and the income of the farers and the loan and credit facility also needed to be enhanced.

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Appendix

Appendix 1: VIF value of continuous value of explanatory variable

No	Variables	Collinearity Statistics	
		Tolerance	VIF
1.	Family size	.648	1.544
2.	Total farm size(ha)	.897	1.115
3.	Age of farmers	.638	1.568
4.	Income per capita	.650	1.538
7.	Risk perception of household	.958	1.044
8.	Dependency ration	.690	1.449

Source: Household survey data (2016)

Appendix 2: Contingency coefficient of the of values of the dummy explanatory variable's

	credit /loan facility and provisions	Land ownership	land not suitable for agriculture	Frequency of visit	Gender	Education level
credit and loan facility and provisions	1					
Land ownership	.025	1				
Land not suitable for agriculture	.188**	.044	1			
Frequency of visit	-.061	-.041	.091	1		
Gender	.003	.060	-.052	-.031	1	
Education level	.017	.033	.107	.100	-.233**	1

Note: **. Correlation is significant at the 0.01 level.