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Determinants of Teff Production in North Showa Zone, Central Highlands of Ethiopia

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ABSTRACT

Using primary data collected from 115 households of North Showa Zone, Ethiopia, the study examined determinants of Teff Production. In order to investigate the effect of each predictor variable on the household teff production level a bivariate analysis was performed. Among the econometric method of analysis, a logistic regression model was fitted to analyze the potential variables affecting household teff production level in the study area. The result of the descriptive analysis revealed that about 85 (73.90%) were teff producers while 30 (26.10%) of the households were found to be non-producer. Moreover, the logistic regression model estimates that among the nine variables included in the logistic model, eight of them were significant at different probability level (1, 5, and 10). These are the education of household head, total cultivated land for teff production per hectare, number of oxen, technology adoption, access of extension services received by households, sex, fertilizer application and kind of teff variety used. Finally, improving land quality, creating awareness towards importance of farm technology adoption, and providing frequent extension service were recommended.

INTRODUCTION

Ethiopian agriculture is virtually small-scale, subsistence-oriented, and depends on rainfall (Anderson, 2007). It is also kicked off, with high population pressure and traditional farming systems have caused ecosystem degradation in the form of soil erosion and declining soil fertility and erratic climate are the challenges to production. Additionally, the current smallholder farming systems are undergoing a reverse transformation in which farm sizes are declining, few farmers are moving out of agriculture, and instead are diversifying into non-farm activities from a small farm base (ATA, 2013).

On the other hand, agriculture is the main source of livelihood for a large proportion of the population, especially for the people residing in the rural areas (Schmidt and Kedir, 2009). Teff is the major staple food crop to most Ethiopian people living in the highlands, comprising more than 65% of the population. However, the national average yield of teff is very low and 1.4 tons per hectare and the development of high-yielding cultivars would be very beneficial (CSA, 2013). Hence, the need for improved crop varieties that are high yielding and with the capacity to survive in such a degraded and risk-prone environment is important (Spielman, 2008). There is still a question of yield stagnation due to the low yield potential of the existing teff varieties and other determinants (Tareke et al., 2008). Hence, the main question of this study was to identify the major determinants of teff production in Grar-Jarso district and provide relevant information to the concerned body.

Data source and sampling

Two-stage probability sampling technique was employed to select the sample of farm households. In the first stage, sample kebeles1 were selected randomly. Then, in the second stage, using the list of farm households living in each of the selected kebeles as a sampling frame, sample households were selected randomly using a probability proportional to size sampling technique. Hence, this study is based on a primary data collected from a sample of randomly selected 115 smallholder farm households. The data was collected through face-to-face interview using semi-structured questionnaire.

Estimation Strategy

The logit model was the appropriate econometric model to identify the determinants of teff production in the study area. This model was chosen; it has an advantage in revealing the relative influence of the probability of teff production through different input utilization. Logit model, which has a discrete part, is appropriate which handles the probability of the extent of production in a proper way. Logit model which helps to test the determinants of teff production can mathematically be specified as follows:

$p_i = E (Y=1$ such that; $x_i = \beta_0 + \beta_i x_i$..... (1)

Where; Y=1 implies the given farmer participates in teff production

x_i= a vector of independent variable

β_0= The constant term

β_i= i= 1, 2 ...n. are the coefficient of independent variable to be estimated

[1] the lower class of district

$$x_i = \frac{1}{1+e^{-(\beta_0 + \beta_i x_i)}} \text{.....} \quad (2)$$

$$p = \frac{1}{1+e^{-zi}} = \frac{e^z}{1+e^z} \text{.....} \quad (3)$$

Where; $zi=\beta_0+\beta_i x_i$ ifp_i, is the probability of being producer and $(1-p_i)$ the probability of being a non producer of teff

$$1 - p_i = \frac{1}{1+e^{zi}} \text{.....} \quad (4)$$

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Therefore, we can write this equation as;

$$\frac{p_i}{1-p_i} = \frac{1+e^{Zi}}{1+e^{-Zi}} = e^{Zi} \quad \text{..... (5)}$$

Laterally, $p_i/(1-p_i)$ is the odds ratio of producer farmers with the ratio of the probability that a given farmer can participate in production to the probability that the farmer who will be participating in production. Then, if we take the natural logarithm of equation (e), we obtain;

$$L_i = ln\frac{Pi}{1-Pi} = ln\ (e^{\beta_0} + \sum_{i=1}^{m} \beta_i x_i) = z_i$$

If the disturbance term Ui is taken in to account, the logit model becomes

$$L_i = z_i = \beta_0 + \sum_{i=1}^{m} \beta_i x_i + \mu_i \text{..... (6)}$$

Where β_0 is an intercept and β_1, β_2, … β_n are slopes of the equation in the model, and X is the vector of relevant farmer characteristics.

Consequently, L_i, which is the log of odds ratio, is called logit or logit model (Gujarati, 2004). Hence, the above Logit Model is employed to estimate the effect of the hypothesized explanatory variables on the teff production decision of farmers.

RESULTS AND DISCUSSIONS

This analysis is based on data obtained from the questionnaire survey. The questionnaires of 115 households had been examined for incorrectness and missing data were grouped (classified) into two groups, namely, teff producer and none producer groups. The data presented in the following part explains the distinction between the two groups of households. This section briefly presents the major determinants of teff production, the relationship of predictor variables with the household outcome variable, and the econometric model analysis in the study area.

Descriptive statistics

The study found that among 115 sample households, the number of male-headed households and female headed households are found to be 82 and 33 in number and covered 71.3% and 28.70%, respectively. Out of 85 producer households, 70 were male and 15 were female and out of 30 non-producer household, 12 were male and 18 were female. Out of 115 sample households, the number of illiterate household heads, grade 1-8, grade 9-10, and grade 11-12 household heads are found to be 47%, 20%, 18.3% and 14.8% respectively. Moreover out of 30 producer households, that 29 which covers 53.7% are illiterate, 1 which covers 4.3% are grade1-8, 0 which covers 0% are grades 9-10 and 0 which covers 0% are grades 11-12.

From the total 115 sample households, 30 were technology adopters. From that, 27 which covered 90% were both adopters and producers but 3 which cover 10% were adopters but non producers. And out of the total sample household, 37 respondents were moderate adopters of the technology. From that 36 which covered 97.3% were both adopter and producers, but out of this 1 which covered adopters, 1 which covers 2.7% was adopter but not producer. From the total 115 households, 70 respondents were getting extension service and both of them are producers and there is no teff producer that got extension access (see Table1 below).

Out of the total, 93.8% of the respondents were growing local teff variety which is recycled from year to year and those farmers who used the improved teff variety were producers. The finding indicates a significant difference in teff variety utilization between producer and non-producer groups at the 1 percent probability level of significance. Consistently, out of the total 115

Table 1: Summary of descriptive statistics for dummy/categorical explanatory variables

Variable	Catagories	Producer %	Non-producer %	x^2 (p-value)
Sex	Male Female	85.4 45.5	14.6 54.57	19.43***
Level of educational	Illiterate Grade 1-8 Grade 9-10 Grade 11-12	46.3 95.7 100 100	53.7 4.3 0 0	40.409***
Technology adoption	Adopter Moderatly adopter Low adopter Non-adopter	90 97.3 100 3.7	10 2.7 0 96.3	90.957***
Access to extension services	Yes No	100 33.3	066.7	63.37***
Teff variety	Local Improved Both	93.8 100 100	6.2 0 0	1.053***
Fertilizer application	Yes No	98.8 17.1	1.2 82.9	84.095***

*Note: *** Significant at 1% probability level, Source: own survey results 2021*

households, 98.8% of smallholder farm households were used fertilizer for their cropping purpose. The finding indicates a significant difference in fertilizer application between producer and non-producer groups at the 1 percent probability level of significance.

The land holding of all sample households ranges from 0 hectares to 5 hectares. The mean land sizes of teff producer and non-producer households were 2.0176 hectares and 0.3167 hectares, respectively. On average, the mean dependency ratios were 56.88% and 60.09% for teff producers, non-producers, respectively. Moreover, on average 1.930 numbers of oxen were used by household teff producers. This means producer households had approximately 2 oxen on average and households who did not produce teff were not having ox. The study indicates that the average farm experience of producer respondents in the study area was 9.86 years and there is a significance difference in teff production experience between producer and non-producer respondents at 1% level of significance showing that producer respondents have better teff production experience than non-producer respondents in the study area (see Table 2 below).

Table 2: Summary of descriptive statistics for continuous explanatory variables

Variable	Producer	Non-producer		t-value
	Mean	Mean	Total mean	
Total farm land size	2.02	0.32	1.57	10.037***
Dependency ratio	0.57	0.6	0.58	1.276
Number oxen	1.93	0.03	1.96	17.765***
Teff production experience	9.86	0.77	7.49	2.909***

Note: refer to 1% significance level, Source: Own survey results, 2021

Determinants of Households' Teff Production

Before entering the variables in to the model, the multicollinearity problems were checked in terms of variance inflation factor (VIF) for continuous and contingency coefficients for dummy variables, respectively. After testing the degree of association of independent variables, all explanatory variables were used for estimation. Binary logit model was applied to identify the major determinants of teff production among hypothesized explanatory variables that are assumed to have an influence on the household's level of teff production by using a statistical package known as STATA version 15 (see Table 3 below).

Based on the model result, a possible explanation for each significant independent variable is given as follows.

Sex of household head: logit model analysis showed that there is a positive relationship between the sex of households and teff production level at a probability level of 10%. It indicates that male-headed households produced more teff than female-headed households. As the involvement of male-headed households increased by one unit, the level of teff production increased by 0.055 on average. Total cultivated land for teff production per hectare: In line with our expectation, farm land size for teff production is found to positively affect the level of teff production at 1% level of significance. It shows that households with more farm land size are more likely to produce teff than those with a small land size. This is possible because when the farmland owned by the household is more, the level of production and income become higher and eventually the amount or yield of teff production increases. The result shows that as the cultivated land increased by one hectare, the level of teff production to be produced increased by 0.058 units on average.

Table 3: The maximum likelihood analysis of logit model

Variable	Coefficients	Std. Err	Sign. Level
Sex	0.055	0.032	0.084*
Farm land size	0.058	0.016	0.000***
Number of oxen	0.142	0.021	0.000***
Teff variety	-0.056	0.014	0.000***
Education	0.03	0.013	0.021**
Technology adoption	0.045	0.017	0.007***
Fertilizer application	0.245	0.046	0.000***
Dependency ratio	-0.031	0 .104	0.762
Extension service	0.072	0 .037	0.051*
FEXPTPPY	0.004	0.004	0.215
Constant	0.184	0.077	0.019
Dependent variable = Level of teff production R2=0.9421 Number of observation =115			

**** Significant at less than 1% probability level; ** Significant at less than 5% probability level; * Significant at less than 10% probability level. Source: Model output, 2021*

Number of oxen

This variable also has a positive effect on the level of teff production at the probability of 1% significant level. This means farmers who own more quantity of oxen produced more output of teff than others. This is because; oxen ownership would help farmers to carry out agricultural operations like ploughing, sowing, and others on time that would improve productivity. The analysis shows that on average, as the number of oxen increased by one unit, the amount of teff to be produced increases by 0.142 units. A previous study by (Gebremedhin et al., 2007) found a similar result.

Education level of household

The level of education has a positive influence on the level of teff production at 5% significant level. It indicates that households led by non-literate heads are less likely to understand the modern farming technologies provided to them through any media (extension workers, radio, etc) than literate household heads. It affect production positively since it makes household's to have ability to take good and well-informed production on teff. And the model shows that as the households' education level increased by one grade level, the amount of teff to be produced increased by 0.030 units. It is consistent with the study found by Amaza et al. (2006) and other literatures; the higher the educational level of household head, the more teff is expected to be produced.

Fertilizer application

The results showed that fertilizer applications may affect teff production positively at a probability level of 1%. It shows that if fertilizer is available in the right amount and time, the level of teff production would be improved. The model analysis shows that as the utilization of fertilizer increased by one unit, the level of teff production to be produced could be increased by 0.245 units on average. This result is similar to the study conducted by (Dickinson et al. 1990).

Technology adoption

This variable is found to have a positive influence on teff production level at a probability level of less than 1%. This means farmers who adopt farm technology like fertilizer, raw planting are more likely to produce more teff than farmers who do not adopt it. The analysis shows that as farmers' technology adoption level increased by one unit, the amount of teff to be produced would be increased by 0.045 units on average.

Access to extension services

Access to extension services received by households has a significant positive association with level teff production status at a probability level of 10%. The positive relationship implies that when households get an extension service, the probability of the household to produce teff would be increased. On average, as producers' access to the extension service increased by one unit, the production level of teff would be increased by 0.072 units. This result is consistent with the study found by (Babatunde, 2007).

CONCLUSION AND RECOMMENDATIONS

Identifying the major determinants of smallholder farmers' teff production was the main purpose of this study. To achieve this, primary data were collected from 115 smallholder farm households. Descriptive statistics were used to explain the different socio-economic characteristics of the sample households and inferential statistics were used to test the dummy and continuous variables. Logit regression model was used to identify the major determinants of smallholder farmers' teff production level. The finding shows that the majorities (73.90% of the sample households) were teff producers and small numbers of households (26.10% of the sample households) were nonproducers of teff. This indicates that more than 50% of smallholder farmers are teff producers in the study area. The results of the logistic regression model indicated that eight out of ten variables, namely, sex of the household, education of household head, total cultivated land for teff production per hectare, number of oxen, technology adoption, and access of extension services received by households, fertilizer application and improved teff variety used were found to be a major determinants of household teff production in the study area. Therefore, stakeholders should be considering these variables when smallholder farmers produce teff.

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