

Determinants of Rice Production Technology Adoption in Fogera Woreda, South Gondar, Ethiopia

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Abstract
The study was conducted in Fogera district, South Gondar zone, Amhara National Regional State (ANRS). Four rice producing kebeles among the fifteen rice producing kebeles were selected and a total of 191 selected households were interviewed to generate primary data. Descriptive statistics and binary logit were employed to determine factors that influence the adoption behavior of farmers. A sum of ten explanatory variables for the binary logit model was used, out of which six variables were found to significantly affect the adoption of rice production technology. These are: age of the household head, family size of household head, participated labor force, level of education of household head, size of cultivated land and extension services. The study recommends that any effort in promoting improved rice production technology should consider the social, economic, institutional and psychological characteristics for better adoption of the technology.
Keywords: Adoption, Production, Rice, Technology, Binary Logit Model, Fogera Woreda.

1. Background of the Study

Agricultural technology is among the most revolutionary and impactful areas of modern technology, driven by the fundamental need for food and for feeding an ever-growing population. The agricultural technology and improved practices play a key role in increasing agricultural production (and hence improving national food security) in developing countries. Adoption refers to the decision to use a new technology, method, practice, etc. by a firm, farmer or consumer. Adoption of technological innovations in agriculture has attracted considerable attention among development economists because the majority of the population of less developed countries derives their livelihood from agricultural production and a new technology, which apparently offers opportunities to increase production and production (Feder et al., 1985).

Ethiopia is an agrarian country where more than 80% of the total population depends directly or indirectly on agriculture. Accelerating agricultural growth in Ethiopia has wide-ranging impacts beyond smallholder farmers and rural development. In spite of its enormous agricultural potential, Ethiopia's history, however, is punctuated by food insecurity and famine due to climatic variability and the poor performance of the agricultural sector. In mindful of these problems, the government of Ethiopia launched policies and strategies that set out agriculture as a primary stimulus to generate increased output, employment, income and agricultural production. Rice was introduced in Ethiopia in the 1970s and has since been cultivated in different parts of the countries. Rice has a great potential to contribute to food self-sufficiency and security in Ethiopia. In the country, four rice ecosystems are identified and these are upland rice, hydro orphic (rain fed lowland) rice, irrigated lowland rice and paddy rice (with or without irrigation). In Amhara region, rice cultivation was started in Fogera Woreda in 1993.

Several adoption research findings have pointed to the fact that the use of new agricultural technology could lead to significant increase in agricultural production in Africa and stimulate the transition from low production subsistence agriculture to a high production agro-industrial economy. Wolelaw (2005) identifies the main determinants of rice supply at farm level. The study uses Cobb Douglas production function model to estimate the limiting factors. The result that identified were, the current price, one year lagged price, actual consumption in the household, total production of rice in the farm, distant to the market and weather variables were significant to influence the supply of rice.

Mamudu, et al. (2012) made a research entitled adoption of modern agricultural production technology by farm households in Ghana using logit model as a tool over 300 farmers who found that, plot size, expected returns from technology adoption, access to credit, and extension services are the factors that significantly affect technology adoption decisions of small farm households in the west district area of that country. Debela, (2011), agricultural growth can be achieved through better small farm management practices and increased adoption of improved agricultural technology such as chemical fertilizers, improved seed varieties, pesticides, and organic minerals. Among other important variables age of the household head, family size, number of oxen, access to credit, and off-farm activities positively affect the probability of participation in an agricultural extension program. Of which age, education level, and access to credit, affects significantly. Ibrahim, (2013) on his constraints to agricultural technology adoption in Uganda panel data using probit model, shows that small farm heads with low educational level and small land holdings are less likely to adopt improved seed and fertilizer technology. Lastly, these reviewed literatures aforementioned have helped for this research to design the potential socioeconomic and demographic factors related to the good quality consideration that support to explain the impact of rice production technology adoption on farm households rice yield.

Despite the significance of rice in the livelihood of many farmers and income generating crop in the study area, it is only recently that few studies have been done on rice. However, most of these studies have focused on marketing and were limited to a specific area and production aspects. Systematic and adequate information on the process of adoption of rice production technology not well identified. Hence, this study was conducted to assess the determinants of adoption of rice production technology adoption in Fogera Wereda.

2. Research Methodology

The study was conducted in Amhara National Regional State (ANRS), South Gondar zone, Fogera wereda (Ethiopia). The wereda is geographically located 11° 58'N latitude and 37° 34'E longitudes. In this study, both primary and secondary data sources were used. Discussion with group of farmers and agricultural extension staff was done to generate information. Key informants were also used as information source from different actors. A multi stage sampling procedure was used to select the kebeles and sample households. In the first stage, four kebeles were selected purposively from 15 rice producing kebeles based on their agro ecological zone. In the second stage after lists of farmers were obtained from the district Agricultural and rural development office, farmers who were cultivating rice in four kebeles, 91 adopter sample household heads were taken as respondent using probability proportional to size. 100 non-adopter respondents were selected using simple random sampling method based on their proportion. The data was collected from December 2017 up to April 2017 for five months.

In this study, descriptive statistics (percentage, frequency and mean) were mainly used. The descriptive analysis was conducted using Statistical Package for Social Science (SPPS). Binary logistic regression was incorporated to analyze relationships between a dichotomous dependent variable and independent variables. The logistic regression was fitted using method of rice production technology adoption as dependent variable and the listed demographic and socioeconomic variables as explanatory variables which is assumed to determine practice of adoption of rice production technology. The response variable is binary, taking values of one if the farmer adopts and zero otherwise. However, the independent variables are categorical, continuous and dummy.

The justification for using logit is its simplicity of calculation and that its probability lies between 0 and 1. Moreover, its probability approaches zero at a slower rate as the value of explanatory variable gets smaller and smaller, and the probability approaches 1 at a slower and slower rate as the value of the explanatory variable gets larger and larger (Gujarati, 2003). The function form of model is specified as follows:-

$$P=E(Y=1/Xi) = \frac{1}{1+e^{-(Bo+BiXi)}} \quad (1)$$

This will be writing as follows, z_i is equal to Bo + Bi Xi

$$Pi = \frac{1}{1+e^{-zi}} \quad (2)$$

$$1-Pi = \frac{1}{1+e^{zi}} \quad (3)$$

The probability that a given household is rice production technology adopter is expressed in equation (2), while the probability for non-adopters of rice production technology is expressed in equation (3).

Therefore, we can write as

$$\frac{Pi}{1-Pi} = \frac{1/1+e^{-zi}}{1/1+e^{zi}} = \frac{1+e^{zi}}{1+e^{-zi}} = e^{zi} \quad (4)$$

The ratio of probability that household is rice production technology adopter to the probability of that it is non-adopters of rice production technology.

$$Li = \ln \frac{Pi}{(1-Pi)} = z_i = \beta_o + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_n X_n \quad (5)$$

Where, Zi= function of explanatory variables (X).

Bo= an intercept, β1, β2, β3…… βn are slope of the equation in model

Li = log of the odds ratio = Zi

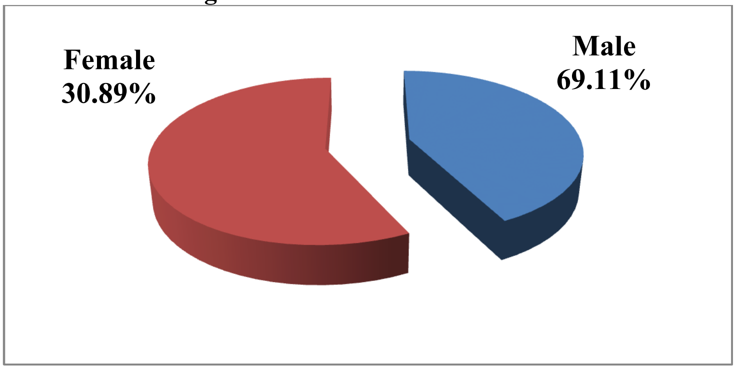
Xi= vector of relevant characteristic or independent variables.

3. Results and Discussion

3.1. Respondents Background

The very majority of the respondents are were headed by males (69.11%) and the remaining about 30.89% of the sample households were headed by females. This is atypical representative of developing countries where male headship is dominant.

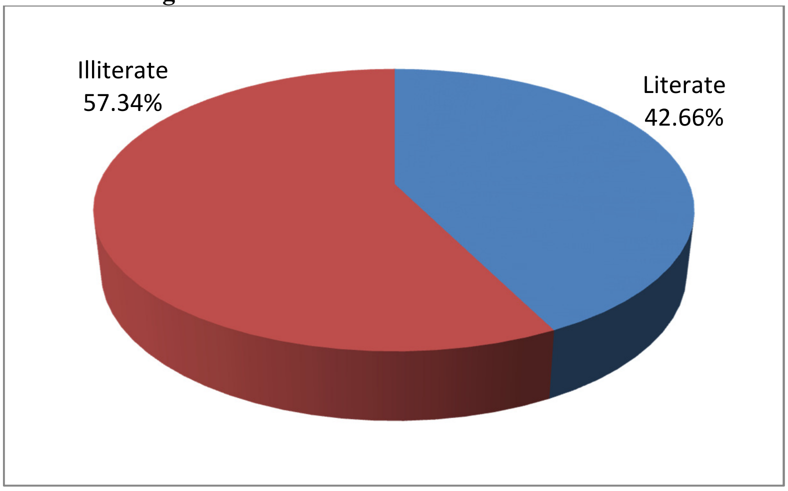
Figure 1: Sex of Household Head



Source: Own survey, 2017

About 42.66% of the respondents were literates; this figure is greater than the national figure for adult literacy (36%) indicating that the area is better off in terms of education.

Figure 2: Education level of Household Head



Source: Own Survey, 2017

As regard to the landholding of the sample households ranges from 0.5 ha to 3 ha with an average figure of 1.066 hectares. The average livestock (including cattle, sheep, goats, pack animals, and poultry) was 4.46 TLU with the minimum and the maximum holdings of 0.7 TLU and 17.8 TLU respectively.

Table 1: Land and Livestock Ownership

	Max	Min	Average
Land (in hectare)	3	0.5	1.066
Livestock (in TLU)	17.8	0.7	4.46

Source: Own Survey, 2017

About 67.02% had access to institutional credit. About 27.75% of the adopters and 17.28% of non-adopters get extension service around their villages while 19.90% of adopters sample household and 35.08% of non-adopters sample household did not get extension support respectively. About 64.4% of households did not get a chance to participate farmers training at farmers training and keeps them away from gaining best agricultural practices.

3.2. Main factors affecting adoption of Rice production technology

The adoption process of agricultural technology depends primarily on access to information and on the willingness and ability of farmers to use information channels available to them. In this sub section, we treat results concerning adoption at household level as well as the socio economic, demographic and other factors that affect the adoption of rice production technology. This study employed logistic regression model to estimate and to figure out factors having a certain sort of relationship to the rice production technology adoption. The output of the logistic regression model showed that six variables determine the probability of participating in adoption of rice production technology. These are age of household head, family size of the household head, participated labor force of household, education level of household head, size of cultivated land of household head and access to extension services.

Age of household head: this variable influences rice production technology adoption negatively and significant at 10% level of significant (p=.073) between adopters and non-adopters of rice production technology (table 1). The marginal effect (-.010) shows that keeping other explanatory variables constant, a 1 year increase in the age of the household head, decreases households probability of adopting rice production technology by 1% (table 1).

Family size of household head: this variable is significant at 1% of significance level (p=.000) between adopters and non-adopters of rice production technology (table 2). The marginal effect (.1134) also reveals keeping all other explanatory variables constant, a 1% increases in family size increases household probability of adopting rice production technology by 11%. This suggests that family size is among the major variable in influencing decisions of households to participate in adoption of rice production technology.

Participated labor force of household head: In this study participated family labor force is found to be significantly different at 10% significant level (p=.072) between the adopters and non-adopters (table 2). This means that it had positively and significantly influenced farmers' decision to adopt rice production technology. The odds ratio (1.28) reveals a household heads that has more family labor is about 1.3 times more likely to participate in rice technology adoption as compared to those who has not available family labor. Due to the fact that rice production is challenging particularly to adopt new technology, which needs high family labor is the possible explanation to the test result.

Table 2: Estimation result of Rice production technology adoption binary logit model

Variables	Robust coefficient	Odds ratio	P>[Z]	S.E	Marginal effect
Aghh	-.0428465	.9580584	0.073*	.0239402	-.0106925
Sexhh	.1493449	1.161073	0.715	.4087765	.0371999
Fshh	.4546282	1.575587	0.000***	.0963557	.1134539
Parlfor	.247736	1.281122	0.072*	.1377916	.0618233
Eduhh	.7201111	2.054661	0.003***	.2393349	.179706
Sicl	.626748	1.871514	0.035**	.2970068	.156407
Livow	.0484799	1.049674	0.530	.0772038	.0120983
Usecrids	.2935556	1.341188	0.475	.4110474	.0729286
Exten	.9447838	2.572257	0.014**	.382531	.2318219
Atftc	.3070263	1.359377	0.420	.381093	.0765751
_cons	-4.768916	.0084896	0.000***	1.194781	----------

Where, * significant level at 10%, ** significant level at 5% and *** significant level at 1%.
Number of obs = 191
LR chi2 (10) = 79.00
Prob > chi2 = 0.0000
Log likelihood = -92.677508 Pseudo R2 = 0.2988

Source: own computation based on data (2017)

Education level of household head: It is a variable positively correlated with both adopters of rice production technology and non-adopters and significantly influence the adoption of rice production technology 1% level of significance (p=.003). The marginal effect (0.179) means that keeping other factor variables constant, a year increase in level of education increases probability of adopting rice production technology by 17.9% (table 2). Education helped farmers to develop perception on production of rice through time which contributes for the adopters of rice production technology.

Size of cultivated land of household head: Farmers with large area of land are more likely to introduce new agricultural technology than those with smaller area of land. This variable is significant at 5% significant level (p=.035) for adoption of rice production technology. It has positive relationship with rice production technology. The implication is that the result is expected since cultivated land is one of the major factors of rice production. The marginal effect (0.156) implies that keeping other factor constant, a unit increase in size of cultivated land increases the probability of households adopting of rice production technology by 15.6%.

Access to extension services: it is positively related with adoption rice production technology. This variable is significant at 5% (p=.014) probability level (table 2). Farmers need to be equipped with knowledge and skill about specific technology to be effective in agricultural production. The marginal effect of this variable is (0.2318) reveals that keeping other factor constant, a unit increase in access to credit services increase the probability of adopting rice production technology by 23.18% (table 2).

4. Conclusion and Recommendation

The objective of this study was to evaluate the factor that affects rice production technology adoption. Binary logit and cross-sectional survey data were used to attain the objective of the study. The study employed cross sectional household level data collected in 2016/2017 cropping season from 191 sample farming households. The main factors affecting adoption of improved rice technology are age, family size of households, participated labor forces, education, size of cultivated land and access extension services. Hence, scaling up the best practices of the adopters to other farmers can be considered as one option to enhance production in the area while introducing new practices and technology is another option.

The most important problem in practicing adoption of rice crop technology is its labor requirement and the associated costs. The availability of larger family labor for agriculture affects the likelihood of participation in improved rice production technology adoption highly significantly and positively, as expected. It is therefore, while disseminating improved rice production technology priority should be given to households with large family size to enhance technology adoption and dissemination. Changing the attitudes of farmers is a crucial factor in adopting rice production technology In case of production, household heads with very limited education encounter in successfully managing, fertilizer and pesticide applications, and also what to produce in line with taste and preference of consumers demand, especially in the presence of ineffective farmer's training services. So stakeholders' and government authorities have to create awareness about the benefits of adopting rice production technology. Continuous education and training are important in this regard. Intervention aimed at improving the fertility status would enhance technology adoption. The improved access to diversified and qualified agricultural extension services still remains critically important.

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