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Determinant of Improved Modern Agricultural Inputs Adoption in Case of Woliso Woreda

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Abstract
This study analyzes the determinant of improved modern agricultural technology adoption by farmers in Woliso woreda. The data used for the study was obtained from 100 randomly selected sample households in the study area. Probit model is employed in analyzing the determinants of farmers' decisions to adopt modern technologies on their farm land as measured by the use of modern fertilizer. The variable such as land ownership, level of education, number of oxen and family size, positively and significantly affected the farm households' fertilizer adoption decision; while age affected their decision negatively and significantly. On the other hand, variables such as distance from market, credit accessibility, education, family size and access to extensions service have a positive and significant impact on adoptions of High Yield Variety while age has a negative and significant impact on their decision.
Keywords: Technology Adoption, Improved seed, Agricultural Sector, Fertilizer and High yield Variety probit model

1. Introduction

Agriculture is the main economic activities in the developing countries. The role of agriculture in economic development has been viewed as largely passive, supportive and secondary. Nevertheless, it provides us with almost all our basic needs: clothing, shelter, and foods. Besides, agriculture provides material used in making industrial products such as paints and medicine. About 50.8% of world populations are engaged in agricultural sector. Based on the historical experience of western nation's economies, economic development was seen to require a rapid structural transformation, from agriculture led economy to modern industrial, and service sectors. As a result agriculture primary role was to provide sufficiently low price food and man power to expand industrial outputs in the process of economic development (Nigate and Aklilu, 2014 E.C)

According to United Nation Development Program (UNDP, 2014 G.C) two third of the people in developing countries are living in rural areas. Agriculture is the main source of subsistence and income for the majority of the rural people; many of them are small scale farmers. Farmers in developing countries are depending on the farm income and experiencing a hand to mouth way of living. This is because of technological backwardness, rapid population growth and low productivity of livestock (FAO, 2014G.C). Approximately 1.4 billion people in the world today lives in extreme poverty level that-they survive on less than the united states dollar of 1.25 per day,(world bank data base 2014) . 842 million people or one out of eight people in the world do not have enough food to eat. 98% of the worlds undernourished people lives in developing countries. Among those 223 million people lives in sub-Saharan Africa.75%of world poorest people lives in rural areas and depends on agriculture and related activities,(FAO,2014).

Ethiopia, the third largest user of inorganic fertilizer, has been striving for agricultural productivity. It was during the imperial period that the the government started to adopt different technological input such as fertilizer, pesticide and herbicides, aiming to enhance agricultural productivity and to ensure food self-sufficiency. (Befekadu, 2014).

Fertilizer is one of the major productivity enhancing inputs. Hence increased and efficient use of fertilizer can be considered as a more plausible alternative in Ethiopia to bridge the made gap of food shortage at least in the immediate future. There is no domestic production of inorganic fertilizer in Ethiopia. Chemical fertility is imported from abroad in the form of Di-ammonium phosphate (DAP) and UREA. Fertilizer import is mainly financed by funds obtained from donors and creditors. More than 90% of all fertilizer are used by small- holder farmers and the remaining 10% is used by private commercial farmers and the research centers. Of the total quantity of in organic fertilizer used in the country 94% was used for the production of major cereals (CSA, 2013).

Agriculture sector has always been an important component of the Ethiopian economy that accounts for about 42% of gross domestic product (GDP), employs 80% of the Ethiopian labor force and supply 90% by value of all exports, (MOA, 2014). A predominant portion of Agricultural production takes place at subsistence level. In all 99% of coffee production and 94% of other agricultural production comes from peasant farms, (Samuel G, 2014). Thus the farmer has to increase agricultural productivity based on the adoption of modern farm input (innovation) more successfully. It is important that the effect of agro-climatic and socio-economic factors on their adoption of modern agricultural inputs shall be assessed. As it has been clearly explained above, there are numerous studies, reports, and findings of different aspects of agricultural and adoption process of innovation technologies. However the factors responsible for adoption variation is not well addressed. Therefore the aim of the study is to assess (investigate) the factors responsible for the adoption of modern agricultural innovations in Woliso Woreda.

2. Statement of the problem

Ethiopian economy is dominated by agriculture. The agriculture accounts for about 40% of GDP. This sector provides employment opportunity for around 85% of the total population. As agriculture plays a dominant role in the economy, the real and sustainable development is unthinkable without prioritizing the progress of agricultural output. It is for this reason that every government has been given priority to the sector by introducing different strategies. (Fact about Ethiopia, 2014 page.71). Although population is growing fast in developing countries in general, population of Ethiopia is increasing at the rate of above 2.5% annually (EEA, 2014) for a long period of time.

The existing conceptual and empirical literature on the topic also suggest that the adoption behavior of modern agricultural technologies is affected by the inter-relation of agro-climatic and socio-economic factors such as age, family size, education, risk aversion, access to information, access to credit, farm labor supply, supply of high yielding varieties, price of farm output, chemicals, extension contacts, and etc (Ibid). The ultimate goal of any rural or agricultural strategy or program is to improve the welfare of rural households. This goal is to be achieved among other things by increasing productivity at farm level and by raising farmer's income and by improving their welfare. This is possible if and only if improvements in agricultural technologies are properly transferred and distributed to farmers, so as to expand and intensify their production (Assefa and Gezahegne, 2014).

Agricultural development project would be successful if evidences on factors responsible for adoption and risk taking behavior are known in advance (EEA, 2014). Accordingly appropriate measure can be taken to mitigate the effect of risk and provide complementary input and output. It would not be possible to increase the productivity of agricultural sector through development programs that involves new production technologies unless farmers are convinced with the benefits expected from the participation (EEA, 2014). Although the total consumption of modern agricultural inputs has shown an increasing trend, farmers in Ethiopia are still using very little, due to various institutional, economic and physical factors.

Several modern technology packages have been introduced in Ethiopia over the past four decades. While some studies in the past have attempted to access the factors behind the adoption behavior of farmers, the adoption and diffusion of these technologies has not been satisfactorily and comprehensively assessed even at national and regional level. So we believe that there are little or not enough empirical and conceptual studies regarding the adoption of improved agricultural modern inputs at Woliso Woreda. Therefore this study is initiated to analyze determinants of modern agricultural inputs adoption by small holder farmers aiming to assess (investigate) the effect of those factors on the adoption of modern agricultural innovations in Woliso Woreda so as to fill the spatial gap in this topic.

3 Objective of the study

3.1. General objectives

The general objective of this study is to assess the determinant of improved modern agricultural inputs adoption in Woliso Woreda.

3.2 Specific objectives

The specific objectives of this study:

- To identify the determinant of fertilizer adoption in the study area.
- To identify the determinant of HYV adoption in the study area.
- To come up with some possible recommendation for policy in the study area.

3.3 SCOPE AND LIMITATION OF THE STUDY

This study is conducted in Woliso Woreda trying to assess the determinant of improved agricultural inputs adoption. One of the main constraints for this study is lack of enough full information because of unwillingness of the respondents in giving reliable information. In addition to the lack of full information, shortages of time and budget have been constrained this study.

4. METHDOLGY OF THE STUDY

4.1. Description of the study area

The study is based on survey result from household in woliso District. woliso District is found in southwest showa zone which is located about 114 km away from the center Addis Ababa. And it is located in tropical climate zone. The climate condition of the District is medium that the altitude of the land is waynadega. The District is one of the south west showa zone in Oromiya regional state. The relative location or visional position of the District has physically contacts with four Districts namely Bachow District, goro District, wanchi District, and sadden sodo District and one region namely SNNP. In terms of these Districts location, Woliso District is boarded in the North by bacho District, in the west by wanchi District, in the south west by SNNP, in the south by gooro District and in the east by sadden sodo District. The total area of the District is approximately around 681.8 km^2 (WDARDO).

According to national population housing census of 2007, the total population of the District was around 165,280. Based on the result of this census the number of female was greater than that of males. The numbers of females out of total population of the District are around 82,788 and the number of male 82, 492, (Ibid).

4.2. Types and Source of data

This study uses both sources of data, primary and secondary sources. Primary data is obtained through questionnaire whereas secondary data is collected from different government offices.

4.3. Method of data collection

For this study the interview and questionnaire were chosen to be used as an appropriate tools to measure the variable under consideration. The data was collected more by questionnaires distributed to randomly selected farmers

4.4. Sampling techniques and size

This study used the sample survey from the total number of households with in the districts; we preferred to apply a simple random sampling method were each farm household is exposed to equal chance. The reason for selecting the three kebeles is that it is very difficult to consider all kebeles the researcher faced time and finance limitations. Selection of the three kebeles is reasonable because the total distributions of the farm households of the woreda are socioeconomically, culturally and institutionally similar.

The administration, technology diffusion procedures and plans of development by the woreda leaders are almost the same for all the 35 kebeles and so any household from any Kebele of the woreda can be representative of the woreda. Multi stage sampling technique was adopted in this study by adopting a simple random technique at each stage. Out of 35 kebele 3 kebeles were randomly selected, out of which 100 respondents were taken as a sample based on the procedures described below.

4.5. SAMPLING SIZE DETERMINATION.

According to Woliso district agricultural and rural development office, the total household in the three kebeles are 18859. And the precision level is 10 percent. The sample size determination technique adopted was as of Yamani T. (1967)

Sample size (n) $=\frac{N}{1+N(e2)}$

Where n= sample size, N=total households of target population in the case study, e= level of precision

$n=\frac{18859}{1+18859(0.1^{2})} = 99.5 \approx 100$

The stratum also calculated as $Ni=\frac{n}{N}$

where Ni= the total number of observation in the kebele i. N= total numbers of house hold heads in the study area. ns= total number of sample size. So by using the above sampling formula the proportional number of respondent in each kebele is calculated as follows.

1. From D/dullatti kebele $(\frac{6963}{18859})\times 100=37$
2. From Obi-koji Kebele $(\frac{8254}{18859})\times 100 =44$
3. From Adami gootuu $(\frac{3642}{18859})\times 100 =19$

4.6. Method of data analysis

For data analysis the researcher used both descriptive statistics and econometrics model. The descriptive analysis includes orderly arranging the data in tabulation frequency percentage and table forms. Econometric model (probit model) is adopted in this study to analyze factors that determine the probability of technology adoption by farm households in the study area. Probit model is preferred due to the fact that our dependent variable (technology adoption) is discrete valued by its nature having binary outcomes.

4.7. Theoretical Model and Empirical Specification

In this paper, regardless of the intensity and quantity of technologies being used, a farmer was taken as an adopter if he or she sows any improved seed and uses chemical fertilizer; either independently or together with their indigenous seeds and manure. The dependent variable, technology adoption, has a binary nature taking the value of 1 for adopters (chemical fertilizer and HYV independently) and 0 for non-adopters. In this regard an econometric model is employed to examining the probability of farm households' agricultural technology adoption decision using the probit model. Often, probit model is imperative when an individual is to choose one from two alternative choices, in this case, either to adopt or not to adopt chemical fertilizer and HYV. Hence, an individual *i* makes a decision to adopt chemical fertilizer and HYV if the utility associated with (the net benefit) from adoption choice (V*1i*) is higher than the utility associated with decision not to adopt (V*0i*). Hence, in this model there is a latent or unobservable variable that takes on the values ranging from (-∞, +∞). According to Koop (2010) these two different alternatives and respective utilities can be quantified as: *Yi** = V*1i* - V*0i* *(we assumed that farmers decide not to adopt if the expected net benefit from adoption is zero)* and the econometric specification of the model is given in its latent as:

$$Y^* = X'\beta + U_i$$

$$Y_i = \begin{cases} 1..if Y^* \succ 0 \\ 0..if Y^* \leq 0 \end{cases}$$

Where Y_i takes the value of One (1) for adopters and Zero (0) for non-adopters

Where $u|\, x$ is a normally distributed with mean zero and constant variance. From this unobserved or latent model specification, therefore, the utility function depends on household specific attributes *X* and a disturbance term (*u*) having a zero mean:

As utility is random, the *i*th household will adopt if and only if Ui1>Ui0. Thus, for the household *i*, the probability of adoption is given by:

$$\begin{aligned} P(Y_i = 1 \mid X) &\Rightarrow P(Y^* \succ 0 \mid X) \\ &= P(X'\beta + U_i > 0 \mid X) \\ &= P(U_i \mid X > -X'\beta) \\ &\Phi(-X'\beta) \end{aligned}$$

Where: *P()* is the probability of adopting chemical fertilizer and *HYV,* $\Phi()$ is the cumulative distribution function of the standard normal distribution. ***β***is the parameters that are estimated by maximum likelihood

x′ is a vector of exogenous variables that explains adoption of chemical fertilizer and *HYV*(e.g. age of household head, sex of the household head, education, membership to an agricultural association, access to credit, etc). Therefore, on the basis of the two dependent variables indicated: chemical fertilizer and *HYV*, probit model was applied independently for each binary dependent variable; given below.

$$P(CHEMF) = \Phi(\alpha_0 + \alpha_1 SEX + \alpha_2 AGE + \alpha_3 EDUC + \alpha_4 FAMILYSZ + \alpha_5 MSTATUS + \alpha_6 NOXEN + \alpha_7 EXTENSION + \alpha_8 LANDOWN)$$

$$P(HYVAD) = \Phi(\beta_0 + \beta_1 SEX + \beta_2 AGE + \beta_3 EDUC + \beta_4 FAMILYSZ + \beta_5 MSTATUS + \beta_6 NOXEN + \beta_7 EXTENSION + \beta_8 LANDOWN + \beta_9 CREDIT + \beta_{10} ASSOC + \beta_{11} ORHTODOX + \beta_{12} LANDSZ + \beta_{13} DISMKT)$$

Where: ***CHEMF*** is a dependent variable indicating for probability of chemical fertilizer adoption; and ***HYVAD*** is a dependent variable representing the probability of **High Yielding Variety adoption**

P ( ) probability of adoption decision, Φ( ) is a cumulative standard normal distribution function (CDF)

Given the above two dependent variables (chemical fertilizer and HYV adoption), to estimate the magnitude of parameters or variables basically to put clearly the percentage probability of adoption, marginal effect of variables was calculated (for marginal effect results). Marginal effect of a variable is the effect of unit change of that variable on the probability of adoption decision

Given that all other variables constant the marginal effect is expressed as:

$$\frac{\partial P(Y_i = 1 \mid X)}{\partial X_i} = \beta_i \phi(X'\beta)$$

Where $\phi()$ is a probability density function (PDF) and all other variables are evaluated at their mean values

4.8. Hypothesis and expected signs
The variables used in the analysis and their theoretical expectations about the sign and magnitude of these variables on the adoption decision of agricultural technologies more particularly chemical fertilizer and HYV as well as its impact on farm income are discussed below. These variables were chosen based on the available literature reviewed.
Sex of household head (GEN): It is a dummy variable 1 if gender of the household head is male and 0 otherwise. Male-headed households would have better opportunity to adopt both chemical fertilizer and HYV since they are exposed to new information and tend to be risk takers (Adebiyi & Okunlola, 2014). In such instances, negative sign was hypothesized while adopting chemical fertilizer due to their reluctant behavior and higher probability of adopting manure as a proxy for chemical fertilizer; whereas positive coefficient was expected for HYV adoption.
Age of household head (AGE): It is a continuous variable measured in numbers; as age increases households' probability of adopting chemical fertilizer and HYV were expected to decrease; where younger farmers were expected to adopt unlike elder farmers. The hypothesized coefficient in the final result for both chemical fertilizer and HYV was negative.
Education (EDUC): It is a continuous variable measured in number of years of schooling; where the educated farmers are believed to acquire, analyze and evaluate information on different agricultural inputs and market opportunities. Positive was the coefficient expected from the final result both for chemical fertilizer and HYV adoption.
Family size (FAMILYZE); This is a continuous variable measured in number; as family size of household increase the probability of adopting chemical fertilizer and HYV were expected to increase. .
Marital status (MRT) it was expected positively influencing the adoption of HYV. Especial **married** farmers highly adoption and use of HYV Hence, as compared to unmarried HHs, being married citrus paribus, would increase , the probability of HYV adoption decision of farm households
Number of oxen (NOOFOXEN); this is a continuous variable measured in number; as number of oxen of household increase the probability of adopting chemical fertilizer and HYV were expected to increase. .
Land Size (LANDSZ): This is a continuous variable measured in hectare. Those with large land size could use chemical fertilizer and HYV mainly to increase productivity. On the other hand, those with large land size could not be in a position to adopt chemical fertilizer since they could use fallowing system. Besides, large land size holders may not use HYV so long they could use their own indigenous seed. On the other side of the coin, small land size holders may use chemical fertilizer and HYV so as to heighten production and productivity and thereby satisfy their annual household consumption needs. Hence, the coefficient was not determined or hypothesized in prior.
Plot Distance (PLTDIST): It is a continuous variable measured in minutes walking; as plot is far away from the homestead, the less will be on time plot preparation, weed, harvest and input utilization and then less will be farm income (Minale*et al*., 2012). Hence, farmers will be less probable to adopt chemical fertilizer and HYV. As a result, negative coefficient was hypothesized from the final probit estimation result.
Land Ownership (LANDOWN): It is a dummy variable 1 if farm households have land ownership right and certified for that 0 otherwise. If farm households do have ownership right and certificate, they tend to purchase and adopt both chemical fertilizer and HYV; on the other hand, if they do not have ownership right, they become reluctant to adopt and incur a cost for chemical fertilizer and HYV. Hence, for these two different independent variables, positive coefficient was expected from the final probit estimation result.
Access to Credit (CREDIT): It is a categorical variable; representing 1 if household has had credit access and 0 otherwise. Credit access reduces liquidity problems that household could face while intending to purchase agricultural inputs; and hence paves the way for timely application of inputs thereby increase the overall productivity and farm income (Mpawenimana, 2005). Hence, from the final estimation result, access credit was expected to have a positive sign both for chemical fertilizer and HYV adoption decision.
Extension Agents' Contact (EXTENS): It is a categorical variable representing 1 if households were visited by extension agents and 0 otherwise. Farmers' visited by extension agents are believed to be exposed for different, new, updated information used to adopt chemical fertilizer and HYV thereby increase and double agricultural production that finally could increase farm income (Wondimagegn*et al.*, 2011). Hence, both for chemical fertilizer and HYV adoption decision, extension agents' contact was expected to have a positive sign or coefficient from the final probit estimation result.
Membership to an Association (ASSOCI): It is a categorical variable; 1 represents if a household was a member of a certain farmers' association or cooperatives and 0 otherwise. Membership to an association let farmers to access inputs easily with an affordable price that is pertinent to increase agricultural production and thereby farm income (Uwagboe*et al.*, 2014 and Tewodaj*et al.*, 2009). Hence, farmers can easily adopt chemical fertilizer and HYV on time through an affordable price as well as through credit that will be returned back soon after harvesting. Due to this, while determining chemical fertilizer and HYV, membership to an association was

expected to have a positive coefficient.

Distance to the nearest market (DISMRKT):

This is a continuous variable measured in kilo meters; and the longer the distance of farmers' residence to the nearest market, the improbable will be their adoption decision for chemical fertilizer and HYV. Hence, negative sign was expected from the final probit estimation result.B.Kassa,B.Kassaand,K.Aregawi

5. DATA ANALYSIS AND RESULTS

This section discusses the estimated results of the probit model.

5.1 Determinants of Agricultural Technology adoption Decision of Farm Households

As we have already indicated in model specification part, there are two dependent variables (adoption of Chemical Fertilizer and adoption of HYV) where different independent variables have been identified and used. Before rushing to econometric estimation1 and result display, different econometric assumptions were tested. In cross sectional data set, expecting and facing multicollinearity is very much common. To check and address multicollinearity problem, pair-wise correlation matrix was made that could let to drop some of the variables that really show a serious multicollinearity problem. Robust standard error calculation of probit model was made. Estimate of the probit model for the two dependent variables and the estimation of Marginal effects of each explanatory variable on the dependent variables are depicted in table below.

5.2 .Determinant of chemical fertilizer Adoption Results from Probit Models

The dichotomous regression model was explaining only the probability of adoption versus non adoptions. In this study we used 8 independents variables which are expected to have significant effect on farmer's adoption of chemical fertilizer based on the empirical studies.

Based on the Probit regression and the estimated coefficients, the first equation become;

$$P(CHEMF) = \Phi(-6.92 + 0.961SEX - 0.196AGE + 0.295EDUC + 1.363FAMILYSZ + 1.093MSTATUS + 2.357NOXEN + 1.728EXTENSION + 3.502LANDOWN)$$

Where P ( ) is probability of adoption of the i^{th} farmer and Φ ( ) is a cumulative standard normal distribution function (CDF)

TABLE 5.1 DETERMINANT OF FERTILIZER ADOPTION FROM PROBIT REGRESSION

Fertilizer	*Coef.*	*Std. Err.*	*Z*	*z P>z*	*Marginal effect*
Sex	***.960657***	***.83017***	***1.16***	***0.247***	***.1492869***
Age	***-.19558***	***.07469***	***-2.62***	***0.009******	***-.0188397***
Familysize	***1.36321***	***.5881***	***2.32***	***0.02*****	***.1313083***
Mstatus	***1.0931***	***.9072***	***1.20***	***0.228***	***.1388873***
Edu	***.2946***	***.1917***	***1.54***	***0.124***	***.028385***
Noofoxen	***2.537***	***1.258***	***2.02***	***0.04*****	***.2444028***
Extension	***1.728***	***1.079***	***1.60***	***0.109***	***.2442831***
Lownersp	***3.502***	***1.367***	***2.56***	***0.01*****	***.5535599***
_con	***-6.9243***	***3.329***	***-2.08***	***0.038***	

LR chi2(8) = 113.46 Prob>chi = 0.0000
Log likehood = -11.860782 Pseudo R2 = 0.8271

Source: *Own Estimation Result, 2017 asterisks*, **and*** significant at 10, 5 and 1 % respectively. SE; Standard Error*

The estimated parameters of the variables taken as the determinants of new technology adoption (fertilizer use) are displayed under table 5.1. Total of 8 explanatory variables were considered in the econometric model 3 of which were found to be insignificant in influencing the adoption probability of fertilizer among farm households. From table 5.1 .the R-squared of the model is 0.8271 which implied out of the total variation in the dependent variable, 82.71 percent is explained by the variation in the independent variable included in the model whereas the remaining 17.29 is explained by other variables not included in the model. Thus these variables collectively have good explanatory power for the variation of the dependent variable (new technology adoption) by farm households in Oromia region.

The overall significance of the model is insured based on the likelihood ration (LR) test above as the value of the chi-squares is sufficiently low.(Prob > chi2 =0.0000) indicating (estimated coefficients are collectively significant) that strong statistical significance, which enhanced the reliability and validity of the model.

The regression result show that education, family size, land ownership, and number of oxen, have positive influence onthe chemical fertilizer adoption decision; while age is carried a negative sign indicating its negative correlation with chemical fertilizer adoption decisions.

Age was found to be a determinant factor of chemical fertilizer adoption, positively; it was found to be significant at 1% level and negatively related with fertilizer adoption decision. Hence, as age increases by one year, citrus paribus, the probability of fertilizer adoption decision of farm households would decrease by 1.8%. The possible explanation here is, as age increases, farm households would become too reluctant and conservative in adopting chemical fertilizer and do prefer their animal dung. Alternatively, the old age farmers are relatively conservative in keeping their old age technologies and relatively reluctant in replacing by the modern inputs.

Land ownership status of farm households was found to be statistically significant in determining adoption decision of chemical fertilizer at 5% significance level. The magnitude of the estimated marginal effect shows that, those who are certified (whose land ownership status is secured), keeping other things constant, have 55 % higher probability of adopting chemical fertilizer unlike their counterparts. Possibly, owning an arable land could best be taken as a prerequisite to adopt and employ agricultural technologies since farmers could incur a cost. Being a rational decision makers, while incurring a cost for technologies, farmers want totally to employ technologies within their own land where the final crop yield could not be shared and sub-divided which is too common in sharecropping system

Family size is statistically significant at 5% significance level. Hence, as family size of household increases by one person, citrus paribus, the probability of fertilizer adoption decision of farm households would increase by 13.13%. Household with large family size has high productivity, and high likelihood of adoption of modern agricultural inputs. This may be because of the fact that agricultural sector is highly labor intensive and farmers with large family size take this advantage.

Number of oxen is statistically significant at 5% in determining adoption decision. Hence, as number of oxen increases by one unit, citrus paribus, the probability of chemical fertilizer adoption decision of farm households would increase by 24.4%. The farmer with two or more oxen has a high fertilizer adoption behavior.

4.2.3 Determinant of HYV Adoption Results from Probit Model

In this study, we used 14 independents variables as the explanatory variables for farmer's adoption of High Yield Variety (HYV) seeds. The estimates of the parameters of the variable as well as the marginal effect of a unit change of each variable on the probability of the dependent variable are displayed in table 5.2. Total of 14 explanatory variables were considered in the econometric model out of which 6 variables were found to be significantly influencing the adoption probability among farm households. From table 5.2. The goodness of fit (R-squared) of the model is 0.5614 indicating the total variation in the dependent variable that can be explained by the independent variable is 56.14. Equivalently, out of the total variation in the dependent variable, 56 per cent is explained by the data and the remaining 44 per cent is explained by the factors other than the explanatory variables. Thus these variables collectively have good explanatory power for a HYV adoption in the study area, south west shoa zone Woliso district. Given the estimated coefficients of the probit model, the equation for HYV become;

$$\begin{aligned} P(HYVAD) = \Phi(&-5.335 + 0.158SEX - 0.040AGE + 0.220EDUC + 0.520FAMILYSZ + \\ &0.584MSTATUS + 0.339NOXEN + 0.993EXTENSION - 0.317LANDOWN + \\ &0.784CREDIT + 0.456ASSOC + 0.417ORHTODOX - 0.165LANDSZ - 0.0005DISMKT) \end{aligned}$$

Where P ( ) is probability of adoption of the i[th] farmer and Φ( ) is a cumulative standard normal distribution function *(CDF).*

Table4.13. Determinant of HYV adoption from probit regression
LR chi2(14) = 77.01 Prob > chi2 = 0.0000
Log likelihood = -30.087877 Pseudo R2 = 0.5614

HYV	*Coef.*	*Std. Err.*	*Z*	*P>z*	*Marginal effect*
Sex	*.1579944*	*1.191841*	*0.13-*	*0.895*	*.0604246*
Age	*-.0402667*	*.0220309*	*1.83*	*0.068**	*-.0156657*
Familysize	*.5203116*	*.1744848*	*2.98*	*0.003***	*.2024267*
Mstatus	*.5841524*	*1.061166*	*0.55*	*0.582*	*.2075257*
Edu	*.2206728*	*.0645836*	*3.42*	*0.001****	*.0858526*
Orthodox	*.4169836*	*.4372731*	*0.95*	*0.340*	*.1633568*
Lsize	*-.1646167*	*.1404888*	*-1.17*	*0.241*	*-.064044*
Noofoxen	*.3395056*	*.2527844*	*1.34*	*0.179*	*.1320843*
Credit	*.7847724*	*.4215028*	*1.86*	*0.063**	*.3014782*
Extension	*.9937559*	*.561139*	*1.77*	*0.077**	*.3389739*
Distance	*.0993372*	*.0574103*	*1.73*	*0.084**	*.038647*
Lownership	*-.317701*	*.5226952*	*-0.61*	*0.543*	*- .1248527*
farmassoci~n	*.4558872*	*.4159577*	*1.10*	*0.273*	*.1741877*
Disfromhome	*-.0005164*	*.0011285*	*-0.46*	*0.647*	*-.0002009*
_cons	*-5.335641*	*1.696177*	*-3.15*	*0.002***	

Source: *Own Estimation Result, 2017 asterisks*, **and*** significant at 10, 5 and 1 % respectively. SE; Standard Error*

The regression result show that family size, distance from market, education, access to credit, and contact with extension agents have positive impact on HYV adoption decision while age of a farmer contributes negatively on the HYV adoption decision.

Age was found to be significant at 10% level and negatively affects HYV adoption decisions. Hence, as age increases by one year, citrus paribus, the probability of HYV adoption decision of farm households would decrease by 1.5%. The possible interpretation here is, as age increases, farm households would become too reluctant and conservative in adopting new seed varieties and do prefer their indigenous seeds.

Education was positively influencing the adoption and use of HYV and it is significant at 1% level. Hence, as education level of household increases by one year, citrus paribus, the probability of HYV adoption decision of farm households would increase by 8.5% . Therefore educated farmers are more likely to adopt HYV as compared to the illiterates.

Family size is statistically significant at 5% significance level. Hence, as family size of household increases by one individual, citrus paribus, and the probability of HYV adoption decision of farm households would increase by 20%. Household has several family size high productivity ,and high adoption modern technology of agricultural inputs because of high labor force participate in production. .

In line with this, farm households who have credit access; keeping other things constant, have 30% higher probability of adopting HYV unlike the credit rationed farmers respectively. As a liquidity factor, the more farmers have access to source of finance, the more likely to adopt agricultural technologies that could possibly increase crop yield.

Distance to the nearest market was positively related with adoption of HYV and statistically significant at 10% level of significance. Actually, there might be HYV suppliers within a district or village, Hence, there is on time procurement and distribution ., as distance from the nearest market increases by one meter, keeping other things constant, the probability of adopting HYV would increase by 3.86%. this finding is against the expectation as access to market would have been contributed positively.

The regression result reveals that contact with extension workers positively affects adoption of HYV and statistically significant at 10% level of significance. The magnitude of positive sign show that, farmers who are visited by extension agents, keeping other things constant, have 33.8% higher probability of adopting, HYV unlike non-visited or non-contacted farmer The finding corroborates with the findings of Ransom et al. (2003); Kandji et al. (2006) and Paudel and Matsuoka (2008). It is worth to note that, access to credit is one best option whereby smallholders could be instigated in diversifying their economic base and adopt all imperative yield increasing technologies. As a liquidity factor, the more farmers have access and source of finance, the more likely to adopt agricultural technologies that could possibly increase crop yield. The finding is in line with the findings of Uaiene et al. (2009) in Nigeria. Possibly, owning an arable land could best be taken as a prerequisite to adopt and employ agricultural technologies since farmers incur a cost. Being rational decision makers, while incurring a cost for technologies, totally, farmers want to employ technologies within their own land where the final crop yield could not be shared and sub-divided which is too common in sharecropping system. The finding is consistent with the findings of Lugandu (2013)

5. Conclusion

Ethiopia is one of the developing countries striving for economic development and food self-sufficiency through adopting different policies and strategies. Since, 1992 the development of Ethiopia revolves around productivity enhancement of small scale farmer and industrialization based on utilization of domestic raw material. Agricultural productivity enhancement required application of technological productive inputs, such as inorganic fertilizers.

In this study factors influencing fertilizer adoption among small holder farm households were analyzed in the selected Woliso district. The study was based on the data obtained from randomly selected households through questionnaire. Analysis of the extent of fertilizer adoption by the sample households had shown that 75% of the sample households were adopters of chemical fertilizer and 25% non-adopters. To come up with the factors responsible of the variation in the adoption among the HHs, this research has employed both descriptive and econometrics analysis. The probit model was chosen as the dependent variables under consideration are binary choice in their nature.

This research paper examined the underlying determinants of chemical fertilizer and HYV adoption by the rural households in Woliso districts of Oromia region, Ethiopia. The probit regression result show that family size, number of oxen land ownership right security were found to be positive in determining chemical fertilizer adoption decision. Besides, ages was statistically significant while influencing chemical fertilizer adoption decision negatively. While adopting HYV, farm households' decision were positively influenced by family size, education, credit, extension contact and distance from market, whereas age carried a negative coefficient.

Recommendation

Based on the findings, the researchers draw the following policy implications that could be applied for the enhancement of adoption of improved modern agricultural inputs in particular and the development of agriculture to the rural poor in general.

- Government should work towards strengthening the relationships between farmers and extension agents and widen the outreach scheme by giving different training for both of the farm-households and extension agents.
- Government should expand and strengthen the extent of education and training of the farmers to bring necessary improvements of awareness and change in attitudes. And this education should also be accessible by old age farmers and farmers located in the remote areas
- Government should work to ensure farmers sense of ownership by facilitating the provision of land ownership right for farmers owing to the fact that timely provision of landownership right (land certificate) is one way of encouraging farm housholds to use improved modern agriculture inputs to their farm land.
- Credit and saving association and Agricultural credit institutions should widen their lending scheme by reaching the low income farmers who are unable to purchase agricultural inputs in order to increase productivity and government should work in collaboration with these institutions

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