Factors that affect the adoption of improved maize varieties by smallholder farmers in Central Oromia, Ethiopia.

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Abstract

This study aims at identifying factors which affect the adoption of improved maize varieties in three woredas in Central Oromia, Ethiopia. The study utilized cross-sectional farm household level data collected by CIMMYT from 300 randomly selected sample households in 2012/13. Both descriptive and econometric methods have been used to analyze the data. The descriptive statistics were utilized to compare adopters and non-adopters. The logit model was employed to assess the adoption determinants.The descriptive analyses results show the existence of significant mean and proportion difference between adopters and non-adopters in terms of farmer characteristics. Adoption of the improved maize varieties among households was found to be positively influenced by adult-literacy, family size, livestock wealth, access to output market and credit access for the new varieties. On the other hand, farmer associations, distance to main markets and fertilizer credit negatively influenced adoption. Thus, the finding of this study revealed that educating farmers, strengthening extension services, improving farmer associations and improving market opportunities are some of the measures that need to be taken to enhance adoption of improved maize varieties by farmers.

Keywords: improved maize varieties, small-holder farmers, adoption, determinants, Ethiopia

1. INTRODUCTION

Agriculture continues to be the dominant sector in Ethiopia's economy, accounting for 51% of the GDP in 2009 (WB, 2013). Within agriculture, cereals play a central role accounting for roughly 60% of rural employment, 80% of total cultivated land. Among cereals, maize is the most important crop in term of production and contributes significantly to the economic and social development of Ethiopia (CSA, 2011). Maize cultivation is a largely smallholder phenomenon. The smallholder farmers that comprise about 80% of Ethiopia's population are both the primary producers and consumers of maize in Ethiopia (Alemu *et al*., 2008).

While maize already plays a critical role in smallholder livelihood and food security of the country, this role can be expanded. Because of lack of modern way of farming, agricultural technologies, the production was 2.2 tons per hectare in 2008/09 with a potential for 4.7 tons per hectare according to on- farm field trials, when cultivated with fertilizer, hybrid seed, and improved farm management practices (Rashid *et al.,* 2010). The implication is that if smallholder farmers have got the ability to adopt the improved maize technologies, they can produce more. Now agriculture has to fulfil diverse objectives such as the need to be internationally competitive, produce agricultural products of high quality while meeting sustainability goals such as food security. In order to be competitive, agricultural producers need rapid access to emerging technologies. This is a crucial issue in countries like Ethiopia where the population is increasing in an alarming rate while the land for cultivation is limited.

Recently, the Ethiopian government has promoted technology ‑ led initiatives to enhance productivity, particularly in smallholder agriculture (Gebreselassie, 2006; FDRE, 2010). Reforming the research and extension systems, and pursuing other relevant strategies such as irrigation, credit and allied services, were undertaken to benefit smallholder farmers. By serving as a channel to transfer products to intermediate and final consumers, a well-developed marketing system creates the economic incentive for producers to invest in production and productivity enhancing activities.

Despite the above efforts, the adoption of improved varieties of major crops such as maize has remained low in Ethiopia (Spielman *et al.,* 2010). For instance, according to Yu *et al*. (2011), the area under improved seed and the area under both improved seed and fertilizer were only 0.6% and 21.6% respectively out of the total 845 300 hectare of land covered by maize in 2007. Moreover, only 26% of farmers used improved maize seed, and 23.6% used both improved maize seed and fertilizer in the country in 2007/08 (IFPRI-EDRI, 2008). Several studies have been conducted so far related to maize technologies adoption in other parts of Ethiopia *(*Yu *et al.* 2011; Shiferaw and Tesfaye, 2005; Yishak and Punjabi, 2011; Alene *et al.* 2000). But as to the knowledge of the researchers, no study has been conducted on maize technologies adoption in the study area. Understanding the

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factors which affect the maize technologies adoption in the study area is vital in promoting use of the maize technologies in order to enhance its production in the study area in particular and in Ethiopia in general.The study is guided by the hypothesis: "Improved maize varieties adoption is not influenced by different demographic and socio-economic and institutional characteristics of farmers."

2. METHODOLOGY

2.1 Nature of data and the study area

The present study used data collected during the 2012/13 cropping seasonby International Maize and Wheat Improvement Centre which is known as *Centro Internacional de Mejoramiento de Maízy Trigo* (CIMMYT) under the SIMLESA project. The dataset contains 300 farm households selected from three *woredas*[1]of two adjacent *zones*[2]in Oromia Region, Ethiopia. The woredas were selected because they are potential for maize production. The woredas are namely Dugda, Adamitulu and Shalla. 101, 100 and 99 sample respondents were randomly selected from Dugda, Adamitulu and Shalla respectively.

2.2 Improved maize varieties

For improvement in production and productivity of maize, a lot of efforts have been made by the researchers in developing different types of improved varieties with appropriate agronomic practices. Among the released maize varieties katumani, bh-543, melekasa 1&2, shaye, bh-660, awasa 511, bh-540 varieties were introduced to the farmers of the study area through government and NGOs such as CMMYT. Thus, in this study the term improved maize varieties refers to any one of the above maize varieties.

2.3 Data Analysis Procedure

2.3.1 Descriptive statistics

Descriptive statistics were used to provide a summary statistics related to variables of interest. Chi-square test was used to identify categorical variables that vary significantly between adopters and non-adopter. Similarly, the t-test was tested to see if there is any statistically significant difference between the mean of the respective adopter and non-adopter with respect to continuous variables. The descriptive statistics in such a way gave some insight about the characteristics of sampled units for the study.

2.3.2 Empirical framework of the logit model for adoption

To deal with the determinants of adoption, the logit model was employed. The dependent variable which was used with logit model is adoption, taking the values 1 or 0. The value 1 indicates a farmer who adopted the improved maize varieties while the value 0 indicates a farmer who did not. Adopters of improved maize varieties were defined as farmers who planted at least one of the improved maize varieties at least for the 2012/13 cropping season and non-adopters were defined as farmers who did not plant the improved varieties in the given cropping season.

Thus, the following simple regression model is considered:

$$Y_i = \beta_0 + \beta_i X_i + u_i \quad \ldots\ldots\ldots\ldots (1)$$

Where;

$Y_i$stands for adoption of improved maize varieties with a value of 1 for adopters and 0 for non-adopters.

$X_i$refers to a farmer's characteristics *e.g.* age of household head for the *i*th farmer.

$u_i$refers to the error term which is an independently distributed random variable with a mean of zero.

Equation (1) looks like a typical linear regression model but, because the dependent variable is binary, it is called a linear probability model (LPM). In the regression model, however, because the dependent variable is adoption taking the value 1 or 0, the use of linear probability models (LPM) is a major problem. The predicted value can fall outside the relevant range of 0 to 1 probability value. Therefore, to overcome the problem associated with the linear probability model, the logit model was used as it has been recommended by (Gujarati, 2004). The model was, therefore, estimated by using Maximum Likelihood Estimation (MLE) procedures. Therefore, the logistic cumulative probability function for adopters is represented by:

$$P_i = \frac{1}{1+e^{-Z}} = \frac{e^Z}{1+e^z} \ldots\ldots\ldots\ldots (2)$$

Where; P_i is the probability that the i^{th} farmer adopted the new varieties and that P_i is nonlinearly related to Z_i(*i.e.* $X_i$andβ_s).

$Z_i = \beta_0 + \beta_1 X_1 + \cdots + \beta_n X_n$and*e* represents the base of natural logarithms.

Then, (1-P), the probability of non-adopter of improved maize varieties is presented as:

[1]*Woreda is the fourth-level administrative division in Ethiopia.*

[2]*Zone is the third-level administrative division in Ethiopia.*

$$1 - P_i = \frac{1}{1+e^Z} \quad (3)$$

Therefore, by dividing equation 2 by equation 3, the odds ratio in favour of adopting the improved variety was obtained as follows:

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

Again in order to estimate the logit model, the dependent variable was transformed by taking the natural log of Equation 4 as follows:

$$L_i = \left(ln \frac{P_i}{1-P_i}\right) = Z_i = \beta_0 + \beta_1 X_1 + \cdots + \beta_n X_n \quad (5)$$

Where:

L_i is the log of the odds ratio, linear not only in the explanatory variablesbut also in the parameters. L is the logit, and hence it is the logit probability model. It is, thus, noted that the logistic model defined in Equation 5, is based on the logit of $Z_i$which is the stimulus index. This verifies that as Z_i ranges from $-\infty$ to $\infty +$,P_i ranges between 0 and 1.

2.3.3 Econometric model specification

Literature on adoption suggests that farmer's decision to adopt agricultural technology depends on household's socio-economic, institutional and environment factors (Mariano *et al.*, 2012; Feder *et al.*, 1985). However, there is no firm economic theory that dictates the choices of specific independent variables in adoption studies. They could vary from context to context. As a result, the explanatory variables assumed in this model are those included in the CIMMYT/SIMLESA baseline survey questionnaire.

Following Menard (2002), the Logit Model for the log odds of improved varieties adoption of improved maize varieties was specified as follows:

$$Y_i = \beta_0 + \beta_1 G + \beta_2 MAR + \beta_3 AGE + \beta_4 AGE1 + \beta_5 AGE2 + \beta_6 AGE3 + \beta_7 AGE4 + \beta_8\, FAMSZ + \beta_9 LITE + \beta_{11}\, LSTOCK + \beta_{12} LAND + \beta_{13}\, FASN + \beta_{14}\, OMKT + \beta_{15}\, IMKT + \beta_{16} EXT + \beta_{17} CRD + \beta_{18} DIST + \beta_{19} ADT + \beta_{20} DGD + \beta_{21} SHA + \varepsilon_i \quad (6)$$

Where: Y_i: is the log odds of adoption for the *i*th farmer; the explanatory variables are briefed in Table 1 andε_i: is the error term.

3. RESULTS AND DISCUSSION

3.1 *Respondents' Socio-Economic Profiles*

3.1.1 Continuous variables

Table 2 presents the t-test comparison of means of the continuous variables by adoption status for the households. The heads of the sample households were, on average, 43 years old. Old aged respondents were observed to be more likely to adopt the new varieties and were significantly different (in terms of age) from non-adopters which suggest that there is positive correlation between adoption and the farming experience. The average family size in the study area was seven. Adopters were observed to have larger family sizes than non-adopters. The results imply that large family size encourages the adoption of the improved maize varieties. Results in Table 2 further show that on average the number of years of education for the respondents is 3.2 years. Moreover, the results show that there is a significant difference between the average number of years of education for adopters and non-adopters. The relatively higher level of education could have helped adopters in comprehension of technical extension services which is important in the adoption process.

In this study, the average land holding was found to be 9.3 ha with standard deviation of 8.12. The land holding included cultivated and uncultivated land for annual crops, permanent crops, grazing land, and homestead in the cropping year. The average land holdings were 11ha and 9ha for adopters and non-adopters respectively. The difference in land holding between adopters and non-adopters is statistically significant at $p<0.05$ suggesting the importance of land holding for adoption of the improved maize varieties. Similarly, the difference in average livestock holding between adopters and non-adopters is statistically significant at $p<0.01$ which imply that having large number of livestock is correlated with a high probability for adopting the new maize varieties in the study areas.

Farmers declared that they had market access to two market places namely: the main market place in their woreda and the village/local market (Table 3). As shown in Table 2, the average walking distance to the main market place was 131 minutes. While adopters had to walk for 108 minutes to get to the main market place, non-adopters needed to walk for 138 minutes to reach the main market. The walking times to the main market for adopters and non-adopters are statistically significantly different at $p<0.01$. This implies that farmers who are close to markets are more likely to adopt the improved maize varieties than those who reside far from the main market.

3.1.2 Discrete variables

Table 3 presents the results of the chi-square comparisons of proportions of the discrete variables by adoption status for the households. Male-headed households constituted about 83% of the farm households. Moreover, the Table show that about 87% of the respondents were married and living with their spouses. However, there was no observable difference among adopting and non-adopting household heads in terms of their gender and marital status. Furthermore results in Table 3 show that about 65% of the respondents were literates. This literacy level is higher than the national average which was 39% in 2010 (UNESCO-UIS, 2012). Respondents significantly varied in terms of adult-literacy which implies that educated households were more likely to adopt than the non-educated ones. This relatively good level of educational achievement in the study areas might be attributed to high number of basic primary school coverage.

Moreover, the results in Table 3 show that about 79% of the farmers had access to extension services. Likewise, the difference in access to extension services between adopters and non-adopters is statistically significant. This finding implies that extension service as a source of information has a positive influence on the farmers' adoption decision. The results also show that 66% of the farmers got extension services about other agricultural inputs such as fertilizer. Moreover, about 56% of households were members of farmer organization. In contrast to earlier findings e.g. Mulugeta (2009), non-adopters (57%) were superior to their counterparts (55%) in terms membership in farmer organizations. However, the difference is not statistically significant.

Results also show that farmers have access to output markets, input markets and credit for purchasing agricultural inputs. On average, about 43% and 47% of the households had the access to output markets and agricultural input markets respectively. Further, the results show that the variation in market access between adopters and non- adopters is statistically significant. This is not surprising because as pointed out by Salami *et al*. (2010), improved access to input and output markets is a key precondition for the transformation of the agricultural sector from subsistence to commercial production. The results in Table 3 show that farmers in Dugda were more likely to adopt improved maize varieties. This difference could be due to the fact that the woredas vary in terms of administrative affairs, which can lead to differences in the delivery of necessary services for adoption.

3.2 *Factors of Adoption from the Logit Estimation*

The logit model was used to examine the factors affecting the adoption of improved maize varieties using maximum likelihood estimation and the results are presented in Table 4. An additional insight is also provided by analyzing the marginal effects, which was calculated as the partial derivatives of the non-linear probability function, evaluated at each variable sample mean. Table 4 shows the parameter estimates (coefficients) and marginal effects at means of the logit regression with their respective robust standard errors. However, to avoid repetition in discussions, the results of the marginal effects are only discussed as they can indicate both the sign and magnitude of each variable in the model.

As presented in Table 4, the logit model is well fitted to the data as shown by the low log pseudo likelihood -117.36 and Wald chi(22) ($p<0.01$). As a result of this, the hypothesis that adoption of improved maize varieties is not affected by socio-economic and institutional factors for all the variables was rejected at $p< 0.01$ level of significance since the Wald $\chi2$ is 63.81 (P=0.00). This indicates that the explanatory variables together influence the probability of adoption of improved maize varieties in the study area. In addition, the model correctly classified the respondents into adopters and non-adopters at 81.67% of correct prediction percentage.

3.2.1 *Household Personal and Demographic Characteristics*

Table 4 shows that new maize varieties are more likely to be adopted in households headed by married, old aged and female respondents. Though these variables were not significant, they were in line with prior expectations.

The results on Table 4 also show that in line with prior expectations, adult-literacy has a positive and significant relationship with the adoption of the new maize varieties. Educated or literate respondents were 14% more likely to adopt at ($p<0.01$) level of significance, *ceteris paribus*. This suggests that being literate would improve access to information, capability to interpret the information, understanding and analyzing the situation easily better than illiterate farmers. Moreover, education enhances the capacity of individuals to obtain, process, and utilize information disseminated by different sources. On the other hand, educated farmers will find it easy to manage production and marketing activities which need certain skill of management. The finding is consistent with the findings of Degu (2012) who found that education has a positive relationship with the adoption of improved potato varieties in eastern Ethiopia.

Table 4 further shows a positive and significant parameter estimate associated with family size. For each additional family member in the household, households were 2.7 % more likely to adopt the improved maize varieties, holding other variables constant. This suggests that large family size provides more labour for farm operation and an increased incentive to produce more output on farm.

3.2.2 Farm characteristics

Livestock ownership was shown to positively and significantly influence the adoption decision of improved maize varieties in the study areas. It is estimated that each additional livestock brought 0.4% more probability to the farmers to adopt the new varieties at high level of significance (p<0.05) keeping other variables constant. The implication is about the importance of livestock for adoption of maize varieties. This might be due to the fact that livestock are source of additional income which supports farmers in buying the improved varieties and farm inputs. Similar studies found that owning large livestock size positively affecting the adoption decision of new agricultural technologies (Mulugeta, 2009).

3.2.3 Institutional factors

As shown in Table 4, institutional factors such as access to output markets, availability of credit for improved maize varieties, walking distance to main market were statistically significant in affecting farmers' adoption decision. Access to input markets, extension services (new varieties and fertilizer), and walking distance to the village market were observed to show the expected sign but were not significant. Participation in farmer associations and availability of credit for fertilizer, on the other hand, were negatively statistically significant and the signs were contrary to the prior expectation.

Distance to the main market was found to be negatively significantly correlated with the likelihood of adoption. Similarly, Shiferaw and Tesfaye (2005) also noted the negative and significant association of market distance with adoption of improved maize in southern Ethiopia. Each additional minute of walking was associated with 0.6% less probability of adoption when other variables were kept constant. This indicates that farmers living at a distance from the main market centers are less likely to adopt the improved maize varieties than those who are located closer. The implication is that the longer the distance between farmers' residence and the market center, the lower will be the probability of improved maize varieties adoption. This may be due to relatively proximity to market also reduces marketing costs. This result is consistent with other studies (Tesfaye *et al*. 2001; Kebede, 2006).

Holding other variables constant, farmers who have the access to output markets were about 19% more likely to adopt the new varieties at high level of significance (p<0.01). Framers who had the access to credit access to maize varieties were about 25% more likely to adopt the new varieties at high level of significance (p<0.01), holding other variables constant. This positive and significant effect implies that farmers who don't have cash and access to credit may find it very difficult to adopt new technologies while those who have access to credit can overcome their constraints and be able to buy inputs (Tigist, 2010).

Farmers who had the access to credit for fertilizer were also 5% less likely to adopt the new varieties of maize while the other variables were held constant. This might be due to the fact that the interest rate is higher than the paying back ability of farmers. In connection with this result, Zelalem (2007) also found that farmers with access to credit were less likely to adopt new fattening technologies.

4. CONCLUSIONS AND RECOMMENDATIONS

According to the findings of this study,adoption of the improved maize varieties was found to be influenced among other things by adult-literacy, family size, livestock wealth, access to output market, and credit access for the new verities. Not-adopting the new varieties, on the other hand, was associated with farmer associations, distance to main markets and access to fertilizer credit. As a result, the hypothesis that the improved maize varieties adoption is not influenced by demographic and socio-economic and institutional characteristics was rejected at p<0.01.

Access to extension service was among the important variable that positively influenced the adoption of improved maizeadoption. This indicates that extension coverage should be widened by establishing additional development centers and empowering them. Therefore, to sustain the positive contribution of the extension service to the adoption of improved potato varieties, strengthening extension services is necessary. In addition, attention also should be given to the research and extension linkages, and frequent training must be organized for development agents and supervisors about existing and newly developed improved technologies and new methods of agricultural practices.

The government should improve farmer associations which can play an important role in the process of adoption decision. The farmer associations should also target the farmers' need and should access them with the necessary information about the associations. The government should also improve the output market environment at least by constructing roads to markets where farmers can sell their products, so they will have the incentive to adopt the new varieties and be more productive.

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Table 1. Description of variables used in the estimation logit model.

Variable	Symbol	Unit	Sign	Description
Gender	GND	Dummy	+	Male HHSs are expected to be better adopter than female household heads.
Age	AGE	Years	+/-	Age of HHH either positively or negatively influences improved variety adoption.
Family size	FAMSZ	Number	+	A larger household provides more labour thus expected to positively influence adoption.
Adult -literacy	LITE	Dummy	+	Educated HHHs are expected to adopt.
Livestock holding	LSTOCK	Number	+	A larger livestock holding is expected to positively influence adoption.
Land holding	LAND	Ha	+	A larger land holding is expected to positively influence adoption.
Farmer association	FASN	Dummy	+	Farmers' associations are expected to positively influence adoption.
Access to output market	OMKT	Dummy	+	It is expected that farmers who have the access to output markets to adopt.
Access to input market	IMKT	Dummy	+	It is expected that farmers who have the access to input markets to adopt.
Extension services	EXT	Dummy	+	The access to extension services is expected to positively influence farmers' adoption
Credit services	CRD	Dummy	+	Getting credit services is expected to positively influence farmers' adoption.
Distance to market	DIST	Minutes	+	It is expected that the closer the grain market is the higher the chance of adoption.
Woreda dummy				
Adami Tulu	ADT	Dummy	+/-	Farmers living in Adami Tulu and are either positively or negatively influenced to adopt.
Dugda	DGD	Dummy	+/-	Farmers living in Dugda and are either positively or negatively influenced to adopt
Shalla	SHA	Dummy	+/-	Farmers living in Shalla and are either positively or negatively influenced to adopt

Table 2: Descriptive summary of continuous variables used in estimations

Variable	Unit	Full		Adopters		Non-adopters		t-value
		Mean	SD	Mean	SD	Mean	SD	
HHH age	Years	43.12	32.6	48.49	59.32	41.23	14.19	-1.7**
HHH Education	Years	3.21	3.42	4.21	3.77	2.86	3.23	-3.0***
Family size	head	7.06	3.05	8.41	3.05	6.58	2.21	-4.7***
Livestock	TLU	20.67	18.3	28.67	26.34	17.85	13.49	-4.6***
Land holding	Hectare	9.31	8.12	11.09	7.29	8.68	8.31	-2.3**
Distance to main market	Minutes	130.52	94.6	102.9	78.31	140.2	98.10	3.0***
Distance to village market	Minutes	34.17	70.1	28.46	62.75	36.18	72.53	0.8

***, **,* denote significant at 1%, 5% and 10% levels of significance respectively.
Source: Computed from the survey data

Table 3: Descriptive summary of discrete variables used in estimations

Variable	**category**	**Total** No	%	**Adopters** No	%	**Non-adopters** No	%	**x^2-value**
HHH sex	Male	251	83.6	65	83.33	186	83.78	0.01
	Female	49	16.3	13	16.67	36	16.22	
HHH Marital status	Yes	260	86.6	68	87.12	192	86.49	0.02
	No	40	13.3	10	12.82	30	13.51	
Adult-literacy	Literate	193	64.3	59	75.64	134	60.36	5.87*
	Illiterate	107	35.6	19	24.36	88	39.64	
Access to output markets	Yes	130	43.3	50	64.10	80	36.04	18.52***
	No	170	56.6	28	35.90	142	63.96	
Access to input markets	Yes	147	49	49	62.82	98	44.14	8.06***
	No	153	51	29	37.18	124	55.86	
Farmer organization	Yes	169	56.3	43	55.13	126	56.76	0.06
	No	131	43.6	35	44.87	96	43.24	
Credit for improved maze varieties	Yes	149	49.6	52	66.67	97	43.69	12.19***
	No	151	50.3	26	33.33	125	56.31	
Credit for fertilizer	Yes	126	42	31	39.74	95	42.79	0.22
	No	174	58	47	60.26	127	57.21	
Extension services	Yes	236	78.6	67	85.89	169	76.13	3.28*
	No	64	21.3	11	14.11	53	23.87	
Adamitulu	Yes	100	33.3	22	28.21	78	35.14	1.25
	No	200	66.6	56	71.79	144	64.86	
Shalla Woreda	Yes	99	33	19	24.36	80	36.04	3.56*
	No	201	67	59	75.64	142	63.96	
Dugda Woreda	Yes	101	33.6	37	47.44	64	28.83	8.95***
	No	199	66.3	41	52.56	158	71.17	

***, **,* denote significant at 1%, 5% and 10% levels of significance respectively.
Source: Computed from the survey data

Table 4: Maximum Likelihood estimates for factors affecting improved maize varieties

Variables	Coef.	Robust Std. Err.	dy/dx	Delta method St.Er
HH head's sex(1=male)	-0.496	0.587	-0.070	0.083
HH head's marital status(1=married)	0.0339	0.644	0.005	0.091
HH head age(years)	0.0128	0.028	0.002	0.004
AGE1: 20-35(1=yes)	2.307	1.581	0.326	0.229
AGE2: 36-50(1=yes=)	2.143	1.354	0.303	0.195
AGE3: 51-65(1=yes)	2.193	1.243	0.310*	0.177
AGE4: >=66(1=yes)	Ref.		0	Ref.
Family size of HH(heads)	0.194	0.059	0.027***	0.008
Adult literacy (1=literate)	1.017	0.409	0.144**	0.059
Total land in the HH(hectare)	0.005	0.020	0.001	0.003
Participation in farmer association(1=yes)	-0.034	0.388	-0.005	0.055
Access to output markets(1=yes)	1.310	0.341	0.185***	0.048
Access to input markets(1=yes)	0.749	0.510	0.106	0.072
Extension services: new varieties(1=yes)	0.227	0.584	0.032	0.082
Extension services: fertilizer use`(1=yes)	0.248	0.454	0.035	0.064
Credit access for new varieties (1=yes)	1.751	0.387	0.248***	0.054
Credit services for other inputs(1=yes)	-0.983	0.413	-0.139**	0.059
Walking distance to village market (minutes)	0.001	0.003	0.0001	0.001
Walking distance to main market(minutes)	-0.006	0.002	-0.001***	0.003
Adamitulu(1=yes)	-0.654	0.445	-0.092	0.065
Dugda(1=yes)	0.497	0.581	0.070	0.081
Shalla(1=yes)	Ref.		0	Ref.
Constant	-6.76	2.567		
Number of obs	300		Prob>chi2	0.000
Log pseudo likelihood	-117.36		Pseudo R2	0.317
Correctly predicted	81.67%		Wald chi(22)	63.81

***, **,* denote significant at 1%, 5% and 10% levels of significance respectively.
Source: Computed from the survey data