Journal of Economics and Sustainable Development
ISSN 2222-1700 (Paper) ISSN 2222-2855 (Online)
Vol.9, No.5, 2018

Logit and Tobit Model Analysis for Determinants of Common Bean Seed Replacement and Its Rate in Southern Ethiopia

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Abstract
The objective of this study was to identify determinants of haricot bean seed replacement and rate of its use in Boricha district of Southern Ethiopia. Data were collected from 162 randomly selected common bean farmers through multistage sampling techniques. Inferential statistics namely the Logit model and the Tobit model were used to identify determinants of seed replacement among respondents and the extent of replacement rate respectively. Among 162 farmers, 105 replaced certified seed of haricot bean at least once in the past three years whereas 57 farmers did not use certified seed in the same period but used home saved seeds. On average seed replacers change their seed stock 1.82 times every three years. The results revealed that, household size, livestock ownership, frequency of contact with extension agent, membership in social organizations, distance from formal certified seed and respondents' opinion on affordability of certified seed price were positively and significantly influenced seed replacement. Negative but significant influence of household head age on seed replacement decision was found. The rate of replacement of certified seed was influenced positively by perception about seed price, haricot bean farming experience, cash income from farm, contact with development agent, livestock ownership, membership in social organizations, and distance from formal certified seed source while age of household head negatively influence replacement rate. Therefore, the findings suggest that seed replacement and its replacement rate should be improved by enhancing asset ownership, delivering input on-time, improving packaging volume based on farmers demand and providing extension service.
Keywords: Common bean farmers, Logit, Multistage, Seed replacement, Tobit

1. Introduction

Agricultural sector is one of driver for the economic development in Ethiopia (Thijssen *et al*., 2008). The sector supports 82 percent of the livelihood, 43 percent of gross domestic product and 80 percent of export value (Bewket, 2014).Legumes are important crops that dominantly produced in most parts of the country and haricot bean (*Phaseolus vulgaris)* serve as both food security and income source (Ferris and Kaganzi, 2008). Currently haricot beans both in the domestic and export market has become demanded and volume of production grows (Frehiwot, 2010).

Dry beans are mostly prepared as ' nifro' (boiled grain mixed with sorghum or maize), can be used for preparing 'wot' (local stew) and also the boiled split beans are eaten mixed with 'kocho[1]' in south Ethiopia. The protein content is (22%) and its amino acid composition is high in lysine, which complements cereals and other staple foods in the diet. It grows in hot humid regions of Ethiopia. The national average yield of the crop is 14 quintal per hectare. In the 2013/14 cropping season, the total area and total production was estimated to be 326,465.88 hectares and 4,574,116.13 quintals respectively (MOA, 2014).

As major agricultural inputs, seed is foundation without which there is no next season production (Bajranglal, 2008). Seed play an important role in deciding the performance of all farming systems (Poonia, 2013). According to Abdisa et al. (2001), seed replacement is a decision to obtain new stock of a variety that they already grow in past cropping season. In case of hybrid varieties farmers are recommended to replace certified for every year, but saved seed of other crop varieties can be used without genetic deterioration and loss of production potential three up to five years (Dawit et al., 2014; Spielman, 2010). Furthermore, as discussed

[1] Kocho is an extract of Ensete ventricosum (*false banana*)

with experts from Ethiopia Institute of Agricultural Research (EIAR) and Southern Agricultural Research Institute (SARI), farmers saved seed of haricot bean varieties can be used for three to four years. For this research, farmers' seed replacement was operationally defined as those farmers who used certified seed of haricot bean at least once in past three years considered as seed replacer/renewed provided that saved seed should be reserved in optimal quality and non-replacer otherwise.

In developing countries, farmers mainly used farm saved seed due to different factors. Use of seed that is produced on farm or obtained from relatives, friends or other informal channels is still by far the most important seed source for agriculture in developing countries (Thijssen *et al*., 2008, Regassa, 2012). It is particularly true in the case of small farmers who generally have low availability of cash on hand (Sangeeta and Sidhu, 2009).

In Ethiopia, formal seed sectors supply 3-10 percent of farmers' actual seed needs (Dawit, 2010; Thijssen *et al.*, 2008). In addition its inadequate supply, limited access to credit, weak extension services and distribution inefficiencies among other hinder seed use in developing countries (Mahoo *et al.,* 2013).

In Boricha district, certified seed of haricot bean have been supplied to the farmers through different seed suppliers but still portion of farmers are grown saved seed beyond recommended period (three to five years). Therefore, this research was undertaken with the aim of assessing why some farmers' use farm saved haricot bean seed beyond recommended period and what determine its' replacement rate among replacers and finally to recommend policy direction that helps to overcome existing problems.

1.1 Objective of the study

General objective

The general objective of this study was to assess the determinants of seed replacement and its intesity. The specific objectives include

1. to identify factors that affect haricot bean seed replacement decision by small holder farmers
2. to identify the main determinants of haricot bean seed replacement intensity.

2. MATERIALS AND METHODS

2.1 Description of the study area

This study was carried out in Boricha district, southern Ethiopia. Boricha district is located between 6°04'N and 38°00'E to 7°00'N and 38°02'E. The district administratively comprises 39 rural kebeles (Figure 1). Agricultural production is characterized mainly by maize-haricot bean based rain fed crop-livestock production system. District has two cropping seasons, meher and belg. Major crops grown in the study area are maize, haricot bean, coffee and root crops like enset (Enset ventricosum), potato and sweet potato. The altitude of the area ranges from 1250m to 2000m high above sea level and annual rain fall ranges between 500-1242 mm. Total areas of the district is 603.45square kilo meters.

2.2 Study Design

Cross-sectional survey research design which is among the most commonly used non-experimental designs were used for the study.

2.3 Sampling Techniques

Multi-stage sampling procedures were used to select the study kebeles and sample households. In the first stage, the district was purposely selected based on high production and wide area coverage of haricot bean crop. In the second stage, 39 kebele administrations were stratified based on proximity to certified seed source. Total of four kebele administrations of which 162 haricot bean growers were selected based on probability proportional to sample size sampling techniques. Structured questionnaire was designed and pretested. Structured questionnaire was designed and pretested. The researchers were assisted in the process of data collection by field enumerators for collection primary data. Furthermore, farm visit, direct observation and informal interview was undertaken to generate additional data. The secondary data were obtained from publications, documentation of central statistics agency and district agricultural office annual report. To determine sample size for the study, the Green (1991) formula was employed. The author suggests that, $n \geq 50+8m$; where n is sample size of the study and m is a number of independent variables included in the model. The independent variables used in the model were 13. Accordingly, the sample size for this study should be greater than or equal to 154 ($n \geq 50+8*13$). variables. Based on this, 162 households were determined as a sample size of the study. To identify respective samples from four *Kebeles* for each stratum, probability proportion to size of population sampling method was used. Finally, representative sample for each stratum was selected through simple random sampling technique.

2.4 Source and Method of Data Collection

The study generated relevant data from both primary and secondary sources. Questionnaire, key informant interview and observation were used to collect primary data. The secondary data were collected from review of

different related literatures.

2.5 Hypothesis and their Definitions

2.5.1. Dependent variables

Seed replacement: Farm saved seed of self-pollinated crops like haricot bean can be used with genetic deterioration for about three to five years if managed well (Dawit *et al.*, 2014; Spielman, 2010). Based on this, seed replacement takes value 1 if a farmer used certified haricot bean seed for replacement at least once in the past three years and 0 otherwise.

Seed replacement rate: Dependent continuous variable measured as the percentage area cultivated under certified haricot bean seed out of total land allocated for the crop (Ponia, 2013).

2.5.2. Explanatory variables

Independent variables used in the model are described below in Table 1 with their measurement and hypothesis.

Table 1. Definition of variables and hypothesis

Variable	Type	Measurement	Hypothesis
Age of household head	Continuous	Years completed	-
Household size	Continuous	Number of people	+
Distance from formal certified seed center	Continuous	Kilometer	-
Educational status of household head	Continuous	Schooling	+
Haricot bean farming experience	Continuous	Years	+
Membership in social organizations	Continuous	Score	+
Contact with development agent	Continuous	Frequency	+
Livestock holding (TLU)	Continuous	TLU	+
Land holding	Continuous	Hectare	+
Cash income from sale of farm products	Continuous	Birr	+
Perception about seed affordability	Dummy	1 for affordable, 0 for non-affordable	+
Use of credit	Dummy	1 for user, 0 for non-user	+
Participation on off-farm activities	Dummy	1 for participant, 0 for non-participant	+

2.6 Data Analysis

Both descriptive statistics and econometric model (Logit and two limit tobit model) were used to analyze data obtained from field survey.

2.6.1 Descriptive Statistics Analysis

The means, percentages and standard deviations were used to characterize household related factors.

2.6.2 Econometric Model Specification

Logistic regression model was used to identify factors affecting seed replacement decision at a recommended period. Moreover, two limit tobit model was employed to identify seed replacement rate (percentage area allocated under certified haricot bean seed).

1. Seed replacement decision (Logit model)

Following Gujarati (2004), in estimating logit model, the dependent variable should be dummy in this case seed replacement which takes value of 1 if household replaced certified haricot bean seed at least once in the past three years and 0 otherwise. Mathematical expressed as:

$$Pi = \frac{e^{zi}}{1 + e^{zi}} \qquad Eq.\ 1$$

Then 1-Pi represents the probability of not replacing seed and can be written as:
Dividing equation (1) by equation (2) and simplifying gives:

$$1 - Pi = \frac{1}{1 + e^{zi}} \qquad Eq.\ 2$$

$$\frac{pi}{1 - pi} = \frac{1 + e^{zi}}{1 + e^{-zi}} = e^{zi} \qquad Eq.\ 3$$

Equation (3) indicates simply the odd-ratio in favor of utilizing the technologies. It is the ratio of the probability that the farmer replace the seed to the probability of not replace it.

Finally, the logit model is obtained by taking the logarithm of equation (3) as follows:

$$Ln\left(\frac{pi}{1-pi}\right) = Ln\left(e^{\beta_0} + \Sigma_{j=1}^{n}\beta_j X_{ij}\right) = Ln\left(e^{zi}\right) \qquad Eq.\ 4$$

Where Li is log of the odds ratio, which is not only linear in X but also linear in the parameter. Thus, when the stochastic disturbance term ui is included,

$$Z_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots\ldots\ldots + \beta_n X_n + ui \qquad Eq.\ 5$$

2. Seed replacement rate (two limit tobit model)

Tobit model can analyze both probability and intensity of use once. The problem with this model is that it assumes both probability and intensity is influenced by the same factors (Heckman, 1979). So that in this study probability of participation (seed replacement) is estimated by using logit model while marginal effect on rate of replacement is determined by two limit tobit model. Idrisa *et al*. (2012) used logit model to identify probability of improved soybean seed adoption and tobit model for the extent of adoption.

The two limit tobit model is specified mathematically as follows:

$$Y_i^* = \beta_0 + \sum_{j=1}^{k}\beta_j X_{ij} + U_i, \qquad .$$

$$Yi = \begin{cases} 100, & if\ Y_i^* \geq 100 \\ Y_i^*, & if\ 0 < Y_i^* < 100 \\ 0, & if\ Y_i^* \leq 0 \end{cases} \qquad Eq.\ 1$$

Where: Y_i= is the percentage of the area cultivated under certified seed which is observed only when it is some number between 0 and 1; otherwise Y_i^* qualifies as an unobserved latent (hidden) variable. X_{ij} = the explanatory variable determining the level of area under certified seed, β_j = parameters to be estimated U_i= independently and normally distributed error term with mean zero and constant variance.

In a tobit model, each marginal effect includes both the influence of independent variables on the probability of dependent variable being uncensored and on the expected value of the dependent variable conditional on it being larger than the lower bound. So that the regression coefficients of two limit tobit model cannot be interpreted directly because of its inclusion of both effect on probability of being seed replacer and fall in the category of replacer. McDonald and Moffitt (1980) proposed a useful decomposition of marginal effects and the equations of three marginal effects are described as follows:

1) The unconditional expected value of the dependent variable

$$\frac{\partial E(y)}{\partial x_j} = \left[\varphi(Z_U) - \varphi(Z_L)\right]\frac{\partial E(y^*)}{\partial x_j} + \frac{\partial\left[\varphi(Z_U) - \varphi(Z_L)\right]}{\partial x_j} + \frac{\partial(1-\varphi(Z_U)}{\partial x_j} \qquad 2$$

2) The expected value of the dependent variable conditional upon being between the limits

$$\frac{\partial E(y^*)}{\partial x_j} = \beta_m.\left[1 + \frac{\left\{Z_L\phi(Z_L) - Z_U\phi\ (Z_U)\right\}}{\left\{\varphi(Z_U) - \varphi(Z_L)\ \right\}}\right] - \left[\frac{\left\{\phi(Z_L) - \phi(Z_U)\right\}^2}{\varphi(Z_U) - \varphi(Z_{L)}\}^2}\right] \qquad 3$$

3) The probability of being between the limits

$$\frac{\partial\left[\varphi(Z_U) - \varphi(Z_L)\right]}{\partial x_j} = \frac{\beta_m}{\sigma}.\left[\phi(Z_L) - \phi(Z_U)\right] \qquad 4$$

Where $\varphi(.)$ = the cumulative normal distribution, $\phi(.)$ = the normal density function,

$Z_{1=} -\beta' X/\sigma$ and $Z_U = ((1-\beta X)/\sigma$ are standardized variables that obtained from likelihood function given the limits of y* and σ = standard deviation of the model.

The marginal effects represented by the equations above were calculated by using STATA version-13 computer software.

Before executing variables in to model, variance –inflation factor (VIF) and Contingency Coefficient (CC) were employed to check multicollinearity among continuous and for dummy variables respectively (Gujarat, 2004). The larger the value of VIF the more serious multi-collinearity problems among continuous variables exist. Similarly as value of CC greater than 0.75 indicate that there are strong associations among discrete variables. Accordingly, there is no serious multi-collinearity problem among continuous as well as dummy variables.

3. Results and Discussions

3.1. Socioeconomic characteristics of sample farmers

Table 2 presents a summary of socio-economic characteristics of respondent households. As indicated in Table 3, mean age of respondents had 40.85 in years; the mean level of household head education was 2.90 schooling years. The mean members of household were 6 persons. Farmers' participation in social organization at different position was accessed by assigning score. Score of 1 for members only, 2 for committee members and 3 for leaders. Based on this, the mean score was 4.72. Moreover, the mean haricot bean farming experience had 9.17 years. While the mean walking in kilometers from farmers homestead to certified seed source is 19.80 km. The number of farmers' contacts with extension agents has a mean value of 2.1 days per year which is very low and there is a need to strengthen extension services.

Table 2: Summary of the socio-economic characteristics of households

Variable name	Variable definitions	Mean	Min	Max
AGEH	Age of household head (yrs)	40.85 (11.77)	22	88
HH_SZ	Household size (number)	6.11 (2.32)	1	15
DIST_SEED	Distance from certified seed center (km)	19.80 (9.88)	2	35
EDU_STAT	Educational status of household head(schooling)	2.90 (3.01)	0	13
EXPRI	Haricot bean farming experience (yrs)	9.17 (4.87)	4	30
MEMB_SCOR	Membership in social organizations (score)	4.72 (2.89)	1	9
SEED_EXT	Frequency of contact with development agent	2.10 (1.96)	0	12
LIVE_STOCK	Livestock holding (TLU)	2.70 (2.16)	0.01	10
LANDSZ	Land holding (hectare)	0.87 (0.58)	0.15	3.25
CASH_INC	Cash income from sale of farm products(birr)1	3933 (3906)	750	20850

Source: Survey result (2015) Figures in parenthesis is standard deviation

Table 2 presents the resource endowments of respondent households. The mean livestock ownership in TLU was 2.70. With regard to land holding, the mean holding was 0.87 hectare which is below national average of 1 hectare (Gebremedhin *et al*., 2009). Cash income enables farmers to buy different agricultural technologies. The mean cash income from sale of farm products was 3933 birr with standard deviation of 3906.

About 60% respondent farmers perceived available seed price per 50 kg as affordable whereas the remaining 40% think as expensive. Seed packaging volume has influence of its use so that it important improve based on farmers demand. Only 10% farmers used credit services during survey period and the remaining vast majority (90%) did not. Moreover, 60.49% of respondent farmers participate on off-farm activities which enable them to generate additional income whereas 39.51% did not participated in any income generating activities other than their own farm.

3.2 Seed replacement frequency for replacer households

In case of self-pollinated crops like that of haricot bean, farmers' can save and reuse seed up to three generations without yield deterioration provided that seed should be clean, rough, free of pest and disease (Dawit *et al.*, 2014). Some authors also recommend up to five years (Spielman *et al*., 2010). Out of 105 seed replaced households, 40.95%, 35.24 and 23.84 of them were used certified seed once, twice and every year for the past three years respectively. On average, seed replacers replace certified seed 1.82 times per every three years. From total sample households, 65% of respondents replaced in the past three years at least once by using certified seed while the remaining 35% used farm saved seed in same period.

3.3 Socio-economic factors influencing the likelihood of seed replacement decision

Logit model coefficient estimates for the seed replacement shows that among 13 explanatory variables, seven variables found significant. Age of household head had negative and significant ($p<0.01$) influence on the seed replacement decision. The sign of age of household head were as expected and showed that younger farmers are more likely to use certified seed than elderly farmers. The result is in line with Awotide *et al*. (2014); Fufa and Hassan (2006). The results in Table 3 also reveal that household size positively and significantly ($p<0.1$) related with seed replacement. Household size is an indicator of labour availability. The finding is consistent with previous study such as Anne *et* al. (2014) which revealed that as family size increases, the adoption of improved seed varieties also increases. The finding also agrees with Michael et al. (2007); Idrisa *et al*. (2012). Membership in different organizations enables farmers to share their know-how. The results in Table 3 shows participation in a social had positive and significant ($p<0.01$). This implies a need of strengthening social organization specially seed multiplication group and saving associations. The result agrees with finding of Meike and Camilla, (2013). Nchinda *et al*. (2010) also found that positive and significant relationship between membership in farmers' organizations and adoption intensity of improved yam (Dioscorea spp.) seed technology

[1] Birr refers to Ethiopian currency, 1USD=19.76 during survey period

in the western highlands and high guinea savannah zones of Cameroon.

Table 3: Model results of determinants of seed replacement and its replacement rate

Variables	Seed replacement Logit model result		Seed replacement rate Two limit tobit result	
	Coefficient	Odds ratio	Coefficient	t-value
AGEH (yrs)	-0.252***	0.7771	-3.1403***	-2.97
HH_SZ (number)	0.5868*	1.7983	1.7949	0.45
LAND_SZ (hectare)	2.9505	19.1165	25.8410	1.40
SEED_PRICE (1=affordable)	4.0886**	59.6606	55.5949**	2.43
SEED_EXTENSION(frequency)	1.2792**	3.5938	11.4395*	1.96
EDU_STAT(schooling)	-0.0456	0.9553	-0.4664	-0.13
DIST_SEED (Km)	0.2071**	1.2301	1.9494*	1.78
OFF_PART(1=participant)	0.5979	1.8184	6.5232	0.31
CASH_INC (birr)	-0.0001	0.9998	0.0070**	2.37
LIVE_STOCK (TLU)	2.0239*	7.5683	12.8127**	2.41
MEMB_SCORE(score)	1.0835***	2.9551	13.2814***	3.20
EXPRI(yrs)	-0.2435	0.7838	3.7701*	1.76
CRED_USE(1=user)	-0.2908	0.7476	-19.1239	-0.58
Constant	-9.0652	0.0001	-123.9812	-1.96
Log likelihood	-13.74		-276.05	
Prob > chi2	0.0000		0.0000	
LR chi2(13)	182.65		145.96	
Pseudo R^2	0.8692		0.2091	

***, ** and * denote significance at 1%, 5% and 10% level, respectively.

Source: Model result (2015)

Contrary to expectation, distance from certified seed source was positively and significantly ($p<0.05$) related with seed replacement decision. The positive relationship between distance to seed source and seed replacement might be due to existence of Kayo seed Multiplier and Marketing Cooperative[1]. Primarily respondents were stratified based on distance from Boricha district agricultural office where certified seed directly and formally distributed to the farmers. Cooperative non-members farmers located at distant area accessed certified seed informally from member seed producers. In agreement with this, Gebremedhin *et al.* (2009) found that those farmers who located nearer to *district* town used less agro-chemical. Bernard *et al*. (2010) also found that distance to source of seed shows a positive and significant relationship to adoption of certified seed in Kenya. While Gbegeh and Akubuilo (2013) found that distance shows negative relationship with adoption of improved varieties.

Frequency of contact with development agent positively and significantly ($p<0.05$) influenced the replacement of haricot bean seed by the respondent farmers. This could be because increased farmers' contact with extension agents enables to get technical support to a farmer which in turn boosts farmers' knowledge of available technologies and their potential benefits. The finding is in accordance with Dick (2005) that participation on extension programs is positively associated with the adoption of improved maize and land management practices.

Livestock ownership is associated positively and significantly ($p<0.1$) with seed replacement as expected. In the study area, livestock helps farmers for draft purpose and as an income source during cash slack period. The finding is concurrent with Gebremedhin *et.al.* (2009) in their work of smallholders, institutional services and commercial transformation in Ethiopia. Finally as expected, perception of farmers about affordability of certified seed had a positive and significant ($p<0.05$) effect on the likelihood of replacing certified.

3.2 Factors affecting seed replacement rate: Two limit tobit results

Age of household head had negative and significant ($p<0.01$) influence on the seed replacement rate. The result shows that, younger farmers have more likelihood of using certified seed than their counter parts. Perceptions about affordability of certified haricot bean seed positively and significantly ($p<0.05$) affected seed replacement rate. This result also goes along with a prior expectation that, as farmers perceived seed price as affordable would improve the farmers' decision to allocate their land for certified seed other than farm saved seed. The result revealed that, it is important to supply certified seed in appropriate price to increase farmers' certified seed use rate.

Cash income from sale of farm products positively and significantly influence percentage area allocated for certified haricot bean seed at $p<0.05$ significant level (Table 3). In the adoption studies farming experience is the

[1] Kayo seed multiplier and marketing cooperative located at distance area from district agricultural office

vital variables most frequently used. Haricot bean farming experience in year had positively and significantly influenced intensity of area allocated for certified seed at p<0.01 significance level. To identify the influence of livestock ownership on seed replacement rate, all livestock type was converted in to standard by using Tropical Livestock Unit (Storck, *et al*., 1991) and livestock ownership had positive and significant influence on area allocated for improved seed at p<0.01 significance level.

Membership in social organization had positive and significant influence on rate of haricot bean seed replacement at p<0.01 level of significance (Table 3). Organizing farmers in different groups would facilitate information gap on the importance of different agricultural technologies and in the study area, there is emerging farmers based seed multiplication scheme in certified haricot bean seed production so that different stakeholders should work toward its success. Krishna *et al.* (2008) also found that membership in group positively associated with adoption of conservation technology.

Opposite to expectation, distance from formal seed source positively and significant influence seed replacement rate at p<0.01. The possible reason of unexpected sign may be those two kebeles located at distant area are more suitable for haricot bean production were informal accessed certified seed from kayo seed multiplier and marketing cooperative. Contact of farmers with development agent helps them to acquire new knowledge about improved agricultural technologies. The Tobit model result shows that, frequency of contact with development agents is positively and significantly (p<0.1) influenced seed replacement rate (Table 3).

3.2.1 Marginal Effects of Changes in Explanatory Variables

The marginal effects of changes in explanatory variables from tobit regression analysis were analyzed following the procedure proposed by McDonald and Moffitt (1980). The derived values for the significant explanatory variables indicate that the effects of a unit change in those significant variables on the unconditional expected value of seed replacement rate, expected value of seed replacement rate conditional upon being between 0 and 100%, and probability of being between 0 and 100% (Table 4).

The result (Table 4) shows on average a unit increase in farmer's age reduces the observed seed replacement rate by about 1.49% for total households and 2.13% for households who already use certified seed. Contrary to expectation, distance from certified seed source shows positive and significant influence on seed replacement rate. Increase in unit kilometer of distance increases the observed seed replacement rate by about 0.92 percent, and for those households who already replaced their seed by 1.32 percent. The practical reason for unexpected sign of distance is that those farmers located in distant kebele informal accessed certified seed from Kayo seed producing cooperative members.

The extension program appears to be effective in promoting use of certified in the study area particularly and in Ethiopia general. Frequency of contact with extension agents increases the observed seed replacement rate by about 5.45% and by about 7.76% for farmers who already use certified seed. A change in the perception of the farmer on the affordability of certified haricot bean seed; that means change from 0 to 1 brings about 26.49% for the total sample in the study and 37.73% increase in the intensity of use of certified seed for replacers.

Table 4: The marginal effects of change in explanatory variables

Variable	$\partial E(y)$	$\partial E(y^*)$	$\partial[\varphi(Z_U)-\varphi(Z_L)]$
Age of household head (yrs)	-1.49662	-2.1317	-0.0130
Distance from formal seed source (Km)	0.9290	1.3232	0.0081
Perception about seed price (1=affordable)	26.4955	37.7387	0.2316
Contact with development agent	5.4518	7.7653	0.0476
Cash income from farm (birr)	0.0033	0.0048	0.00002
Livestock ownership (TLU)	6.1063	8.6974	0.0533
Membership in an organization(score)	6.3297	9.0156	0.0553
Haricot bean farming experience(yrs)	1.796805	2.559265	0.01571

Note:- $\partial E(y)$: Unconditional expected value of seed replacement rate

$\partial E(y^*)$: Expected value of seed replacement rate conditional upon being between 0 and 100

$\partial[\varphi(Z_U)-\varphi(Z_L)]$: Probability of being between 0 and 100% (Probability of being censored)

Cash income from farm products helps farmers to buy improved agricultural technologies. On average for the population of study, cash from sale of farm products increases by 1000 birr, observed seed replacement rate increases by about 3.3%, and for households who already used certified haricot bean seed, cash from farm increases seed replacement rate by about 4.8%.

Marginal change in frequency of participation in a social organizations increases rate of haricot bean seed replacement by 6.32% and 9.01% for total sample and seed replacers, respectively. This implies that strengthening and promoting farmers organizations like saving and credit association, and seed multiplication scheme will enhance the intensity of use of technology. The estimated increase in rate of seed replacement resulting from change in the tropical livestock unit of livestock owned is 6.10% for population in the study and

8.69% for seed replacers. Farming experience of enable farmers to evaluate how important to use improve technologies. On average a unit increase in farmer's haricot bean farming experience would improve the observed seed replacement rate by about 1.79% for population in study and 2.55% for households who already use certified seed (Table 4).

4. SUMMARY AND POLICY DIRECTIONS

This study assessed the determinants of seed replacement and replacement rate in Boricha district, Ethiopia. To increase production and productivity, it is important to use improved agricultural inputs like certified seed. Creating conducive environment like supplying seed in time shows significant influence on seed replacement which shows in turn a need to smoothen existing long seed supply system. The finding also shows an extension system a vital role in facilitating seed replacement and stakeholders should educate farmers about importance of using certified seed.

The frequency of seed replacement in the study was 1.82 times in every 3 years, 35% of farmers did not used certified in the past three years but used home saved seed. Farmers' seed replacement rate was influenced by demographic factors such as age and household size; resource endowment like livestock; institutional factors of extension service, participation in social organizations. Similarly distance from seed source and perception on affordability of certified seed had also significant influence on seed replacement. Moreover, proportion of area under certified seed significantly affected by factors such as age, farming experience, frequency of contact with extension agent, affordability of seed, cash income from farm, membership in a social organization, livestock ownership and distance from formal seed source.

Findings of the study show that as an agricultural package, the effect of farmers contact with extension agents found significant. Thus frequent deliver of extension service regarding utilizations of certified seed can help farmers to know its' importance.

The volume of seed put in one package was beyond the amount required by the farmers so that seed suppliers should consider the appropriateness of the packed volume of seed. Moreover, seed supply does meet farmers demand and sometimes seed is not supplied at right time. Regarding to this, seed suppliers have to strengthen their internal capacity to supply certified seed in time. Finally, in the study area seed is mainly supplied by government organizations and it better to invite private sector to make seed market competitive through direct seed marketing scheme.

Acknowledgments

The authors gratefully acknowledged the financial support of Integrated Seed Sector Development Ethiopia (ISSD).

References

Abdisa Gemeda, Girma Aboma, H.Verkuijl, And W.Mwangi (2011). Farmers' Maize Seed Systems in Western Oromia, Ethiopia. Mexico, DF: International Maize and Wheat Improvment Center (CIMMYT) and Ethiopian Agricultural Research Organization (EARO).

Anne Gesare Timu, Richard Mulwa, Julius Okello And Mercy Kamau (2014). The role of varietal attributes on adoption of improved seed varieties: the case of sorghum in Kenya. Journal of Agriculture and Food Security 2014, 3:9.

Awotide B.A.,Abdoulaye T., Alene A., And Manyongv.M. (2014). Assessing the extent and determinants of adoption of improved cassava varieties in south-western Nigeria.International Journal of Sustainable Development 02:12(2011)Vol.6 (9). Pp. 376-385, September, 2014.

Bajranglal (2008). Technology Transfer and the Seed Innovation System in India Presented in "EUUS Early Research Conference on Research and Innovation Studies", STeHPS

Bewket Abebe. 2014. Ethiopia's Agriculture: Analysis of Agriculture production and its trends. http://www.marcopolis.net/ethiopia-sector-analysis/

Dawit Alemu (2010). Constraints and opportunities for enhancing the seed sector, IFPRI

Dawit Alemu, Fisseha Zegeye, Yoshiaki Nishikawa, And Shiratori Kiyoshi (2014). Perception of farmers and agricultural experts for farmers' saved seed: The case of East Showa, Ethiopia. Sky Journal of Agricultural Research Vol. 3(5), pp. 074 - 081, May, 2014.

Dick Sserunkuuma. 2005. The Adoption and Impact of Improved Maize and Land Management Technologies in Uganda. *e-Journal of Agricultural and Development Economics* Vol. 2, No. 1. 67-84.

Ferris S, Kaganzi E. (2008). Evaluating marketing opportunities for haricot beans in Ethiopia IPMS (Improving Productivity and Market Success), of Ethiopian Farmers Project Working Paper 7. ILRI (International Livestock Research Institute), Nairobi, Kenya. 68pp

Fufa B. and Hassan RM. 2006. Determinants of fertilizer use on maize in Eastern Ethiopia: A weighted endogenous sampling analysis of the extent and intensity of adoption. Agrekon, Vol 45, No 1. 38-49.

Gebremedhin berhanu, Motijaleta And Dirk Hoekstra, (2009). Smallholders, institutional services and commercial transformation in Ethiopia. International Livestock Research Institute (ILRI, Addis Ababa, Ethiopia. Agricultural Economics 40 (2009) supplement 773–787.

Gbegehb.D and Akubuiloc.J.C. (2013). Socio-economic determinants of adoption of yam minisett by farmers in Rivers state, Nigeria, Wudpecker Journal of Agricultural Research ISSN 2315-7259 Vol. 2(1), p. 033 – 038.

Gujarati, D.N. (2004) Basic Econometrics (4thed.). New Delhi: Mc-Graw Hill Publishing Company.

Heckman, J.J. (1979). Sample selection bias as specification error.Econometrica47(1), 153–161.

Idrisa, Y.L. Ogunbameru, B.O. and Madukwe, M.C. 2012. Logit and Tobit analyses of the determinants of likelihood of adoption and extent of adoption of improved soybean seed in Borno State, Nigeria. *Greener Journal of Agricultural Sciences. Vol. 2 (2), 037-045.*

Green, S. B. 1991. How many subjects does it take to do a regression analysis? Multivariate Behavioral Research, 26, 499 - 510.

Krishna R. Tiwari, Bishal K. Sitaula, Ingrid L. P. Nyborg and Giridhari S. Paudel. 2008. Determinants of Farmers' Adoption of Improved Soil Conservation Technology in a Middle Mountain Watershed of Central Nepal. *Environmental Management*. 42:210–222.

Mahoo H, Radeny M, Kinyangi J, Cramer L, Eds. (2013). Climate change vulnerability and risk assessment of agriculture and food security in Ethiopia: which way forward? CCAFS working paper no 59 CGIAR Research Program on climate Change, Agriculture and foodsecurity (CCAFS). Copenhagen, Denmark.

Mcdonald JF & Moffit RA. 1980. The use of Tobit analysis. Review of Economics and Statistics 62:318-320.

Meikewolni and Camilla Andersson (2013). Spatial Patterns of Organic Agriculture Adoption: Evidence from Honduras. Georg-August-university of Göttingenpp 29.

Ministry of Agriculture. 2014. Plant variety release, protection and seed quality control directorate. Crop variety registers. Issue No.17. Addis Ababa, Ethiopia. P290.

Nchinda, V.P., Ambe, T.E., Nathalie, H., Leke, W., Che, M.A., Nkwate, S.P.; Ngassam, S.B.,Njualem, D.K..2010. Factors influencing the adoption intensity of improved yam (Dioscorea spp.) seed technology in the western highlands and high guinea savannah zones of Cameroon. Journal of Applied Biosciences 36: 2389- 2402.

Poonia T. C., 2013. History of seed production and its key issue international journal of food, agriculture and veterinary sciences Issn: 2277-209x

Regassa Feyissa (2012). Farmers' Strategies to Ensure Seed Security: A Key Component in Seed demand Assessment.

Sangeeta Verma And M.S. Sidhu (2009). Sources, Replacement and Management of Paddy Seed by Farmers in Punjab.

Spielman D, Derek B, Dawit K (2010). Policies to promote cereal intensification in Ethiopia: The Search for Appropriate Public and Private Roles. Food Policy 35: 185-194.

Storck, H., Bezabih Emana, Berhanu Adnew, A. Borowiecki, and ShimelisWeldehawariat. 1991. Farming systems and farm management practices of small holders in the Hararge highlands: A baseline survey. *Farming systems and resource Economics in the tropics* Vol. 11. Kiel: Vauk

Thijssen, Mh, Z. Bishaw, A. Beshir And W.S. De Boef, 2008 (Eds.). Farmers, seeds and varieties: supporting informal seed supply in Ethiopia. Wagenengen International 348p.