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Factors affecting improved seed and soil conservation technology adoptions in Bore District

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ABSTRACT

Low adoption of agricultural technology is among the main reasons for low farm productivity and high incidence of poverty and food insecurity in Ethiopia. The aim of this study was to examine the factors affecting adoption of improved seed and soil conservation and to estimate the interdependency of improved seed and soil conservation technology in Bore district Southern, Ethiopia. The three stage sampling technique was employed to select 138 rural households for the interview. Bivariate probit model was employed to estimate the joint success and failures of the technologies. The biprobit model results showed that plot distance from home, soil fertility status, adoption of organic fertilizers and time change which is adjusting planting date were significantly influence the decision to adopt improved seed varieties whereas, amount of organic fertilizer used, distance of household from market and plot distance from home were the three important variables affecting soil conservation technology where plot distance and time change negatively affect improved seed and distance to market and plot distance from home negatively affected the soil conservation technology in the study area, respectively. The probability of adopting improved seed variety, probability of adopting only soil conservation, success probability of adopting both technologies and probability fail to adopt both of the technologies were 57.5%, 42.77%, 22.73% and 22.43%, respectively. Therefore, improve credit access, extension and infrastructures that promote improved seed and soil management technologies. Training to extension agents and farmers during farmer training and field days are valuable to supporting these important linkages.

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1. Introduction

The future of agriculture in Ethiopia largely joints on the country's ability to generate and out scale improved agricultural technologies that increase productivity and income (Degife et al., 2021). Familiar of this fact is, the government of Ethiopia is

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devoting substantial amounts of resources towards strengthening the national research system. In this effort, more emphasis is given to the development of agricultural technologies in general and crop improvement, integrated natural resource management of soil conservation and extension programs in particular. Over the last four decades, the crop improvement programs in the country have released over 73, 44, 38 and 21 improved varieties of wheat, maize, barley and faba beans, respectively. Despite all these efforts, crop productivities on farmers' at field still less than a third of yields obtained in research. This leading to debate that agricultural research and development endeavors in the country have had low impacts on productivity enhancement and poverty reduction (Chilot et al., 2015).

In addition, crop improvement different soil conservation practices were introduced to Ethiopia. Various types of terraces, area closure and other soil conservation structures have been practiced on individual and communal lands through productive safety net and food for work programs since the 1970s and 1980s (Belachew et al., 2020). The Guji Zone, Bore district both traditional and modern soil conservation structures have been practiced by farmers. About 32,746 ha of farmland planned for conservation in five consecutive years (2014 to 2019), but about 14,124 ha of farm land achieved. The conservation practices were includes check dam, stone bund, microbasin, water pond, waterway, area closure, crop rotation, strip cropping, mulching, crop residue, compost, tree plantation and other biophysical soil conservation practices have been introduced and practiced in the study area.

Soil conservation is very crucial to enhance crop yields and ameliorate the livelihoods of rural families (Karidjo et al., 2018). Various soil and water conservation practices have been tested through development projects and local knowledge of farmers. It is imperative to create favorable conditions and large number of farmers can take advantage from the practices (Makate et al., 2018). The practices fully adopted only when their execution is sustained and fully integrated in the household's farming systems (Kimaru-Muchai et al., 2020). Adoption of soil conservation practices jointly with crop technology can leads to sustainable land management. In the recent research and extension efforts have resulted in better agricultural practices, new and improved crops varieties and improvements in soil and water management practices. However, according to Kaliba et al. (2018) the only way for sub-Saharan farmers to gain from new agricultural technologies is through adoption, after perceiving them to be beneficial and profitable. Additionally, the author quoted that to enhance the adoption, there are several studies that focus on mapping agricultural technology adoption patterns and on finding variables associated with adopters of these technologies. Even though the government of Ethiopia promoted various soil conservation practices, farmers could not implement practices and improve agricultural productivity (Asfaw & Neka, 2017).

The performances of soil conservation practices are less effective and mostly undertaken in campaigns without the full participation of crop producers and livestock keepers. Demographic, economic, institutional and physical factors influence farmers' decision on adoption of agricultural technologies (Asfaw & Neka, 2017; Belete, 2017; Lasway et al., 2020; Mekuria et al., 2018; Sileshi et al., 2019). Adoption of improved variety and soil and conservation technology have interdependency where researches on adoption of improved seed and soil conservation practices in

Bore district received limited attention and there is no empirical information that crucial for designing policies and strategies on joint adoption of soil and water conservation practice and improved seed. Therefore, the objective of this study was to identify factors influencing adoption of improved seed and Soil conservation practices among farmers in the study area.

2. Research methodology

2.1. The study area

The study was conducted in selected highland Bore district of the Guji Zone. Southern Ethiopia. Bore district is placed at a distance of 385 km from Addis Abeba, capital city of Ethiopia. Geographically, Bore district is situated between 5° 57’23"–6° 26’52" northing latitudes and 38° 25’51"–38° 56’21" easting longitudes. Most of the earth surface of the district has an undulating land surface with an elevation ranging from 1450 to 2900 meters above sea level. It has the annual rain fall of 1250 mm and the annual temperature ranges from 15 to 24 °C. The district is characterized by two agro climatic zones, namely humid which starts in early April up to October and sub-humid which starts late November up to beginning of March. The major soils of the district are Nitosols (red basaltic soils) and Orphic Acrosols. The two soils are found on the highland areas, and they are red brown and black brown in colors and on sloping topography and their utilization are good under natural vegetation. The farmers of this district produce cereals such as wheat, barley and maize, pulses such as faba bean and check pea, tubers like Irish Potato and others such as high land fruits and vegetables. Map of district extracted displayed in (Figure 1).

2.2. Data

The data used in this study were obtained through a cross-sectional survey of rural households. A three stage random sampling procedure was followed to select rural

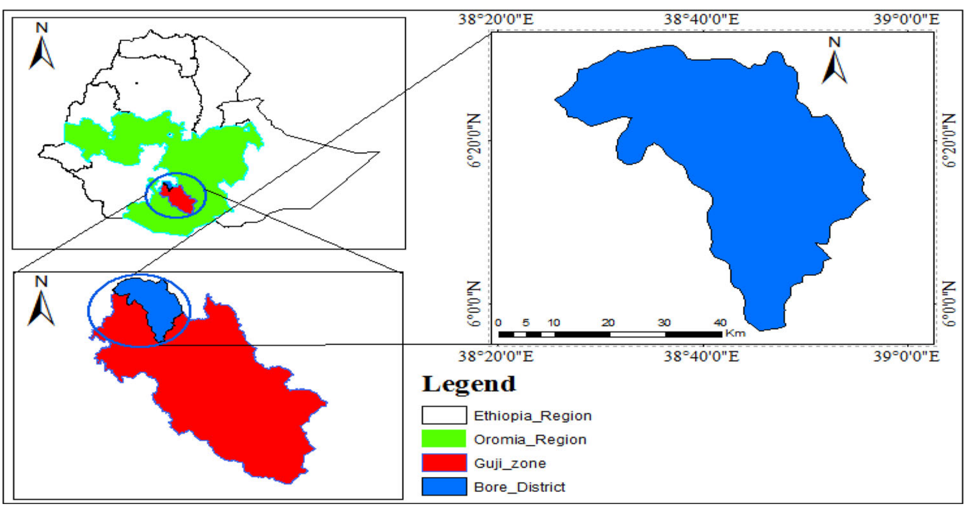

Figure 1. Study area map. Source: Geographical information system version 10.1.

households in consultation with district agricultural officers. First, Bore District from Guji Zone was selected purposively because district advantageous in using technology from the Bore Agricultural research center. Second, out of 324 rural Peasant associations in the District, six major technology advancement peasant association two peasant associations of Songo and Alayo Diba were selected using simple random sampling techniques. Third stage, updated list of farmers from the Peasant association was taken from Development agent of the two peasant association and 138 households were selected using Yamane (1967) and allocated to two selected Peasant association using proportional probability sampling to size. Yamane (1967) sampling determination method is computed as:

$$n = \frac{N}{1 + N(e)^2} \tag{1}$$

where n is sample size, N is target population in selected PA and e is margin of error. The questionnaire applied to collect data contained questions on the key adoptions of improved seed and soil conservation activities of households including demographic, socioeconomic, indicators for input and market access, institutional arrangements and technology adoption either solely or jointly. Data were entered into SPSS version 20, cross checked and cleaned before being transferred to STATA version 15 for statistical analysis.

2.3. Analytical analysis and model specification

The theoretical framework technology adoption decision is based on utility maximization theory. In this framework, economic agents are small-scale farmers whose adoption decisions were measured by the perceived utility from any option. Even though utility was not directly observed, the actions of economic agents are observed through the choices they made. So far, empirical studies on analysis of the smallholder technology adoption decision and their level of continuity have used various analytical models depending up on their nature of dataset. These analytical models include probit, logit model, Heckman sample selection model and double hurdle model. As justification and test among the candidate model provided in analytical framework part biprobit model is the best fitted model or fathomed model for the data to identify factors that influence smallholder adoption decision of improved seed and soil conservation farmers' decision jointly in the study area. The specification of the econometric models used in the study followed literature on empirical studies of biprobit has been used extensively for modeling joint influence of variables which provides consistent and asymptotically efficient estimates for all the parameters. Then, the inverse Mills ratios or marginal effect computed from the probit regression is used with different explanatory variables to help explain variances to the continuous non-zero dependent.

In this study, what is observed is the choice to adopt or not to adopt a technology and, conditional on adoption. The unobservable latent variable y_j^* from adoption depends on the vector of explanatory variablesx_i's so that the binary outcomes $y_j = 1$ arise when the latent variable $y_j^* > 0$. In this case y_2 which soil conservation is observed if and if y_1 which is adoption of improved seed which is soil conservation since improved seed occurred since the technology is not mutually exclusive. The outcome of the decision represented by the first probit equation is fully observed but there is a censored sample in the second equation representing soil conservation use of the technology, because only a subset of original farmers are involved. This censoring of observations implies the importance of taking into account self-selection at the adoption decision making stage to ensure proper estimation of model parameters. The standard bivariate probit model with additive errors can be specified as:

$$y_1^* = x_1^{'}\beta_1 + \varepsilon_1,\ \ y_1 = 1\ \ if\ \ y_1^* > 0,\ \ 0\ \text{other wise}\qquad \text{And} \tag{2}$$

$$y_2^* = x_2^{'}\beta_2 + \varepsilon_2,\ \ y_2 = 1\ \ if\ \ y_2^* > 0\ \text{and}\ \ if\ \ y_1^* > 0,\ \ 0\ \text{other wise} \tag{3}$$

where x and β are vectors of explanatory variables' and coefficients to be estimated, respectively. The estimation by maximum likelihood is straight forward given the additional assumption that the correlated errors are jointly normally distributed and constant variance with the following further assumptions:

$$E(\varepsilon_1|x_1, x_2) = E(\varepsilon_2|x_1, x_2) = 0 \tag{4}$$

$$\text{var}(\varepsilon_1|x_1, x_2) = \text{var}(\varepsilon_2|x_1, x_2) = 1 \tag{5}$$

$$\text{cov}(\varepsilon_1, \varepsilon_2|x_1, x_2) = \rho \tag{6}$$

Accordingly, three types of observations and associated probabilities can be specified:

$$y_{1=}0 : \text{prob}(y_1 = 0) = \Phi(-x_1\beta_1) \tag{7}$$

$$y_1 = 1, y_2 = 0 : \text{prob}(y_1 = 0,\ \ y_2 = 0) \tag{8}$$

$$= \Phi(-x_1\beta_1) - \Phi_2\left(x_1\beta_1,\ \ x_2\beta_{2,}\ \ \rho\right) \tag{9}$$

$$y_1 = 1, y_2 = 1 : \text{prob}(y_1 = 0,\ \ y_2 = 1) = \Phi_2\left(x_1\beta_1,\ \ x_2\beta_{2,}\ \ \rho\right) \tag{10}$$

where Φ is the univariate normal distribution, and Φ_2 is the bivariate normal distribution. The log-likelihood function to be maximized is based on these probabilities and can be specified as:

$$lnL\sum_{i}^{n}\left\{y_{i1}y_{i2}\ln\Phi_2\left(x_1\beta_1,\ \ x_2\beta_{2,}\ \ \rho\right)y_{i1}\begin{pmatrix}1-y_{i2}ln\left[\Phi(x_1\beta_1) - \Phi_2\left(x_1\beta_1,\ \ x_2\beta_{2,}\ \ \rho\right)\right]\\ +(1-y_{i1}\end{pmatrix}ln\Phi(-x_1\beta_1)\right\} \tag{11}$$

Further, multicollinearity, heteroscedasticity and endoginity tests were carried out and diagnostic tests were made to correct the problems. Multicollinearity situation of there exist strong linear relationships among independent variables which tends to inconsistent estimated parameters. This problem makes large variance associated with the parameter estimates or large forecasting errors (Green, 2008).

3. Discussions

3.1. Socio demographic characteristics of households

As shown in (Table 1), the average age of sample household-heads was found to be 42.41 years where age of household is ranged from 22 to 70 years. The study that revealed that the average off farm income was about 450 Birr where the minimum and maximum are 0 and 10,800, respectively. From this result it can be deduced that there was high variation of off farm income in the study area. The study results showed that the average livestock holding was 8 ± 1.64. The minimum and maximum livestock sizes were 0 and 81 tropical livestock unit per household, respectively. Livestock production played important roles. Farmers reared animals of different type for various purposes such as food (egg, milk and meat), clothes, means of transport and source of cash for urgent household expenses, health insurance against various diseases in family members, house construction, wage labor and fuel, draft power and manure to improve the fertility of soil in the study area. Among the household surveyed the maximum and minimum adopted amount of organic fertilizer to the area was 0 and 50 kg, respectively. The average distance of each household travel to manage is plot was 3.79 km with minimum distance of 0.1 and 9 km, respectively. Similarly the farm house hold was travelled in average 1.4 km to local development office to obtain either advisory service concerning improved seed and soil conservation adoption practice with minimum 0.01 and 5 km in the study area.

The average land holding of the study area is 0.532 hectare where minimum and maximum land holding were 0.022 and 0.489 which indicated that the land holding is small and intensive farming and use of improved technology and soil conservation is more recommended to the area to boost production and productivity for sustaining farming production. The plot distance from home the farmers travelled were 1.1 km in average with minimum and maximum distance of 0.01 and 5 km, respectively. The average income of the farmers of the area from farming activity was 10,886.55 in cash or kind

Table 1. Summary statistics analysis result for continuous variables.

Variables	Mean	*SD*	Min	Max	*SE*	95 % CI	
Age of household	42.41	11.1	22	70	0.945	40.54	44.3
Experience of farming in year	20.3	10.57	2	50	0.9	18.52	22.077
Off farm income in Birr	450.1	1576.451	0	10,800	134.2	184.75	715.48
Amount of organic fertilizers in kg	11.9	13.35	0	50	1.14	9.64	14.13
Livestock in TLU	8	9.79	0	81	0.83	6.41	9.71
Distance from market in km	3.79	1.93	0.1	9	0.16	3.47	4.12
Distance to development agent office in km	1.4	1.14	0.01	5	0.098	1.21	1.59
Plot size in ha	0.532	0.26	0.125	1	0.022	0.489	0.58
House hold plot distance from home in km	1.1	0.98	0.01	5	0.083	0.935	1.26
household total income in Birr	10,886.85	22,354.07	1200	214,460	1902.91	7123.98	14,649.71

Source: Own survey result, 2020.

Table 2. Frequency analysis result for dummy and categorical discrete variables.

Household characteristics	Frequency	Percent
Sex of household		
Female	9	6.52
Male	129	93.48
Marital status of household		
Single	6	4.35
Married	123	89.13
Divorced	1	0.72
Widow	8	5.8
Religious of household		
Muslim	102	73.91
Orthodox	13	9.42
Catholic	2	1.45
Protestant	20	14.49
Others	1	0.72
Education of household		
Illiterate	9	6.52
Read and write	47	34.06
Grades 1–4	11	7.97
Grades 5–8	48	34.78
Grades 9–12	21	15.22
Above	2	1.45
Training		
Yes	99	71.74
No	39	28.26
Credit		
Yes	67	48.55
No	71	51.45
Soil fertility		
Good	47	34.06
Medium	91	65.94
Change Time(adjusting plant date)		
Yes	96	69.57
No	42	30.43
Diversification of livelihoods		
Yes	30	22.06
No	106	77.94

Source: Own survey result, 2020.

where the minimum and maximum income was 1200 and 214,460, respectively. From this descriptive analysis of income, it can be seen that there was higher variation in the income of the individual from farming activity which may due to adoption of improved of improved technology and a difference in a farm management of the study area.

In the study area, 51.45% of sampled households could access to agricultural credit. However, there was no credit for improved seed and soil conservation practices for 48.55%. This indicated majority (48.55%) of respondents reported that there is lack of credit access in the study are for boosting production and productivity through adopting improved seed and soil conservation practices (Table 2).

3.2. Factors affecting adoption of improved seed and soil conservation

The main goal of the study was to examine factors influencing adoption of improved seed and soil conservation practices among farmers in the study area. Biprobit model was employed to examine determinants of adoption practices of the two technologies. As shown in (Table 3), the Wald test was used to test the model fitness, which was $\chi^2(34)$ *is* 75.3 with $> \chi^2$ is 0.0001 which was significant at 1% level of significance.

Table 3. Bivariate probit analysis result.

	Improved			Soil conservation		
Variables	Coeff	$P>\|Z\|$	Marginal effect	Coeff	$P>\|Z\|$	Marginal effect
Age of household	−0.013	0.695	−0.005	0.001	0.743	0.005
Religion	−0.002	0.988	−0.001	0.025	0.884	0.010
Education	−0.090	0.461	−0.035	−0.067	0.894	−0.030
Experience	0.000	0.995	0.000	−0.011	0.587	−0.004
Off-farm income	0.000	0.608	0.000	0.000	0.959	0.000
Amount organic fertilizer used	0.006	0.608	0.003	.034 ***	0.001	0.0133***
Training*	0.421	0.192	0.166	−0.443	0.181	−0.175
Access to credit*	−0.123	0.675	−0.048	0.162	0.600	0.064
Market distance	0.061	0.429	0.024	−.234***	0.002	−0.092***
Distance from FTC	−0.084	0.544	−0.033	0.174	0.140	0.068
Amount land owned	1.007	0.156	0.395	0.415	0.354	0.163
Plot distance from home	−0.304	0.137	−.119	−.367*	0.054	−0.144*
Soil fertility*	1.087**	0.021	.426**	0.283	0.282	0.111
Slop of plot of land	0.644	0.167	0.252	0.090	0.502	0.035
Adoption of organic fertilizer *	3.84 ***	0.000	.8176***	0.700	0.125	0.254
Adjusting planting date *	−1.33***	0.011	−.453***	−0.042	0.615	−0.017
Diversification *	0.013	0.971	0.005	0.234	0.434	0.093
Soil conservation status	−5.205**	0.020	–	−0.506	0.354	–
Predicted probability of adopting improved seed only(P_{10})						0.575
Predicted probability of adopting soil conservation only(P_{01})						0.4277
Predicted probability of adopting both simultaneously(P_{11})						0.2273
Predicted probability of adopting neither of the technology(P_{00})						0.2243

*, **, *** is significant at 10%, 5% and 1% respectively.
Source: Own survey result, 2020.

It indicated that the subset of coefficients of the model was jointly significant and that the explanatory power of the factors included in the model was satisfactory. The likelihood ratio test of the null hypothesis of independency between the adoption of improved seed and soil conservation practices ($\rho = 0$) was in significant. Therefore, the null hypothesis that all the correlation coefficient between adoption of improved seed and soil conservation values jointly zero is rejected, indicating the goodness-of-fit of the model or implying that the decisions to adopt improved seed and soil conservation practices are interdependent.

The result of the study showed that plot distance, soil fertility status of plot of land, adoption of organic fertilizers and time change (adjusting planting date) were variables affecting adoption of improved seed. While amount of organic fertilizers, distance to market and distance of plot of land from home were variables affecting the adoption of soil conservation technology. Similarly, amount of organic fertilizer used, distance of household from market and plot distance from home were the three important variables affecting soil conservation technology where among the three variables, distance to market and plot distance from home were negatively affected the soil conservation technology in the study area (see Table 3).

The result of soil fertility status and adoption of organic fertilizer was positively influence the adoption of improved seed indicating there is a significant correlation between the selected technologies, suggesting that adoptions of technologies are interrelated. Specifically indicating there is complementarity between organic fertilizer and improved seed revealing complementarity between adoption of improved seed and manure; and adoption of improved seed and crop diversification because of crop diversification like crop rotation of legumes and cereal crop to boast soil fertility biologically which is in line Kaliba (2018). It can be seen from the marginal effect result soil fertility status, among the sample respondents of improved seed adopter, 1% increase in soil fertility from medium fertility status to good fertility status likely to increase adoption of improved seed by 42.6%. This result revealed farmers enhance soil fertility biologically through crop rotation or mulching and physically using different soil and water conservation mechanisms are more likely to adopt improved seed than farmers who does not do that.

Adoption of organic fertilizer was also one among the important variables of influencing adoption of improved seed in the study area. As described by the result, adoption of organic fertilizer is positively affect adoption of improved seed with magnitude of 3.84 and its marginal effect revealed that, among the sample respondents of improved seed a 1% increase in the adoption of organic fertilizer to boast production and productivity in the study area likelihood to increase adoption improved seed 81.76% compared the nonadopters of organic fertilizers. It is known that organic fertilizer is easily produced by the farmers or it can be done by through crop rotation or using cow dung which minimizes cost of production expended for inorganic fertilizers in the study area. Adjusting planting date is also other variable affecting adoption of improved seed with magnitude −1.33 and marginal effect −0.453 describing that among the sample respondents of improved seed adopters, as the number of planting date is adjusted by 1 number for those practicing adjusting plant date to those not practicing adjusting plant date, the adopting improved seed is likely to decreased by 45.3%. This result implies that every improved seed is accustomed with its full package and farmers adopt improved with its entire full package meets the potential yield of improved.

Similar result was reported by Mekuria et al. (2018) as adoptions of technologies are interrelated which indicates complementarity between inorganic fertilizer and improved seed; and substitutability between inorganic fertilizer and manure generalizing complementarity between adoption of improved seed and manure; and adoption of improved seed and crop diversification. As far as this study area is employed in dega plot characteristics, adoption of organic fertilizer like cow dung or locally known as “*didira*” with improved seed is common in the study area. Amount of organic fertilizer, market distance and plot distance from home negatively influence adoption of soil conservation revealing that as the plot of land is far from home, and the farm household is far from the market the likelihood to adopt soil conservation practice is diminishing and increasing using amount of organic fertilizer increases adoption of soil conservation technology. Since the study area populations are agro pastoralist, they are not permanently settled in one area because they move from place to place in search of water and gassing land for their cattle and made owned land every place they have been rest. As the result most of their plot of land are used for over grazing which may be reason for decreasing soil conservation in relation to distance from home. It can be also justified that farmer having plot of land away from the home may rent land to near farmers and not suitable for management whenever needed.

Similar result was reported by Belachew et al. (2020) and Gessesse (2021) that distance was hypothesized to be negative on the adoption of soil and water conservation practice as farm land is far from home, farmers could not have interest to manage their land. According Asfaw and Neka (2017) and Belete (2017) reported, limited numbers of farmers were frequently inspected and maintain their land whilst the distance has increased. Less time and energy are needed to manage closed farmland than far from their homes as a result they are discouraged from conserving their farm land. In relation to this finding those similar report implies that longer walking distance between farmland and residential area was reduced the adoption of soil conservation practices.

The success probability of adopting improved seed variety only by farmers was about 57.5%, the probability of adopting only soil conservation technology was 41.3%, the joint success probability that farmers adopt both technologies simultaneaously is about 21.81% and the joint probability that farmers fail to adopt both of the technologies is about 22.34%. from this result it can be suggested that the farmers of the are are more likley to adopt both technoloigies exclusively. The result implies that the likelihood of practicing adoption of soil conservation was relatively low as compared to probability of adopting improved seed in the study area. This implies that farmers are not interested to adopt soil conservation practice as compared to adoption of improved seed that might take more time and demand high labor and skill at time of constructing soil conservation practices as quoted by (Belachew et al., 2020). Conversely, the decision to adopt improved seed and soil conservation decision is interdependent. The joint probability of success or failure of adopting improved seed and soil conservation technologies were suggested that households were likely to adopt improved seed and soil conservation jointly inidicating households were likely to succeed to choose both selected practices of adopting improved seed and soil conservation at the same time is minimal and failure to succeed adopting improved seed and soil conservation technologies also almost equal.

The join marginal effects result showed that amount of organic fertilizer used, distance to market, plot distance, soil fertility status and adoption of organic fertilizers and time change which are significant at 1%, 10%, 5% and 1% are important variables jointly affecting adoption of improved seed and soil conservation technology in such a way that, amount of organic fertilizer used, adoption of organic fertilizers and soil fertility affects positively whereas distance to market, plot distance and time change affect negatively. This implies that among the sample respondents 1% increase in amounts organic fertilizers used likely to increase the probability of adopting improved seed and soil conservation by 10.23% as compared nonadopters. Similarly, among the sample respondents as market distance and plot distance is increased by 1 km the probability that the probability of jointly adopting improved seed and soil conservation is likely decreased by 0.048 and 0.139, respectively. The likelihood probabilities of improved seed and soil conservation were increased by 26.1% and 38.54%, respectively, to those increased soil fertility status and adoption of organic fertilizers on their plot land compared to those who are not adopt the technology and among the sample respondents as planting date is adjusted by 1 day the joint probability of improved seed and soil conservation decreased by 0.277 from improved and soil conservation adopter to nonadopters.

4. Conclusions

Low adoption of agricultural technology is among the main reasons for low farm productivity and high incidence of poverty and food insecurity in Ethiopia. The aim of this study was to examine the factors affecting adoption of improved seed and soil conservation using data from 138 randomly selected sample households in Southern Oromia, Guji Zone and Bore district. Biprobit model was employed to examine determinants of adoption practices of the two technologies. The result showed that the decision to adopt improved seed and soil conservation decision was interdependent. The output showed that the probability that farmers practices improved seed and soil conservation were 57.5 and 42.77, respectively. The probability of farmers jointly adopt both improved seed and soil conservation was 22.73% and about 22.43 fail to succeed in adopting improved seed and soil conservation technologies. The result of joint marginal analysis showed that amount of organic fertilizer used, distance to market, plot distance, soil fertility status and adoption of organic fertilizers and time change were simultaneously affect adoption of improved seed and soil conservation technology. Soil fertility status, adoption of organic fertilizers and time change (adjusting planting date) were variables affecting the decision to adopt improved seed where time change is negatively affect the adopter to nonadopter. Amount of organic fertilizer used, distance of household from market and plot distance from home were the three important variables affecting soil conservation technology where plot distance both market and home is negatively influence soil conservation technology. Therefore, policy should improve credit access, extension and infrastructures that essential in promoting appropriate, easily accessible and current agricultural and soil management technologies. Training to incentivize scientists and extension agents and engagement of policymakers during farmer training and field days are valuable to supporting these important linkages.

Disclosure statement

No potential conflict of interest was reported by the authors.

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