Factors affecting adoption of watershed management program in Mirab-Abaya Districts of Southern Ethiopia.

Abebe Asele Mamo (biherawi123@gmail.com)
Ministry of Energy and Water: Ministry of Energy https://orcid.org/0000-0002-5395-5113

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Factors affecting adoption of watershed management Program in Mirab-Abaya Districts of Southern Ethiopia.

Abebe Asele Mamo[1]

[1] FDRE Ministry of Water and Energy, Rift Valley Lakes Basin Development Office, Hawassa, Ethiopia.

Email: biherawi123@gmail.com ORCiD: **0000-0002-5395-5113**

Abstract

Land degradation is an important issue because of its adverse impact on agronomic productivity, the environment and its effect on food security and quality of life. The study was conducted in Achekore sub watershed of adopters and Layotirga sub watershed non-adopters of Mirab-Abaya district. The major objectives of the study was to investigate the factors affecting the adoption of watershed program. The study used random sampling techniques and selected 334 total sample size, and analyzed using econometric model called binary logistic model. The findings revealed that among the hypothesized explanatory variables included in the model, land size and land tenure were found affecting the dependent variable at 5% significant level, whereas age, gender, family size, participation in nonfarm activity, distance and slope variables influencing at 1% significant level. Moreover, Education and extension contact variables was found not significant to adoption of watershed management technologies. It is concluded that the watershed management practice is adopted by the community as it plays a significant role to enhance household's livelihood, ecosystem balance and cope with climate change impacts.

Key words: Adoption, watershed management program, Binary Logit,

Background.

In Asia and Africa, hundreds of millions of poor and marginal farmers rely on degraded land and water resources and struggle to cope with a diverse array of agro-climatic, production and market risks (Bharat R. Sharma, J.S. Samra, C.A. Scott and Suhas P. Wani. 2005). Environmental degradation due to human pressure and land use has become a major problem in developing countries because of the high population growth rate and the associated rapid depletion of natural resources. Land degradation is an important issue because of its adverse impact on agronomic productivity, the environment and its effect on food security and quality of life (Eswarn and Reich, 1998).

The landscape of Ethiopia has changed considerably during the past years. Rapid population growth, internal migration, policy shifts, and regime change were identified as the key driving forces of LULC changes in the country. The LULC changes and related trend of increasing landscape fragmentation in turn increases soil erosion, the volume of surface runoff and sediment transport in the landscape and, consequently, affected the levels and water quality of the Lakes found in the rift floor. Furthermore, the destruction and fragmentation of shrub land and natural grassland led to the decline of wild plants and animals previously prominent in the country (Ashebir et al. 2017).

Ethiopia, particularly those having significant areas with complex, mountainous, and fragile ecosystems have developed national watershed programs or projects. The overall plan for the management of a small watershed emphasizes on comprehensive erosion control measures including measures for hill slope and gully stabilization, regulating river system and rearranging farmlands. Participatory watershed planning and development is a vital necessity in complex landscapes. Interactions, between and within, communities depend on what happens at different levels of the watershed. (Lakew Desta, Carucci, V., Asrat Wendem-Ageňehu and Yitayew Abebe (eds). 2005).

Land degradation of Rift Valley Lakes' basins of the country is severe on the uplifted high lands at Western and Eastern escarpments of the Rift. The 2010 RVLB Reconnaissance Master Plan Study identified some areas as being devastated by erosion with a significant expansion of the land area being lost to erosion each year. Such areas include the Mirab-Abaya district watersheds, north of Hossana, north of Lake Abaya and between Dilla and Lake Abaya. Apart from these specific areas that are severely affected by gully erosion, the study identified sheet erosion stripping-off the topsoil over a great deal of the rest of the area, particularly the eroded north-east area of Lake Abaya, where poorly consolidated volcanic ash forms the structurally weak topsoil (MoWR, 2010).

A *watershed* is the area that drains to a common outlet. It is the basic building block for land and water planning. *Degradation of watersheds* in recent decades has brought the long-term reduction of the quantity and quality of land and water resources, as shown. Changes in watersheds have resulted from a range of natural and anthropogenic factors, including natural soil erosion, changes in farming systems, over abstraction of water, overgrazing, deforestation, and pollution. The combination of environmental costs and socioeconomic impacts has prompted investment in watershed management in many developing countries. Size is not a factor in the definition, and watersheds vary from a few hectares to thousands of square kilometers. Unless a watershed discharges directly into the ocean, it is physically a part of a larger watershed that does, and may be referred to as sub watershed. (Salah D., Christopher W.,Gretu G.,Erika S., and Julianne R., 2008)

Watershed management is the integrated use of land, vegetation and water in a geographically discrete drainage area for the benefit of its residents, with the objective of protecting or conserving the hydrologic services that the watershed provides and of reducing or avoiding negative downstream or groundwater impact. (Salah D., et al ,2008)

Integrated watershed management is the process of formulating and implementing a course action involving natural and human resources in watershed, taking into account the social, political, economic and institutional factors operating within watershed and the surrounding and other relevant regions to achieve specific social objectives (as cited in P. Lodha and K. Gosain,2008).

The key characteristics of a watershed that drive management approaches are the integration of land and water resources, the causal link between upstream land and water use and downstream impacts and externalities, the typical nexus in upland areas of developing countries between resource depletion and poverty, and the multiplicity of stakeholders. Watershed management approaches need to be adapted to the local situation and to changes in natural resource use and climate (Salah D., et al ,2008).

The watershed development programmes involving the entire community in Gamo Zone has grown in recent years from more technical interventions to restore degraded lands. CBWM is a widely implemented in Mirab-Abaya. One of wich is a watershed management program implemented by FDRE RVLBA and Mirab-Abaya district Agricultural development offices. At the beginning of the physical year RVLBA and the district ADO sign MOU to achieve their own action with regard to the watershed management projects. They select the project area of sub watersheds based on the severity of the problem.

The overall objective of the project is to tackle sedimentations load that will disturb the natural habitat of Abaya and Chamo lakes in the sub basin. The project components include: soil and water conservation, afforestation mainly through agro forestry, improve income generating activities of farmers that involved on integrated watershed management (survey study by RVLBA, 2015).

Therefore, this study tried to investigate to determine factors influencing the adoption of watershed management in Mirab-Abaya district of southern Ethiopia.

Methodology

Description of the study area

Mirab Abaya is one of the woredas in the Southern Nations, Nationalities, and Peoples' Region of Ethiopia. Part of the Gamo Gofa Zone, Mirab Abaya is bordered on the east and south by Lake Abaya which separates it from the Oromia Region on the east and Arba Minch Zuria on the south, on the west by Chencha, on the northwest by Borena, and on the north by the Wolayita Zone. Towns in Mirab Abaya include Birbir. Mirab Abaya was part of former Boreda Abaya woreda (https://en.wikipedia.org/wiki/Mirab_Abaya).

The name of the selected study area watershed is called Achekore which is found in Borede Kebele of Mirab-Abaya District.

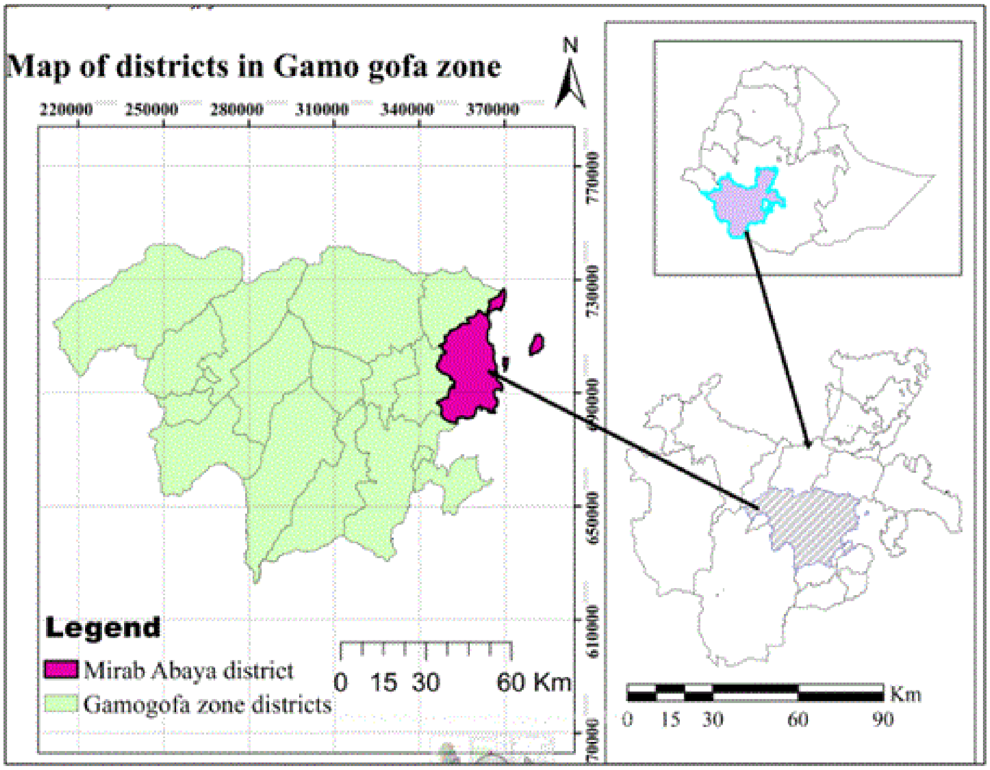

Figure 1: Mirab-Abaya map

Source: Birhanu Wolde, Wudinesh Naba, and Abiy Gebremichael (2020)

Description of the project

The name of the project was called Abaya-Chamo sub basin watershed management projects. It comprises seven project Districts namely Humbo, Mirab Abaya, Chencha, Arba Minch City administration, Amaro, Abaya and Lokabaya. Based on the preliminary study survey in targeted area, highly eroded sub watershed of the sub basin with the financial support of RVLBA, has initiated an integrated watershed management project in all sub watershed of Abaya Chamo sub basin of RVLBA in 2014 and projects are still in action. The overall objective of the project is to tackle sedimentations load that will disturb the natural habitat of Abaya and Chamo lakes in the sub basin. The project components include: soil and water conservation, afforastation mainly through agro forestry, improve income generating activities of farmers that involved on integrated watershed management (survey study by RVLBA, 2015).

This study was held in Mirab-Abaya district. This is because, the availability of secondary data in relation to the watershed management project.

Data source and method of data collection

The sources of the data for this study was from both primary and secondary sources. Primary data was obtained through structured and semi-structured questionnaires collected using enumerators. To supplement the primary data, secondary data are collected from published and unpublished sources. Enumerators were coordinator of the project in district level, who are permanent employer of ADO. All secondary data available in RVLBA, such as Master plan of RVLB, survey study, and others, were used.

Sampling techniques

The study is conducted in purposively selected project sub watershed called Achekore sub watershed of Mirab-Abaya district. The availability of baseline socio economy and biophysical data in the selected project sub watershed is account for selection of study area. But when sampling households cluster and systematic random sampling (upper stream and lower stream of the sub watersheds) techniques were used.

1.1. Sampling size

According to Israel (2012) the appropriate sample size should have the following criteria: the level of precision, the level of confidence or risk, and the degree of variability in the attributes being measured.

Yamane (1967) provides a simplified formula to calculate sample sizes.

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

Where n is the sample size, N is the population size, and e is the level of precision (5%).

The total numbers of households in the study sub watersheds are 2,862. Therefore, the total sample size for total households at e=5% was:

$$n = \frac{2028}{1 + 2028(0.05)^2} = 334$$

For selection of sample size, adoption and non-adoption households, we usually follow the method of proportional allocation under which the sizes of the samples from the different strata are kept proportional to the sizes of the strata (C.R. Kothari,2004).

Sample size : Achekore sub watershed (adopters)=334 (1093/2028) =180

Layotirga sub watershed (non-adopters) = 334 (935/2028) = 154

Methods of data analysis

The level of socio economic and demographic characteristics are analyzed and explained using descriptive statistical analysis and the selected dependent and independent variables were analyzed using binary Logit model to estimate factors influencing adoption of watershed management.

Specification of the model

To determine the influencing factors for adoption of watershed management, binary Logit model is used. According to Jeffery (2012) Coefficients can be compared across models, the estimated coefficients in Logit is four times OLS estimation and 1.6 times Probit estimation. For this study, therefore, Logit model is used in addition of descriptive analysis using ratios and percentages.

In Logit estimation one hypothesizes that the probability of the occurrence of the event is determined by the function:

$$p_i = F(Z_i) = \frac{1}{1 + e^{-Z_i}}$$

As *Z* tends to infinity, *e–Z* tends to 0 and *p* has a limiting upper bound of 1. As *Z* tends to minus infinity, *e–Z* tends to infinity and *p* has a limiting lower bound of 0. Hence there is no possibility of getting predictions of the probability being greater than 1 or less than 0.

The marginal effect of *Z* on the probability, which will be denoted *f*(*Z*), is given by the derivative of this function with respect to *Z*:

$$f(Z) = \frac{dp}{dZ} = \frac{e^{-Z}}{(1 + e^{-Z})^2}$$

The model is fitted by maximum likelihood estimation and this uses an iterative process to estimate the parameters .and the coefficients are interpreted using marginal effects.

Diagnostic test for Logit model

Testing significance of the model: Testing for significance of a model is the act of assessing the model to see how good it fits (goodness of fit of a model). It is best practice to investigate how the fitted values compare with the observed values, which act either require to be revised or accepted (Andrew S. Fullerston and Jun Xu,2015) . In Logistic Regression the process usually involves testing for the significance of the k coefficients of explanatory variables (factors) using Wald test test based on the statistic Z statistic. (Andrew S. Fullerston and Jun Xu,2015) .

Likelihood ratio test of the model used to estimate the parameters with the hypothesis:

H_0: $\beta_1 = \ldots = \beta_p = 0$

H_1: there is at least one $\beta_i \neq 0$; i=1,2,…,p, where i is the number of explanatory variables.

Likelihood ratio test statistic uses the G, where $G=-2\ln(L_0/L_k)$ where L_0 is the likelihood function without variables and L_k is the likelihood function with variables (Muhammed Nur Aidi M.S and Tuti Purwanings il S.Stat,2013).

If H_0 is true, statistics G will follow a chi-squere distribution with degree of freedom p and H_0 will be rejected if the value of $G>X^2_{(p,\alpha)}$ or p-value < α.

Wald test will be used to test the significance of each coefficient in the model. The hypothesis is:

H_0: $\beta_i = 0$

H_1: $\beta_i \neq 0$; i=1,2,…,p, where i is the number of explanatory variables.

A Wald test calculates a W statistic which is:

$W_\beta = \left[\frac{\widehat{\beta}}{SE(\widehat{\beta})}\right]^2$ reject H_0 if $|W| > Z_{\alpha/2}$ or p-value < α.

Detecting multi collinearity and handling: Explanatory variables are correlated with each other resulting in so-called multi collinearity. In logistic regression, there must be no multi collinearity because in the presence of multi-collinearity the standard error of regression coefficient will be increased so that the possible results of Wald test of each X will not be significant. However, this assumption is actually not very important because multi collinearity does not change its estimate value (Saroje Kumar Sarkar,2013).

Logit is subject to a similar (no) perfect multi collinearity assumption as OLS, and hence encounters similar problems associated with imperfect multi collinearity. Like OLS, the inclusion of two independent variables that are highly correlated fails to bias logit's log-odds coefficients, but does increase the standard errors associated with them. (A. Johnston, 2013)

Using stata by calculating **pair-wise correlation** for each explanatory variable we can detect multi collinearity. If the absolute value of the correlation coefficient was high (i.e. between 0.75 and 0.8), there was strong evidence for the presence of severe multi collinearity. (A. Johnston, 2013).

Table 1: description and expected sign of explanatory variables for adoption analysis

Description of explanatory variable	**Operational definition of variables**	**Expected hypothesis**
Household age	Continuous variable –age of household head	Negative
Household gender	A dummy variable with value 1 if household is female and 0 otherwise	Positive
Number of children in the household	Continuous variable	Positive or negative
Household educational level	A dummy variable with value 1 if household is illiterate and 0 otherwise.	Positive
Household extension contact	Extension contact: 1 if the farmer gets extension contact, 0 otherwise	Positive
Household participation in non farm income	Participation in non-farm activities; O, if participate; 1, otherwise	Negative
Household Farm land	the size of the farm in hectares	Positive
Distance	Proximity of farm from the residence; 1 if the distance to be far 0 otherwise	Negative
Slope	Slope of the plot; 1 if steep and 0 otherwise	Positive
Land tenure	1 If the farmer feels that the land belongs to him/her at le least in his/her lifetime; 0 otherwise.	Positive

Source: own computation, 2019

RESULTS AND DISCUSSION

Descriptive statistical analysis

The descriptive statistics results for continuous variables summarized using StataMP 13 software presented below.

Table 2: Variable description continuous variables

Variable	Observation	Mean	Std. Dev.	Min	Max
Age	334	38.98182	7.389694	26	60
Family size	334	7.287879	2.582176	2	17
Size of farm land	334	1.083591	.6494095	.125	2.5

Source: own survey result, 2019

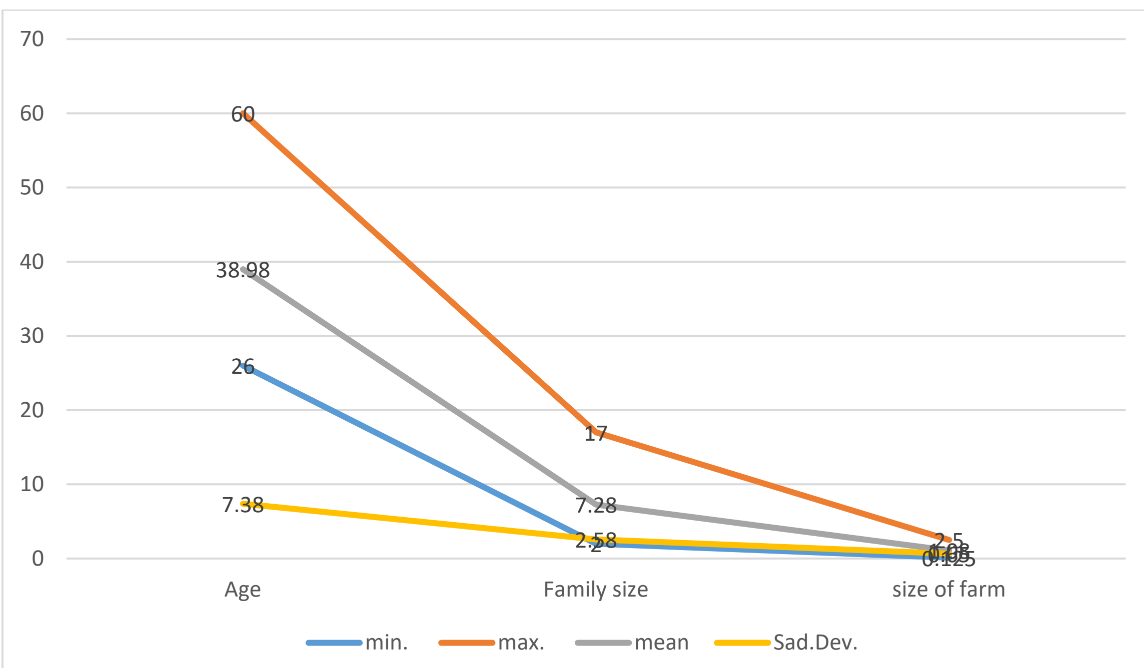

Figure 2: continuous variables description

Source: own survey result, 2019

The variable description of farmers by adoption status for a categorical variables are presented in Table 3.

Table 3: Variable description for continuous variables

Variables	Frequency	Percent	Cum.
		Gender	
Female	56	15.76	15.76
Male	278	84.24	100
		Education	
Literate	172	50.91	50.91
illiterate	162	49.09	100
		Extension contact	
Not gets extension	151	44.55	44.55
Gets extension	183	55.45	100
		Distance	
Not far	184	54.55	54.55
far	150	45.45	100
		Slope	
Not steep	185	54.85	54.85
Steep	149	45.15	100
		Land tenure	
Not feels	0	0	0
Feels	334	100	100
		Participation	
Not participate	158	46.67	46.67
participate	176	53.33	100
		Adoption	
Non adopters	154	45.45	45.45
Adopters	180	54.55	100

Source: own survey result, 2019

The Binary logistic analysis result: the dependent variables analyzed in this study was adoption quantified in terms of dummy variable. The result revealed that among the hypothesized explanatory variables included in the model, land size and land tenure were found affecting the dependent variable at 5% significant level, whereas age, gender, family size, participation in nonfarm activity, distance and slope variables influencing at 1% significant level. Moreover, Education and extension contact variables was found not significant. The discussions of each variable in the light of other scholars were presented as follows.

Table 4: The binary Logit model result

Logistic regression **Number of obs = 334**

LR chi2(10) = 367.98

Prob > chi2 = 0.0000

Log likelihood = -43.382818 **Pseudo R2 = 0.8092**

Variables	Estimated coefficients	S.E	Wald statistics	Sig. level	Marginal effect
Age	0.3208	0.0882	3.64	0.000***	0.0734
Gender	2.6558	0.8931	2.97	0.003***	0.4008
Education	1.9833	2.4948	0.79	0.427	0.0024
Extension	-1.0310	1.1450	-0.90	0.368	-0.0015
Family size	-0.6568	0.2042	-3.22	0.001***	-0.1502
Participation	-2.4976	0.7303	-3.42	0.001***	-0.5291
Land size	-0.8587	0.4083	-2.10	0.035**	-0.1964
Distance	-0.3532	0.5531	-2.97	0.003***	-0.3533
Slop	1.8943	0.6062	3.12	0.002***	0.4188
Land Tenure	1.94	0.8423	2.30	0.021**	0.4494
Constant	-8.8431	2.8222	-3.13	0.002***	-

*,**,and*** significant at 10%,5% and 1% probability level.

Source: own survey result, 2019

Age of the household

Age of the household was found to be positively associated with adoption of watershed management program and statistically significant. This can be explained by the fact that older farmers have relatively old age experience with problems of watershed management and its impact in reduction of their crop products compared to youths. This implies that older farmer have higher personal preference which can reduce the impact of soil erosion through the implementation of watershed management. Thus, this has been suggested to influences the farmer attitude towards the technology and the problem.

However, the finding of Belete Limani Kerse (2017) opposes this suggestion. According to him, older farmer lack labor required to maintain SWC activities. Hence these situations affect farmer's attitude negatively on soil conservation structures.

Gender of the household

As hypothesized, being male significantly and positively influencing the tendency of a household to adopt watershed management program practices at 1% significant level. Thus, the male-headed households were more likely to participate in the program than female headed households. Compared to female headed household, male headed household have more probability of adoption of watershed management program. The possible reasons for these results are male households are better exposed to modern SWC technologies and have more power to make adoption decision than female households.

This result is in line with the argument that male headed households are often considered to be more likely to get information about new technologies and take risky businesses than female-headed households W.Norton George et al, (2014) and Meta Alen et a,l (2018).

Family size

As the result in binary logistic regression showed family size is statically significant at 1% level. It was negatively related with adoption rate of watershed management practices. The coefficient value in table 4 indicates that other factor held constant when family labour increases by one unit the probability to participate in the program decreases by 0.15. This negative impact may be due to households with larger family size are likely to face food scarcity. Consequently, they try to maximize short-term benefits and would be less interested in soil conservation measures whose benefits can be reaped in the long run also found similar results.

However, in the contrary to this study Belete Limani Kerse (2017) and R.S. Waghmore and Oingle (2001), large family size was positively related with adoption. This positive impact may be due to the laborious nature of conservation work which needs more labor force. Hence, the household who has more family size is favorable to supply more labor.

Participation in Non –farm activities

As hypothesized, engaging in non-farming activities discourages a household not to participate in program activities. Thus, non-farm activities influence farmer's use of watershed management technologies negatively and significantly at 1% significant level. It decreases the probability of adopting watershed management programby 0.529. This could probably be the chance of a household for alternative income generation. Therefore, rather than focusing on measures that might enhance the productivity of their farm they tend to participate in non-farm activities. Thus, the involvement in non-farm jobs is common in the study area. Some are engaged in handicrafts, daily labor work, selling of firewood, selling of charcoal, and small scale trading. Similarly, Study is in line with the finding of P. Huckett Steven (2010).

Land size

The size of farm land was found to be negatively associated with continuous use of conservation structures and statistically significant at 5% significant level. The negative coefficient implies that farmers with relatively larger holdings had higher probability to apply labor intensive nature of constructing soil conservation structures. This can be attributed to the fact that conservation structures needs lots of labor compared to those with relatively lower farm size. However, in the contrary Meta Alen et al, (2018) found that farmers who have a larger farm are more likely to invest in soil conservation measures because they have the funds to do so.

Distance

As hypothesized during variable description, distance between a farm plot and residence of a household influence their motivation to adopt watershed management programs negatively. The coefficient of distance of a farm was found being negative as shown in Table 4. The possible reason could be farmers with plot of land that are far to the soil erosion prone area and technologies implementation site have showed unwillingness to adopt SWC structures. In other word, it implies that longer walking distance between farm land and residential area was related to a reduced adoption of soil and water conservation practices. This is because the time and energy farmers spend to reach farm plots is lesser for nearer farm plots than distant farm plots and also the closer the plot is to the residence area the closer supervision and attention it will get from family. Similar result was found by R.S. Waghmore and Oingle (2001).

Slope

Slope of a farm plot has been found statistically significant and positively correlated with continued use of structures at 1% probability level. This implies that slope of a land influences the adoption of watershed management program positively. As stated in the hypothesis, a household inclines implementation of watershed management program as he or she owns very steep land which could probably be exposed to soil erosion. Commonly as slope is an indicator of soil and water loss from farmland, farmers cultivating steep slope fields perceive the threat of soil loss. This implies that households farming steep land are more likely to adopt conservation structures than less steep lands. Additionally, the slope of land affects farmers' decision by influencing the productivity of their cultivated land and significance of soil erosion through reducing the availability of fertile farm land. This study is in line with the findings of W.Norton George et al (2014).

Tenure security

Land tenure is about the characteristics of tenure security in the study area which is linked with property rights. Farmers can freely invest on their farms on watershed management structures. it was statistically significant and positive at 1% significant level, tenure is positively related to the adoption of soil and water conservation structures. Thus, the result of the marginal effect shows that tenure security significantly increases the likelihood of implementing watershed management program by 0.449. Conversely, this study is in line with the findings of Merkineh Mesene et al (2018).

Diagnostic tests in binary Logit estimation

Goodness of fit test: In accordance with Binary logistic regression result, there were two goodness of fit tests. First, likelihoods ratio chi square test is a significant chi2 test. According to regression result it was very high value (LR chi2 (10) =367.98) of with a significant p_value (0.000). These indicate, we have evidence of good model fit.

Second, Hosmer-Lemeshow chi2 is non-significant chi2 test which is indicator of goodness of fit. We require insignificant p_value. The model result in stataMP13 showed below. Therefore, in both tests of goodness of fit we have used good model of fit.

Table 5: Goodness-of-fit test

Logistic Model for Adoption, goodness-of-fit test
(Table collapsed on quantiles of estimated probability)
No. of observation = 334
No. of groups = 10
Hosmer-Lemeshow chi2(8) = 2.66
Probb > chi2 =0.9538

Source: own survey result, 2019

Pretest results of multi collinearity: Prior to undertaking the binary logistic regression analysis, existence of multi collinearity was checked. According to A. Johnston (2013), multi collinearity among the explanatory variables can make difficult to measure the separate effects of the independent variables on dependent variables. This in turn hinders to drive estimators of parameter coefficient and make statistical inference difficult. Therefore the problems of multi collinearity were tested by computing Variance Inflation Factor (VIF). Then, if the value of VIF is greater than 10, it is an indicator for the presence of multi collinearity problem among the variables. The result of VIF in the table 6 shows that there is no multi collinearity problem among the variables since there is no variable which resulted VIF greater than 10.

Table 6: VIF of continuous explanatory variables

Variables	**VIF**
Age	2.32
Family size	3.46
Farm land	2.53

Source: own survey result, 2019

Besides VIF, it is very important to check the existence of multi collinearity among dummy variables. According to A. Johnston (2013), for dummy variables if the value of contingency coefficient is between 0.75 and 0.8, the variable is said to be collinear. Thus, contingency coefficient (cc) analysis was made to detect presence of association between dummy variable. The output of the pair-wise correlation coefficients of the predictor variables in table 7, show there is no problem of multi collinearity.

Table 7: Correlation matrix of coefficients of Logit model

e(V)	Adoption Gender	Edu	Excon	Par	landten	slop	dis
Adoption							
Gender	1.0000						
Edu	0.4481	1.0000					
Excon	-0.4947	-0.3255	1.0000				
Par	-0.2139	-0.0027	0.3203	1.0000			
Landten	-0.3506	-0.2853	0.3048	0.0320	1.0000		
Slop	0.4378	0.2276	-0.4791	0.0216	-0.2723	1.0000	
Dis	-0.1771	-0.1880	0.2880	0.1300	0.0885	-0.2435	1.0000

Source: own survey result, 2019

Conclusion

Adoption of watershed management program provides an opportunity to improve productivity of crops, employment and improvement in the overall livelihoods of the household. The binary Logit regression analysis indicated that six explanatory variables were found to have a positive significant influence on the farmer's decision to participate in watershed management program. Whereas, family size, participation on nonfarm activity, land size, and distance were found to have a negative significant influence to adoption of watershed management. These variables were age, gender, education, extension contact, slope and land tenure. These indicates the overall respondents' knowledge and interest towards the watershed management program was relatively low because of the factors that have a negative impact on their participation. Hence, more effort is needed for raising farmers' awareness through delivering information on the importance of watershed management programs. The study also recommends that similar research should be conducted in other watersheds to validate the findings of this study and a more in-depth study should be done by incorporating other variables such as farmers past experiences and farmers' trust to government policy, to further enhance the identification of factors that affect farmers' participation in watershed management programs to improve the prediction of the level of their participation.

Declarations

List of Abbreviations

LULC	Land Use Land Cover
FDRE	Federal Democratic Republic of Ethiopia
RVLBA	Rift Valley Lakes Basin Authority
CBWM	Community Based Watershed management
ADO	Agricultural Development Office
MOU	Memorandum of Understanding
RVLB	Rift Valley Lakes Basin
OLS	Ordinary Least Square
SWC	Soil and Water Conservation

Ethics approval and consent to participate

- ✓ Not applicable

Consent for publication

- ✓ Not applicable

Availability of data and materials

- ✓ All data supporting my article are organized in soft copy in excel or Stata Mp format. The main raw data that were used in this articles are available, therefore, I have full right to share the data.

Competing interests

- ✓ No computing interest at all.

Funding

- ✓ All funds with regards to design of the study, analysis and interpretation of data were only by researcher him selves, no external funds were used.

Authors' contributions

- ✓ All contribution towards data organization, analysis and interpretation is goes to one author.

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- Last but not the least, I am also very grateful to the farmers of project and non project sub watersheds and various heads and experts of the Kebeles for sharing me all the information I sought and the cooperation of the sampled households in replying to all questions patiently and active participation in the discussion made is also highly acknowledged.

Authors' information

- The author has enough experiences in watershed and water sectors, and obtained different national and international certificates with regard to water resource management.

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