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Factors Influencing Farmers Decision on the Use of Introduced Soil and Water Conservation Practices in the Lowland's of Wenago Woreda, Gedeo Zone, Ethiopia

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Abstract Understanding the decision-making ability of farmers with regard to soil erosion is an essential take-off point in the development of policy instruments that will achieve conservation objectives. Without a thorough understanding of the factors that eventually lead to conservation investments, environmental policy makers and extension agents may not be able to communicate effectively with farmers. Therefore, this study was conducted with the objectives of identifying factors influencing farmers' decisions on the use of introduced soil and water conservation practices in the lowland areas of wonago woreda is, Gedeo Zone, and South Nation Nationality People Regional State of Ethiopia. To conduct the research, three representative kebeles were selected from the study woreda based on prevalence of soil erosion and ongoing soil and water practices. From the selected kebeles, 120 household heads were chosen using systematic sampling from which data were gathered using both structured and unstructured questionnaires procedure. The data were analyzed using the Binary Logit model to identify the influential factors in soil and water conservation practices. From the selected seventeen (17) explanatory variables, fourteen (14) of them have shown the existence of significant association with farmer's decision on the use of introduced soil and water conservation practices. Total household labor in man equivalent, farm distance, farm size and slope of plot were the variables that significantly influenced farmer's decision in adopting the introduced soil and water conservation practices in the study areas. The influences of the determinant variables specified were positive except in the case of farm distance. From this study, it is concluded that socio-economic and physical factors play a major role in determining farmer's decision to adopt soil and water conservation practices. Therefore, in order to implement and adopt soil and water conservation practices measures sustainably, the government and Non-governmental organizations must take into consideration the compatibility of introduced soil and water conservation practices measures to the local agro-ecological situations and socio-economic factors and introducing soil and water conservation practices measures with relatively less labor requirements which are effective in reducing land degradation and increasing agricultural production in the study areas.

Keywords: *adoption, soil erosion, logit model, soil and water conservation practices, decision making*

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1. Introduction

Today, throughout the world depletion of natural resources is among the major problems threatening life. Despite the efforts to reverse environmental degradation in the past many years, rampant degradation of natural resources continued to be a serious environmental problem in Ethiopia distressing land/agricultural productivity and slowing down economic progress. [1]. Most soils in SSA are inherently poor. Studies indicate that nearly 60 percent of the total land area in the region is only marginally suitable for cultivation, with soils characterized by limited organic matter and water-retention capacity. Close to 30 percent is considered low to medium potential land, which is very vulnerable to erosion, a decline in organic matter, and infertility when few inputs are applied. About 25 percent of the world's degraded land is located in Africa, and it is estimated that 65 percent of Africa's agricultural land is degraded because of water and soil erosion and/or chemical and physical degradation [2]. Thus, the conditions of high population density in both Ethiopia and Eastern Kenya create constraints on land resources. Farmers tend to continuously cultivate the same piece of land with few soil amendments and inadequate water conversation techniques, thereby mining (not replenishing) soil nutrients reducing soil fertility and fostering conditions for pests and diseases outbreaks [3].

Until recently, agriculture (mainly smallholder farming and livestock production) was the dominant sector in the economy. While the services sector has recently outstripped agriculture in terms of its share of GDP (currently estimated at 46%) agriculture remains critical for broad-based growth. The agriculture sector accounts for 42% of GDP, 80% of employment and 85% of Ethiopia‘s export earnings. According to the same source, Ethiopia‘s ecological system is highly fragile and vulnerable to climate change. This is compounded by population pressure and stress on natural resources, especially land. The key challenges include soil degradation, deforestation and loss of biodiversity. All these have important implications for sustainable livelihoods [4].

Recognizing the seriousness of soil erosion problems and the necessity of improving soil fertility and increasing agricultural productivity, the Ethiopian government and international donors have initiated a number of programs such as a massive soil conservation program since 1971 [5]. The conservation measures were in most cases physical measures and undertaken through campaign using Food-for-Work or Cash-for-Work as an instrument to motivate farmers to putting up the conservation structures both on communal holdings and on individual farm plots.

As a result, the achievement of soil and water conservation measures is below the expectation and the country loses tremendous amount of fertile top soil and, threat of soil degradation is alarmingly broadening [6]. This is partly attributed to the biophysical, socio-economic, institutional and policy factors.

The introduction and implementation of soil conservation programs and technology adaptations need to consider the socio-economic, physical, institutional and agro-ecological factors affecting farmer’s willingness to adopt and use these technologies. So, the rehabilitation of land degradation is extremely important since the livelihoods of many Ethiopians are entwined with land resources.

According to [7], from the total 17 kebeles of Wonago Woreda, 13 of them were under the safety net program and in these Kebeles, 2,054 children were with bilateral endemic and 1,465 pregnant women were under child survival intervention which was donated by EOS (Enhanced Outreach Strategy). This indicates that the problem of food insufficiency in the study areas could probably be due to the decline in land productivity and crop production because of the depletion of natural resources mainly due to the increase in population pressure and the low level of perception of the farmers about the problem of soil erosion and the farmers decision to adopt soil and water conservation technologies that lead to the mismanagement of the land. Even though the government has been implementing various kinds of strategies to mobilize local people in soil and water conservation activities in order to enhance people’s awareness on the problems of soil degradation, not yet much is achieved in the study areas.

Thus, the reasons behind this must be investigated, analyzed and answered at various management levels. So, understanding of the causes and effects of the natural resource degradation and their appropriate measure taken by farmers should be given consideration in order to assess those factors affecting the farmer’s decision to use the introduced soil and water conservation technology. Farmers’ decision on the use of introduced soil and water conservation technologies is considered to be affected by a variety of factors. However, there was no empirical information so far regarding factors influencing the farmers’ decision on the use of introduced soil and water conservation practices. Therefore, this study is designed to focus mainly on identifying factors influencing farmers’ decision in using the introduced soil and water conservation practices in the study areas.

2. Methodology

2.1. Description of the Study Areas

Gedeo is a zone in the South Nation Nationality and People Regional State (SNNPR) of Ethiopia. This Zone is named after the Gedeo people, whose homelands lie in this zone. The zone is well known by producing high quality coffee (*yirgachefe-coffee*) to international market. Gedeo is bordered on the east, south and west by the Oromia region, and on the north by *sidama*. This study was conducted in the low land areas of *Wenago* Woreda (*Kara Sodity, Tumata Cherecha & Deko kebeles)* of Gedeo Zone, and Southern Nations, Nationalities and Peoples Regional state. Wonago Woredais located to the North West of the Zone and its center of political administration is Wonago. It is bounded by Dilla Zuria Woreda in the North, and East; Yirgacheffe Woreda in the South and Oromia Regional State in the West. The woreda is geographically located 60 13’-60 26’ North latitude and 380 13’-380 24’ East longitudes. Its total area coverage is estimated to be 137Sq.km.

According to the Wonago *woreda* Agricultural office, the Woreda is sub- divided into 17 administrative rural kebeles among which 13 kebeles (81%) belongs to Woina Dega agro- climatic zone and the remaining 4 Kebeles (19%) are under Kola agro-climatic Zone. In general, the physical features of land forms of this Woreda are dissected and undulating plane in which each hillside or mountain is followed by plateau and then by short or long slopping to flat lands.

According to [7], the total population of Wonago was estimated to 147, 940 of which 70,964 are male and 76,976 are female. The total number of headed households in the 17 rural kebeles of the woreda was about 24,463 of which 3,981 are male headed and the rest 20,482 are female headed households. According to the same source, the climate of Wonago Woreda is characterized by mean annual rainfall and temperature of 1001 mm - 1800 mm and 12°C – 25°C respectively. The rainfall is bi-modal and the Belg (short rainy season) extends from March to May (60 - 90 days) while the main rainy season is from July to September (90 - 120 days).

2.2. Research Design

A concurrent mixed method research design was employed because both qualitative and quantitative types of data were collected at the same time during one data collection phase and may have equal or unequal priority. Both quantitative and qualitative method was mainly used to get insight into reasons (why) some of land users adopt SWCP and others are not.

2.3. Sampling Method

The lowland areas of Wonago Woreda and its three kebeles (Deko, Kara Sodity and Tumata Cherecha) were purposively selected on the basis of similar agro-ecology, agricultural system and livelihoods and the degree of being affected by soil erosion. In addition, these areas are among the places in the woreda where soil and water conservation activities have been going on. Thus, they are ideal for this specific study. 120 sample respondents were selected from the three kebeles using a systematic sampling method (using the formula: n^{th} term = N/n). Since the numbers of farmers in each kebeles different, samples were selected proportional to size to ensure representativeness of the sample.

2.4. Sources and Methods of Data Collection

The primary data collection method used for this study were field observation (to characterize and understand the biophysical and terrain features such as topography, erosion status, types of soil and water conservation practices, land uses type, etc…), questionnaire (structured and unstructured questionnaires were used for *woreda* agricultural experts, agricultural extension workers, finance and economy experts to collect information about the general population characteristics of the study areas, existing types of soil and water conservation practices) and, focus group discussions with woreda level natural resource management experts, agricultural extension workers and community leaders were employed to collect data which need high elaboration and which cannot be collected by using questionnaire). Face-to-face interviews with those respondents were employed to collect household characteristics, farm land characteristics, detailed plot level data, types of soil and water conservation practices, perceptions on the problem of soil erosion, knowledge and attitude of farmers towards introduced soil and water conservation measures and determinant factors affecting farmers' decision to use the introduced soil and water conservation measures.

2.5. Data Analysis Techniques

Means and standard deviation were computed for different variables to see variability. The t-test was run to see if there is statistically significant difference in continuous variables of farm characteristics of household who have adopted introduced soil and water conservation practices and those have not done so. The chi- square was used to see if there is systematic association between decision on the use of introduced soil and water conservation practices and with some of the independent variables, for categorical data.

2.5.1. Econometric method (Binary Logit Model)

Analytical Model (Probit and Logit Models) were used to assess the adoption of introduced SWC technologies. The Binary Logit Model was applied in this study to assists in estimating the probability of decision on the use of introduced soil and water conservation practices that can take one or more of practices or do not practiced the technologies.

2.5.2. Model Specification the Binary Logit Model

A basic statistical method in the social scientist's toolbox is linear (or linearizable) regression analysis, which requires a continuous dependent variable. Much of the social scientists study, however, cannot be analyzed with the classical regression model, because many attitudes, behaviors, characteristics, decisions, and events in the social science research – be they intrinsically continuous or not- are measured in discrete, nominal, ordinal or, in short, non-continuous way (Liao, 1994). The adoption behavioral model with dichotomous (binary, dependent variables) is frequently used as a conceptual framework to examine the factors associated with the adoption of technology [8].

There is no articulated model that provides a conceptual framework to determine the factors that influence soil and water conservation decision. However, studies have been carried out to relate farmers' adoption of new technologies to various socio economic factors [9]. Based on these studies, a conceptual model was developed to explain the effects of socio- economic factors on the adoption of soil and water conservation practices.

For this study the logistic distribution function (logit) model is selected. The logistic function is used because it represents a close approximation to the cumulative normal distribution and is simpler to work with. [10] has pointed out that the logistic distribution has advantages over the others in the analysis of dichotomous dependent variable. The logistic distribution is extremely flexible, relatively simple from mathematical point of view and lends itself to a meaningful interpretation.

Following [11] and [10], the logistic distribution function for the adoption of soil conservation practices can be specified as:

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

Where P (i) is a probability of adopting a given practice for i^{th} farmer and Z (i) is a function of m explanatory variables (Xi), and is expressed as:

$$Z_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + --- + \beta_m X_m \quad (2)$$

Where,

β_0 Is the intercept and β_i are the slope parameters in the model.

The slope tells how the Log-odds in favor of adopting soil conservation practices change as independent variables change by a unit. Since the conditional distribution of the outcome variable follows a binomial distribution with a probability given by the conditional mean P_i, interpretation of the coefficient will be understandable if the logistic model can be rewritten in terms of the odds and log of the odds [10].

Since the conditional distribution of the outcome variable follows a binomial distribution with a probability given by the conditional mean P_i, interpretation of the coefficient will be understandable if the logistic model can be rewritten in terms of the odds and log of the odds [10]. The odds to be used can be defined as the ratio of the probability that a farmer uses or adopts the practice P_i to the probability that he or she will not $1-P_i$

But,

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

Therefore,

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

And

$$\frac{P_i}{1 - P_i} = \frac{1 + e^{Z(i)}}{1 + e^{-Z_i}} = e^{\beta_0} + \sum_{i=1}^{M} \beta_i X_i \quad (5)$$

Taking the natural logarithm of the odds ratio of equation (5) will result in what is known as the logit model as indicated below:

$$L_n\left[\frac{P_i}{1 - P_i}\right] = L_n\left[e^{\beta_0 + \sum_{i=1}^{M} \beta_0 X_i}\right] = Z_i \quad (6)$$

If the disturbance term Ui is taken in to account the log it model becomes:

$$Z_i = \beta_0 + \sum \beta_0 X_i + U_i \quad (7)$$

Hence, the above econometric model was used in this study and was treated against potential variables assumed to affect the farmer decision of soil conservation practices.

The parameters of the model were estimated using the iterative maximum likelihood estimation procedure. The later yields unbiased and asymptotically efficient and consistent parameter estimates.

3. Results and Discussion

This session consists of the overall findings of the study under factors influencing the farmers' decision on the use of introduced soil and water conservation practices. In this chapter the current status of the farmers' decision on the use of introduced soil and water conservation practices are discussed in detail. Subsequently, the influence of different personal, demographic, socio-economic, physical, institutional and psychological factors on farmers' decision on the use of introduced soil and water conservation practices were discussed consecutively.

3.1. The Status of Farmer's Decision on the Use of Introduced Soil and Water Conservation Practices

Out of 120 sample respondents, about 56.7 % and 43.3 % of sample households were non-users and users of soil and water conservation practices respectively (Figure 1).

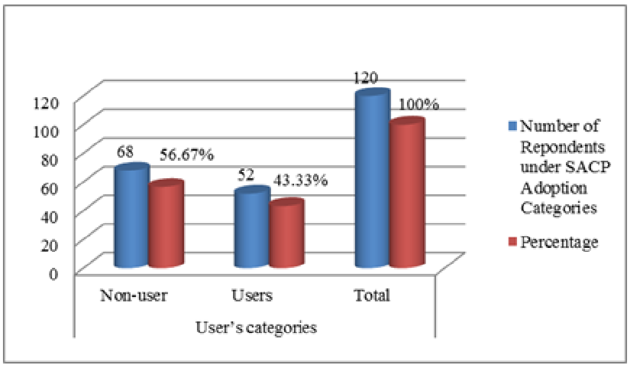

Figure 1. The status of farmer's decision on the use of introduced soil and water conservation practices

3.1.1. Characteristics of Sample Respondents

Demographic, socio-economic, institutional, physical and psychological factors of the households are directly/indirectly related to characteristics influencing farmer's decision on the use of introduced soil and water conservation practices. Therefore, the demographic and Socio-economic of sample respondents in the study areas were presented and discussed briefly in this section as follows:

Table 1. Descriptive Statistics between Non-Users and Users of SWCP

	Adopter Category						
	Non-users		**Users**		**Total**		**(χ2)**
	n	**%**	**n**	**%**	**n**	**%**	
Sex of sample respondents							
Male	66	55	48	40	114	95	
Female	2	1.67	4	3.3	6	5	1.40^{NS}
Educational level							
Illiterate	0	0	2	1.7	2	1.62	
Read & Write	13	10.8	15	12.5	28	23.33	
Primary		45	37.5	18	15	63	52.5
Secondary	17	14.2	10	8.3	27	22.5	13.6***
Contact with extension agents							
Yes	64	53.3	51	42.5	115	95.8	
No	4	3.3	1	0.01	5	4.17	1.2^{NS}
Radio listening habit							
Yes	44	36.7	37	30.8	81	67.5	
No	24	20	15	12.5	39	32.5	558^{NS}
Land holding ownership certificate							
Yes	51	42.5	52	43.3	103	85.8	
No	17	14.2	0	0	17	14.2	15.2***
Social participation							
Yes	65	54.2	49	40.8	114	95	
No	` 3	2.5	3	2.5	6	5	0.114^{NS}
Frequency of visit nearby Town							
Daily	34	28.3	18	15	52	43.3	
Most often	27	22.5	19	15.8	46	38.3	
Once a weak	5	4.7	10	8.3	15	12.5	
Sometimes	2	1.7	5	4.2	7	5.8	7.26*

Source: own survey data, 2013; ***, and NS significant at 1 and non-significant respectively.

Table 2. Descriptive Statistics between Non-Users and Users of SWCP

Independent	SWC Users' Categories		
Variables	Non-Users	Users	t-value
Farming Experience	30.23	25.78	2.09**
Family Size	.34	7.35	2.19**
Farm Distance	18.84	8.89	7.68***
Farmers' Knowledge of SWCP	28.13	25.06	3.00***
Farmers' Attitude towards SWCP	19.54	21.19	1.76*
Farmers' perception on SWCP	18.82	20.48	1.92*

Source: own survey data, 2013; ***, ** and *significant at 1, 5%and 10% respectively.

3.1.2. Economic Characteristics of Sample Respondents

Resources like farm land, livestock and labor are perhaps the most vital resources as they are fundamental for any economic activities especially in the rural and agricultural sector. Farm activities, particularly crop production, require the availability of those resources.

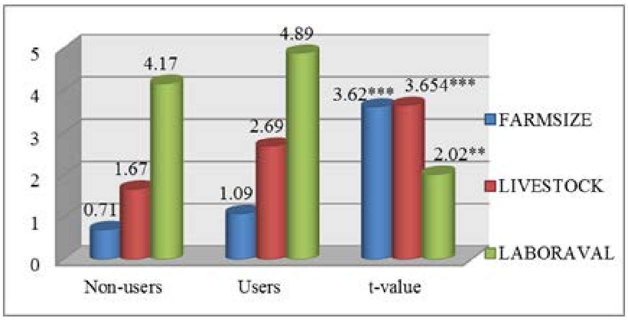

Figure 2. The association of farm size, livestock holding and labor available with SWCP user's categories

The average farm size of the sampled respondents was 1.79 ha with the standard deviation of 1.12 ha. The mean size of land for SWCP users and non-users were 1.09 and 0.71 ha respectively. The result of t-independent analysis indicated that there is statistically significant mean difference in farm size at 1% level (t=3.619, P=.000) between user's categories and farmer's decision on the use of introduced soil and water conservation practices (Figure 2).

According to the survey result, the average livestock holding of the sample household was 4.36 TLU (Tropical livestock unit) with the standard deviation of 3.08. On the other hand, as figure 2 shows that the average livestock holding in terms of TLU for non-users and users categories were 1.67 and 2.69 respectively. Test of mean variance using independent sample t- test showed that there was significant mean difference at 1% (t=3.654, P=.000) among users categories with respect to farmer's decision to use introduced soil and water conservation practices.

The man equivalent (ME) was calculated for the sample respondents. As the survey results revealed that the average labor availability in terms of man equivalent for sample household was 4.49 with the standard deviation of 1.96. The average number of available labor force in terms of man equivalent for non-users and users were 4.17 and 4.89 respectively. The result of t-independent analysis indicated that there is statistically significant mean difference at 5% level (t= 2.020 and P= .042) between user's category with farmer's decision on the use of introduced soil and water conservation practices (Figure 2).

3.1.3. Physical Factors of SWCP Activities

Out of the total sample respondents 6.67%, 57.50%and 35.83% respondents reported that the status of their farm land is gentle, steep and very steep respectively. About 6.67% of non-users sample respondents responded that the slope of their farm land was gentle types of slope while users sample respondents said no one's farm land was gentle. The same number of users reported that the slope of their farm were steep and very steep. Whereas 35.83% and 14.17% of non-users respondent responded that the slope of their farm was steep and very steep types of slope respectively.

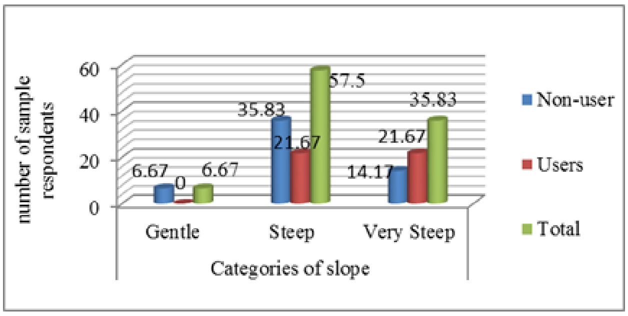

Figure 3. Testing data- farm land by slop categories

Therefore, the result of Chi-square test indicated that statistically significant different ($\chi2$= 12.155, P= .002) at less than 1% exist between categories of slope with respect of farmer's decision to use introduced SWC practices.

3.2. Determinants of Farmer's Decision to Use Introduced Soil and Water Conservation practices

The Binary logit model results used to study factors influencing farmer's decision to use introduced SWC practices are shown in Table 3. The result of the model shows that the explanatory variables: Total household labor in man equivalent, farm size and slope of plot were having statistically positive and significant influence on adoption of SWC practices whereas farm distance were found to have a significant and negative influence on the use of introduced SWC practices. The results of statistically significant explanatory variables of farmer's decision to use introduced SWC practices are interpreted as follows.

Table 3. Determinants of Farmer's Decision to Use Introduced Soil and Water Conservation Practices

Explanatory Variable	Estimated	Wald	Odds Ratio	P-value
Constant	19.2	.00	.00	.99
EDUCESTA	.03	.97	.01	.92
FARMEXPHH	1.02	.24	.63	.63
COSMOPLT	.84	2.31	.08	.07
TLU	.39	1.48	2.77	.10
FAMILYSIZE	.27	.76	1.60	.21
LABERAVAL	.48	1.62**	3.74	.04
FARMSIZE	2.26	9.59**	5.15	.02
CONTDAS	-1.26	.28	4 46	.49
LANDTENER	20.33	6.73	.00	.99
DISTANFARM	- .22	.81***	11.29	.00
SLOPEPLOT	1.74	5.71**	5.53	.02
KNOWLEDGE-	.02	.93	1.17	.28
ATTITUDE	- .02	.99	.03	.86
PERCEPTION	.13	1.13	1.67	.19
Pearson Chi-square			96.04***	
-2Log likelihood =			68.18	
Sensitivity			86.5	
Specificity			86.8	

Source: Model output, *** and ** represents significance at 1% and 5% level respectively.

3.2.1. Interpretation of the Influence of Explanatory Variables

Total household labor in man equivalent: The model output showed that labor availability was found statistically significant at less than 10% probability level with the expected value and positively related with adoption of introduced soil and water conservation practices. The model result confirms that households with high labor availability in man equivalent are more likely to adopt introduced soil and water conservation practices than households with low labor availability in adult equivalent. As a result, other things held constant, the odds ratio in favor of farmer's decision to use introduce soil and water conservation practices increases by a factor of 1.62 for a unit increase of total household labor in man equivalent. Households with large human capital may adopt introduced soil and water conservation practices.

Farm Size: As the logit model result revealed that the farm size variable was important variables which had positively and significantly influenced farmer's decision to use introduced soil and water conservation practices at less than 5% significant level. This indicates that farmers who have large farm land are in a position to use more introduced SWC practices. The probable reason for this was a farmer with larger farm size means relatively perceived that the amount of land used to the practices not significantly affected their economical states, willing to maintain sustainable land productivity and able to hiring additional labor. The odds ratio of 9.59 for farm size indicates that, other things being constant, the odds ratio in favor of adopting introduced SWC practices increases by a factor of 9.59 as the farm size increases by one hectare.

Farm distance from homestead (PLOTDIS): In line with our expectation, the variable was found negatively and significantly (at less than 1% probability level) influenced the use of introduced soil and water conservation practices. The negative sign of the coefficients was as anticipated indicating that as the distance of a plot from homestead is far, farmers are not interested to use SWC practices due to inconvenience in controlling and close supervision. The odds ratios 0.81 indicate that keeping the influences of other factors constant, the use of SWC practices decrease by the rate of 0.81 as distance of the plot increases by one unit. The result of this study agrees with the finding of [12].

Slope of the plot (SLOPLOT): This variable has positively and significantly correlate with farmer's decision to use introduced SWC practices at less than 5% significant level. The higher slope category of a plot, the greater will be the severity of soil erosion. This means that on sloppy plot the impact of soil erosion would be more visible to the farmers and this force them to construct appropriate measures and take remedial action. The results of the odds ratio show that adoption of SWC practices by a factor of 5.71 for a unit increase in slope of the plot. The result of this study confirms the findings of [13] which revealed the slope of the plot positively and significantly related to the adoption decision of farmers.

4. Conclusion and Recommendations

This study was conducted mainly to identify the factors affects farmer's decision to use introduced SWC practices at household level in the study areas in a process towards mitigation of such problem. The study tried to assess farmers' perception on soil erosion, the introduced soil and water conservation measures taken by the farmers. And these factors coupled with other demographic, socio-economic, institutional, physical and psychological factors greatly affected farmer's decision to use introduced soil and water conservation practices.

In this particular research the binary logit model exposed that total household labor in man equivalent, farm size and slope of plot were found to have positive and significant effect farmer's decision to use introduced soil and water conservation practices. Contrary to this, farm distance was found negative and significant influence on farmer's decision to use introduced soil and water conservation practices.

Despite the contribution of SWCPs to households' food consumption, income and food security at household level and national level, institutional supports given to the sector, such as credit service, research and extension were not to the expected level. These factors coupled with other household personal, demographic, socio-economic and psychological factors greatly affected farmer's decision to use introduced SWCPs and consequently production and productivity of the sector. Therefore, as per the research findings of this study, the following points are recommended to improve farmers' decision to use of soil and water conservation practices.

SWC practice demands labor for different SWC activities. Households with high labor availability in man equivalent were found to adopt soil and water conservation than households with low labor force. Hence, different soil and water conservation practices with relatively less labor requirements such as (*vetber*) grass strip, contour farming and etc…should be widely and appropriately practiced.

Policy support from the government is required to build infrastructures particularly rural road networks with transport services in minimum costs. This will encourage and motivate farmers to use SWC practices due to convenience in controlling and close supervision

Farm size significantly affects farmer's decision to use introduced soil and water conservation practices. Farm households with large farm size have potential to allocate plot of land to establish SWCPs. Therefore, agricultural extension workers should motivate and encourage those farmers with large farm size to participate in SWC practices.

Finally, further researches have to be done on examining the extent of adoption and the extent to which socio-economic (such as education, leadership status, off-farm income, etc…), institutional (such as credit service, land security, etc…), physical (such as soil type), technical and other factors affect the intensity of adoption decision using time series data.

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