

Factors Affecting Adoption of Soil and Water Conservation and Its Impact on Crop Productivity in Assosa Woreda

Assistant Professor, Temesgen Desta Tolessa
Lecturer at Wollega University, College of Business & Economics
Department of Business management
P.O. Box: 395, Nekemte, Ethiopia
Email:bekambenol04@gmail.com

Abstract

The purpose of this study was investigating the factors affecting adoption of soil and water conservation and its impact on crop productivity in Assosa Woreda. The study has employed explanatory research design in quantitative research approach. Data for this paper come from the cross-sectional survey collected from four kebeles of household at Assosa Woreda. Out of 336 questionnaires were distributed and 314 were collected using dichotomous and bounded questionnaires. The researcher was used stratified sampling techniques to select representative participants from four kebeles of household at Assosa Woreda. Likewise, representative individual household in each kebeles was selected using purposive sampling techniques. The collected data were analysed using standard deviation, mean, correlation and regression analysis. The descriptive report findings of age, education and family size shows high variability of respondent rating. On the contrary, adoption of SWC, access to credit, gender, road distance, farm land size, slope of land, sorghum production income, access to training and off farm income shows low variability of respondent rating in Assosa Woreda. The correlation coefficient finding shows there is a strong and positive relationship between adoption of SWC; and age, family size, literacy, access to credit, access to training, road distance, off farm income and slope of farm in the study area. The inferential finding of the study indicates that relatively household literacy level, access to training, access to credit, farm land distance and farm land size have major probability of predicting household decision to adopt SWC, holding other variables Ceteris paribus. On the other hand, household decision to adopt SWC has impactful predicts their income from sorghum production in Assosa Woreda. Hence, it is advantageous, if the agricultural extension office, households, local government body, non-governmental bodies and other stakeholders give primarily focus for literacy of household to adopt SWC, followed by access to training, access to credit, farm land distance and farm land size respectively, holding other variables Ceteris paribus in Assosa Woreda. Subsequently, to make stronger the probability of adoption SWC, agricultural extension practitioners, local government body and non-governmental bodies should organize and train household to well introduce SWC resourcefulness. It also advisable for farmer household to plan SWC devices that combine contemporary scientific thoughtful with native technological knowledge in order to feast them and maintain their long term feasibility in the study area.

Keywords: Demographic Factor, Economic Factor, Institutional Factor, Physiological Factor, Adoption and Sorghum Production Income
DOI: 10.7176/JRDM/94-04
Publication date: May 31st 2024

1. Introduction

The government of Ethiopia instituted a national physical SWC construction campaign since 2011 that has been running for two months every year in the high potential as well as low potential areas. The campaign is aimed at mobilizing the community to construct the necessary structures following watershed conservation principles. This approach is intended to change the attitudes of the farmers and ensure that the SWC structures are sustainable and effective irrelevant (Asnake et al., 2018). Notwithstanding substantial efforts to establish and encourage different types of SWC practices, land users have not been generally adopted and used on a sustained basis for various reasons (Zenebe A, Kessler A, 2012). The problem might be explained by the fact that the adoption of SWC practices is influenced by demographic, socioeconomic, institutional, and biophysical factors that are unique and complex in the area (Hengsdijk et al., 2012). These studies on the decision to invest in SWC practices are not complete. For instance, (Aklilu., A & Graaff., J., 2007), used the stone terrace to determine the farmers' adoption of SWC practices. However, considering a single conservation technology to determine the adoption of SWC practices is not complete as every conservation technology is not applied everywhere (Morgan, RPC, 2005). The adoption and diffusion of sustainable agricultural practices have become an important issue in the development-policy agenda for sub-Saharan Africa, especially as a way to tackle land degradation, low agricultural productivity, and poverty (Kassie et al., 2013). To improve the productivity, stabilize the yields and to reduce the chances of crop failures, soil and water conservation (SWC) practices are considered one of the key strategies. Moreover, in the rained areas, SWC practices are crucial to sustain crop production in view of growing water shortages, deteriorating soil health and increasing incidence of drought and desertification, and also to moderate the negative effects of climate change and variability (Kato et al., 2011). Given this thought, the main objective of this study was seek to investigate factors affecting adoption of soil and water conservation and its impact on crop productivity in Assosa Woreda.

1.2. Statement of the Problem

A substantial literature has examined the impact of SWC practices on productivity, but very few studies attempted to examine the impact of SWC practice adoption on crop yield variability and downside risk exposure, i.e., crop failure. Most importantly, the influence of SWC practices on downside risk exposure (on the probability of crop failure) remains poorly explored in the rainfed areas (Kim et al., 2003). Any intervention for SWC and sustainable land use ought to begin with an empirical and local-specific understanding of the multiple factors affecting conservation decisions of farmers (Adimassu et al., 2017). Study by (Gizachew., S. & Birhan., A., 2022) on farmers' adoption of soil and water conservation practices in Ethiopia was focus only on one dependent variable and binary logistic model without considering income from crop production and tobit model. At the time he employed small sample size, did not logically infer to other farmer household in Ethiopia including Assosa Woreda household. Similarly, study on the impacts of soil and water management measures on crop production and farm income of rural households in Ethiopia by (Mamush et al., 2021). They used a propensity score matching research design and they also employed small sample size, they did not logically conclude to other farmer household in Ethiopia including Assosa Woreda household. Thus, to the best of the researcher's knowledge, there are inadequate studies that exhaustively conducted on the factors affecting adoption of soil and water conservation and its impact on crop productivity in Assosa Woreda. Hence, this is the gap this study sought to fill.

1.2.1. Research Questions

The research questions of the study would answer;

1. To what extent off farm income and land size predicts household decision to adopt soil and water conservation.
2. To what extent road distance and slope of land predicts household decision to adopt soil and water conservation.
3. To what extent in which access to credit and access to training predicts household decision to adopt soil and water conservation.
4. To what extent age, gender, family size, and literacy level predicts household decision to adopt soil and water conservation in the study area.

1.3. Objectives of the Study

1.3.1. General Objective

The general objective of the study is to investigate the factors affecting adoption of soil and water conservation and its impact on crop productivity in Assosa Woreda.

1.3.2. Specific Objectives

The specific objectives of the study were:

1. To analyze the extent in which age, gender, family size, and literacy level predicts household decision to adopt soil and water conservation.
2. To examine the extent in which off farm income and land size predicts household decision to adopt soil and water conservation.
3. To evaluate the extent in which road distance and slope of land predicts household decision to adopt soil and water conservation.

4. To investigate the extent in which access to credit and access to training predicts household decision to adopt soil and water conservation in the study area.

1.4. Significance of the Study
The main importance of the study is to produce academic research that may indicate some possible adoption of soil and water conservation practice and its impact. This study may use as a source of information regarding to related fields. This would add new ideas to the existing literature and to similar rural endeavor of the country at large. Added to these, it would recommend policy issues related to adoption of soil and water conservation measure improving crop productivity in region and the country at large.

1.5. The Scope of the Study
Conceptually, this study focus on the factors affecting adoption of soil and water conservation and its impact on crop productivity in Assosa Woreda. It was dealing with independent variables such as age, gender, family size, literacy, access to credit, access to training, road distance, slope of land, off farm income and land size having strong theoretical bond with household decision to adopt soil and water conservation as per different literature were reviewed by researcher for this study. On the other hand, geographically, it was confined to Assosa Woreda kebeles such as Amba 11, selega 24, Affedehonsho and komoshiga 26.

2.1. Factors Affecting Adoption of Soil and Water Conservation
Adoption of agricultural technologies is influenced by a number of interrelated components within the decision environment in which farmers operate. For ease of grouping, the factors identified as having relationship with adoption are categorized as household's demographic, economic, social and institutional factors.

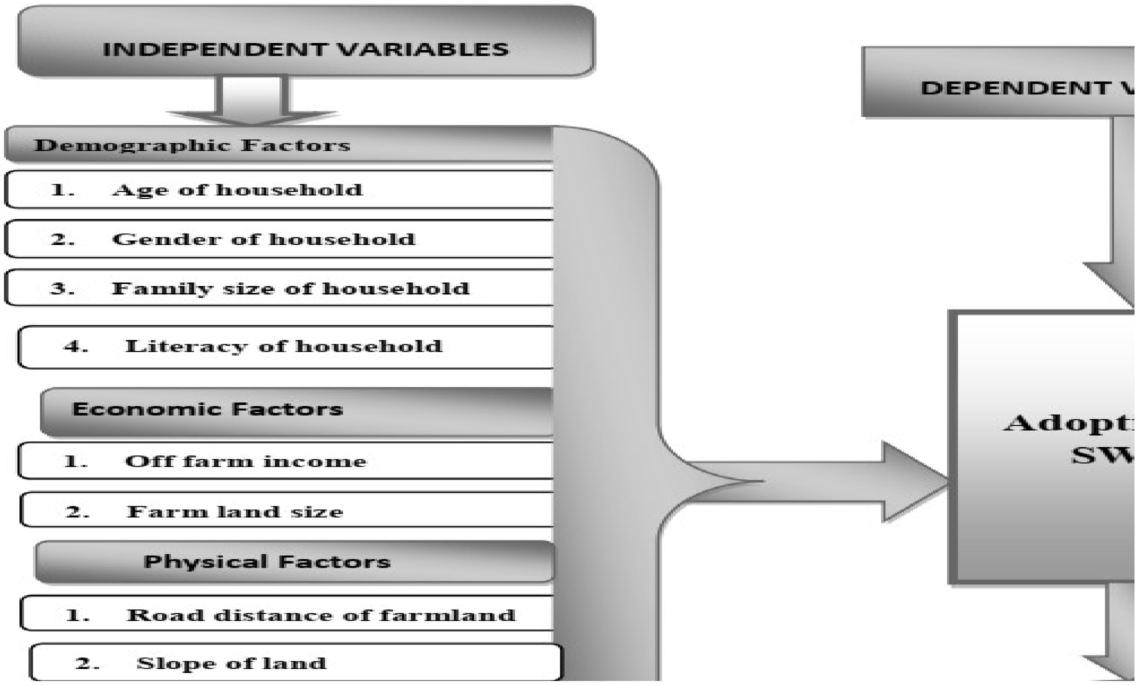
2.1.1. The Economic factors
Several empirical adoption literatures focus on farm size as the first and probably the most important determinant. Studies conducted in different areas were showed mixed result. Seid (2009) has found a significant positive relationship between farm size and adoption of conservation measures indicating that the larger the farm size, the greater the probability of adopting the conservation structures. According to (Aziz, 2007) farm size had positively and significantly affected the probability of adoption and intensity of rain water harvesting technologies.

2.1.2. The Institutional Factors
Institutional factors in the context of this study include support provided by various institutions and organizations to enhance he use of improved technologies such as extension, land source and land tenure system. Extension provides farmers with information related to agricultural technologies. Participation of farmers in extension events like involvement in hosting on-farm trials or demonstration and related training improves their consciousness on improved agricultural technologies and enhances adoption. In this line, Kebede (2006) and Minyahel (2007) reported that participation on farm demonstration and attendance of training conducted positively to farmers' adoption decision.

2.1.3. The Social Factors
Study conducted by (Dereje, 2008) indicated that social participation had positive and significant effect on the adoption decision of farmers. The above evidence and reviews of empirical studies indicated the importance of local and site specific studies to identify factors affecting adoption of PSWC technologies and to generate scientific information which might be useful to policymakers to develop policies and strategies which are compatible to the local conditions to contribute to the solution of soil erosion problems and might give a clue to researchers for further research in the field and similar socio-economic and topographic conditions and help to recommend solution to the specific local problems based on the level and scope of the study.

2.2. Conceptual Framework
The decision to adopt SWC practices or not is assumed to be determined by Socio-economic and institutional factors. It is assumed that these factors along with the farmer's perceptions towards SWC practices influences the decision to adopt as well as the level of adoption of SWC practices are expected to have well maintained sustainable fertility farms which enhance crop productivity and better quality produce among other benefits.

Figure 2.1: Conceptual Frame Work of the Study



Source: Developed from (Gizachew., S. & Birhan., A., 2022) and (Alka., 2020)

3.1. Research Design and Methodology

Research design primarily refers to a framework for the analysis of data (Bryman, 2012). Research design has a significant role in facilitating the overall flow of the entire research and provides a blueprint for collecting, measuring, and analyzing data (Mamush et al., 2021). To thoroughly explain the relationship between variables the most appropriate approach is explanatory research design, which helps analyze the nature and extent of the relationship that might exist between the research variables/dimensions/constructs by applying various inferential statistical tools (Churchill, 2002). According to (Gujarati, 2004), the multiple linear regression model is a powerful tool for summarizing the nature of the relationship between variables and for making predictions of likely values of the dependent variable. It also attempts to test hypotheses on the causality of research variables (Kothari, 2004). The types of research design employed for this study were explanatory research design to explain the cause-effect relation/ predictive power of (age, gender, family size, literacy, access to credit, access to training, road distance, slope of land, off farm income and land size) on decision to adoption of Soil and Water Conservation in Assosa Woreda. It was also used to investigate the cumulative effect/ degree of association among the study variables such as age, gender, family size, literacy, access to credit, access to training, road distance, slope of land, off farm income and land size in the study area.

3.2. Target Population

The total population of the study were *1875* household in Amba 11, Selega 24, Affendonsho and komishiga 26 as per Assosa Woreda Agricultural Extension Office report of 2015 E.C.

3.3. Sampling Size Determination

The sample groups was limited by using Watson's formula, and then comparing the divisions in four kebele in Assosa Woreda before using stratified random sampling to collect the data. One of the sampling methods is simple random sampling which adopt in identifying respondents from each level to minimize bias. According to (Watson, 2001) the correct sample size in a study is dependent on the nature of the population and the purpose of the study. This research was conducted with 5 percent marginal error and 95 percent confidence interval and 5 percent non response rate. Then the following formula was used for the calculation of the sample size since it is relevant to studies and sampling method (Watson, 2001).

$$\frac{\left(\frac{P(1-P)}{\frac{A^2}{Z^2}+\frac{P(1-P)}{N}}\right)}{R}=\frac{\left(\frac{0.5(1-05)}{\frac{0.05^2}{1.96^2}+\frac{0.5(1-0.5)}{1875}}\right)}{0.95}=\frac{\left(\frac{0.25}{\frac{0.0025}{3.8416}+\frac{0.25}{1875}}\right)}{0.95}=\frac{\left(\frac{0.25}{0.0007841033}\right)}{0.95}=336$$

Where:
n = sample size required
N = number of people in the population
P = estimated variance in population, as a decimal of 0.5 for 50-50
A = Precision, expressed as a decimal 0.5 for 5%,
Z = based on confidence level: 1.96 for 95% confidence,
R = Estimated Response rate, as a decimal 0.95% response will be return

The following table lists the sectors as strata with population size for each stratum. The researcher calculate the below sample by taking the total number of respondent and calculate the strata for the sample size by dividing for each stratum.

Table 3.1: Proportionate Distribution of Sample Size

№	Name of Kebele	Households(N)	Sample(**n**)
1	Amba 11	365	*65*
2	Selega 24	703	*126*
3	Affendonsho	426	*77*
4	komishiga 26	381	*68*
		1875	**336**

***Source**:* Assosa Woreda, Agricultural Extension Office report of 2023.

3.4. Sampling Techniques

There are four kebeles in Assosa Woreda which are taken as they are; and to reduce the population heterogeneity and to increase the efficiency of the estimates, stratified random sampling procedure by proportion allocation was used. This study has carried out by taking a portion of the population, making observation on a smaller group and generalizing the findings at large. According to (Dattalo, 2008), purposive sampling involves the use of the researcher's knowledge of the population in terms of research goals and also elements are selected based on the researcher's judgment that they will provide access to the desired information. Hence, the *individual households'* respondent from (*Amba 11, Selega 24, Affendonsho and komishiga 26*) kebeles are selected using purposive sampling techniques.

3.5. Data Type and Source

To undertake this study the researcher was used primary data which were obtained from primary source that is from Amba 11, Selega 24, Affendonsho and komishiga 26 kebeles households using dichotomous and continuous/bounded questionnaires in the study area.

3.6. Method of Data Collections

Close-ended questionnaires have the advantages of easy handling, simple to answer, and quick and relatively inexpensive to analyse. Hence, the researcher has used a dichotomous and continuous/bounded questionnaires to obtain required data from Amba 11, Selega 24, Affendonsho and komishiga 26 kebeles farmer householder.

3.6. Method of Data Analysis

Data were analyzed using both descriptive and inferential statistics as per their relevance. Primarily, binary logistic regression analysis was employed to identify the extent and probability in which the study independent variables (age, gender, family size, literacy, access to credit, access to training, road distance, slope of land, off farm income and land size) predicts decision to adopt soil and water conservation in Assosa Woreda. The binary logistic model was selected as an appropriate estimation model given the nature of the dependent variable: with two possible outcomes (1, 0), the decision to adopt SWC response represents (Yes=1) and decision of non-adopters of SWC response represents (No=0), in the study area. Next, descriptive statistics like correlation, mean, and standard deviation were used to analyze the descriptive part. So mean and standard deviation were used to describe the existing practices of adopters and non-adopters of soil and water conservation in study area. Lastly, the Pearson Product Moment correlation matrix was also used under descriptive statistics to assess the strength of the relation between (age, gender, family size, literacy, access to credit, access to training, road distance, slope of land, off farm income and land size); and adoption of soil and water conservation in Assosa Woreda.

3.7. Model Specification

3.7.1. Binary Logistics Regression Model

Binary logistics regression is a specialized form of regression that is formulated to predict & explain a binary (two-group) categorical variable or it is used to predict anything where the outcome is binary (defaulters/non-defaulters), (Harrell, 2001) and (Joseph F.Hair, 2010).

Usually, the categories are coded as "0" and "1" as its results is a straightforward interpretation. Therefore, decision to adoption SWC is a dependent variable with two possible outcomes (1, 0) in which the probability of adopting SWC (adopters of SWC =1) and the probability of failure (Non-adopters of SWC =0). The logit is the log of the odds:

$$\text{Logit (p)} = \log\left(\frac{p}{1-p}\right) \quad (1)$$

Where, p is the probability of success (in our case, the probability of adopting SWC). This function spreads the probabilities over the entire number range. Therefore, the binary logistic regression model looks like:

$$\log\left[\frac{P_i}{1-P}\right] - B_0 + B_1x_1 + B_2x_2 + B_3x_3 + B_4x_4 + B_5x_5 + B_6x_6 + B_7x_7 + B_8x_8 + B_9x_9 + B_{10}x_{10} + +\varepsilon_{ip}$$

However, for interpretation, first we relate this equation back to odds rather than the log odds by exponentiation both sides as follows:

$$\left[\frac{P_i}{1-P_i}\right] = 1 + e^{B_0} + e^{B_1x_1} + e^{B_2x_2} + e^{B_3x_3} + e^{B_4x_4} + e^{B_p p x_p}$$

The econometric form of equations above is represented as:

$$Probability\ of\ (adopting\ SWC) = B_0 + B_1xAge_1 + B_2Accesscredit_2 + B_3Accesstraining_3 + B_4family\ size_4 + B_5Landsize_5 + B_6roaddistance_6 + B_7gender_7 + B_8Incomelevel_3 + B_9literacy_9 + B_{10}slopeland_{10} + \varepsilon_{ij}$$

Thus, major factors affecting household decisicion to adoption of soil and water conservation are age, gender, family size, literacy, access to credit, access to training, road distance, slope of land, off farm income and land size are intended to be studied in Assosa Woreda.

3.7.2. Tobit Regression Model

Tobit regression analysis is the study of how a dependent variable **y** is related one independent variables (Anderson et al., 2011). The tobit regression model that describes how the dependent variable **y** is related to one independent variables $\boldsymbol{\lambda}_1$ and an error term is called regression model (Griffiths, 2017). The following simple tobit regression model was used to investigate the effect of an independent variable on a dependent variable. The dependent variable is (*sorghum production income)* and the independent variables (*household decision to adopt SWC,*) in the study area. Hence, the following simple linear regression models is used as follows;

$$SPI = \beta_0 + \beta_1 adoptionSWC_1 + e \ \ldots (2)$$

Where**: SPI** is *Sorghum production income* (Dependent Variable) and the Independent Variables include the following:

- $\boldsymbol{\beta_0}$ Is constant amount or intercept
- $\boldsymbol{\beta_1}$ Is Sorghum production income
- The ***e*** is the stochastic error of the study

Where: $\boldsymbol{\beta_0}$ - is the intercept term- it gives the mean or average effect on X of all the variables excluded from the equation, although its mechanical interpretation is the average value of X when the stated independent variables are set equal to zero.

$\boldsymbol{\beta_1}$, refers to the coefficient of their respective independent variable, which measures the change in the mean value of X, per unit change in their respective independent variables.

e = the Stochastic error.

4.1. RESULTS, DISCUSSIONS AND INTERPRETATIONS

This chapter presents the analysis, interpretation, and findings of the study. The data gathered through the questionnaire was classified, tabulated, and summarized using means and standard deviations distribution tables. The discussion begins with the descriptive statistics analysis such as mean, standard deviation and correlation of study variables. Next, the inferential analysis particularly binary logistic regression was used to infer the study findings. Out of 336 distributed questionnaire to the target household respondents, and *314(93%)* data collected from farmer household in Assosa Woreda but *22(7%)* were non-response rate. As a result, the collected data were coded, entered in Stata 14 software version and the result of the study are presented, analyzed, and interpreted as follows.

4.2. Descriptive Analysis of Study Variables

The descriptive statistics analysis of the study variable are age, gender, family size, literacy, access to credit, access to training, road distance, slope of land, off farm income, land size income from sorghum production and adoption of SWC are described using mean and standard deviation as follows;

Table 4.1: Descriptive Analysis of the study Variables

	(*N=314*)		
№	Overall Study Variables	Mean	Standard deviation
1	Adoption SWC	.4490	.0281145
2	Age household	41.4777	.6753813
3	gender household	.5605	.028054
4	Eduction household	2.5064	.0613974
5	Family Size	2.4459	.0665728
6	Farm Land Size	.3854	.0275087
7	off farm activity	.4172	.0278714
8	Access to training	.2548	.0246292
9	Access to credit	.5223	.0282336
10	Farm land distance	.4841	.0282473
11	farm land slope	.4108	.0278086
12	Sorghum production income	.3790	.0274214

Source: Survey Data of 2023

The data obtained from the respondents were analyzed and interpreted by using standard deviation and where the associated mean score of the study variable is Ceteris paribus. Scholars (Field, 2009) and (Kothari, 2004) state that when the standard deviation of the study variable close one (1) shows that high variability of sample respondent rating and when the standard deviation of the study variable close zero (0) shows that low variability of sample respondent rating meanwhile the mean score of the study variable remain unexplained . Based on these fact, the study variable analysis has made as follows: As signposted in Table 4.1, the study age mean score is 41.47 with standard deviation 0.6753, high variability of sample respondent rating followed by, *education mean score* is 2.506 with standard deviation 0.06657 and *family size* mean score is 2.44 with standard deviation 0.0613 respectively. These finding shows that there is *high variability of sample respondent rating* of age, education and family size in the study area. Likewise, the adoption of SWC mean score is 0.449, gender mean score is 0.56, access to credit mean score is 0.522, and road distance mean score is 0.484 with their respective standard deviation value *0.028* this implies that there is low variability of sample respondent rating in the study area. Moreover, farm land size mean score is 0.385, off farm income mean score is 0.417, income of sorghum production mean score is 0.378 and slope of land mean score is 0.41 with their separate standard deviation value *0.027* this implies that there is low variability of sample respondent rating. Finally, access to training mean score is 0.254 with standard deviation value *0.0246* this shows that low variability of sample respondent rating in the study area

4.2.1. Correlation Analysis

With an objective of measuring the strength of relationship between the explanatory variables such as age, gender, family size, literacy, access to credit, access to training, road distance, slope of land, off farm income and land size with adoption of SWC. To achieve this, a researcher was used Pearson correlation coefficients output as seen in the Table 4.1 below.

Table 4.2: Correlation with Decision to adopt SWC

```
. correlate adoptionswc flmslope education accestraining frmldis gender fmsize accescredit agehh offincm frmlsiz
(obs=314)
```

	adopti~c	flmslope	educat~n	accest~g	frmldis	gender	fmsize	accesc~t	agehh	offincm	frmlsiz
adoptionswc	1.0000										
flmslope	0.6705	1.0000									
education	0.7183	0.5625	1.0000								
accestrain~g	0.7061	0.5050	0.6156	1.0000							
frmldis	0.6598	0.4865	0.6828	0.5866	1.0000						
gender	0.3636	0.4136	0.5894	0.2996	0.4864	1.0000					
fmsize	0.6298	0.9437	0.5087	0.4398	0.4286	0.3673	1.0000				
accescredit	0.6899	0.5567	0.9509	0.5863	0.6493	0.5852	0.5041	1.0000			
agehh	0.6108	0.5137	0.5760	0.9052	0.5534	0.3153	0.4510	0.5483	1.0000		
offincm	0.6618	0.4903	0.6829	0.5860	0.9962	0.4848	0.4320	0.6494	0.5531	1.0000	
frmlsiz	0.3486	0.4048	0.5770	0.2864	0.4888	0.9882	0.3591	0.5736	0.3037	0.4870	1.0000

Source: Survey Data of 2023

The relationship between an independent and dependent variable with the value of *0.8 to 1.0, 0.6 to 0.8, 0.4 to 0.6;* and *0.2 to 0.4*; and below *0.0 to 0.2* , are described as very strong, strong, moderate, weak and very weak (Anderson et al., 2011). Hence, the strength of the relationship between the dependent and independent variables has interpreted for each pair of variables under the study. Therefore, education have a *strong* relationship with household decision to adopt SWC that accounts 71.83% followed by *access to training* has also a strong relationship with household decision to adopt SWC that accounts 70.61%. access to credit have a *strong* relationship with household decision to adopt SWC that accounts 68.99% followed by slope of land has also a strong relationship with household decision to adopt SWC that accounts 67.05%, off farm income have a strong relationship with household decision to adopt SWC that accounts 66.18%, farm land distance have a strong relationship with household decision to adopt SWC that accounts 65.98% by farmer household in Assosa Woreda However, gender of household have a weak relationship with household decision to adopt SWC that accounts 36.36% and farm land size have a weak relationship with household decision to adopt SWC that accounts 36.36% in the study area.

4.3. Inferential Analysis of Study Variable

Table 4.3: Binary Logistic Regression Analysis with adoption of SWC

```
Logistic regression                         Number of obs   =        314
                                            LR chi2(10)     =     140.20
                                            Prob > chi2     =     0.0000
Log likelihood =  -145.9127                 Pseudo R2       =     0.3245
```

adoptionswc	Odds Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
agehh	.7218305	.112472	-2.09	0.036	.5318698	.979637
gender	.708963	.1107002	-2.20	0.028	.5220519	.9627941
eduction	1.902457	.3589381	3.41	0.001	1.314371	2.753669
fmsize	1.451914	.2251018	2.41	0.016	1.071451	1.967476
frmlsiz	.5874594	.1049728	-2.98	0.003	.4138826	.8338321
offincm	1.62343	.2439605	3.22	0.001	1.20926	2.179454
accestraining	1.821797	.2773391	3.94	0.000	1.351818	2.45517
accescredit	1.740744	.2707433	3.56	0.000	1.283349	2.361157
frmldis	1.607008	.2999868	2.54	0.011	1.114605	2.316943
flmslope	1.644902	.2782429	2.94	0.003	1.180743	2.291526
_cons	.8000156	.1199301	-1.49	0.137	.5963415	1.073252

(*) dy/dx is for discrete change of dummy variable from 0 to 1

Based on the above table 4.3, regression result, the following model has formulated to examine factors affecting adoption of soil and water conservation and its impact on crop productivity in Assosa woreda. The hypotheses of the study have tested by using binary logistic regression model as seen in table 4.3. It can be noticed from table 4.3 the LR chi2 (10) statistics in the regression model effect is 140.20 with probability (Prob > chi2 = 0.000) which indicates a good fitness of the predictability of the regression model used in this study. This indicates that the overall model is highly significant at 0.000 and that all the independent variables are jointly significantly causing variation of households in adopting of soil and water conservation in study area. The Pseudo R^2 indicates the strength of interpretation in binary logistic regression model as it is explained by 32.45% variation of household decision to adopt SWC in study area but the remaining 67.55 % variation of household decision to adopt SWC are caused by other factors that are not included in this study. As observed from the above table 4.3, out of the study explanatory variable under study, the age, gender, family size, literacy, access to credit, access to training, road distance, slope of land and off farm income, since it had relatively better amount of standardized coefficient than others.

Depending on their odd ratio coefficient, the interpretation of each explanatory variable was carried out as follows; one unit increase in *literacy level of household* holding other variables constant leads to an increase in the likelihood of household decision to adopt SWC by 1.9%; followed by a unit increase of *access to training* holding other variables Ceteris paribus will increase the probability of household decision to adopt SWC by 1.82%; a unit increase of access to credit of farmers holding other variables Ceteris paribus will increase the probability of household decision to adopt SWC by 1.74%; a single increase in the farm land sloppiness will increase the probability of household decision to adopt SWC by 1.64% holding other variables Ceteris paribus; a unit increase in off farm income of household will increase the possibility of household decision to adopt SWC by 1.62% holding other variables Ceteris paribus; a unit increase of farmland distance will increase the prospect of household decision to adopt SWC by 1.6%; a unit increase in family size of household will increase the probability of household decision to adopt SWC by 1.45% holding other variables constant; a unit increase in age of farmers will increase the likelihood of household decision to adopt SWC by 0.721% holding other variables constant; a unit increase in gender of farmers will increase the probability of household decision to adopt SWC by 0.7089% holding other variables constant; and a unit increase in the land size of farmers will increase the likelihood of their decision to adopt soil and water conservation by 0.578% holding other variables constant in Assosa Woreda. As the magnitude of weighted beta, it can be concluded that if all independent variables are ignored, the study area itself (α=0.8000156) have the probability of predicting household decision to adopt soil and water conservation, *holding other variables constant*, in Assosa Woreda. As per the regression analysis, the best fit for the data has defined by the following equation:

$$AdoptionSWC = .8000156 + \sum 1.9education + \sum 1.82accestraining + \sum 1.74accescredit + \sum 1.64flmslope + \sum 1.62offincm + \sum 1.6frmldis + \sum 1.45fmsize + \sum .72agehh + \sum .7gender + \sum .587frmlsiz + \varepsilon_0$$

Where;

- Adoptionswc adopt SWC in Assosa Woreda
- agehh Age of household
- Gender Gender
- Eduction Education
- fmsize Family size
- frmlsiz Farm land size
- offincm Off farm activity
- accestraining Access to training
- accescredit Access to credit
- frmldis Farm land distance
- Flmslope Farm land slope
- And ε is the stochastic error of the study

Table 4.4: Marginal Effects After Logistic

```
Marginal effects after logistic
      y  = Pr(adoptionswc) (predict)
         =  .44444988
```

variable	dy/dx	Std. Err.	z	P>|z|	[95%	C.I.]	X
agehh	-.0804854	.03847	-2.09	0.036	-.155891	-.00508	-4.5e-07
gender	-.0849266	.03855	-2.20	0.028	-.160491	-.009362	7.7e-07
eduction	.1588019	.04659	3.41	0.001	.067496	.250108	2.3e-06
fmsize	.09207	.03828	2.41	0.016	.01704	.1671	-1.3e-07
frmlsiz	-.1313455	.04412	-2.98	0.003	-.217821	-.04487	-1.9e-07
offincm	.1196401	.0371	3.22	0.001	.046916	.192365	-6.0e-07
accest~g	.1481048	.03759	3.94	0.000	.074432	.221777	4.2e-06
accesc~t	.1368676	.0384	3.56	0.000	.061598	.212137	-2.4e-06
frmldis	.1171297	.04609	2.54	0.011	.02679	.207469	-1.8e-06
flmslope	.1228845	.04177	2.94	0.003	.041023	.204746	2.3e-06

****Significant at P < 0.01, P < 0.05 and P < 0.1, values of the variables are transformed to natural logarithms, (*) dy/dx is for discrete change of dummy variable from 0 to 1.***

According to scholars (Harrell, 2001) and (Joseph F.Hair, 2010), marginal effects are interpreted based on the sign and category. This means an estimated positive coefficient for a category indicates that an increase in that variable increases the probability of being in that category. Conversely, a negative coefficient indicates a decrease in the probability of being in that category. Interestingly, the marginal effects are fairly consistent with the results of model estimated coefficients. All the study variables are statistically significant with the marginal effect estimates model. The marginal effect estimation results of the study variables have reported as follows.

Firstly, household literacy level has positive and significant relationship with adoption of SWC (β_1=0.158 at p<0.001), which indicates household literacy level has the probability of predicting household decision to adopt SWC 0.158. *Secondly*, access to training has positive and significant relationship with adoption of SWC (β=0.148 at p<0.000), which designate household access to training has the prospect of predicting household decision to adopt SWC by 0.148. *Thirdly*, access to credit has positive and significant relationship with adoption of SWC (β=0.136 at p<0.000), which signpost household *access to credit* has the probability of predicting household decision to adopt SWC by 0.136. *Fourth*, farm land sloppiness has positive and significant relationship with adoption of SWC (β=0.122 at p<0.003), which specify farm land sloppiness has the prospect of predicting household decision to adopt SWC by 0.122. *Fifth*, household off farm income has positive and significant relationship with adoption of SWC (β=0.119 at p<0.003), which indicate household off farm income has the possibility of predicting household decision to adopt SWC by 0.119. *Sixth*, household farmland distance has positive and significant relationship with adoption of SWC (β=0.117 at p<0.011), which indicate household farmland distance has the chance of predicting household decision to adopt SWC by 0.117. *Seventh*, household family size has positive and significant relationship with adoption of SWC (β=0.092 at p<0.016), which show household family size has the likelihood of predicting household decision to adopt SWC by 0.092 in the study area.

Eighth, household land size has negative and significant relationship with adoption of SWC (β=-.131 at p<0.003), which indicate household land size has the likelihood of predicting household decision to adopt SWC by -0.131. *Ninth*, household gender has negative and significant relationship with adoption of SWC (β=-.0849 at p<0.028), which show household gender has the probability of predicting household decision to adopt SWC by -0.0849 and *Tenth*, household age has negative and significant relationship with adoption of SWC (β=-.0804 at p<0.036), which designate household gender has the possibility of predicting household decision to adopt SWC by -0.0804 in Assosa Woreda.

Table 4.5: Tobit Regression Analysis with Income from Sorghum Production

```
Tobit regression                              Number of obs   =        314
                                              LR chi2(1)      =       3.63
                                              Prob > chi2     =     0.0567
Log likelihood = -454.10271                   Pseudo R2       =     0.0040
```

incomesorg~p	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
adoptionswc	.3896389	.2044911	1.91	0.058	-.012712	.7919898
_cons	-.6432045	.1364744	-4.71	0.000	-.9117277	-.3746813
/sigma	1.653429	.1009448			1.454813	1.852045

```
  138  left-censored observations at incomesorg~p <= -1.12752
  176     uncensored observations
    0 right-censored observations
```

Source: Survey Data of 2023

The hypotheses of the study had tested by using regression model (*see table 4.5*). It can be noticed from the regression model the LR chi2 (1) is 3.63 with the probability Pseudo R^2 (chi2=0.0040), which indicates a good fitness of the predictability of the model used. This indicates that the overall model is highly significant at 0.004 and that household decision to adopt SWC has significantly causing variation in household income from sorghum production.

The R^2 result indicates the strength of regression model interpretation as *explained* by 5.67% variation of household income from sorghum production in Assosa Woreda; and the remaining 94.33 % is *unexplained variation* of household income from sorghum production in the study area; and it might has caused by other factors that are not included in this study.Hence, one unit increase in household decision to adopt SWC will increase their income from sorghum production by 0.389 in the study area. This, proves that household decision to adopt SWC has impactful predicts their income from sorghum production in Assosa Woreda.

Table 4.7: Marginal effect after tobit

```
Marginal effects after tobit
      y  = Linear prediction (predict)
         = -.49305703
```

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.	]	X
adopti~c*	.3896389	.20449	1.91	0.057	-.011156	.790434	.38535

(*) dy/dx is for discrete change of dummy variable from 0 to 1

***Significant at P < 0.01, P < 0.05 and P < 0.1, values of the variables are transformed to natural logarithms, (*) dy/dx is for discrete change of dummy variable from 0 to 1.*

As seen from table 4.7, the marginal effects are consistent with the results of model estimated coefficients. The marginal effect estimation results of the study variables has reported as follows. Therefore, household decision to adopt SWC has positive and significant relationship with their *income from sorghum production* (β_1=0.389 at p<0.057), which indicates household decision to adopt SWC has impactful predicts their income from sorghum production in Assosa Woreda.

5.1. Conclusions and Recommendations

This chapter deals with the conclusion and recommendations parts of the research. The firstly the conclusion has drawn by the researcher and recommendations has made by the researcher.

5.2. Conclusions

This study has tried to investigate the factors affecting adoption of soil and water conservation and its impact on crop productivity in Assosa Woreda. In linkage with each specific objectives of the study, the researcher has made the following conclusions as follows;

The descriptive report findings of age, education and family size shows that there is *high variability* of sample household respondent rating in the study area. Similarly, the descriptive report findings of adoption of SWC, access to credit, gender, road distance, farm land size, slope of land, sorghum production income, and access to training and off farm income shows that low variability of sample household respondent rating in Assosa Woreda.

The correlation coefficient study result shows that age, family size, literacy, access to credit, access to training, road distance, off farm income and slope of farm land a strong and positive relationship with adoption of SWC in the study area. The binary logistic regression coefficient of age, gender, family size, literacy, access to credit, access to training, road distance, slope of land, off farm income and land size have the probability of household decision to adopt SWC, holding other variables constant . From these explanatory variables, *household literacy level, access to training, access to credit, farm land distance and farm land size* have major probability of predicting household decision to adopt SWC, holding other variables Ceteris paribus. On the other hand, household decision to adopt SWC has impactful predicts their income from sorghum production in Assosa Woreda.

5.3. Recommendations

Based on the findings of the study, the researcher forwarded the following recommendations to the agricultural extension practitioners, households, local government body, non-governmental bodies and other stakeholders in Assosa Woreda. The major recommendations suggested by the researcher are as follows.

- The study explanatory variables age, gender, family size, literacy, access to credit, access to training, road distance, slope of land, off farm income and farm land size have the likelihood of predicting household decision to adopt SWC, holding other variables Ceteris paribus but they do not have equally probability of predicting household decision to adopt SWC. Out of these explanatory variables, household literacy level, access to training, access to credit, farm land distance and farm land size have major probability of predicting household decision to adopt SWC, holding other variables constant in the study area. Therefore, it is beneficial, if the agricultural extension office, households, local government body, non-governmental bodies and other stakeholders give primarily focus for *literacy of household* to adopt SWC, followed by access to training, access to credit, farm land distance and farm land size respectively, holding other variables Ceteris paribus in Assosa Woreda. Subsequently, to make stronger the probability of adoption SWC, agricultural extension practitioners, local government body and non-governmental bodies should organize and train household to successfully introduce SWC resourcefulness. Depending the findings of this study, the researcher also recommend household to adopt SWC based on the organizational and human ability building of farmworkers. It also advisable for farmer household to plan SWC devices that combine contemporary scientific thoughtful with native technological knowledge in order to feast them and maintain their long term feasibility in the study area.. Moreover, there is a need of SWC training, particularly focusing on the benefits of the conservation efforts to encourage farmers to take up soil and water conservation measures.

- If other studies livelihood the discoveries testimony here, then the following policy implications develop. A farmer's decision to adopt SWC practices was significantly associated with household age, gender, family size, literacy, access to credit, access to training, road distance, slope of land, off farm income and farm land size in the study area. As a mainstream of the household in the study area are poor, for improving their financial capacity, it is essential to expand credit access. Hence, they emphasis on soil and water conservation programs.
- Nevertheless, the useful contributions of the study, it is clear that this research study had the following limitations. Firstly, the scope of the study is limited household at Assosa Woreda. Secondly, the data were collected at one point in time, the direction of the causality of the relationships examined in this study is not certain.
- Depend on the results of the study, additional research has needed to enhance the understanding of the factors affecting adoption of soil and water conservation and its impact on crop productivity in Assosa Woreda. The scope of this study is limited household at Assosa Woreda. The participants were only taken from Assosa Woreda. Further research, therefore, needs to extend sampling to other Woreda in Benishangul Gomez Regional state. Considering, household at Assosa Woreda as a case study, the interested researchers who are willing to do their research on the factors affecting adoption of soil and water conservation and its impact on crop productivity in *Benishangul Gomez Regional state* Woreda households on a cross-sectional bases households. Additionally, the future researcher must also focus on the mediating variables that underlie the factors affecting adoption of soil and water conservation and its impact on crop productivity in Benishangul Gomez Regional state Woreda households.

REFERENCE

Adimassu et al. (2017). *Impacts of soil and water conservation practices on crop yield, run-off, soil loss and nutrient loss in Ethiopia:review and synthesis," Environmental Management, vol. 59,no. 59, pp. 87–101.*

Alene, A., et al. (2001). *Determinants of the Adoption and Intensityof Use of Improved Maize Varieties in the Central Highlands of Ethiopia: A Tobit Analysis. Agrekon 39(4):633-643.*

Alka., S. (2020). *Does Adoption of Soil and Water Conservation Practice Enhance Productivity and Reduce Risk Exposure? Empirical Evidence from Semi-Arid Tropics (SAT), India.* https://www.researchgate.net/publication/343904405.

Anderson et al. (2011). *Statistics for Business and Economics,11th Edition.* United States of America: MPS Limited, A Macmillan Company.

Aziz, S. (2007). *Analysis of Determinant in Adoption of Rainwater Harvesting Technology in LanfuroWoreda, Southern Region, Ethiopia.An unpublished M.Sc. Thesis Haramaya University, Ethiopia. Indian Journal of Agricultural Economics, 56: 239 -252.*

Beshir, H. (2014). *Factors affecting the adoption and intensity of use of improved forages in the north east Highlands of Ethiopia. American Journal of Experimental Agriculture 4(1): 12-27.*

Bryman, A. (2012). *Social Research Methods.* 4th ed., Oxford: Oxford University Press.

Churchill, G. a. (2002). *Marketing Research: Methodology and Foundation.* 8th ed., New York: South West Publishers.

Dattalo, P. (2008). *Determining Sample Size.* new york: Oxford University Press, Inc.

Dereje, J. (2008). *Factors Affecting the Production of Small Ruminants Among Small holder Farmers in MarekoWoreda of Gurage Zone. An unpublished M.Sc.ThesisHaramaya University, Ethiopia.*

Field, A. (2009). *Discovering Statistics Using SPSS: Third Edition.* SAGE Publications India Pvt Ltd.

Gizachew., S. & Birhan., A. (2022). *Farmers' adoption of soil and water conservation practices: The case of Lege-Lafto Watershed, Dessie Zuria District, South Wollo, Ethiopia.* https://doi.org/10.1371/journal.pone.0265071.

Griffiths, W. (2017). *Using Eviews: For principles of econometrics, 4th ed.*

Gujarati, D. N. (2004). *Gujarati: Basic Econometrics, Fourth Edition.* New York: The McGraw−Hill Companies.

Harrell, F. E. (2001). *Regression Modeling Strategies: With Applications to Linear Models, Logistic Regression, and Survival Analysis. Springer.* USA.

Joseph F.Hair, J. C. (2010). *Multivariate Data Analysis,7th ed.* Pearson Prentice Hall.

Kato et al. (2011). *Soil and Water Conservation Technologies: A Buffer against Production Risk in the Face of Climate Change? Insights from the Nile Basin in Ethiopia. Agric. Econ. 42, 593–604.*

Kim et al. (2003). *Technological Change and Risk Management: An Application to the Economics of Corn Production .* Agric. Econ., 29, 125–142.

Kothari, C. (2004). *Research Methodology:Method and Techniques.* New Delhi: 2nd ed.,Published by New Age International (P) Ltd., Publishers.

Mamush et al. (2021). *Impacts of Soil and Water Management Measures on Crop Production and Farm Income of Rural Households in the Damota Area Districts, Southern Ethiopia.* International Journal of Agronomy Volume 2021, Article ID 5526713, 13 .

Watson, J. (2001). *How to Determine a Sample Size: Tipsheet #60,University Park, PA: Penn State Cooperative Extension.*