**WOLKITE UNIVERSIY**
**COLLEGE OF AGRICULTURE AND NATURAL RESOURCE**

**DEPARTMENT OF AGRICULTURAL ECONOMICS**

A Senior Research Paper on Adoption of Physical Soil and Water Conservation Measure in Yirgalem Zurya Woreda.


**prepared By:** **ID.No**

**Chernet Asfaw** **0653/14**

**Advisor:Mr.Tadele Alemayehu (M.Sc.)**


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**Table of content**


**ACKNOWLEDGEMENTS** ..... 5
**LIST OF ABBREVIATIONS** ..... 6
**LIST OF ABBREVIATIONS (CONTINUED)** ..... 7
**LIST OF TABLES** ..... 8
**APPENDICES** ..... 9
**LIST OF FIGURES** ..... 10
**ABSTRACT** ..... 11
**CHAPTER ONE** ..... 12
**1.INTRODUCTION** ..... 12
**1,1 Background of the Study** ..... 12
**1.2 Statement of Problem** ..... 12
**1.3 Objective of the Study** ..... 14
1.3.1 General Objective ..... 14
1.3.2 The Specific Objectives of the study are ..... 14
**1.4 Research Question** ..... 14
**1.5 Significance of the Study** ..... 14
**1.6 Scope and Limitation of the Study** ..... 14
**1.7 Organization of the Paper** ..... 15
**2.CHAPTER TWO** ..... 16
**2.REVIEW OF PERTINENT LITERATURE** ..... 16
**2.1 Concept of Land Degradation** ..... 16
**2.2 Problems of Land Degradation** ..... 16
**2.3 Consequences of Land Degradation** ..... 16
**2.4 Soil Conservation Methods** ..... 16
**2.5 Adopters' Personal Characteristics** ..... 17
**2.6 Adoption and Agricultural Conservation Practices** ..... 17

**2.7 Empirical Studies on the Determinants of Soil Conservation ..... 18**
**2.8 Conceptual Framework of the Study ..... 19**
**CHAPTER THREE ..... 21**
**3. METHODOLOGY ..... 21**
**3.1. Description of the Study Area ..... 21**
3.1.1. Description of Yirgalem zurya woreda ..... 21
3.1.2. Soil and Water Conservation Practices in Yirgalem zurya woreda ..... 21
**3.2 Research Design ..... 22**
3.3.1 Methods of Data Collection and Sampling Techniques ..... 23
3.3.2 Analyses of Data3.3.3 Descriptive Statistics ..... 24
**CHAPTER FOURE ..... 30**
**4. DATA ANALYSIS AND RESULTS ..... 30**
**4.1 Descriptive Analysis of the study ..... 30**
**4.2 model result ..... 39**
4.2.1.Econometric Model results on predictors of Stone Bunds base Category is both (Stone Bund and Soil Bund) ..... 39
**4.3 Physical Soil and Water Conservation practices adopted by farmers in the study area ..... 43**
4.4 Definition of Variables used in Multinomial Logistic Regression Model ..... 44
**4.3 Variance Inflation Factor for Continues Variables Multi-collinearity Test ... 45**
4.3.1Contingency Coefficient for Dummy/Categorical Variable ..... 46
**4.4 Summary of Qualitative Analysis ..... 47**
**CHAPTER FIVE ..... 49**
**5.CONCLUSION AND RECOMMENDATIONS ..... 49**
**5.1 Conclusion ..... 50**
**5.2 Recommendations ..... 51**
**REFERENCES ..... 53**
**APPENDICES ..... 55**
**APPENDIX I: Household Survey with Interview Schedule ..... 55**

I. Psychological Factors ..... 55
13.Perception of farmers towards soil erosion as a problem ..... 56
15. The following are significant causes of soil erosion ..... 58
16. The consequences of soil erosion ..... 58
17. Attitudes toward Soil and Water Conservation ..... 58

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## LIST OF ABBREVIATIONS

**AGEHH** : Age of Household Head

**ASSCOSOIL** : Assistance in Soil Conservation Practices

**CSA** : Central Statistical Agency

**CVM** : Contingent Valuation Method

**DA** : Development Agent

**DPNCY** : Dependency Ratio

**EDUCHH** : Education Level of Household Head

**EXTSRS** : Extension Service

**FARMERATID** : Attitude of the Farmer

**FAMSIZ** : Family Size of a household

**FARMSZ** : Farm Size of the household

**FGD** : Focused Group Discussion

**FHH** : Female-Headed Household

**GDP** : Gross Domestic Product

**HH** : Household Head

**MHH** : Male-Headed Household

**NGO** : Non-Governmental Organization

**FINCOM** : Estimated amount of Farm Income in Birr

**SECTEN** : Security of Tenure

## LIST OF ABBREVIATIONS (CONTINUED)

**SOCPOSN** **:** Social Position in Kebele

**SLO** **:** Slope Category of the Farm

**SWC** **:** Soil and Water Conservation

**SM** **:** Soil Management

**SSA** **:** Sub-Saharan Africa

**WA** **:** Woreda Agriculture

## LIST OF TABLES

**Table..... Page**

Table1: Hypothesized variable and their relationship. ..... 29

Table 2: Age of the sample household respondents ..... 30

Table 3: Physical SWC activities implemented by farmers Sex of respondent. ..... 31

Table 4: Educational level of household Vs. Soil and water conservation structures ..... 32

Table 5 ..... 33

Table 6: Dependency Ratio and the survey Households ..... 33

Table 7: Shows the mean value of farm household income of sample households based on ..... 34

each structure implemented and its t-value. ..... 34

Table 8 ..... 36

# APPENDICES

**Appendix..... Page**

I: Household Survey with Interview Schedule.....50

II: Checklist for Key Informants Interview.....51

III Tropical Livestock Unit equivalencies for different domestic animals.....52

## LIST OF FIGURES

**Figure.....Page**

1. Conceptual Framework of Study.....20
2. Figure 2: Sampling Procedure..... 23

## ABSTRACT

*Different SWC works have been done in many parts of Ethiopia.but, the farmers' perception of soil erosion and their responses to soil and water conservation practices need investigation. Often contact between planners and stakeholders used to be minimal. The failure of conservation programs partly emerges from the fact that planners and implementing agencies ignore or fail to consider the socio-economic factors as critical determinants of the success or failure of conservation programs. Therefore, this study's objective was to identify what factors affect the adoption of physical soil and water conservation practices and examine farmers' perceptions of soil and water conservation practices. . This study indicated that farmers' adoption of the Soil and Water Conservation decision was influenced more by socio-demographic, economic, institutional, and physical factors. The household head age, education levels, family size, and dependency ratio influenced socio-demographic factors; economic factors influenced farm size and household income. The slope category of the farm was of physical factor that influenced the adoption of soil water conservation practices. Of these significantly influenced variables, the dependency ratio was negatively affected, while the rest of the factors positively influenced the adoption of SWC practices. Based on the obtained result, the following recommendations were made: There should be a clear understanding of the socio-economic conditions of a given locality to undertake SWC activity; a closer relationship will need to be developed between land-use planners and soil conservationists; strengthening resettlement in unused areas; the way of farming culture has to be investigated before planning to undertake conservation activity of a given community; To implement SWC, exploring existing local resource and availability of farmland is vital because most farmers who have stones availability in their locality were replayed that they choose stone bunds to protect their farm.*

**Keywords**: Soil fertility; soil management; sustainable agriculture; soil and stone.

# CHAPTER ONE
# 1.INTRODUCTION
## 1,1 Background of the Study

Soil fertility decline remains the major biophysical root cause of the reduction in per capita food availability on smallholder farms of Sub-Saharan Africa (SSA). Recent estimates indicate that by 2020, the SSA annual cereal imports were rise to more than 30 million metric tons. The per-capita food production continues to decline against a background of the rapidly growing population estimated at 3% per annum. This failure to match food supply to demand is mainly attributed to soil nutrient depletion following an intensification of land use without proper land management practices and inadequate external inputs (Aklilu, A. 2006).

Soil is a natural gift formed from different rock materials through a long process involving heat and cold. It is also a base for any nature on the earth; Even though it takes a long time to form and develop, it would lose within a brief period if the users do not care.

Hailu et al. **(2022)**: This research focuses on the effectiveness of various soil conservation techniques in Ethiopia, including terraces and bunds. The study presents quantitative data demonstrating that these practices can reduce soil erosion by up to 50% and improve overall soil health.**Morgan (2018)**: In this research, the focus is on the effects of soil erosion on agricultural productivity. The study provides empirical data indicating that soil erosion has led to a reduction in yields across various crops, with some regions experiencing losses of up to 30%.

## 1.2 Statement of Problem

Although Ethiopia's biophysical potential is significant, land degradation and poverty continue to challenge sustainable agricultural development opportunities. This problem is further aggravated by high population pressure in rural areas - currently, 86 per cent of Ethiopia's 72 million inhabitants live in rural areas, climatic variability, limited use of sustainable land management practices, the widespread dismantling of constructed soil and water management structures, and a high dependence on rain-fed agriculture. Moreover, deforestation due to farmland expansion and energy needs, as well as fragile soils, undulating terrain, and heavy seasonal rains make the rural family of Ethiopia highly vulnerable to soil erosion and gully formation (Terrence *et al.,* 2002)

Approximately two-thirds of the Omo River Basin area (including the researcher's study area) is located in the highlands that receive relatively high levels of rainfall (800 to 2,200 millimetres per

year). Most precipitation falls during the Meher rainy season (June– August). Agricultural production in these areas of the Omo river basin is dominated by cereal crops, which necessitates frequent ploughing and provides minimal ground cover during the Meher rains, thus rendering soil in the Omo river basin more susceptible to erosion

(Vernon 1999).

**Woldeamlak (2020)** highlights that soil erosion and degradation can lead to significant losses in agricultural productivity, with some regions reporting annual crop yield declines of up to 40%. These findings underscore the urgent need for effective land management and conservation strategies to mitigate these economic losses.Additionally, a comprehensive assessment by **Kassie et al. (2021)** emphasizes that the cumulative effect of land degradation not only threatens immediate agricultural output but also compromises long-term sustainability, suggesting that the costs could escalate further if proactive measures are not implemented.

on-site costs of erosion, the country also experiences off-site effects. For example, eroded soil washed out of the plot could positively or negatively impact the productivity of plots downstream. The negative effects include crop burial by sediment deposition, gully formation, and crop damage due to excessive overland flow in depressions. On a larger scale, erosion creates the siltation of dams, wetlands, and productive farmlands in foot- slope areas (Yesuf *et al.,* 2009).

In response to the extensive degradation of its resource base, Ethiopia has made some efforts to mitigate soil erosion and enhance or maintain agricultural land production. New soil conservation technologies were introduced in some degraded and food deficit areas of the highlands, mainly through food for work incentives since the early1980s. However, even though soil conservation technologies were promoted through the Ministry of Agriculture in Ethiopian highlands and other parts of the country where successive food- deficit recorded, including the study area, the farmers' perception of the problem of soil erosion and their responses to soil and water conservation practices have not been well studied. Moreover, the factors influencing Soil and Water Conservation measures were not identified (Shiferaw and Holden 1998).

## 1.3 Objective of the Study

### 1.3.1 General Objective

- The study's general objective was to determine Factors Affecting the Adoption of Physical Soil and Water Conservation Practices in yirgalem zurya woreda.

### 1.3.2 The Specific Objectives of the study are

- to identify the Physical Soil and Water Conservation practices adopted by farmers in the study area,
- to examine the perception of farmers on Soil and Water Conservation practices.

## 1.4 Research Question

- What is the perception of farmers on Soil and Water Conservation practices?
- What are factors affect the adoption of Soil and Water Conservation practices by farmers?

## 1.5 Significance of the Study

Currently, erosion control measures/Soil and Water Conservation practices have been undertaken in a campaign, often without the involvement of the land users. As a result, those constructed physical structures were not sustained due to farmers' widespread dismantling of structures entirely or selectively.

## 1.6 Scope and Limitation of the Study

This study aims to identify the factors that affect the adoption of physical Soil and Water Conservation activities, especially bunds (stone bund, soil bund and both), to recommend practically accepted Soil and Water Conservation measures for farmers. Regarding its limitation, this study is limited to one district in Sidama region, yirgalem zone, in yirgalem zurya woreda of 108 HH selected from Dega and Woyna Dega agroecology in 5 kebele. Even though the area to be covered and sample size chosen is limited due to time and money scarcity, the expected result could be generalized to more expansive areas with similar geographicalsettings.Several challenges hinder effective research efforts, including a lack of sufficient time, which

can limit the depth and rigor of investigations. Additionally, inadequate funding can restrict access to necessary resources and tools, making it difficult to conduct comprehensive studies. Furthermore, a lack of experience in research methodologies can lead to difficulties in designing and implementing projects effectively. These factors collectively contribute to obstacles that can diminish the quality and impact of research outcomes, highlighting the need for more support and training in these areas.

## 1.7 Organization of the Paper

This thesis is organized into five chapters. Chapter one is the Introduction, followed by chapter two: a review of literature that comprises definitions, history of soil and water conservation practices, existing soil and water conservation practices, and factors influencing the adoption of soil and water conservation activities, etc. The third part includes an intensive description of the study area, research type and design, data collection, and analysis method. The fourth chapter describes the results and discussions, and finally, chapter five presents a research summary and recommendations based on the study's findings.

# 2.CHAPTER TWO
# 2.REVIEW OF PERTINENT LITERATURE
## 2.1 Concept of Land Degradation

Soil is a natural resource that generates yearly through the natural process. Soil erosion is interchangeably used with land degradation; however, soil erosion is only one form of land degradation. Land degradation can be defined in various ways concerning soil erosion to describe its negative impacts on land productivity (Hudson, 1995).

## 2.2 Problems of Land Degradation

Ethiopia is one of the Sub-Saharan African countries where soil degradation has reached a severe stage. Land degradation, mainly due to soil erosion and nutrient depletion, has become the most critical environmental problem in the country; coupled with poverty, a fast-growing population, policy failures, and social unrest, land degradation poses a severe threat to national and household food security (Shiferaw and Holden, 1998).

## 2.3 Consequences of Land Degradation

The degradation of soils has become an alarming global environmental problem threatening sustainable development in most developing countries. Barrett (1996) stated that the depletion of oil reserves, and its effect on world oil prices, is the most immediate threat to world economic stability.

The degradation of agricultural soil resources in Ethiopia is seriously limiting production. In economic terms, the annual rate of land degradation results in reduced agricultural output by about 2% per year (Hurni, 1983). According to FAO (1987), available estimates on the economic impact of soil conservation for three agro-ecological zones in Ethiopia indicated an annual on-site productivity loss of 2.2% from the 1985 yield level.

## 2.4 Soil Conservation Methods

Soil erosion causes considerable and, in most cases, irreversible soil fertility and productivity loss. The primary cause of low soil fertility in the watershed is soil erosion due to runoff. As a result, crop productivity remains very low, and some farmers were registered even for migration.

:**Compatibility** – Evaluation of the apparent consistency with the adopter's current operation, values, beliefs, past experiences, peer influence and perceived needs of potential adopters. Ideas that are more compatible fit more closely with the situation or circumstance and have more meaning to the potential adopter (Rogers, 2003).

**Complexity** – Similarly, the adopter determines the degree of complexity or the extent to which an innovation can be understood and relatively easily implemented (Wilkinson, 1989; Rogers, 2003). If the effort needed to implement increases the risk of an innovation failing, the relative advantage of adopting that innovation is proportionately reduced. Suppose an innovation is not complex but adds to the overall complexity of managing existing practices or an existing operation.

**Trialability** – This refers to the degree to which an innovation can be tested on a small scale to reduce the uncertainty associated with adoption; the greater the level of trialability, the tremendous potential for adoption to occur (Tonks, 1983 Ohlmer *et al.*, 1998).

**Observability** – The degree to which the measurable effects of an innovation are visible to adopters and other individuals in the community (Pannell, 2001; Rogers, 2003). A high level of observability provides a more incredible opportunity to evaluate the relative advantage and complexity of potential adopters and others "over the shoulder" – in the social system.

## 2.5 Adopters' Personal Characteristics

- Innovativeness is the "degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than the other members of a system" (Rogers, 2003).

- **Innovators** – This group can be described as venturesome and unafraid of trying new ideas, regardless of peer-social perceptions of their behaviour.

- **Early Adopters** – These adopters are more integral to the social systems in which they belong and typically accept innovations quickly,

- **Early Majority** – They are situated just ahead of most of the system and typically do not hold positions as opinion leaders.

- **Late Majority** – This group adopts innovation after the majority due to caution and skepticism. Their decision to adopt may be due to limited economic resources and/or peer pressure, which may influence their sense of social standing.

- **Laggards** – This group is typically described as socially isolated and the last to adopt innovations. They are generally suspicious of change and change agents instead of relying on their experience to guide their adoption decisions.

## 2.6 Adoption and Agricultural Conservation Practices

In agricultural systems, producers experience high levels of uncertainty due to economic, institutional, social, and environmental factors. High competition, product price instability, and low returns to investment are typical characteristics of the agricultural market and contribute to these feelings of uncertainty (Workman *et al*., 1972; Kearl, 1975; Buttel and Swanson, 1986; Workman and Evans, 1993). When producers adopt conservation.

## 2.7 Empirical Studies on the Determinants of Soil Conservation

Studies on the determinants of soil and water conservation decision behaviour of farmers in Ethiopia have been limited. Generally, the past approach to soil conservation study emphasized technical solutions to soil erosion problems to neglecting socioeconomic constraints (Shiferaw and Holden, (1998).

Technological innovations and scientific methods were the answers to soil erosion problems for decades. However, regardless of advances in the development and promotion of technologies, the soil erosion problem persisted, forcing changes in attitudes toward the way to tackle the problem. This led to the realization that soil conservation is a technical and socio-economic problem, which directed attention to socioeconomic and behavioural factors influencing soil conservation decision-making. This is evident from the ever-increasing literature on this area (Wegayehu, 2003).

**Beshah (2003)** explored farmers' perceptions of land degradation and their adaptive responses in the Ethiopian highlands. This study found that farmers are acutely aware of the impacts of soil degradation on their livelihoods and are motivated to implement conservation practices. Beshah's research emphasizes the importance of understanding local perceptions and motivations, which can inform more effective interventions and support for land conservation efforts.

**Sutherland (2015)** examined the effectiveness of stone bunds as a soil conservation measure in East Africa, with a specific focus on Ethiopia. The study demonstrated that stone bunds significantly reduce soil erosion and enhance soil fertility, thereby improving agricultural productivity. Sutherland's findings underscore the critical role of physical conservation measures in combating soil degradation in hilly terrains.

**Zeller and Sharma (2014)** investigated the impact of physical soil conservation measures on crop yields among smallholder farmers in Ethiopia. Their research showed that the adoption of these measures leads to substantial increases in crop productivity, highlighting the direct benefits of

conservation practices on food security. The study advocates for the integration of soil conservation techniques into agricultural policies to support smallholder farmers.

**Kauffman and Kauffman (2016)** focused on the role of fanyajuu systems (contour bunds) in promoting water conservation and enhancing crop productivity in Ethiopia. Their findings indicate that fanyajuu systems can significantly improve water infiltration and retention, which is vital for crop growth in areas prone to drought. This research highlights the importance of innovative soil conservation strategies in ensuring sustainable agricultural practices in water-scarce regions.

## 2.8 Conceptual Framework of the Study

The conceptual framework of the research study is based on the principles of the innovation-decision process described by Recent findings suggest that the decision-making process is more complex than previously thought, with socio-economic factors, risk perceptions, and environmental conditions playing significant roles. For instance, the introduction of climate-smart technologies has shown that farmers' decisions are influenced by their perceptions of climate change and its impacts on their livelihoods (Kassam et al., 2019).

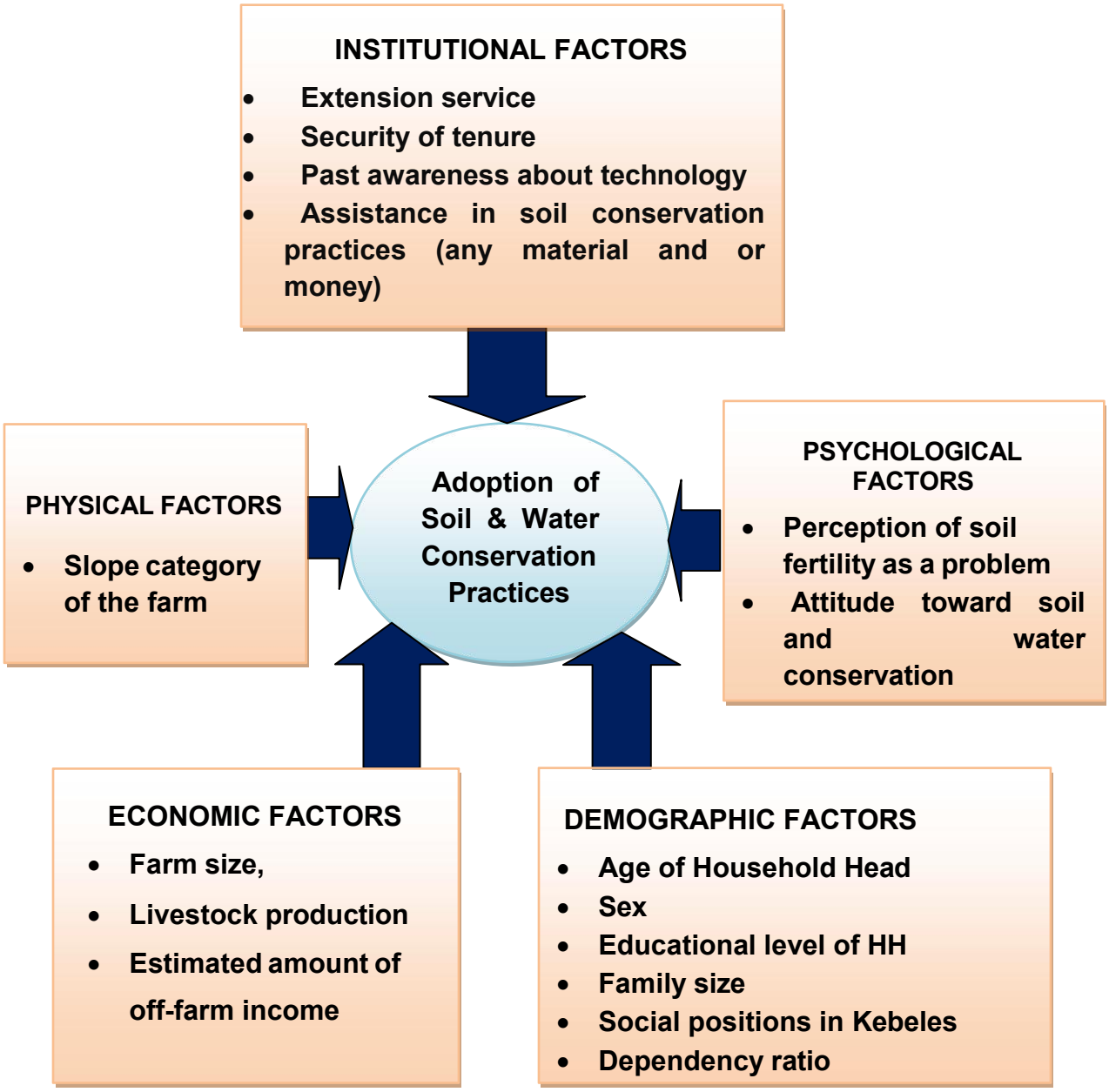



Figure 1: Conceptual Framework of the Study

# CHAPTER THREE
# 3. METHODOLOGY

## 3.1. Description of the Study Area

### 3.1.1. Description of Yirgalem zurya woreda

**Yirgalem** (Amharic: ይርጋለም, *Yirgaläm*) locally known as Diko Dalle alternate names include **Yirgalem**, **Aposto**, **Dalle**) is a town in southern Ethiopia. Surrounded by Lakes Woyima and Gidawo, it is located 260 kilometers south of Addis Ababa and 40 kilometers south of Awasa in the Sidama Zone of the Sidama Region. The town has a latitude and longitude of 6°45′N 38°25′E and an elevation of 1776 meters. It is the largest settlement in Dale woreda.

**Population**

Based on figures from the Central Statistical Agency of Ethiopia published in 2005, Yirgalem has an estimated total population of 43,815 of whom 21,840 are men and 21,975 women.[6] The 1994 national census reported this town had a total population of 24,183 of whom 12,092 were men and 12,091 were women.

**Economy**

The major economic base in the study area is agriculture, which is subsistence in its nature. The maximum land holding size in the area is the agriculture as well coffee production. The major crop production in yirgalem zuriya woreda cultivate different type of crops like maize,teff and other vegetation like carrot, onion, cabbage, potato, sugar beet, lettuce. In addition to this production of tree like Banana, Mango, Papaya is widely practices by using furrow irrigation, which has been suitable for being practices farmers.

**Soil type**

The major soil types of the area based on their texture are clay loam and sandy loam are most common. From those soil types, the dominant one is clay loam which covers 75% of the total area which is found in crop land, forest land and grazing land. The second type soil is sandy

### 3.1.2. Soil and Water Conservation Practices in Yirgalem zurya woreda

Considering land degradation as a significant environmental and socio-economic problem as it was in other parts of the country, the Woreda has made remarkable efforts to reduce the negative impact of erosion by mobilizing the whole communities for free contribution and in the form of money in the PSNP program for the last 10 to 15 years. As the area is categorized as food insecure, different Non-governmental organizations in Woreda was engaged in Soil and Water Conservation activities in different forms. As a result, large areas have been converted into terraces, covered by soil bunds, closed by area closures, and planted with thousands of trees and multi-purpose tree seedlings.

## 3.2 Research Design

Both relevant qualitative and quantitative data were collected from primary and secondary sources. The primary data were collected from 108 individual farm households selected from two kebele in yirgalem zurya woreda district using a formal sample survey. The general information collected from this source includes household characteristics, landholding and farm characteristics, farmers' awareness and perception of soil erosion problems, soil conservation technologies and attitudes, tenure arrangement, institutional support, demographic characteristics, and income status of the sample households.

**Sampling Procedure**

.In the selection process, only villages from the Highland agroecology settings were chosen. Villages from the Lowland agroecology and midland were excluded due to the rarity of conservation structures in that area. For the two Highland Kebeles, villages were selected to ensure a representative sample of the Highland agroecology.

simple random sampling was conducted from the household lists obtained from village chiefs and headmen. Farming households were then selected for interviews using a table of random numbers. To ensure sensitivity towards female-headed households, over 20% of the interviewers were from these households.

**Pictorial form of Sampling Procedure**

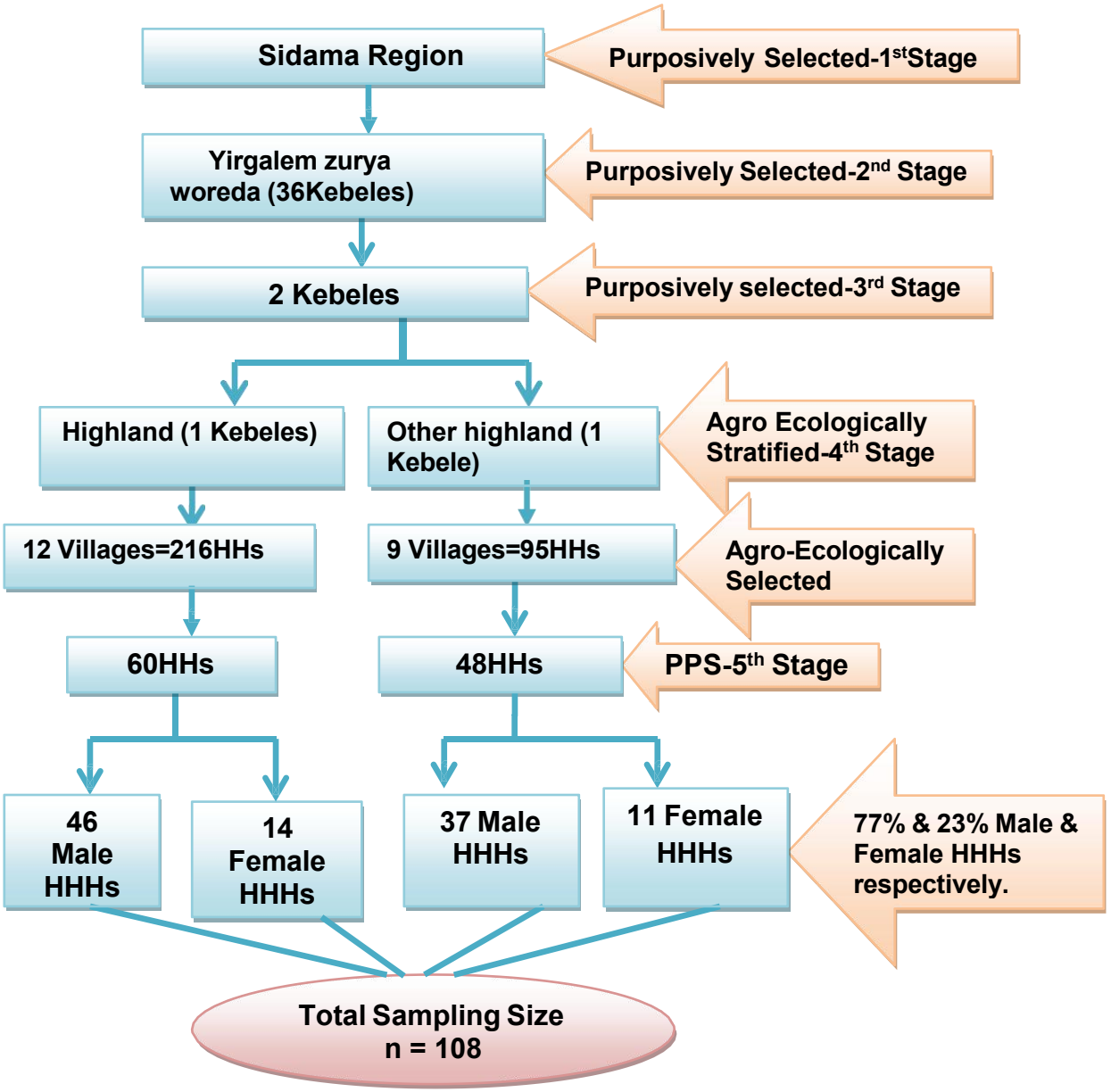



**Figure 2: Sampling Procedure**

### 3.3.1 Methods of Data Collection and Sampling Techniques

This study's primary data was generated from the sample households by conducting a formal survey using a structured interview schedule . Then structured interview schedule was developed, and before conducting the formal survey, a pre-test was conducted with three respondents.

Because the diffusion and implementation of soil conservation technologies have been undertaken only in Dega and Woyna Dega climatic zone, each Kebele was categorized into three agroecology to

exclude those households which belong to Kolla agroecology so that the selected households in these two Kebeles are found in one the two agro ecologic zones.

### 3.3.2 Analyses of Data

### 3.3.3 Descriptive Statistics

Analysis was made using inductive reasoning to describe the collected data and the integration, generalization, and classification of the data into categories. First, the data set was coded and categorized.

**The multi-nominal logit regression model** was applied to analyse the data. Farmer's use of physical soil and water conservation practices was dependent,that means **Soil Bund , Stone Bund and both used** while different hypothesized/conceptualized variables were considered independent variables.

To identify the determining factors behind the farming household's decision to engage in various physical soil and water conservation practices, the assumption is that a rational farming household head chooses among the three mutually exclusive physical soil and water conservation practice alternatives in a given period the maximum benefit. Following (Gujarati, 1995), suppose for the ***i*th** respondent faced with **j**th choices, we specify the utility choice **j** as:

**Uij= Zijβ + εij**.....(1)

If the respondent makes choice j in particular, we assume that **Uij**is the maximum among the j utilities. So the statistical model is derived by the probability that choice j is made, which is:

Prob (**Uij>Uik**) for all other **K≠ j**..... (2)

Where **Uij** is the utility to the **i**th respondent from physical soil and water conservation activity **j Uik** the utility to the **i**th respondent from physical soil and water conservation activity **k**

Suppose the household maximizes its utility defined over income realizations. In that case, the household's choice is simply an optimal allocation of its asset endowment to choose.

physical soil and water conservation activity that maximizes its utility. Thus, the **i**th household's decision can, therefore, be modelled as maximizing the expected utility by choosing the **j**th conservation structure among J physical soil and water conservation activities, i.e.,

$\max_j \quad E(U_{ij}) \quad f_j(x_i) \quad _{ij}; j \quad 0...J$..... (3)

In general, for an outcome variable with J categories, let the $j^{th}$ soil and water conservation activity that the $i^{th}$ household chooses to maximize its utility could take the value 1 if the $i^{th}$ household chooses $j^{th}$ soil and water conservation activity 0 otherwise. Then, the probability that a household with characteristics x chooses soil and water conservation activity j, $P_{ij}$ is modelled as
In order to determine our sample size we will be use Yamane's formula which was developed 1967.

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

Where, n=sample size
N=number of target population
e=significance level(maximum variability)
1=probability of event occurring

**The Dependent Variable of the Study**

According to adoption studies, various factors are responsible for farmers' decisions to adopt or reject new agricultural technologies. These factors include socio-demographic, economic, psychological, institutional, and physical factors. Therefore, this study's intended dependent variable is farmers' adoption of physical Soil and Water Conservation practices, especially bunds (Soil bunds =$\mathbf{Y_0}$, Stone bunds=$\mathbf{Y_1}$, Soil and Stone bund=$\mathbf{Y_{2)}}$ )

**The Independent Variables of the Study**

It is hypothesized that a set of explanatory variables influences the decision to participate in environmental schemes. Various authors have examined the role of different variables. Much research on the uptake of environmental schemes has investigated farmers' behaviour concerning policy objectives and farming context. Physical form factors (percentage of the total area under crops, grassland area, total labour available, slope, etc.) were considered necessary to uptake environmental schemes in agriculture Wynn *et al.*, (2001). Based on the findings of past studies on farmers' decisions on investment and participation in soil management practices, the following explanatory variables were hypothesized to determine the farmers' willingness to participate in soil conservation practices.

**Age of the household head (AGEHH)**

The effect of a farmer's age on investment decisions can be a composite of farming

experience and planning horizon. While more extended experience has a positive effect, young farmers, on the other hand, may have a longer planning horizon and may be more

likely to invest in conservation. A priori Lucila et al. (1999) could not determine the net effect. However, Featherstone and Goodwin (1993) reported that an older individual looking at a shorter time horizon might not recoup all of the benefits from conservation investment. Similarly, Tegegne (1999) found that age negatively affected conservation decisions because it decreased participation in environmental protection. Thus, in this study, it is hypothesized that age negatively influences participation in soil conservation activity.

**Sex of the household head (SEXHH)**

This is a dummy variable, which takes a value of 1 if the household head is male and 0 otherwise. The sex of the household head was included to differentiate between males and females in their valuation of environmental protection. Tegegne (1999) reported that females, instead of males, participate more in environmental protection during peak season while males participate more during the slack season.

**Education level of the household head (EDUCHHH)**

This is a dummy variable, which takes 1 if the household head is literate and 0 otherwise. Education increases farmers' ability to get, process, and use information. Education is positively correlated with farmers' adoption and soil conservation efforts Tegegne, (1999); Ervin and Ervin, (1982).

**Family Size (FAMSIZ)**

This refers to the total number of family members. Imperfections in labour markets imply that households with sizeable human capital may invest more in conservation.

In addition, the larger the family, the higher the probability that future generations will farm the land and reap the benefits of conservation investments (Featherstone and Goodwin, 1993).

**Farm Size owned by the Household in hectares (FARMSZ)**

As the farm size of a given household increases, the probability of a household investing in soil and water conservation practices will decrease, indicating a negative relationship

**Dependency Ratio (DPNCY)**

An increase in the consumer-worker ratio (dependency ratio) reduces the ability to meet subsistence needs and increases the personal rate of time preference (Bekele*et. al.,* 1997). Therefore, this variable is expected to have a negative effect on farmers' willingness to participate in soil conservation activities.

It also reduces the subjective rate of time preference (Shiferaw and Holden, 1998) and provides security (lower risk) to land users, enhancing conservation investments. On the other hand, more specialization in livestock, away from cropping, may reduce the economic impact of soil erosion and/or increase the availability of manure needed to counter nutrient depletion, thus lowering the need for soil conservation. Hence, the effect of the size of livestock holding on conservation decisions was challenging to hypothesize a priori.

**Security of tenure (SECTEN)**

A dummy variable would take a value of 1 if the peasant considered that he/she would be able to use the parcel at least during their lifetime and 0 otherwise. The incentive to land improvement decisions is partly based on secured future land access. In many studies, tenure insecurity is a limiting factor to conservation investment (Barret, 1996). In this study, the farmer's feeling about using a given parcel at least during his/her lifetime was hypothesized to positively affect his/her decision to participate in conservation activities

**Perception of Farmers as erosion is a problem (PERCP)**

A dummy variable for the perception of soil erosion problem. The recognition of the soil erosion

problem is considered to be vital for soil conservation decisions. In other words, farmers who have already perceived the problem of soil erosion are more likely to be willing to participate in soil conservation activities than those who have not perceived the problem. Thus, the perception variable was expected to strongly affect farmers' decision to participate in soil management practices (Lynee *et al*., 1988).

**Attitude of the farmer (FAMERATID)**

This variable takes a value of 1 if there is a desire to try a new technology at its own cost and 0 if the desire is to wait until other land users have adopted it. Economic incentives will increase efforts, but responsiveness will differ with conservation-related attitude strength (Lynee *et al*., 1988).

**Extension Service (EXTSRS)**

The extension services were one of the institutional characteristics expected to influence farmers' decision to adopt new technology. The service could be rendered to the farm households through various means such as field days, visiting demonstration fields, and participation in training.

conservation practices is expected to increase in areas where Governmental and Non- Governmental Organizations are involved in agricultural development activities. Hence, any source's assistance (material, technical, and other incentives) encourages the farmers to decide on conservation practices, and a positive effect was hypothesized.

**Slope category of the farm (SLOP)**

This is a dummy variable for the slope category of a parcel, which takes a value of 1 if the slope is steep or very steep and 0 otherwise. The slope category of the parcel has been found to positively affect the farmer's decision to invest in conservation technology. and Ervin, 1982; Gould *et al.*, 1989). The slope variable is thus expected to positively affect farmers' decision to participate in soil conservation practices. Table three presents the name of the variables used, variable types, their measurements, and effects.

**Hypothesized Variables**

**Table1: Hypothesized variable and their relationship.**

| S. No. | Name of Variables | Measurement | Variable Type | Expected Effect |
|---|---|---|---|---|
| 1 | Age of the household head | Years | Continuous | - |
| 2 | Sex of the household | | Dummy | - |
| 3 | Education level of the household head | - | Dummy | Positive |
| 4 | Family size | Number | Continuous | Positive |
| 5 | Dependency ratio | Number | Continuous | Negative |
| 6 | House hold income | Birr | Continuous | Positive |
| 7 | Extension service | Rate of visit | Dummy | Positive |
| 8 | Farm size owned by the household in hectares | Hectare | Dummy | Negative |
| 9 | Security of tenure | - | Dummy | Positive |
| 10 | Attitude of the farmers | - | Dummy | Positive |
| 11 | Slope category of the farm | Perecent | Dummy | Positive |

# CHAPTER FOURE
# 4. DATA ANALYSIS AND RESULTS

This section deals with the description and interpretation of the findings of this study. It also compares the present research findings of this study with previous research studies.

## 4.1 Descriptive Analysis of the study
## Socio-Demographic Factors concerning Adoption of SWC practices

### Age

The age of the farmer was hypothesized to influence in two directions. That is farming experience and planning horizon. While more ample farming experience has a positive effect, young farmers, on the other hand, may have a longer planning horizon and hence, may be more likely to invest in conservation, showing also it has a positive effect on soil and water conservation decision

.The mean age of soil conservation structures shows significant investment in sustainability. Stone bunds average 49.02 years, indicating they are relatively old. Soil bunds are slightly younger at 42.62 years, yet still reflect a long history of use. The combined average age of both structures is 45.05 years, demonstrating ongoing efforts to combat soil erosion. Overall, the total mean age of 45.56 years highlights that these practices have been integral to agricultural management for decades. The maximum age of 72 years suggests some structures have been in place for over seven decades, while the minimum age of 25 years indicates recent implementations in response to emerging challenges.

A T-value of 19.86 is quite large, suggesting a substantial difference between the group means compared to the variability within the groups. This typically implies that the means are significantly different from each other.

**Table 2: Age of the sample household respondents**

| Soil conservation structures | Mean age |
|---|---|
| Stone bund | 49.02 |
| Soil bund | 42.62 |
| Both | 45.05 |
| **Total mean** | **45.56** |
| **Maximum** | **72** |
| **Minimum** | **25** |
| **SD** | **10.824** |
| **t- value** | **19.86** |

**Sex of the Household**

Studies conducted on Sex to differentiate between Males and Females in their valuation of environmental protection show that females instead of males tend to participate more in environmental protection during peak season while males participate more during slack season Tegegne (1999). .

The data on soil and water conservation (SWC) activities reveals a significant gender disparity in participation. Of the 108 households surveyed, 84 are male-headed and 24 are female-headed. In terms of specific activities, 41 households use stone bunds (35 male, 6 female), 16 use soil bunds (12 male, 4 female), and 51 households employ both methods (37 male, 14 female). This indicates that male-headed households dominate SWC practices across all categories, highlighting potential inequalities in access to resources and decision-making within agricultural practices.A **Chi-Square value of 2.24** indicates the degree of deviation from the expected frequencies. The larger the Chi-Square value, the more likely it is that there is a significant difference between the observed and expected data.

**Table 3: Physical SWC activities implemented by farmers Sex of respondent.**

| Type of SWC Conservation Activities. | Sex of the Household | | Total |
|---|---|---|---|
| | Male | Female | |
| Stone bund | 35 | 6 | 41 |
| Soil bund | 12 | 4 | 16 |
| Both | 37 | 14 | 51 |
| Total | 84 | **24** | 108 |
| Chi-square | | | 2.24 |

## Educational Level of household

The result depicts that better-educated households have a more realistic understanding of soil erosion problems and more knowledge of soil water conservation practices and can more easily be involved in conservation activities, indicating a positive relationship.

The table illustrates the relationship between education level and the implementation of soil conservation structures among households. Out of 108 households surveyed, 38 are illiterate, with 22 using stone bunds, 1 using soil bunds, and 15 using both structures. In contrast, 70 households are

literate, with 19 employing stone bunds, 15 using soil bunds, and 36 utilizing both methods. Overall, the data indicates that literate households are more likely to adopt multiple conservation practices, suggesting that education may play a significant role in promoting effective soil conservation strategies. The Chi-Square statistic of **17.54** indicates a significant association between education level (illiterate vs. literate) and the type of soil conservation structure used, suggesting that the distribution of education levels varies significantly across different structures.T-test value of **0** implies that there is no difference between the means of the two groups being compared, indicating that any continuous variable measured does not differ significantly between illiterate and literate individuals

**Table 4: Educational level of household Vs. Soil and water conservation structures**

| Education level | Structure carried out by households | | | |
|---|---|---|---|---|
| | Stone bund | Soil bund | Both | Total |
| Illiterate | 22 | 1 | 15 | 38 |
| Literate | 19 | 15 | 36 | 70 |
| Total | 41 | 16 | 51 | 108 |
| Chi-square | | | | 17.54 |
| t test | | | | 0 |

**Family size sample households Vs. Conservation measures**

It was hypothesized that households with sizeable human capital might invest more in conservation (Shiferaw and Holden, 1998). In addition, the larger the family, the higher the probability that future generations will farm the land and reap the benefits of conservation investments

The data on conservation measures and family size reveals insights into household demographics. Households using stone bunds have a mean family size of 5.6, while those employing soil bunds have a smaller mean size of 4.8. For households utilizing both conservation methods, the mean family size is 5.29. The overall mean family size across all households is 5.23, indicating a generally larger family structure among those practicing soil conservation. The minimum family size recorded is 2, and the maximum is 10, suggesting a range of household sizes. This information highlights the potential influence of family size on the adoption of conservation practices.

The T-test value of **3.83** indicates a significant difference between the mean family sizes of the conservation measures being compared. This positive T-value suggests that at least one group's mean family size is notably higher than that of the others.

**Table 5 Family size sample households Vs. Conservation measures**

| Conservation measures | Mean Family size | Total |
|---|---|---|
| Stone bund | 5.6 | 41 |
| Soil bund | 4.8 | 16 |
| Both | 5.29 | 51 |
| Total mean | 5.23 | 108 |
| Minimum | 2 | |
| Maximum | 10 | |
| sum | 12 | |
| t- test | | 3.83 |
| Std. Deviation | | 1.75 |

## Dependency Ratio

An increase in the consumer–worker ratio (dependency ratio) reduces the ability to meet subsistence needs and increases the personal rate of time preference (Shiferaw and Holden, 1998). This variable is expected to have a negative effect on farmers' willingness to participate in soil conservation activities.

The data on physical structures used in soil conservation shows the following mean values: stone bunds have a mean value of 1.08, soil bunds have a mean of 1.34, and households using both structures average 1.23. The maximum value recorded is 4, while the minimum is 0.1, indicating variability in the effectiveness or extent of these structures. The total sum of values is 130.98, with a standard deviation of 0.83, suggesting moderate variability in the performance of these conservation measures. Overall, these figures reflect differing levels of investment and effectiveness in soil conservation practices among households.The T-test value of **-24.02** indicates a highly significant difference between the means of the groups being compared. A negative T-value suggests that the mean of one group (presumably the one with the lower mean) is significantly lower than that of the other group.

**Table 6: Dependency Ratio and the survey Households**

| Physical structures | Mean value for structures |
|---|---|

| | |
|---|---|
| Stone bund | 1.08 |
| Soil bund | 1.34 |
| Both | 1.23 |
| Maximum | 4 |
| Minimum | 0.1 |
| Sum | 130.98 |
| SD | 0.83 |
| t-test -24.02 | -24.02 |

**Household income**

This may be due to the scarcity of farmland and the sloppiness of their farm, which forced them to use a more intensive type of conservation structure(stone bund) as it takes less area to construct other forms of conservation structure

The data on soil conservation structures and their associated mean incomes reveals important trends. Households using stone bunds have a mean income of 2,495.86, while those employing soil bunds report a higher mean income of 4,061.25. Households utilizing both structures have a mean income of 3,191.97. The overall mean income across all households is 3,249.69. The maximum income recorded is 17,800, and the minimum is 100, indicating significant variability in income levels. With a standard deviation of 3,138.04, this suggests considerable disparities in income among households engaged in different soil conservation practices. Overall, the data indicates that the type of conservation structure used may influence household income levels.The positive T-value suggests that at least one group, particularly the soil bund, has a significantly higher mean income compared to the others

**Table 7: Shows the mean value of farm household income of sample households based on each structure implemented and its t-value.**

| Soil Conservation Structures | Mean income |
|---|---|
| Stone bund | 2495.86 |
| Soil bund | 4061.25 |
| Both | 3191.97 |
| Total mean | 3249.69 |
| Maximum | 17800 |
| Minimum | 100 |
| SD | 3138.04 |

| | |
|---|---|
| t-value | 5.92 |

**Attitude of the farmer (FAMERATID)**

Past studies on farmers' attitudes toward soil and water conservation indicated that peasants with a generally positive attitude towards new technologies are keen on undertaking and keeping conservation structures. Based on this, farmers were asked how they perceived soil fertility since they started farming compared to the past and were cross-tabulated to know how many of them undertook soil conservation works on their farms. The cross-tabulation result shows that, of those who perceived their farms' soil fertility increased, 89% were undertaken soil conservation activities on their farm plot. On the other hand, of those who not perceiced SWC that their farm's soil fertility was declining, 55% Farmers show varying attitudes towards SWC activities. For stone bunds, 2 are neutral, 25 agree, and 14 strongly agree. With soil bunds, none are neutral, 11 agree, and 5 strongly agree. Those using both structures have 4 neutral, 29 agreeing, and 18 strongly agreeing. Overall, there is strong support for SWC practices.The Chi-Square value of **3.955** indicates a statistical test of the relationship between farmers' attitudes (neutral, agree, strongly agree) and the type of physical soil water conservation (SWC) activities implemented (stone bund, soil bund, both).

**Table 8 Attitude of the farmer (FAMERATID)**

| Physical SWC activities | Farmers attitude | | | |
|---|---|---|---|---|
| | Neutral | Agree | Strongly agree | Total |
| Stone bund | 2 | 25 | 14 | 41 |
| Soil bund | 0 | 11 | 5 | 16 |
| Both | 4 | 29 | 18 | 51 |
| Tota | 6 | 65 | 37 | 108 |
| Chi-square | | | | 3.955 |

**Extension Service (EXTSRS):**

It indicates whether the household head gets extension service from development agents (DAs). Extension service provides the necessary information to acquire new skills and knowledge for farmers to improve soil conservation efforts.

The data on sources of agricultural information reveals how farmers learn about soil and water conservation (SWC) activities. For stone bunds, 1 farmer relies on other sources, none use mass media, and 40 consult extension agents. For soil bunds, 1 farmer uses other sources, 1 uses mass media, and 14 rely on extension agents. Households using both structures have 3 relying on other sources, 1 using mass media, and 47 consulting extension agents. Overall, extension agents are the primary source of information for farmers regarding SWC practices.The Chi-Square value of **7.18** reflects the association between the source of agricultural information for farmers (other, mass media, extension agent) and the type of physical soil water conservation (SWC) activities implemented (stone bund, soil bund, both).

**Table 8**

| Physical SWC activities | Source of Agricultural information for farmers | | | |
|---|---|---|---|---|
| | Other Farmer | Mass media | Extension Agent | Total |
| Stone bund | 1 | 0 | 40 | 41 |
| Soil bund | 1 | 1 | 14 | 16 |
| Both | 3 | 1 | 47 | 51 |
| Tota | **5** | **2** | 101 | 108 |
| chi-square | | | | 7.18 |

**Slope category of the farm**

expected, the slope variable has a strong positive effect on farmers' decision to participate in soilconservation practices. It significantly affects farmers' decisions on soil and water conservation practices.Based on sample farmers' respondent results, those farmers (21.3%) with flat category of their land have applied soil bunds to protect their soil from erosion. The data shows how farmers

| Physical SWC activities implemented by farmers | In what category of slope do your farms categorize | | | |
|---|---|---|---|---|
| | Flat | Gentle | Steep | Total |
| Stone bund | 6 | 20 | 15 | 41 |
| Soil bund | 11 | 4 | 1 | 16 |
| Both | 8 | 29 | 14 | 51 |
| Tota | 23 | 53 | 30 | 108 |
| Chi-Square | | | | 23.22 |

**security of tenure (SECTEN)**

Security of tenure indicates the scope the right farmer has to use his land for long-term development. Therefore, security gives the farmers confidence to invest in the land, bringing maximum benefits. On the other hand, farmers are expected to be reluctant to improve theirs and have no full rights on their land.Therefore, it is hypothesized that tenure security and soil conservation efforts are positively correlated.

The data on land inheritance rights shows strong support among farmers. For stone bunds, 34 farmers believe they have the right to inherit land, while 7 do not. In the case of soil bunds, 13 say yes and 3 say no. Among those using both structures, 47 affirm their rights and 4 do not. Overall, 94 farmers support inheritance rights, while 14 do not.

| Physical soil and water conservation activities | Do you think you have the right to inherit the land for your children? | | |
|---|---|---|---|
| | Yes | NO | Total |
| Stone bund | 34 | 7 | 41 |
| Soil bund | 13 | 3 | 16 |
| Both | 47 | 4 | 51 |
| Tota | 94 | 14 | 108 |

**Area of farmland (Farm Size)**

Soil and water conservation structures may take some area that would have been used for the farm (growing of crops). Therefore, farmers who operate on larger farms can allocate some part of the land more than on small farms. On the other hand, farmers with a more apparent farmland size seem to be less interested in investing more time in soil and water conservation practices; instead, they like to increase their production by extending their farm size.The mean land sizes for different physical structures implemented by households are as follows: stone bunds average 0.63 hectares, soil bunds average 0.96 hectares, and those using both structures average 0.69 hectares. Overall, the total mean land size across all households is 0.74 hectares, indicating that households using soil bunds tend to have larger land sizes on average.

| Physical structures implemented by survey Household Head | Mean of Land size |
|---|---|
| Stone bund | 0.63 |
| Soil bund | 0.96 |
| Both | 0.69 |

| | |
|---|---|
| Tota Mean | 0.74 |

| Independent Variables | Stone Bund vs. Both Bunds | SE | EXP(B) | Wald | Sig. | Soil Bund vs. Both Bunds | SE | EXP(B) | Wald | Sig. |
|---|---|---|---|---|---|---|---|---|---|---|
| Intercept | 26.14 | 3.13 | 67.42 | 66.36 | 0.001** | 66.36 | 1283.9 | 0.003 | 0.959(NS) | |
| AGEHH | 15.29 | 0.66 | 3.44 | 286.18 | 0.000*** | 15.06 | 0.58 | 4.8 | 272 | 0.000*** |
| SEXHH | 0.47 | 0.318 | 0.194 | 1.107 | 0.324(NS) | 0.038 | 0.39 | 0.5 | 0.005 | 0.46(NS) |
| EDUCHH | 17.122 | 1.211 | 2.57 | 199.8 | 0.031** | 18.73 | 0.51 | 3.6 | 1.31 | 0.000*** |
| FAMSIZ | 10.2 | 0.34 | 3.36 | 45.9 | 0.000*** | -0.93 | 1.31 | 0.22 | 0.73 | 0.41(NS) |
| DPNCY | -13.93 | 1.35 | 2.86 | 53.87 | 0.000*** | -28.9 | 1.76 | 5.8 | 252.68 | 0.000*** |
| FARMSZ | 13.53 | 0.47 | 5.21 | 228.2 | 0.000*** | 0.48 | 2.04 | 1.62 | 0.115 | 0.56(NS) |
| FINCOM | 13.86 | 0.34 | 3.4 | 176.8 | 0.000*** | 11.21 | 0.34 | 2.35 | 164.5 | 0.000*** |
| FAMERATID | 0.29 | 0.8 | 1.34 | 0.14 | 0.706(NS) | -1.54 | 1.26 | 0.21 | 1.5 | 0.22(NS) |
| EXTSRS | 12.8 | 0.37 | 1.6 | 94.9 | 0.36(NS) | 7.08 | 0.68 | 0.12 | 0.32 | 0.1(NS) |
| SECTEN | 0.21 | 0.35 | 0.76 | 0.19 | 0.26(NS) | 0.145 | 0.33 | 0.67 | 0.09 | 0.35(NS) |
| SLOP | 1.59 | 0.66 | 5.69 | 5.66 | 0.000*** | 0.7 | 0.45 | 2.02 | 3.29 | 0.09** |

## 4.2 model result

### 4.2.1.Econometric Model results on predictors of Stone Bunds base Category is both (Stone Bund and Soil Bund)

## Summary of Quantitative analysis for Soil bund and stone bund

**AGEHH (Age of Household Head)**:

A study by **Zhang et al. (2016)** found that older farmers are more likely to adopt SWC practices due to their extensive experience and understanding of soil management. The authors noted that age significantly increases the likelihood of implementing conservation techniques, the econometric result depicts positively influenced Soil and Water Conservation activities when the household age increases or the older farmers tend to take conservation work increase; this may be due to prolonged experience with soil erosion.

the above table result, with a unit increase in the age of the household head, there is a **3.44 unit increase** in the odds of adopting Stone Bunds ($p = 0.001$). Older farmers may possess more experience or resources, enhancing their capacity for sustainable practices. Additionally, they might have greater access to information and networks promoting these methods. This trend is indicative of the value placed on experience in agricultural innovation.For Soil Bunds, a unit increase in age corresponds to a **4.8 unit increase** in odds of adoption ($p = 0.001$), further emphasizing the positive relationship between age and sustainability. Both practices show a positive correlation with age, but Soil Bunds appear to benefit more from older household heads. This suggests that educational outreach should consider leveraging the experience of older farmers to promote both practices effectively.

**EDUCHH (Education Level of Household Head)**

Education enhances farmers' capacity to access, process, and utilize information, which is crucial for adopting Soil and Water Conservation (SWC) practices. Studies show that higher education levels correlate with increased participation in conservation activities, as educated farmers are better equipped to understand sustainable practices and their benefits **(Adesina & Baidu-Forson, 1995; Adebayo et al**.,

**2018**).Education level increases farmers' ability to get, process, and use information. Based on the literature reviewed and researchers' investigation, it is hypothesized to participate positively in soil conservation practices. For Stone Bunds, each additional unit increase in education level results in a **2.57 unit increase** in the odds of adoption (p = 0.031). Educated individuals are likely to be more aware of the benefits of sustainable farming techniques. They may also be better equipped to implement these practices effectively. This suggests that educational initiatives could play a crucial role in enhancing agricultural sustainability

For Soil Bunds, the odds increase by **3.6 units** for each unit increase in education level (p =0.001), indicating that education has a stronger positive influence on this practice.**Conclusion**: Education is a significant predictor for both practices, with a stronger effect for Soil Bunds. This highlights the importance of enhancing educational opportunities, particularly for Soil Bund adoption.

**DPNCY (Dependency Ratio)**

The dependency ratio is also a socio-demographic factor referring to the consumerworker ratio. This variable was hypothesized to influence Soil and Water Conservation practices negatively. An increase in the consumer-worker ratio reduces the availability to meet subsistence needs and increases the personal rate of time preference (Shiferaw and Holden 1998).above table indicats that

For Stone Bunds, a higher dependency ratio leads to a **2.86 unit decrease** in the odds of adoption (p 0.001). This trend indicates that households with more dependents may face financial constraints limiting their ability to invest in farming innovations. The economic pressures of supporting a larger family can detract from resources available for sustainable practices.

In the case of Soil Bunds, the odds decrease by **5.8 units** with an increasing dependency ratio (p = 0.001), indicating that households burdened with dependents may prioritize immediate needs over long-term agricultural practices. The negative impact of dependency ratios on both types of bunds underscores the importance of economic support systems. However, the stronger effect on Soil Bunds suggests a need for targeted financial assistance to households with higher dependency ratios.

**FINCOM (Household Income)**:

Household income (FINCOM) is an economic factor that positively influences Soil and Water Conservation (SWC) practices by alleviating liquidity constraints. Higher income levels enable farmers to invest in conservation technologies and practices, as they have more financial resources to allocate toward sustainable agriculture (Shiferaw et al., 2009) econometrics result shows that For Stone Bunds, each unit increase in household income results in a **3.4 unit increase** in the odds of adoption ($p = 0.001$). Higher income enables households to access necessary inputs and technologies for effective farming. This financial capacity significantly influences the ability to adopt sustainable methods.For Soil Bunds, the odds increase by **2.35 units** with rising income levels ($p = 0.001$), emphasizing that financial resources are essential for adopting both practices. Income positively influences the adoption of both practices, but its effect is stronger for Stone Bunds. This indicates that improving household income is critical for promoting sustainable farming across different practices.

**SLOP (Slope Category)**

Studies indicate that farms with steeper slopes are more likely to implement stone bunds and other erosion control techniques, as these practices effectively reduce runoff and enhance soil retention (Mekuria et al., 2011) The slope of the farm was hypothesized to influence conservation activity positively For Stone Bunds, a unit increase in slope results in a **5.69 unit increase** in the odds of adoption ($p < 0.001$). Steeper terrains are likely more suited for Stone Bunds, which are effective in controlling erosion. This indicates that environmental factors can significantly influence agricultural decisions.For Soil Bunds, the slope effect is marginally significant, with a **2.02 unit increase** in the odds of adoption ($p = 0.09$), suggesting that while terrain may influence adoption, its effect is less pronounced compared to Stone Bunds.The significant influence of slope on Stone Bunds emphasizes the importance of environmental characteristics in agricultural practices, while the marginal effect for Soil Bunds suggests that farmers may need tailored advice based on their specific terrain.

These findings underscore the critical factors influencing the adoption of both Stone and Soil Bunds. Age, education, and income emerge as strong positive predictors for both practices, while the dependency ratio negatively impacts the likelihood of adoption. The slope plays a significant role, particularly for Stone Bunds. Notably, the results indicate that while both practices benefit from similar factors, there are distinct variations in their influences, with Soil Bunds showing stronger correlations with education and a greater negative impact from dependency ratios. Understanding these relationships

can guide targeted interventions to promote sustainable farming practices effectively, thereby improving agricultural resilience and productivity.

In the comparison of **Stone Bunds** against **Both Bunds**, the significant variables include the intercept, age of the household head (AGEHH), education level of the household head (EDUCHH), dependency ratio (DPNCY), household income (FINCOM), and slope (SLOP). Each of these factors plays a crucial role in determining the likelihood of adopting Stone Bunds. For **Soil Bunds** versus **Both Bunds**, the significant variables are the age of the household head, education level, dependency ratio, household income, and a marginally significant effect of slope. The intercept for Soil Bunds is not significant. Overall, both models identify age, education, income, and dependency ratio as key predictors of adoption, with slope being a more pronounced factor for Stone Bunds.

## 4.3 Physical Soil and Water Conservation practices adopted by farmers in the study area

Based on the qualitative survey, farmers in the study area have adopted several Soil and Water Conservation practices:

**Stone Bund and Soil Bund Construction**: Many farmers utilize stone bunds or stone terraces, regardless of agro-climatic variations. Stone bunds are labor-intensive and primarily employed in areas where stones are available. They are effective in preventing soil erosion, especially on steep slopes, capturing soil washed away by floods.While other conservation methods can be effective when designed properly by local specialists, soil bunds are less frequently used. Some farmers with flatter land attempt to implement soil bunds, but often with poor design, which leads to reduced effectiveness in soil conservation. This highlights the need for improved design and training in soil bund construction.

### Soil Bund

Soil bunds improve soil conservation by involving the construction of a trench, with the excavated soil thrown downhill to create an embankment. Over time, this process facilitates the deposition of fertile soil in front of the embankment, allowing for the planting of hedge crops.

Survey results indicate that this structure was not commonly used by respondents, except in areas where NGOs have implemented Soil Conservation projects. Those who have utilized soil bunds noted several advantages, including:

- **Enhanced Soil Fertility**: The accumulation of fertile soil supports better crop growth.
- **Erosion Control**: The bunds help prevent soil erosion during heavy rains.
- **Increased Water Retention**: The structure aids in retaining moisture in the soil, benefiting crops.
- **Support for Biodiversity**: Planting hedge crops can enhance local biodiversity and provide additional resources.

**Stone Bund**

Stone bunds are constructed by gathering stones along the contours of the land to create barriers that help in soil conservation. This method is particularly effective in areas with steep slopes, where it prevents soil erosion and captures sediment during heavy rainfall. The stones act as a solid structure that can withstand water flow and reduce the impact of floods.

Survey results show that while stone bunds are utilized by some farmers, their use is often limited to regions where stones are readily available. Farmers who have implemented stone bunds reported several advantages, including:

- **Durability**: Stone bunds are robust and can last longer than other soil conservation methods.
- **Effective Erosion Control**: They significantly reduce soil loss during heavy rains.
- **Improved Soil Retention**: By capturing sediment, stone bunds enhance soil fertility over time.
- **Minimal Maintenance**: Once established, they require less upkeep compared to other structures.

## 4.4 Definition of Variables used in Multinomial Logistic Regression Model

**Dependent and Independent/Explanatory Variables and their definitions applied in the Multinomial Logistic Model**

| Dependent variables are Physical Soil and Water Conservation Practices Dependent Variables: $Y_0$ = Stone Bund, $Y_1$ = Soil Bund, $Y_2$ = Stone Bund + Soil Bund Independent Variables | |
|---|---|
| AGEHH | Age of the household. |
| SEXHH | Sex of the respondent (1= Male, 0= Female) |
| EDUHHH | Education level of the respondent (1= Literate, 0= Illiterate) |
| DPNCY | Dependency ratio of the household. |
| FAMSIZ | Family size of the respondent. |
| FARMSZ | Farm size owned by the household. |
| FINCOM | Estimated amount of farm income. |
| FAMERATID | Attitude of a farm household toward SWC practices. |
| EXTSRS | Extension service delivered to farm households. |
| SECTEN | Security of tenure (1=if he can use the land in his lifetime, 0= otherwise) |
| SLOP | Slope category of the farm. |

### 4.3 Variance Inflation Factor for Continues Variables Multi-collinearity Test

Before running the Multinomial Logistic Model for analysis, it is imperative to check multicollinearity or association among the hypothesized independent variables.

The existence of multi-collinearity is the situation where independent variables are correlated. Hence, separating the effect of each explanatory variable from predicting the parameters of interest was challenging. As most econometricians suggest, two types of measures are often suggested for checking for multi-co linearity. Variance Inflation Factor (VIF) for associations among the Continuous explanatory variables and contingency coefficients for dummy variables.

**VIF** can be defined as:

$$\mathbf{VIF(xi) = 1/(1 - Ri\ 2\ )}$$

Where is co-efficient of multiple determinations, and the variable $x_i$ represents the explanatory variables? Each selected continuous explanatory variable and coefficient of determination are computed. VIF shows how the existence of multi-collinearity inflates the variance of the inflation factor. Suppose the VIF of a variable exceeds **10** (this will happen if $\mathbf{R^2}$exceeds **0.90**);

that variable is said to be highly collinear. The remedy is omitting variables with a value of 10 and more from the model analysis (Gujarati, 2004). Accordingly, the Variance Inflation Factor (VIF) was employed to test the degree of multicollinearity among continuous variables As a result, there was no multi-collinearity problem for the continuous drop from the model.

**Variance Inflation Factor (VIF) for Continuous Explanatory Variable.**

| Variables | VIF | Tolerance level |
|---|---|---|
| AGEHH | 8.06 | 0.124 |
| EDUCHH | 2.54 | 0.393 |
| FAMSIZ | 1.81 | 0.552 |
| DPNCY | 9.09 | 0.11 |
| FARMSZ | 1.46 | 0.681 |
| FAMINCOM | 1.35 | 0.74 |
| TLU | 6.53 | 0.153 |

### 4.3.1Contingency Coefficient for Dummy/Categorical Variable

Conversion coefficients were employed to test the degree of association among Dummy or Discrete variables. The contingency coefficient is a chi-square-based measure of association. The decision rule sets that when the result approaches 1, it indicates the existence of multi-collinearity, whereas values less than 0.75 indicate there is no problem

The contingency coefficients are computed as:

$$C=\sqrt{x}_2/N+x_2$$

Where, **C**= Coefficient of contingency, $\mathbf{X^2}$ = Chi-square random variable, **N** = total sample size

As indicated (Table 26), independent discrete variables have no high degree of association. Hence, all the variables were fitted into the logit model for further analysis. Contingency coefficient for dummy variables such as sex, social position, and land security.

**Contingency Coefficient for Dummy Variables**

| Variable | SEX | SOCP | PERC | ATTID | EXTSRS | SECTEN | TECHWAR | ASSIS | SLOP |
|---|---|---|---|---|---|---|---|---|---|
| SEXHH | 1 | 0.15 | 0.03 | 0.25 | 0.23 | 0.07 | 0.03 | 0.012 | 0.146 |
| SOCPOSN | | 1 | 0.244 | 0.104 | 0.307 | 0.093 | 0.141 | 0.091 | 0.155 |
| PERCP | | | 1 | 0.38 | 0.019 | 0.122 | 0.173 | 0.207 | 0.16 |
| FARMERATID | | | | 1 | 0.144 | 0.126 | 0.187 | 0.273 | 0.55 |
| EXTSRS | | | | | 1 | 0.112 | 0.186 | 0.302 | 0.227 |
| SECTEN | | | | | | 1 | 0.256 | 0.366 | 0.260 |
| TECHAWARE | | | | | | | 1 | 0.520 | 0.483 |
| ASSCOSOIL | | | | | | | | 1 | 0.598 |
| SLOP | | | | | | | | | 1 |

## 4.4 Summary of Qualitative Analysis

Farmers in the study area employ both improved and traditional soil conservation methods. Improved practices include enhanced stone bunds, soil bunds, and fanyajuu, alongside various physical and biological conservation techniques. Traditional methods comprise ditches, stone bunds, trash lines, and grass strips.

Focus Group Discussions and Key Informant Interviews revealed that both improved and traditional methods work together to combat soil erosion. Most farmers prefer hand tools for land preparation over oxen, which helps control soil erosion without additional conservation measures. However, the use of fanyajuu bunds and improved terracing is limited due to various constraints.

Farmers often adapt traditional systems lacking technical specifications, leading to significant variability in application. The most common traditional measures include crop residue covering, tie ridges, and trash lines. Traditional stone bunds are used where stones are available, while unploughed strips are rarely utilized due to land shortages. Tie ridges are constructed each cropping season and run

diagonally across cultivated fields, with some farmers using oxen to create ditches. Overall, a mix of methods reflects the farmers' adaptation to local conditions and resource availability.

# CHAPTER FIVE
# 5.CONCLUSION AND RECOMMENDATIONS

In response to the extensive degradation of its resource base, Ethiopia has made some efforts to mitigate the problem of soil erosion and enhance or maintain the production potential of the agricultural land with promoted Water and Soil Conservation mechanisms through the Ministry of Agriculture in Ethiopian highlands and other parts of the country where successive food deficit was recorded including the study area.

Yirgalem zurya woreda has made remarkable efforts to reduce the negative impact of erosion and covered significant areas with different physical and biological measures by mobilizing the whole community for free contributions and money in the PSNP program for the last 10 to 15 years. As the area is categorized as food insecure, different NGOs in Woreda were engaged in Soil and Water Conservation activities in different forms. The area still loses a tremendous amount of fertile topsoil, and the threat of land degradation is broadening alarmingly.

Farmers' perception of soil erosion and their responses to soil conservation practices have not been well studied. Moreover, the factors influencing soil conservation measures were not identified.

Therefore, this study's objective was to identify what factors affect the adoption of physical soil and water conservation practices and examine farmers' perceptions of soil and water conservation practices.

Both primary and secondary data were collected for this purpose. The primary data were collected from 108 proportionately and randomly selected sample households from 2 Kebeles in yirgalem zurya woreda while secondary data was from group discussions of different sources.

The multinomial logit model was applied to identify socio-demographic, Economic, Institutional, Psychological, and Physical factors that affect the adoption of soil and water conservation practices.

This study indicated that farmers' adoption of soil and water conservation decision was influenced by socio-demographic, economic, institutional, and physical factors. Education levels, age of household head, family size, and dependency ratio have influenced factors from socio-demographic factors;

Farmers in the study area used both improved and traditional soil conservation methods. Improved soil conservation practices include improved stone bund, soil bund, fanyajuu, and other physical and biological conservation methods. Indigenous soil conservation methods include traditional ditches, traditional stone bunds, making trash lines, leaving grass strips, etc.

## 5.1 Conclusion

In concluding the exploration of factors affecting the adoption of physical soil and water conservation practices, it is essential to synthesize the key elements that influence farmers' decisions and practices. The successful implementation of these conservation techniques is critical for sustainable agricultural development, environmental protection, and resource management.

Despite agriculture is the leading sector, the Ethiopian economy was and still characterized by low productivity in general and low yield per unit area in particular. This is attributed to faster rate of population growth, soil nutrient depletion, low crop productivity,

Most socio-economic factors were the primary determinant for farmers to undertake soil and water conservation measures which designers and planners mainly neglected to carry out conservation activities. Most farmers experience a land shortage, forcing them to use steep slopes for crop production, which is technically and scientifically not recommended.

Social norms and cultural practices can either facilitate or hinder the adoption of conservation practices. Peer influence and community engagement are vital; farmers are more likely to adopt practices that are validated by their peers. Additionally, cultural beliefs about land use and conservation can shape attitudes toward new practices

·Most farmers choose to prepare their land with hand tools rather than tilling it with oxen which enables them to protect their farmland from soil erosion. Furthermore, it enhanced them to allocate their parcel of small land for crop production rather than leaving their land for bunds construction. Traditional soil and water conservation practices are directly related to improved soil and water conservation practices. It was identified that those farmers who have traditional stone bunds, soil bunds, and cut-off drains have likely

shown their interest in implementing the structures in an improved manner.
Apart from the technical gap in selecting appropriate measurement that fits with sloppiness, farmland situation, and standardization, they have no problem perceiving soil and water conservation practices in the study area. This may be due to long-time experience with the consequences of soil erosion, The adoption of physical soil and water conservation practices is influenced by a complex interplay of economic, social, cultural, and policy-related factors. To promote these practices effectively, it is essential to address these factors holistically, fostering a supportive environment that encourages sustainable farming practices. Future initiatives should focus on enhancing education, providing financial incentives, and ensuring that policies are aligned with the goals of soil and water conservation, ultimately leading to more resilient agricultural systems.

## 5.2 Recommendations

Any soil and water conservation interventionist must understand a given locality's socio-economic conditions before undertaking any soil and water conservation activity.

Most of the best land is already in use, with considerable sloping areas for crop production and erosion problems. It can be expected that land-use planners will be called upon to help decide how best to use this sloping land. In preparing plans for these sloping lands, increasing attention will need to be given to preventing and controlling erosion

In implementing soil and water conservation practices, investigating existing local resources and the availability of farmland is vital because most farmers who have stones available in their locality are replayed and choose stone bunds to protect their farms. In addition, they chose this structure because it consumes less area when compared to soil bunds and
Most of the best land is already in use, with considerable sloping areas for crop production and erosion problems. It can be expected that land-use planners will be called upon to help decide how best to use this sloping land. In preparing plans for these sloping lands, increasing attention will need to be given to preventing and controlling erosion. A closer relationship between land-use planners and soil conservationists will need to be developed. At the same time, land-use planners will need to understand erosion and methods for its control better. Farmers' main problem with bund construction is the lack of enough spacing between bunds to intercept run-off before the flow becomes too large to create channels

and form rills. So there should be enhanced extension service to clarify his farm land's sloppiness and the recommended spacing between bunds to be constructed.

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**APPENDICES**

# APPENDIX I: Household Survey with Interview Schedule

**Name of the Enumerator: _____**
**Date: _____**

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## I. Psychological Factors

### 1. Farmer's Perception of Soil Erosion

**1.Is your farmland prone to erosion?**
(1) Yes
(2) No

**2.If 'Yes', how much of your farmland is affected by erosion (in ha)?**

---

3.**How do you perceive the level of your parcel's exposure to soil erosion?**
(1) No risk
(2) Medium
(3) High exposure to erosion

**4.Has your farmland been severely affected by soil erosion before?**
(1) Yes
(2) No

**5.If 'Yes,' what has been the severity of erosion on your farming plots since you started farming?**
(1) Very severe
(2) Severe
(3) Minor

**6.When did the soil erosion problem start on your farm?**
(1) Before birth (heard from parents)
(2) Since childhood
(3) In recent years (before _____ years)
(4) Others (specify): _____

**7.How does your household perceive soil depth/fertility since starting farming compared to the past?**
(1) Increasing
(2) Decreasing
(3) No change
(4) Do not know

**8.If the answer to question 7 is 'Decreasing', what measures did your household take to rehabilitate conditions?**
(1) Apply Manure
(2) Apply Chemical Fertilizer
(3) Practice Terracing
(4) Planted Trees or Grass
(5) Fallow System
(6) Strip Cropping along the contour
(7) Bunds Construction (soil bunds, stone bunds, and both)
(8) Check Dams
(9) Others (specify): _____

**9.How severe is the decline in soil fertility on the main plot of your farm since you started farming concerning average year/adequate rainfall?**
(1) Very Serious
(2) Serious
(3) Minor
(4) No problem

**10.Do you think soil erosion will affect your farmland in the future if situations remain unchecked?**
(1) Yes
(2) No

**11.If 'Yes', what would you recommend to tackle this problem?**
(1) Practice Terracing (hillside)
(2) Planted Trees or Grass
(3) Fallow System
(4) Strip Cropping along the contour
(5) Bunds Construction (soil bund, stone bund, fanyaju)
(6) Check Dams
(7) Others (specify): _____

**12.Physical Soil and Water Conservation activities implemented by farmers on their farms:**
(1) Stone Bund
(2) Soil Bund
(3) both
(4) Terracing
(5) Combination

## 13.Perception of farmers towards soil erosion as a problem

| S. No. | Statements | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|---|
| 1 | Supply of enough water is good for plant growth | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 2 | Less water supply deteriorates plant growth | | | | | |
| 3 | Frequent tillage of land by oxen will promote the quality of the soil | | | | | |
| 4 | Frequent ploughing incurs a higher cost for the poor farmers | | | | | |
| 5 | Indigenous soil water conservation practices reduce the soil erosion | | | | | |
| 6 | Indigenous soil and water conservation practices may not be appropriate for sloppy areas. | | | | | |
| 7 | Soil and water conservation practices make the land productive | | | | | |
| 8 | Poor soil and water conservation practices lead to land degradation. | | | | | |
| 9 | Effective land management practices protect the damage to structures | | | | | |
| 10 | Heavy rain creates a loss of the land management structure | | | | | |

**15. The following are significant causes of soil erosion**

| S. No. | Causes of Soil erosion | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|---|
| **1** | Deforestation | | | | | |
| **2** | Overgrazing | | | | | |
| **3** | Over cultivation | | | | | |
| **4** | Poor agricultural practices | | | | | |
| **5** | Cultivation of steep slopes | | | | | |
| **6** | Excess rainfall | | | | | |
| **7** | Poor government policies | | | | | |

## 16. The consequences of soil erosion

| S. No. | Statements | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|---|
| **1** | Land productivity (yield) decline | | | | | |
| **2** | Change in type of crops grown | | | | | |
| **3** | Reduces farm plot size | | | | | |
| **4** | Silt deposition | | | | | |
| **5** | Road dissection | | | | | |

## 17. Attitudes toward Soil and Water Conservation

| S. No. | Statements | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|---|
| 1 | Soil and water conservation measures retain the soil macro-nutrient | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 2 | Depletion of soil macro-nutrients from the land occurs due to mismanagement of the farmland | | | | | |
| 3 | Proper soil management practices will increase the income of the farmers | | | | | |
| 4 | Sound soil and water conservation management requires huge expenditure | | | | | |
| 5 | Effective soil management will promote the yield of the farmers. | | | | | |
| 6 | Lack of farmers' knowledge of soil and water conservation will reduce the yield | | | | | |

The following types of soil conservation measures are efficient in reducing the problem of soil erosion in your farmland

| S.No. | Types of Soil Conservation Measures | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|---|
| 1 | Stone bund | | | | | |
| 2 | Soil band | | | | | |
| 3 | Fanyajuu | | | | | |
| 4 | Cut off drain | | | | | |
| 5 | Hillside terrace | | | | | |
| 6 | Waterway | | | | | |

What are the problems related to each soil conservation structure?

| S.No. | Categories of Problem | Soil bund | Stone bund | both |
|---|---|---|---|---|
| 1 | Source of wild grass invasion | | | |
| 2 | Reduce farmland size | | | |
| 3 | Difficult to turn oxen | | | |
| 4 | Difficult to implement | | | |
| 5 | Labour intensive | | | |
| 6 | Others, (Specify) | | | |

V) Institutional Factors

## 1. Security of Tenure

1.1) To whom do you think that the land belongs?

1.To my own

2. To the government

3. Other_____

1.2) Do you think you have the right to inherit the land for your children?

1= Yes 2= No

1.3) Do you expect that you will use the land throughout your lifetime? 1= Yes, 2= No

1.4) Do you agree that the government allows farmers to sell their land?

1) Agree 2) Disagree 3) Difficult to decide

1.5) Have you rented the land before? 1= Yes 2= No

1.6) If ´Yes´, who is responsible for keeping the rented land quality?

1) The owner

2) Myself

3) Both of us

1.Do you agree that existing Soil and Water Conservation practices support Kebele farmers?

2.How can the land management strategies be improved in your Kebele?

3.What factors affect the adoption of Physical Soil and Water Conservation Practices in Woreda?

4.What are Physical Soil & Water Conservation practices adopted by farmers in the study area?

5.What is the Development Agent's contribution to saving the Kebele farmers in Soil and Water Conservation practices?

6.What is the role of government in Physical Soil and Water Conservation practices?

How is the extension structure and support to far

| Independent Variables | Stone Bund vs. Both Bunds | SE | EXP(B) | Wald | Sig. | Soil Bund vs. Both Bunds | SE | EXP(B) | Wald | Sig. |
|---|---|---|---|---|---|---|---|---|---|---|
| Intercept | 26.14 | 3.13 | 67.42 | 66.36 | 0.001** | 66.36 | 1283.9 | 0.003 | 0.959(NS) | |
| AGEHH | 15.29 | 0.66 | 3.44 | 286.18 | 0.000*** | 15.06 | 0.58 | 4.8 | 272 | 0.000*** |
| SEXHH | 0.47 | 0.318 | 0.194 | 1.107 | 0.324(NS) | 0.038 | 0.39 | 0.5 | 0.005 | 0.46(NS) |
| EDUCHH | 17.122 | 1.211 | 2.57 | 199.8 | 0.031** | 18.73 | 0.51 | 3.6 | 1.31 | 0.000*** |
| FAMSIZ | 10.2 | 0.34 | 3.36 | 45.9 | 0.000*** | -0.93 | 1.31 | 0.22 | 0.73 | 0.41(NS) |
| DPNCY | -13.93 | 1.35 | 2.86 | 53.87 | 0.000*** | -28.9 | 1.76 | 5.8 | 252.68 | 0.000*** |
| FARMSZ | 13.53 | 0.47 | 5.21 | 228.2 | 0.000*** | 0.48 | 2.04 | 1.62 | 0.115 | 0.56(NS) |
| TLU | 7.08 | 1.09 | 7.95 | 1.63 | 0.14(NS) | 0.69 | 1.15 | 2.67 | 0.72 | 0.4(NS) |
| FINCOM | 13.86 | 0.34 | 3.4 | 176.8 | 0.000*** | 11.21 | 0.34 | 2.35 | 164.5 | 0.000*** |
| PERCP | 1.03 | 1.56 | 1.82 | 0.44 | 0.506(NS) | 1.1 | 0.85 | 3.03 | 1.7 | 0.19(NS) |
| FAMERATID | 0.29 | 0.8 | 1.34 | 0.14 | 0.706(NS) | -1.54 | 1.26 | 0.21 | 1.5 | 0.22(NS) |
| EXTSRS | 12.8 | 0.37 | 1.6 | 94.9 | 0.36(NS) | 7.08 | 0.68 | 0.12 | 0.32 | 0.1(NS) |
| SECTEN | 0.21 | 0.35 | 0.76 | 0.19 | 0.26(NS) | 0.145 | 0.33 | 0.67 | 0.09 | 0.35(NS) |
| TECHAWARE | 0.26 | 0.28 | 0.84 | 0.44 | 0.17(NS) | 0.24 | 0.28 | 1 | 0.37 | 0.195(NS) |
| ASSCOSOIL | 6.48 | 0.59 | 9.89 | 86 | 0.79(NS) | 6.84 | 0.59 | 9.89 | 86 | 0.79(NS) |
| SLOP | 1.59 | 0.66 | 5.69 | 5.66 | 0.000*** | 0.7 | 0.45 | 2.02 | 3.29 | 0.09** |

# THANK YOU