COLLEGE OF AGRICULTURE AND NATURAL RESOURCES

DEPARTMENT OF NATURAL RESOURCE MANAGEMENT

ASSESSING EFFECTS OF SOIL AND WATER CONSERVATION MEASURES ON LAND PRODUCTIVITY OF CHEHA WOREDA IN CASE OF GASORE KEBELE GURAGE ZONE IN CENTRAL ETHIOPIA

A **SENIOR RESEARCH PAPER SUBMITTED TO COLLEGE OF AGRICULTURAL AND NATURAL RESOURCE, DEPARTMENT OF NATURAL RESOURCE MANAGEMENT WOLKITE UNIVERSITY FOR FULFILLMENT FOR REQUIREMENT FOR THE DEGREE OF BACHELORS OF SCIENCE IN NATURAL RESOURCE MANAGEMENT.**

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APRIL 2025

WOLKITE, ETHIOPIA

APPROVAL SHEET

Assessing effects of soil and water conservation measures on land productivity in case of Gasorie Kebele, Cheha Woreda, Gurage Zone, Central Ethiopia Region, Ethiopia

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AKNOWELDGEMENT

First and foremost we would like to thanks almighty of God for his immeasurable help and complete this work successfully, secondly we, greatest thank for our advisor Mr. Degemu .A for his full heart and unreserved comments, advice in conducting, editing this research project. And also, we would like to thank all respondent farmers and district agricultural of the kebele for their willingness to provide information.

LISTS OF ACRONYMS

CSA	Central Statistical Agency
DA	Development Agency
FAO	Food and Agriculture Organization.
HHS	Households
IRAF	International Research on Agroforestry
NMA	National Meteorological Agency
SWC	Soil and Water Conservation
UNCCD	United Nations Convention to Combat Desertification
WOCAT	World Overview of Conservation Approaches and Technologies

Table of Contents

List of Table

List of Figure

ABSTRACT

This study assessed the effects of Soil and Water Conservation (SWC) measures on land productivity in Gasore Kebele, Cheha Woreda, Gurage Zone, Central Ethiopia. With agriculture as the backbone of Ethiopia's economy, land degradation caused by soil erosion, deforestation, and unsustainable farming practices poses significant threats to food security and livelihoods. The research employed a mixed-methods approach, combining household surveys (n=88), key informant interviews, and field observations to evaluate the impacts of SWC practices.

Findings revealed that 95% of farmers implemented SWC measures, with 84% adopting both physical (terraces, stone bunds) and biological (agroforestry, mulching) techniques. These interventions significantly improved land productivity, with 72% of respondents reporting moderate enhancements in soil fertility and crop yields, while 20% observed high improvements. Additionally, 96% of farmers acknowledged SWC's effectiveness in reducing soil erosion and land degradation. However, challenges such as over cultivation (29%), deforestation (12%), and overgrazing (23%) persisted, with 40% of respondents indicating severe erosion risks.

The study highlights the critical role of SWC in sustainable land management but underscores the need for targeted interventions, including farmer education, policy support, and community engagement

Keywords: *Soil and Water Conservation, Land Productivity, Soil Erosion,*

1. INTRODUCTION

1.1. Background of the study

Soil and water conservation (SWC) measures are vital components of sustainable agricultural practices, particularly in regions experiencing significant land degradation. In Ethiopia, where agriculture is the backbone of the economy, the challenges posed by soil erosion and declining soil fertility are critical issues that threaten food security of environmental stress due to factors such as deforestation, overgrazing, and unsustainable farming practices. Teshome et.al (2020)

Land productivity is essential for ensuring food security, sustaining livelihoods, and promoting economic development, particularly in heavily dependent on agriculture. Land degradation in the form of soil erosion, deforestation, overgrazing, salinization and alkalization contributes significantly to low agricultural productivity. This causes food insecurity and poverty in many developing countries of the world including Ethiopia (Addisu *et al*., 2015).

In Ethiopia, nearly half the population (41%) lives on severely degraded land, which constitutes about 10% of the country's overall area (FAO, 2005, cited in Sisay, 2016). Land degradation has been a significant global issue throughout the 20th century and continues to be of high importance in the 21st century, as it impacts the environment, agricultural productivity, food security, and overall quality of life (Eswaran *et al.,* 2001). Soil erosion alone leads to an annual loss of approximately 24 billion tons of fertile soil, resulting in reduced land productivity and increased vulnerability to climate change (Pimentel & Burgess, 2013). To address these challenges, Soil and Water Conservation (SWC) measures have been widely promoted as effective solutions to mitigate land degradation and enhance agricultural productivity (Lal, 2015).

Assessing the effect of SWC measures on land productivity involves evaluating changes in soil quality, moisture content, and crop yields before and after the implementation of conservation practices the most effective measures for specific agro-ecological contexts (Bossio *et al*., 2010). For instance, research in the Ethiopian Highlands revealed that soil bunds and terraces significantly reduced soil loss and increased maize yields by up to 50% compared to non-conserved plots (Hurni, 1993). Similarly, studies in Tanzania showed that contour bunding and agroforestry practices improved soil moisture retention and enhanced crop productivity (Tenge *et al*., 2005).

The problem is primarily caused by soil erosion; that cause by cultivation of steep slope and inadequate investments in soil conservation, erosive rain falls patterns, declining use of fallow, limited recycling of crop residues to the soil, deforestation and overgrazing (Belay, 2003). Soil erosion is the main form of land degradation, caused by the interacting effects of factors, such as biophysical characteristics and socio-economic aspects. Degradation resulting from soil erosion and nutrient depletion is one of the most challenging environmental problems in Ethiopia. The Ethiopian highlands have been experiencing declining soil fertility and severe soil erosion due to intensive farming on steep and fragile land (Amsalu and de Graaff, 2006).

Erosion removes the most productive portion of soil, that is, the chemically active part such as organic matter and clay fractions. It also causes a deterioration of soil structure, moisture holding capacity through lowering soil depth, increasing bulk density and reducing water infiltration. Thus, soil erosion has been a major threat to the reduction of productive capacity of the soil (Nsabmana*et al*., 2008). To reverse the major problems of soil erosion, massive soil and water conservation and aforestation program have been ongoing in Ethiopia since the early 1970s (Bekele and Holden, 1998; Gemachu, 1988).

To overcome the problem of soil and water conservation practice, the current Government of Ethiopia has taken different measures such as policy interventions, conducted studies, and implemented massive (SWC) and capacity building programs, especially after the 1987/88 of rainy seasons (Shiferaw and Holden 1999; Tilahun 2006). Since 1990s, resource conservation activities mainly SWC works in cultivated land have been undertaken as part of agricultural extension package of present government.

In Ethiopia, where sustainable land management is priority for the overall development, availability of relevant soil and water conservation information at all levels are very crucial (Million, 2000) cited in Temesgen,(2015). Since soil and water conservation in Ethiopia was closely related to the sustainable development of its agricultural productivity and economical at large. Similarly in the study area there are a number of physical and biological SWC measures that are applied by the involvement of local peoples both in the farm and outside the farm land.

So in this view study was worthwhile to assess the effects of that conservation measures on the land productivity in the study area (Lal, R. 2015).

1.2. Statement of the Problem

Agricultural productivity in Ethiopia is increasingly threatened by soil erosion and land degradation, which includes soil degradation, water pollution, nutrient depletion, deforestation and degradation of vegetation cover, is major ecological problem in Ethiopia (Temesgen, 2012). Land degradation and soil erosions are caused by lack of effective SWC practice, in appropriate land use and mismanagement of natural resource. The outcome of those problems brings to decline in soil fertility status led to diminish agricultural production, increasing food insecurity and low income of stallholder farmers. In spite of the efforts made over the last two decades in the agricultural sector, a combination of population growth, little intensity of soil and water conservation practices, and climate disruption has resulted in a dramatic fall in per capita food production (Wegayehu, 2006).

The problem in Cheha Woreda that prompted this study is the degradation of agricultural lands due to soil erosion and water scarcity, leading to declining land productivity and food insecurity in the area. Despite the implementation of various soil and water conservation (SWC) measures, there is a lack of comprehensive studies assessing their effectiveness in improving land productivity in specific kebele like gasore. This research aims to fill this gap by evaluating the impact of SWC measures on land productivity in gasore kebele, providing valuable insights for sustainable agriculture and natural resource management in the region.

1.3. Objectives

1.3.1. General Objective of the Study

The general objective of this study is to assess the effect of SWC measures on land productivity of Cheha Woreda, in case Gasore kebele in Central Ethiopia Region, Ethiopia

1.3.2. Specific Objective of the Study

- To identify the impacts of SWC measures on land productivity
- To assess the extent of soil erosion and land degradation in the study area
- To identify the type of SWC practices that carried out on the study area.

1.4. Research questions

In order to assess the effect of SWC measures on land productivities the following research question will be answered.

- How do SWC measures impact land productivity in the study area?
- What is the extent of soil erosion and land degradation in the study area?
- What are the specific types of SWC practices being implemented in the study area?

1.5. Significance of the Study

The finding of this research can be used as input for research institute, policy maker, academic purpose and also assist local farmers to design effective soil and water conservation technology practices by knowing the adverse effect of not practicing this technology. Moreover, farmers of the study area know the correlation between soil erosion and land productivity as they are two side of the same coin. This help to develop sustainable manage.

1.6. Scope of the study

The scope of this study was limited to Gasore Kebele, Cheha Woreda, Central Ethiopia region.

The study was focus on the assessing of SWC measures on land productivity in the study area.

1.7. Limitation of the study

While this study aims to provide a comprehensive understanding of how soil and water conservation (SWC) measures impact land productivity, there are some limitations to consider.

First, the differences in ecological zones, soil types, and climate across the study areas may affect how widely the findings can be applied. Second, there are challenges related to data availability and quality. In some areas, historical information on land productivity and previous conservation efforts may be missing or inconsistent. This can make it difficult to accurately compare results over time. Additionally, data reported by farmers can be useful but might also include personal biases, which could influence the findings.

2. LITERATURE REVIEW

2.1. Concepts of Soil and Water Conservation and Related Terms

2.1.1 Soil

Soil is one of the most important of all natural resources. It hosts both animate and inanimate beings. Soil is defined as a natural body that consists of layers (horizons), composed primarily of minerals, which differ from their parent materials in their texture, structure, consistency, colour, chemical, biological and other physical characteristics (Birkeland, 1999). Soil is the most fundamental and basic resource as a medium for plant growth (Blanco and Lal, 2008). However, soil provides four main functions, including production functions, physiological functions, cultural functions and ecological functions (Mitiku*et al*., 2006)

2.1.2 Soil and Water Conservation

There are different definitions of soil and water conservation measures separately and/or together. Sanders (2005), defined soil and water conservation as a combination of appropriate land use and land management practices that promote productivity and sustainable use of soil and water resources, which minimize soil and water resource degradation. Soil conservation practices involve managing soil erosion and its counterpart process of sedimentation, reducing its negative impacts and exploiting the new opportunities it creates and it is the function of controlling erosion and maintaining soil fertility. Farmers with larger farm land area are more likely to use improved soil and water conservation measures to reduce soil erosion and conserve water in their farm land than farmers with small farm land (Kirubel*et al.,* 2011).

Soil and water conservation refers to a set of practices designed to protect soil and water resources, thereby enhancing agricultural productivity and sustainability. According to Pimentel et al. (1995), SWC practices aim to prevent soil erosion, improve soil fertility, and manage water resources effectively. These measures are crucial in combating the adverse effects of land degradation, which has been identified as a primary factor contributing to declining agricultural productivity globally (FAO, 2021). Soil and water conservation interventions are first and foremost a response to the perceived land degradation problem (Mazzucato and Niemeigerm, 2000). They include all forms of human actions to prevent and treat soil degradation (Demeke, 2009). Basically physical SWC

practices are categorized in to two: traditional (indigenous) and improved practices. Whether the measures might be these measures aim to control run off, improve soil fertility and harvest water.

According to Yohannes (2006), SWC is defined to be a practice or idea generated locally or imported from outside and transformed by the local people and interpreted in their way of life. Whereas Kruger *et al*. (2009) understood traditional conservation measures as a farming practice that have involved through the course of time without any known outside institutional interventions and which have same soil conservation effects. Various mechanical, biological agronomic techniques used by farmers in various combinations are incorporated in the term.

The traditional SWC are simple structures of a short-term nature that could be reshuffled each to year to make use of the soil captured above the structure and avoid rodent production. These structures are much more flexible and tend to spread labor requirements for construction and maintenances (Scoones *et al*., 2008). They are frequently site specific and accordingly vary in purpose. They may harvest water in low land areas (with the help of tide ridges, level physical SWC structures); conserve soil in-situ (traditional stone and soil bund), dispose of excess water from crop lands during heavy rains, improve drainage and conserve soil while simultaneously increasing soil fertility (agroforestry, mixed cropping and intercropping) (Kruger *et al.,* 2009).

2.2. Physical and Biological Soil and Water Conservation Measures

2.2.1. Physical Soil and Water Conservation Measures

Physical SWC measure is mechanical barriers constructed on the land surface to protect the soil from the effect of excessive run off. Terraces, stone bunds, soil bunds, cut off drain, fanyajuu and water ways are some example of physical SWC measures (Tewodros, 2009). The function of terraces in humid areas are to decrease the length of slopes and their by reduce erosion and allow for sediment to settle, where as in drier areas it serves to retain run off and increase water available for plant growth (Schwab, 2002). Terracing is one of the most common physical SWC measures, especially in hilly and mountainous regions. Studies have shown that terracing can reduce soil loss by up to 60% and increase crop yields by 25-50%, depending on local conditions (Tenge *et al*., 2005; Mekonnen *et al*., 2018).

The function of stone bunds is to reduce surface runoff, trap eroded soil particles, and promote water infiltration, which helps to prevent soil degradation and improve soil fertility Sharma *et al.* (2010)**,** Fanyajuu (Gilbert Irken) it is a physical method of soil and water conservation, which is similar to soil bund commonly constructed in a very steep slope land. Fanyajuu is a traditional soil and water conservation method practiced primarily in East Africa, particularly in Kenya, to manage water runoff and prevent soil erosion on agricultural land Gichuki *et al*. (2004)**,** Check dams are small and low drop structures built across channel to prevent it from deepening further. The dams decrease the slope gradient, reducing the velocity of water flow and the erosive power of the runoff (Shrestha*et al.,* 2012). Waterways In the research site especially lowland part in the rainy season, farmers used the waterway to remove excess water in their farmland (Schwab *et al.* (2002). Cut off Drain soil and water conservation era have been broadly practised by using lowlander research sites in the lowland explained that cut off drain became more effective than other soil and water conservation technologies inside the black soil kind to prevent the farmland from high excessive rainfall erosion Shrestha *et al*. (2012).

2.2.2. Biological Soil and Water Conservation Measures

It is a measure that is applied by covering the surface of the land by vegetation or other dead and live organism to reduce soil erosion, to improve the quality and fertility of the soil (Amanul, 2002). The most commonly used type of biological SWC measures are mulching, strip cropping, cover crop, crop rotation and green manuring (Hough, Hammond and Bennent, 2009).

Cover Cropping: Cover crops are non-harvested plants grown primarily for soil conservation purposes. They help to reduce soil erosion, improve soil organic matter, and enhance nutrient cycling. According to Glover *et al*. (2010), the use of cover crops like legumes and grasses has been shown to significantly increase soil fertility and water infiltration, which are key factors in enhancing land productivity.

Mulching**:** Mulching with organic materials such as straw, leaves, and grass is another biological SWC practice that improves land productivity. According to Farage *et al.* (2010), mulching provides a protective layer on the soil surface, reducing evaporation, maintaining soil temperature, and preventing soil erosion. By enhancing water retention and improving soil organic matter,

mulching significantly boosts soil fertility and crop growth, especially in areas affected by water stress or drought.

Manuring: In the study area, the mixed farming system is a common one. As proportional most of the people were participate in Enset (false banana) production because of the common type of food is Kocho (a type of carbohydrate food produced from Enset production) Fikru (2009).

Agroforestry is a land use system that receiving greater attention in many countries to protect the land from various types of degradation and also it is a practices offer considerable benefits for the long term agricultural sustainability (IRAF, 2004).Similar study was carried out by UNCCD (2003), and reported the result as AF practice used as a tool for achieving sustainable agricultural farming and improving the quality of life of the affected communities while simultaneously reversing the process of environmental as well as land degradation. Crop rotation and intercropping means that the different crops are alternated in the same field and it minimize the risk of crop failure and increase food security when there is insufficient rain fall as well as combining the production of cattle food with food for human consumption (FAO, 2014).

2.2.3. Effects of Soil and Water Conservation on Land Productivity

Soil erosion has accelerated on most of the world, especially in developing countries, due to different socio-economic, demographic factors and limited resources. For instance (Reusinget al., 2000), mentioned that increasing population, deforestation, land cultivation, uncontrolled grazing and higher demand for fire often cause soil erosion. Excessive numbers of livestock on a given area of land can cause significant soil erosion problems due to overgrazing and poaching of the soil which can lead to high rates of soil exposure, capping and increased overland flow (Alex, 2006).

Ethiopia is one of the developing countries in sub-saharan Africa, depends on agriculture to satisfy the demand for food, fiber and other goods, nevertheless diminishing productivity result from degradation of land induced by soil erosion has been and is the major concern (Admasu, 2005). So in Ethiopia highlands, the agricultural production system cannot maintain a permanent vegetation cover throughout the year under the given ecological, economic and social circumstance (Ludi, 2004). Thus, soil and water conservation measures are necessary parts of the system for combating erosion during critical times of the year and showed a certain effect (Kato *et al.*, 2011; Adimassu *et al.*, 2012).

The use of conservation practices in agricultural production is determined by the different income earning strategies themselves and in combination with some of the biophysical and socioeconomic conditions (Jansen *et al*., 2006). Soil and water conservation is a vital to the achievements of food security, poverty reduction and environmental sustainability in Ethiopia (Woldeamlak, 2007). To achieve SWC practices a collaboration of upstream and downstream stakeholders to manage water and land resource in the watershed with sustainable watershed management measures can lead to reduce soil erosion and sediment loads (Awulachew , 2010).Farmers were aware of the problem of soil erosion and soil fertility decline and believed that the severity of the problem had increased over time and also farmers knew the problems were more severe in the untreated land units than the SWC treated (Melese, 2010).

In Ethiopia, there is SWC problem that causes the decline of soil fertility as indicated by Barry and Ejigu (2005) report, the main causes of fertility decline in Ethiopia are deforestation, removal of crop residues from fields, land fragmentation, reduction of fallowing periods, overgrazing, low fertilizer inputs, inadequate soil and water conservation practices and cropping of marginal lands. These have resulted in lowering of agricultural production, leading to food insecurity and increased poverty. Even though the consequence of soil fertility decline is very serious; it has not received as much research attention as soil erosion and other forms of land degradation.

2.2.4 Effects of SWC on Land Degradation and Soil Erosion

Land degradation can be defined that lowers the current and future capacity of the land to support human life (Demeke, 2009), however, in most cases both soil erosion and land degradation are interchangeably used. So SWC are practices at local level which maintain or enhances the productive capacity of the land include soil, water and vegetation in areas prone to degradation through, preventing and reducing soil erosion, soil compaction; conservation of drainage of water and maintenance or improvements of soil fertility (WOCAT, 2007). Soil erosion, land degradation limits the productive capacity of land, so SWC was implemented on the cultivated land (Teklu, 2003). This because SWC measures can improve the physical condition of soil like soil bulk density, soil porosity, soil pH and workability. Soil conservation in Ethiopia is not only closely related with the improvement and conservation of ecological environment, but also sustainable development of agricultural sectors and its economy at large (Wogayehu and Drake, 2003).

2.2.5. Effects of SWC on Livelihoods of the Communities

Agriculture is the major source of livelihood of the communities in Ethiopia. So SWC is important to control the loss of nutrient for agricultural land, to prevent pollution of water bodies, sedimentation in reservoirs and limit crop damage by windblown. On the other hand, SWC and productivity are highly complementary because conservation of soil, water and natural vegetation leads to higher productivity of crop and livestock (Kerr,2002). According to Adgo *et al.* (2013), SWC on livelihood of the communities increase crop production, food security and household income.

3. MATERIALS AND METHODS

3.1. Description of the Study Area

3.1.1. Location

The Cheha Woreda in Gasore kebele of the Gurage Zone, within the Central Ethiopia Regional State. The kebele is position between latitudes 8°8′ North and longitudes 37°46′ East. It lies 10 km from Emdibir, the administrative center of Cheha Woreda, and about 170 km southwest of Addis Ababa. To the north, it borders Bedele Woreda while to the south, boundaries with the Silte Zone. Gasore is accessible via a network of all-weather roads connecting it to Wolkite Town—the capital of the Gurage Zone—and other neighboring kebeles (Gurage Zone Agricultural Office, 2021).

3.1.2. Population

According to the 2007 CSA, Cheha Woreda had a total population of 163307, with 79788 men and 83519 women; 8,992 individuals (7.76%) were urban dwellers. The majority of the inhabitants were reported as Muslim (42.98%), followed by Ethiopian Orthodox Christians (36.31%), Protestants (12.87%), and Roman Catholics (7.73%).Gasore Kebele has total population of 3894 residents. The population is predominantly rural, with most 708 households engaged in mixed farming. Population pressure has contributed to land fragmentation, increased cultivation on marginal lands, and heightened vulnerability to land degradation.

3.1.3. Climate

Gasore kebele agro ecology is wonia-dega climate with a bimodal rainfall pattern. The average annual precipitation ranges between 800 and 1,200 mm, with the main rainy season occurring from June to September. The mean annual temperature varies from 15°C to 25°C (NMA, 2021).

3.1.4. Soil types

Predominant soil types in Gasore include Nitisols and Cambisols, which are moderately fertile but susceptible to erosion due to the region's undulating topography (FAO, 2019).

3.1.5. Topography

The elevation in Cheha Woreda ranges from 1,900 meters to 2,800 meters above sea level, encompassing diverse altitudinal zones. Specifically, Gasore Kebele is classified within the

lowland areas of the woreda, with elevations ranging between 1,887 and 1,923 meters above sea level. This varied topography influences land use patterns, agricultural practices, and the overall lifestyle of the inhabitants. The steep slopes and elevation gradients present both opportunities and challenges for sustainable land management and agricultural productivity in the region.

3.1.6. Land Use and Land Cover

Gasore Kebele, located within Cheha Woreda in Ethiopia's Gurage Zone, predominantly practices homestead agroforestry, integrating various agricultural and forestry activities within household compounds. This system is characterized by the cultivation of enset (Ensete ventricosum), coffee (Coffea arabica), Banana, and chat (Catha edulis) alongside fruit trees and timber species. These practices are central to the livelihoods and income generation of the local population. In addition to homestead agroforestry, the land use system in Gasore Kebele includes annual and perennial crop cultivation, grazing lands, and eucalyptus plantations. The average landholding size in the area ranges from 0.6 to 0.8 hectares per household, with a significant portion allocated to enset, coffee, and chat-based home garden agroforestry practices.

3.1.7. Vegetation

The vegetation of Gasore Kebele is characterized by a mix of natural forests, shrublands, and cultivated plants. which play a vital role in preventing soil erosion and maintaining local biodiversity. Shrublands consist of species like *Euphorbia* and *Acacia*, which are adapted to the region's climatic conditions. Farmlands are interspersed with perennial crops, particularly enset (*Ensete ventricosum*), coffee (*Coffea arabica*), and fruit trees such as avocado and mango. The degradation of natural vegetation cover has heightened the need for sustainable land management practices (Gurage Zone Agricultural Office, 2021; CSA, 2022).

3.1.8. Crop Production

Crop production in Gasore Kebele is a key component of the local economy, with most households engaged in mixed farming systems that combine crop cultivation and livestock rearing. The major food crops grown include maize (*Zea mays*), teff (*Eragrostis tef*), wheat (*Triticum aestivum*), and barley (*Hordeum vulgare*), which are primarily cultivated for household consumption and local markets. Enset (*Ensete ventricosum*), a staple food in the region, is widely planted around

homesteads and serves as a vital food security crop. Cash crops such as coffee (*Coffea arabica*) and cgashat (*Catha edulis*) also play an important role in household incomes. Seasonal vegetables, including cabbage, onions, and tomatoes, are cultivated in smaller plots, particularly during the dry season with the aid of small-scale irrigation. Despite favorable climatic conditions for diverse crop production, productivity is constrained by soil erosion, declining soil fertility, and limited access to improved agricultural inputs (Gurage Zone Agricultural Office, 2021; CSA, 2022).

3.2. Methods

3.2.1. Data Sources and Types

The data source to be used for this study was primary and secondary sources. The primary data source was obtained from the sample of households (HHs) through interviews, using questionnaires, and direct observation of the study area. The secondary data source was obtained from various sources, including unpublished and published documents, books, articles, journals, reports, and electronic websites.

3.2.2 Sampling Technique and Sample Size

A sampling technique was applied to select the site and draw representative samples of the HHs for this study. Among the 16 Woredas in the Gurage Zone, Cheha Woreda was selected purposively due to the extensive practice of agriculture, especially irrigation, and its significance in cultivating various agricultural crops. Additionally, from the 41 kebeles of Cheha Woreda, Gasore Kebele was selected using a simple random sampling technique. The reason for using this technique was that there were no soil and water conservation practices in all kebeles of the Woreda. The number of households was determined from the total of 708 households, and the sample size was calculated. Households were then selected using a simple random sampling method.

To determine the sample size, the Yamane formula was applied. Out of the 708 total HHs of the kebele, HHs was selected for the interview.

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

Where n=sample size

N=number of households

e=acceptable level of error 10% $n=\frac{708}{1+708(0.1)2}$

=88 households n=88

The reason for selecting simple random sampling method was the fact that the gasore kebele has above 90% homogeneous population

3.2.3 Data Analysis

The collected data was analyzed using qualitative data like descriptive statistics. This technique of data analysis was applied to show the number of respondents who were involved in questionnaires and interviews. MS-Excel were used to generate tables. For the informal key informant interviews and field observation notes, a qualitative analysis was used in the form of tables, percentages, and graphs.

4. RESULTS AND DISCUSSION

The results from the household survey, key informant interviews with the representatives of the community with the farmers of the gasore kebele were discussed under this chapter.

4.1. Demographic Characteristics

4.1.1. Age-Sex of the Household

Family size and composition are intrinsically linked to the supply and demand dynamics of fundamental human necessities, such as nourishment, housing, healthcare, and educational resources. These factors, in turn, directly or indirectly impact the implementation of soil and water conservation (SWC) practices that can boost land productivity. Among the 88 households sampled, the findings reveal that 87% are led by males, while 13% are headed by females who are either unmarried, widowed, or divorced (as shown in Table 1). The survey results indicate that maleheaded households are more engaged in SWC practices, likely due to their greater access to information and ability to regularly monitor their land's productivity. Conversely, female-headed households in the study area showed minimal involvement in SWC practices. Discussions with female household heads revealed that their limited participation in SWC activities stems from restricted access to information and socio-economic constraints related to traditional social barriers that limit women's resources. Additionally, women tend to be more involved in routine household tasks compared to men. In the region, women shoulder the majority of domestic responsibilities, including childcare, food preparation and harvesting, weeding, and water collection. These factors collectively hinder the participation of female-headed households in SWC activities, either directly or indirectly.

The respondents in the study area were categorized into three age groups: approximately 5% were under 18 years old, 86% were between 19-64 years old, and 9% were over 65 years old. The majority of household heads fell within the 19-64 age range. This age group typically demonstrates a good understanding of soil and water conservation issues and tends to be more interested in implementing SWC practices compared to other age groups. Despite the moderate risk of soil erosion in the study area, the data suggests that a significant portion of the community is implementing and maintaining SWC practices to enhance land productivity. The proportion of

elderly individuals (over 65 years) and young people (0-18 years) represents age groups where labor shortages could potentially impede the implementation of soil-water conservation measures.

Nevertheless, these farmers, particularly those in the elderly age group, generally accept SWC practices and possess considerable experience with them, although they may lack the physical capacity to implement them effectively for land productivity improvement.

Table 1: Age-Sex characteristics in the study area.

Age	**No of respondent**	**Percentage (%)**	**sex**	**No of respondent**	**Percentage (%)**
<18	4	5	Male	76	86
19-64	76	86	Female	12	14
>65	8	9			
Total	88	100	Total	88	100

Source: field survey 2025

4.1.2. Level of Education

The field survey reveal that households with higher educational attainment tend to have more accurate perceptions of the soil erosion issue, possess greater knowledge of soil and water conservation (SWC) practices, and are more likely to participate in conservation activities. The study categorized the educational background of respondents into six groups: illiterate, able to read and write, grades 1-4, grades 5-8, secondary schooling (grades 9-12), and diploma or higher. According to the survey, 20% of household heads are illiterate, 32% can read and write, 10% have completed grades 1-4, 18% have completed grades 5-8, and 15% have completed secondary education(9-12) and 5% have completed diploma and above. (See Figure 1). Nearly half of the farmer household heads in the study area have some level of education, which contributes to their heightened awareness of the impact of SWC technologies on land productivity. The results indicate that better-educated household heads can better recognize erosion as a threat to land productivity compared to those without formal education. This aligns with broader research suggesting that

education significantly boosts farmers' adoption of soil and water conservation practices and their awareness of environmental risks.

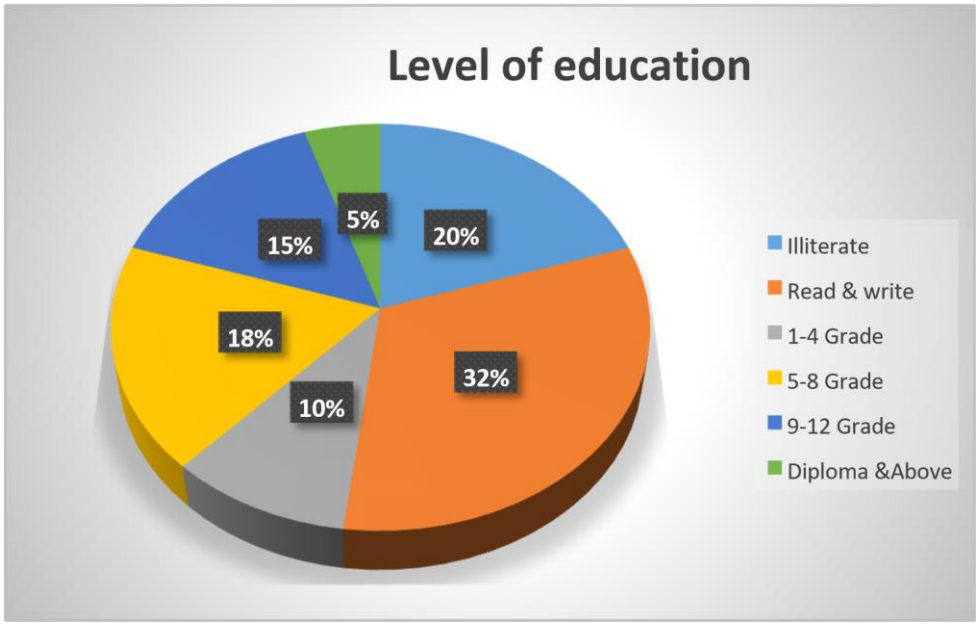

Figure 1: Sampled HHs educational level (source: field survey, 2025)

4.1.3. Family Size and Marital Status

The basic sampling unit for this study was the farm household. Among the sampled households,

11% had a family size of 1-3 members, 81% had 4-6 members, and 8% had 7-10 members (Table 2). The survey findings indicate that 81% of households, representing the largest proportion, fall within the 4-6 family size category. This suggests that households with this family size are better positioned to construct soil and water conservation (SWC) measures more effectively. These measures play a crucial role in enhancing land productivity by improving soil fertility, reducing soil erosion caused by runoff, and conserving adequate moisture. This result aligns with findings by Alemayehu (2007), which highlight that in most rural areas of Ethiopia, family members, including wives and children, are the primary sources of labor for building SWC structures.

In the table show that below 14% of the sample is Single, 77% of the sample was married, 3% is divorced and 6% are widow.

Table 2: Family size and marital status characteristics in the study area.

Marital status	No of respondent	percentage	Family size	No of respondent	percentage
Single	12	14	1-3	10	11
Married	68	77	4-6	71	81
Divorced	3	3	7-10	7	8
Widowed	5	6			
Total	88	100	total	88	100

Source: field survey 2025

4.1.4. Livestock

The type and total number of livestock owned across all sample HHs were given in (Figure 2). The sample respondents of farmers were rear livestock for various purposes, including power, milk, meat, transport and other purposes. The main sources of feed for their livestock in the study area include grazing land.

Figure 2: Type and number of livestock owned by the sample households (source field survey, 2025)

Farmers were reported that there was a shortage of feed for their animals, especially during the dry season. On the other hand, agricultural expert said that in our kebele the number of livestock had a negative impact on the biological and physical SWC measures by distracting the physical terraces, overgrazing, cracking the soil by their moving activities and distract shrub tree species, these activities leads to decrease land productivity, increase sensitivity of soil erosion, decrease the moisture content of the soil and its infiltration rate. This finding similar with(Alex, 2006), excessive numbers of livestock on a given area of land can cause significant soil erosion problems due to overgrazing and poaching of the soil which can lead to high rates of soil exposure, copping and increased overland flow Land characteristics of the household.

4.2. Farm Size of Household

Land is one of the most important factors that determine the level of agriculture. In the study area the field survey result shows that 20% of the sampled households have 0-0.5 hectares, 58% of the sampled households have 0.5-2.5 hectares and 22% of the sampled households have 2.5-5 hectares farm land show below in (Figure3). As the view of the respondent shows that, more SWC practices were practiced by farmers with have larger farm land than smaller farm land because more flexibility in their practices, more opportunity to use new practice of SWC structures and have the possibility to follow their farm land. The result of this study is similar with the findings of (Kirubel et al., 2011), farmers with larger farm land area are more likely to use improved soil and water conservation measures to reduce soil erosion and conserve water in their farm land than farmers with small farm land.

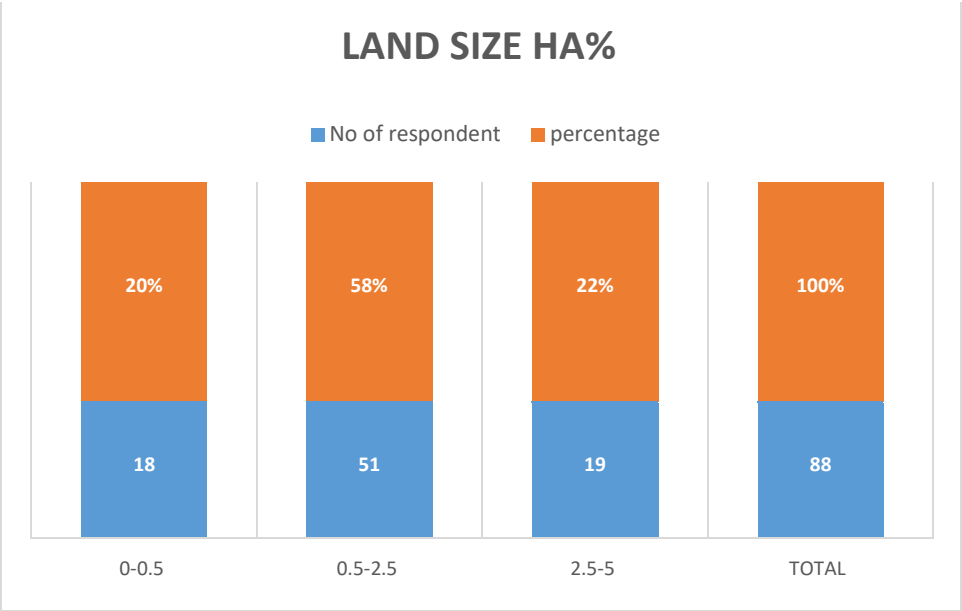

Figure 3: Sampled household farm size (Source: field survey, 2025)

4.2.1. Slope, Cause and Degree of Erosion

From 88 respondents, most respondents replied that soil erosion was the major problem in their farm lands.

Table3: Distribution of farm plots by slope category, cause of erosion, Indicator of soil erosion and degree of erosion.

Cause of erosion	No of respondent	percentage	Degree of erosion	No of respondent	percentage	Slope category	No of respondent	percen
Over cultivation	26	29	Very sever risk	12	14	Gentle slope	37	42
Less fallowing period	24	27	Sever risk	35	40	Moderate slope	41	47
Over grazing	20	23	Moderate risk	30	34	Steep slope	10	11

Deforestation	12	14	Minor risk	8	9	Very steep slope		
Other cause	6	7	No risk	3	3			
Total	88	100	Total	88	100	Total	88	100

Source: field Survey 2025

From sampled HHs, the respondent replied that 29% was over cultivation, 27% was less fallowing period, 23% was overgrazing, 12% was deforestation and 7% were other cause of soil erosion (Table3). According to the survey result, farmers point out that most common ones often used to describe the severity of erosion and/or degradation these are over cultivation, less fallowing period and deforestation are the major cause of soil erosion in the study area. So, from these visible formation low soil depth with 47% of respondents, low productivity (absence of fertile topsoil) 43% and it requires high amount of fertilizer use per ha with 10% was perceived as major indicators. So, farmers could identify when soil erosion occurred in their farm lands simply by observing the physical land characteristics and experiences through cultivating over time. And those indicators which have already brought an economical and environmental damage to the area were easily realized by farmers, even if these are beyond their capacity to control and costly as they stated it.

According to the above table3 about to 14% of was the respondent very sever risks, 40% of was the respondent the sever risk, 35% of was the respondent moderate risk, 8% of was the respondent minor risk, and 3% of was the respondent no risk. This indicate that, in Gasore Kebele there was visible erosion problem and there was much practices of SWC measures to influence the negative impacts of soil erosion in the farm land or outside the farm land. In line with (Melese, 2010), farmers were aware of the problem of soil erosion and soil fertility decline and believed that the severity of the problem had increased over time and also farmers knew the problems were more severe in the untreated land units than the SWC treated.

According to the view of respondent, the slope of the farm land can be classified into gentle slope, moderately steep slope and steep slope farm land in the study area. Most respondent replied that 42% is moderately steep slope, 47% is gentle slope and 11% is steep slope.

4.3. Soil and Water Conservation Practices

To address the issue of soil and water conservation (SWC) in the study area of Cheha Woreda (Gasore kebele), the District Agricultural (DA) office advised farmers that it wasn't necessary to destroy the terrace benches. They also suggested that it would be better to redevelop the existing terraces and support them with other soil fertility and SWC practices, such as using compost, implementing improved fallows, and establishing grass strips in areas that were intensively cultivated, had high population density, and exhibited significant land fragmentation. The costs and benefits associated with these structural soil-water conservation measures influenced farmers' decisions to adopt the practices. SWC measures were widely implemented to reduce soil erosion and enhance land productivity.

4.3.1. Participation of Household in SWC Practice

Farmers of the study area were participating in different method of SWC practice. The study results indicated that, 93% of the sample respondent participate on soil and water conservation practice by their interest (voluntarily) but about 7% of the sample respondents participated on SWC practice by the force of SWC experts and kebele community leaders, and also shows, about 85% of the sample respondent practices SWC in a group and 15% of the respondent practices of SWC in individual (figure 4). This cooperation’s have impacts on the quality of SWC structure on farm land, to reduce the severity of soil erosion and land degradation in order to improve the productivity of land. This implies the participation of farmers in SWC methods is almost uniform in the study kebele.

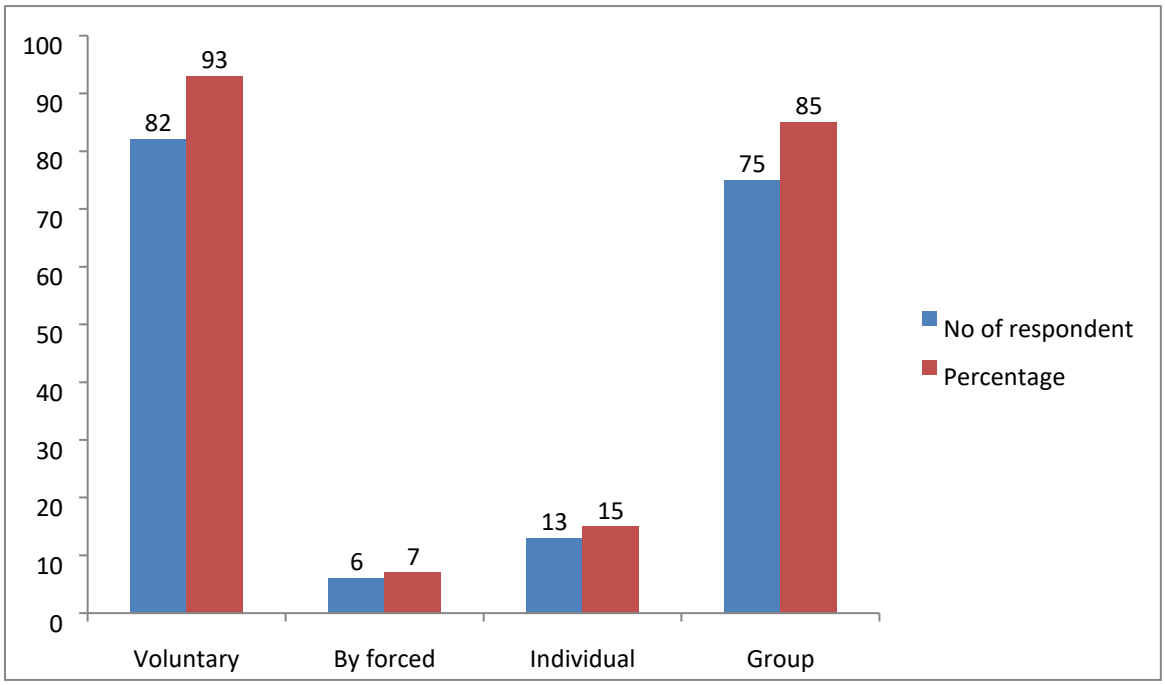

Figure 4: participation of household (source: field survey, 2025)

4.3.2. Analysis of Knowledge on SWC measures

This subsection indicates the analysis weather the farmer have applied SWC measures on their farm land or not in the study area.

Table 4: Analysis of Knowledge on SWC measures.

Applied SWC measures	**No of respondent**	**percentage**
Yes	84	95
No	4	5
Total	88	100

Source: field Survey, 2025

As noticed in the above (Table4) almost 95% of the respondent replied that they have applied a SWC measures on their farm lands as well as outside their farm lands and the remains 5% of the respondent not applied SWC measures on your farm land because physical SWC measures as a

factor for the productivity loss through the indicating the rat, insect, weed and rodent effect as the major factor for agricultural production. They are also briefly define SWC as the measures of that keeps the upper most top soil from any erosive agents through applying physical as well as biological barriers to encourage the stable land productivities. According to agricultural DA in the study area, all peoples were participated in conservation activities in winter because during this season there was no much more additional work. So SWC were more practices in order to develop soil fertility, enhance land productivity, and minimize soil erosion and compact land degradation in the study area.

4.3.3. Analysis the Preference of SWC Measures

Basically there are two types of SWC measures. From these preference of farmers was vary in accordance with their thinking and interest.

Table 5: Types of SWC measures.

Types of SWC measures	No of respondent	percentage
Biological	5	6
Physical	9	10
Both	74	84
Total	88	100

Source: field survey, 2025

As noticed in the above (Table5) the majority 84% of the respondents preferred both biological and physical SWC measures, 6% of respondents preferred only biological SWC measures and also 10%of the respondents preferred only physical SWC measures.

Terraces are constructed in areas where construction material like stone is available and it was the conservation measure of soil and water practiced highly over farmland of the study kebele. The construction of stone terracing was labor demanding. Therefore, farmers of the area construct the structure of SWC in groups mainly during the dry season. During those season farmers have

relatively more free time to work in groups along with their families. Nevertheless, a little farmers are not practiced the physical SWC measures in the study area.

4.3.4. The Contribution of SWC Measures on Enhancing Land Productivity

Table 6: The Contribution of SWC measures on enhancing land productivity

Levels of contraption of SWC measures on enhancing land productivity	No respondent	Percentage (%)
Less	-	-
Moderate	63	72
High	18	20
Unknown	7	8
Total	88	100

As noticed in the above table 20% of the respondents replied as SWC have high contribution on enhancing land productivity, this SWC measures has impact on runoff, losing fertile land and landscape, productive capacity of land , loses of nutrient etc. There were also 72% of the respondents that were replied as SWC has moderate contribution on enhancing land productivity. That they have supported their idea by relying that land productivity was achieved not only by SWC measures but it also needs other constraints like appropriate farming system, fertilizer and pesticide application, proper aeration, and technological progress and climate conditions.

Furthermore, 7% of respondents replied that unknown about SWC contribution on enhancing land productivity. This indicates that, the respondent has no more awareness about the SWC

Practices but most respondents have deep awareness about SWC practices on their own farm land and outside farm land. The finding of this result harmonizes with (Kato *et al.,* 2011; Adimassu*et al.,* 2012), soil and water conservation measures are necessary parts of the system for combating erosion during critical times of the year and showed a certain effect.

4.3.5. Effects of SWC Measures to Reduce Soil Erosion and Land Degradation

The study result indicates that the use of improved SWC in the study area have been use from to the present time. This period coincides with time when improved SWC were introduced through traditional knowledge. Construction of conservation structures on farm land was very limited but different types of improved soil and water conservation measures have been introduced in to the study area. From these, the most widely and intensively used improved structures in the study area were soil bunds, stone bunds, terrace and cut-off drain.

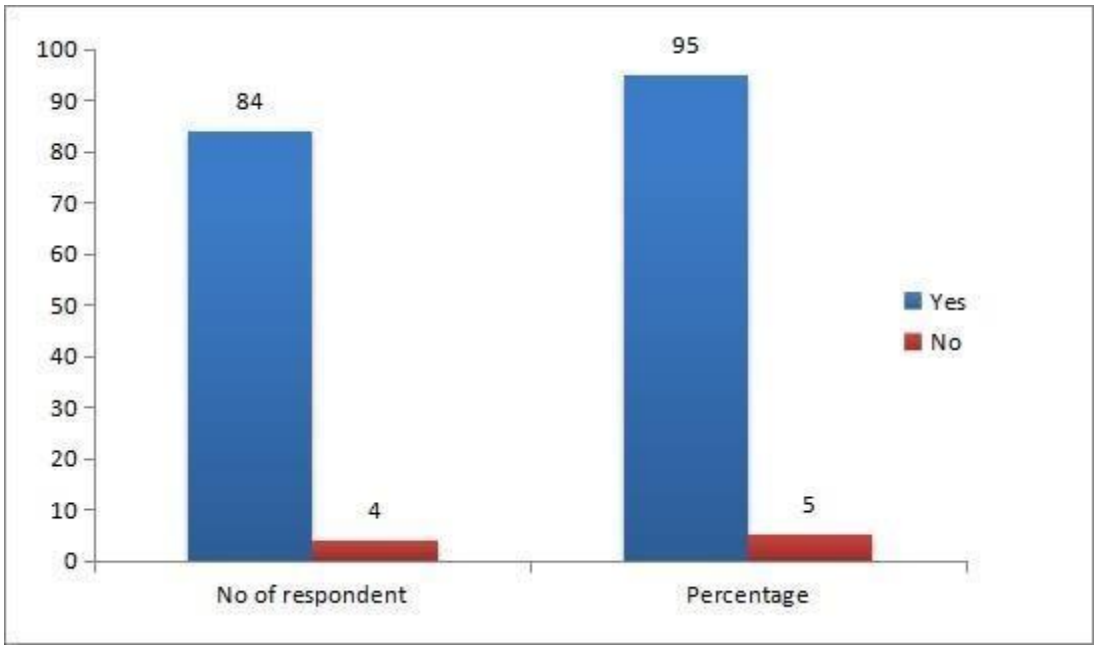

Figure 5: Effects of SWC measures in reducing soil erosion and land degradation (Source: field survey, 2025).

As indicated in the above (Figure 5) 95% of the respondents replied as SWC have highly effect on soil erosion and land degradation because SWC have positive impacts to increase land

productivity, minimize soil erosion, enhance soil fertility, increase soil moisture, etc and the other remain respondent 5% response that SWC has no effect on soil erosion and land degradation in the study Kebele.

This finding supported by (WOCAT, 2007), SWC are practices at local level which maintain or enhances the productive capacity of the land include soil, water and vegetation in areas prone to degradation through, preventing and reducing soil erosion, soil compaction and soil salinity; conservation of drainage of water and maintenance or improvements of soil fertility.

5. CONCLUSION AND RECOMMENDATION

5.1. Conclusion

In the study area most of the HH heads were aged from 19-64 groups, these age groups to have a good understanding on the problem of soil and water conservation, and usually interested in implementing soil and water conservation practices than the other age group especially the female farmers were practiced SWC on the farm land but they are less in number as compared to male farmers. However, the male farmer have more flexibility in their practices of SWC, more opportunity to use new practice of SWC structures and have more ability to deal with the risk takes place on their farm land on large size farm land.

The study assessed the effects of Soil and Water Conservation (SWC) measures on land productivity in Gasore Kebele, Cheha Woreda, Central Ethiopia. The findings revealed that SWC practices, including physical measures such as terraces, stone bunds, and cutoff drains, as well as biological measures like agroforestry, mulching, and cover cropping, have significantly contributed to reducing soil erosion and improving land productivity. A majority of respondents (72%) reported that SWC measures moderately enhance land productivity, while 20% indicated a high contribution, highlighting their role in improving soil fertility, moisture retention, and crop yields. Additionally, about 96% of respondents acknowledged that SWC measures effectively reduce soil erosion and land degradation by preventing nutrient loss and maintaining soil structure.

The challenges such as overcultivation, deforestation, and overgrazing remain major contributors to soil erosion, with 40% of respondents reporting severe erosion risks. The study also found that while most farmers (93%) voluntarily participate in SWC activities, with 84% adopting both physical and biological measures, a small percentage (7%) still rely on forced compliance due to limited awareness. Overall, the study confirms that SWC measures play a crucial role in sustainable land management, enhancing agricultural productivity, and mitigating environmental degradation in Gasore Kebele. Continued efforts in education, policy support, and community engagement are essential to maximize the benefits of these conservation practices.

5.2. Recommendation

Assessing Effects of Soil and Water Conservation Measures on Land Productivity in Cheha Woreda, Gasore Kebele, Gurage Zone, Central Ethiopia.

- Provide comprehensive training programs for local farmers on sustainable agricultural practices and the importance of soil and water conservation (SWC) measures.
- Develop partnerships with agricultural extension services to facilitate continuous education on advanced SWC techniques and their benefits.
- Promote the adoption of diverse SWC practices tailored to the specific environmental and socioeconomic contexts of Gasore Kebele, such as terracing, contour plowing, and agroforestry.
- Establish a local monitoring and evaluation system to regularly assess the effectiveness of implemented SWC measures on land productivity, taking into consideration factors such as soil health, crop yield, and water retention.
- Utilize participatory approaches, involving local communities in data collection and evaluation to encourage ownership and sustainable practices.
- Advocate for supportive policies from local and national governments that recognize and promote the importance of soil and water conservation in enhancing agricultural productivity.

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Appendix

Questionnaire

This questionnaire was prepared as an instrument to conduct an academic research for fulfillment of Bachelor of Science (B.Sc.) degree in natural resource management in Wolkite University. The main objective of the research was to assessing the effect of soil and water conservation measures on land productivity. Therefore, the information you would provide is very important for research.

Furthermore, the information you give will be used for only the academic research.
The following question answered by the respondent

Part I: personal information

1. Name of respondent_____
2. Age A. below 18 year B. 19-64 year C. greater than 65 year
3. Sex A. male B. female
4. Level of education

A. illiterate B. read and write C. 1-4 grade (first cycle) D. 5-8 grade (junior) E. Secondary school (9-12 grade) F. diploma and above

5. Martial statues: A. single B. married C. divorced D. widow
6. Family size: A. 1-3 B. 4-6 C. 7-10 D. >10

Part II: Question for effect of SWC measure on land productivity

1. How many hectares do you have? A. 0-0.5 B. 0.5-2 .5 C. 2.5-5 D. 5-7 E. >7
2. How do you describe the slope of your land?

A. gentle B. Moderately steep C. steep D. very steep

3. Do you have domestic animals? A. yes B. no
4. If yes how many livestock's do you have? List them_____
5. Is there soil erosion in your area? A. yes B. no
6. If yes how do know?

A. low productivity B. Increasing amount of fertilizer we use per ha C. Low soil depth D. Other specify_____

7. What is the main cause of erosion? A. over cultivation B. less fallowing period C. overgrazing D. deforestation E. other causes
8. How do you describe the status /degree of erosion in your farm land? A. sever risk (increase) B. moderate risk C. minor risk (decrease) D. no risk
9. What was the level of your land productivity before starting to practices of SWC? A. low B. high C. no change
10. What is the change of your production status after the application of SWC? A. increase B. decrease C. no change
11. How do you participating in SWC today? A. voluntary B. by forced
12. How do you participate in SWC practices? A. Individual B. group
13. Do you practices SWC on farm? A. yes B. no
14. If your answer yes why is the reason? A. Improving soil humus B. enhancing land productivities C. minimize soil erosion D. other if any_____
15. Do you apply any SWC on off farm area? A. yes B. no
16. If your answer is yes what are the main advantages?

A. To minimize soil erosion B. to combat land degradation C. to develop soil fertility D. others

17. What type of SWC measure do you apply on your farm?
    a. biological B. physical C. both physical and biological
18. If your answer biological what types of biological SWC do use? A. crop rotations B. strip cropping C. planting tree D. green manure E. other
19. If your answer physical which one was mostly practices on your farm land? Rank it.
    a. stone bund B. soil bund C) terraces D. fanyajuu F. other _____
20. SWC measures have effect on land degradation and soil erosion? A. yes B. no
21. If your answer yes what are the contribution of SWC on the land productivity?
    a. less B. moderate C. high D. unknown

Picture of field survey