



**ASSESSMENT OF SOIL AND WATER CONSERVATION PRACTICES
AND CHALLENGES IN CASE OF META ROBI WOREDA, WEST SHOA
ZONE, OROMIA REGIONAL STATE**

Hundessa Tolera Tolasa

A Thesis Submitted to Department of Zoological Sciences, the School of Graduate
Studies, Addis Ababa University in Partial Fulfillment of the Requirements for
Degree of Masters in Biology (M.Sc.)

Advisor: Habte Jebessa Debella (PhD)

February, 2024

Addis Ababa, Ethiopia



ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES
COLLEGE OF NATURAL AND COMPUTATIONAL SCIENCES
DEPARTMENT OF ZOOLOGICAL SCIENCES
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APPROVAL SHEET FORM

The final and acceptance of this thesis is reliant upon the submission of the final copy of the thesis to the Council of Graduate Studies through the Department of Graduate Committee of the candidate's major department.

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DECLARATION

I, the undersigned, declare that this thesis is my original work and all sources of materials used for this thesis have been acknowledged.

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LIST OF ACRONYMS

FAO	Food and Agricultural Organization
IIE	International Institutes for Environmental and Development
LSC	Land Suitability Classes
m.a.s.l	Meter above sea level
MCA	Multi Criteria Analysis
SLM	Sustainable Land Management
SPSS	Statistical Package for Social Sciences
SWC	Soil and Water Conservation
UN	United Nation
UNESCO	United Nation Educational, Scientific and Cultural Organization
WAO	Woreda Agricultural Office
WB	World Bank

ABSTRACT

Due to a combination of human and natural factors, there has been a global increase in the severity of land degradation. The purpose of this study is to assess soil and water conservation practices and challenges in Oromia Regional State, “Meta Robi Woreda”. The research was conducted from November 2022 to July 2023. Both qualitative and quantitative research approaches were used in this descriptively designed study. Questionnaires, focus group discussions, and personal and field observation were the main data collection tools. A total of 181 questionnaires were given to the farmers in Kimo Dima, Baka, and Baka Koricha Kebeles using a systematic random selection technique. Because of their extremely vulnerable ecological sites to soil erosion, the three kebeles were purposefully chosen. For DA experts, stakeholders, educated people, and other experienced individuals, purposeful sampling was employed. SPSS was used to analyze the data. Descriptive analyses were performed on the collected data. Of the farmers in the sample, 33.1% thought that deforestation was the main factor causing soil erosion, whereas only 12.2% thought that overpopulation was the main factor. The result indicated that 44.8% of the respondent farmers rated erosion as high in their farmland and 4.4% of them rated erosion as low in their farmland. Training of soil and water conservation structures in the study sites was primarily done by NGOs, particularly ‘SLM’. In the study area, farmers use a number of traditional and improved soil and water conservation structures on the farmland, which was statistically significant ($P = 0.000$). Among the major factors, the majority of the sampled farmers repeatedly mentioned household size, age, gender, topography, deforestation, overgrazing, educational status of farmers, and land size as the major problems in the study area. Destroying built terraces by various farmers was the other series issue. Generally, these problems and challenges hinder the effectiveness of soil and water conservation in the study area. To maintain soil and water conservation structures, farmers should not have to release their livestock freely to grazing lands, and stakeholders should have to check and look after the constructed soil and water conservation structures.

Key words: Deforestation, Meta Robi, Soil and water conservation, Soil erosions, Terraces

CHAPTER ONE: INTRODUCTION

1. Background of the study

Due to a combination of human and natural reasons, there has been a global increase in the severity of land degradation. This has resulted in environmental deterioration. The reduction in water availability due to land degradation and soil erosion is the major global threat to food security and the environment (Pimentel, 2006). In Ethiopia's highlands, where agriculture is centered on small-scale cereal production, increased pressure on land use of the hill slopes since the 1970s has led to degradation. Numerous investigations into the reasons behind environmental degradation have been conducted in Ethiopia's highlands, and technical corrective measures have been suggested (Mitiku, *et al.*, 2006).

One of the primary causes of degradation is soil erosion in conjunction with improper land management techniques. The degradation of agricultural lands and the siltation of lakes and reservoirs downstream are caused by ineffective planning and implementation strategies for soil conservation, as well as by poor land and water management practices. For many years, the foundation of soil conservation initiatives in Ethiopia's highlands was the belief that farmers were unaware of erosion and had little to no motivation to stop it. The majority of planning strategies for soil and water conservation depends on expert empirical assessment techniques and rarely takes farmers' awareness of soil erosion into account. Conservation programs relied on coercive approaches and performed poorly (Herweg, 2000).

Failure to balance land management interventions with the current level of land degradation is still a growing challenge to small holder farmers on the hill slopes to meet both immediate economic objectives and sustainable environment. One of the main issues facing farmers in the Ethiopian highlands is land degradation, which reduces their ability to increase agricultural productivity and lessen poverty and food insecurity (Amsalu and de Graaff, 2006).

Land degradation manifests itself in various forms, including soil erosion, sedimentation, depletion of nutrients, deforestation, and overgrazing. Reduced crop yield is the direct result of land degradation, which is followed by social unrest and economic downturn. The primary cause of land degradation is soil erosion, which is brought on by the interaction of various elements like socioeconomic and biophysical traits. 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).

1.1 Statement of the Problem

It is clear that protecting soil and water is essential to maintaining biodiversity and human life. It's a major problem in wealthy nations. Ethiopia and other developing nations do not place enough emphasis on execution. Water and soil conservation are usually regarded as political mottos in Ethiopia. The primary causes are the lack of awareness in cultures regarding the importance of conserving soil and water, as well as the function that these activities have in the environment.

The study area is one of the parts of the highlands of West Shoa, Oromia Regional State. It has experienced visible symptoms of land degradation in the form of soil erosion and sedimentation in the highlands. Different studies examined the effect of soil and water conservation measures on enhancing the productivity of crops as well as their social and economic impacts on rural land users. For instance, the World Bank identified that many of the watershed projects successfully invested in the conservation of natural resources had a significant beneficial impact on the livelihoods of the users (WB, 2008). Furthermore, Tesfaye Habtamu (2011) investigated how conservation efforts pertaining to water and soil can enhance the physical and chemical characteristics of soil, hence augmenting crop yields. None of these papers, however, discussed the success of the soil and water conservation initiatives carried out in the research area by social mobilization. This research paper is aimed at filling the gap in the methods of soil and water conservation practices by assessing the challenges of implementation in Meta Robi Woreda.

1.2 Objectives the Study

1.2.1 General Objective

The general objective of this thesis was to assess soil and water conservation practices and challenges in Meta Robi Woreda, West Shoa Zone, Oromia Regional State.

1.2.2 Specific Objectives

The specific objectives of this research are to:

- identify major causes of soil erosion and its consequences in the study sites.
- identify methods of soil and water conservation techniques.

- assess the attitudes and awareness of local community towards soil and water conservation practices in the study area.
- identify the challenges in soil and water conservation structures.

1.3 Research Questions

In relation to the research objectives, the study was attempted to answer the following research questions. What:

1. are the major causes of soil erosion and its consequences in Meta Robi?
2. are the most practiced methods of soil and water conservation techniques?
3. is the attitude of local community towards soil and water conservation practices?
4. are the challenges in association to soil and water conservation structures?

1.4 Significance of the Study

The study was conducted to assess soil and water conservation practices and challenges in the study area in order to determine whether or not the soils are highly eroded. It was also used to assist farmers, agricultural development agents, soil conservation experts, and other stakeholders in planning and identifying reasonable conservation measures for soil and water. It may also be used as a starting point for future research on the issues surrounding the practices and measures for soil and water conservation that will be conducted in the study area.

1.5 Scope of the Study

Although there are numerous environmental problems in Meta Robi Woreda, the study was delimited to assess soil and water conservation practices and challenges in certain kebeles of Meta Robi Woreda, West Shoa Zone, Oromia Regional State. The study was restricted to regions with a high risk of soil erosion.

1.6 Limitation of the Study

While conducted this research, the following factor was faced:

- Lack of secondary materials
- Absence of organized data in the area
- Lack of access to internet services
- Problem of transportation services in the selected kebeles.
- Problem of peace in the selected kebeles.

CHAPTER TWO: LITRATURE REVIEW

2.1 Definition and Concepts of Soil and Water Conservation

Water, land and other natural resources are the basis for humans to generate income and produce consumable goods and services (Wallace, 2007). Nevertheless, their availability is limited in space and time, and this influences livelihoods, especially of the rural poor who directly depend on them (Antoci *et al.*, 2009). The population density of the developing countries is already higher than the agricultural production of the arable land, which leads to natural resource misuse (Cuffaro, 1997). Therefore, population growth, resource management and degradation are central elements for sustainable ecosystem functioning. Conversely, resource deterioration cumulatively leads to environmental and land degradation (Cuffaro, 1997; Antoci *et al.*, 2009).

The scope and concept of resource management and land degradation are broad and multi-dimensional. Sustainable resource use could determine management practices and priority setting in the processes to fulfill human interests in a given time. Therefore, the loss of usefulness or prospective utility resulting from the destruction or diminution of physical, sociocultural, or economic aspects and/or the decline in ecological diversity is referred to as land degradation. One cause or a complicated combination of causes could exist (Headworth and Steines, 2003). Land degradation is defined as the temporary or permanent reduction of the land's productive capacity, per UN (1992), quoted in FAO (1993).

On the other hand, indigenous soil and water conservation refers to regional methods or approaches that farmers have traditionally used as opposed to recently developed or contemporary methods that are imposed from without. Social learning is the source of indigenous knowledge. It is produced as a result of social contact. Protecting rich topsoil against wind and water erosion and replenishing the soil with new nutrients through crop rotation, cover crops, terracing, contour farming, and other techniques are collectively referred to as soil conservation. SWC is the result of combining sensible land use with sustainable land management techniques to encourage the beneficial and long-term use of erosion and other types of land degradation. SWC is not restricted to the protection of the threatened hillside or its rehabilitation by planting trees. Its scope is much larger, and it involves the whole of agricultural and natural resource conservation. Generally, soil-water conservation includes all forms of human action to prevent and treat soil degradation (IIED, 1998).

2.2 Bio-physical conditions and economy of Ethiopia

Ethiopia has a diverse geographical setup, and as a result it has a wide range of biophysical conditions such as geology, water resources, soils, climate and biodiversity (Tefera *et al.*, 1996, Hurni, 1998). For example, the country has geological formations of three categories namely sedimentary, volcanic and metamorphic rocks (Tefera *et al.*, 1996). The topography ranges from depressions below sea level at Danakil to high mountains like Ras-Dashen and other landforms such as plateaus, plains and valleys (FAO, 1984; Tefera *et al.*, 1996; Coltorti *et al.*, 2007). Based on agricultural and ecological characteristics, the country can be classified into five agro-ecological zones, i.e., Berha (arid), Kolla (warm), Weyna-Dega (mild), Dega (cool) and Wurch (cold) (Hurni, 1998).

According to the FAO system of soil classification, more than 18 major soils types have been reported (FAO, 1984). The climatic differences have favored a wide bio-diversity (Asefa *et al.*, 2003). Thus, Ethiopia is endowed by more than 6000 plant, 280 mammal, 861 bird and 201 reptile species (USAID, 2008). It also has a wide range of crop types and a large livestock population of different species. However, only 14% of the land is arable (World Bank, 2011). Due to the climatic and geomorphologic conditions, the country has ample ground and surface-water potential. As a result, Ethiopia is regarded as the water tower of Africa (Awulachew *et al.*, 2007).

2.3 Soil Erosion and Soil Degradation in Ethiopia

According to Edward (2009) "soil erosion is the removal of soil by wind action or water". It is a natural process that occurs without human intervention but it has been greatly exacerbated by cultivation of the land. Indeed, there will be serious erosion as long as farmers continue farming. Tillage is also erosion induces factor in agriculture as it directly detaches the soil and tends to oxidizes it is organic matter. Removal of soil from one part to another usually downhill, by the action of water is water erosion. Erosive action of water is great and most destructive where the protective cover of vegetation has been removed exposing bare land surface to the direct action of rain storms in the world (Coltorti *et al.*, 2007).

2.4 Major Causes of Soil Erosion

In Ethiopia the severity of soil erosion can be attributed to intense rainfall and rugged and dissected nature of the topography with merely 70% of high lands having slopes exceeding 30%. The rate of water erosion occurring at a site depends, in the first instance, on the rainfall itself (the source of rain splash detachment) and the runoff generated during the rainfall event, which both detaches and transports the eroded soil. The erosive action of the rainfall and runoff is moderated by the surface conditions of the land, which includes the resistance the soil offers to detachment and transport, the effects of vegetation, and the slope gradient and configuration. Rapid population growth, cultivation on steep slopes, clearing of vegetation and over grazing are the main factors that are accelerating soil erosion in Ethiopia (Lulseged and Paul, 2008).

2.4.1 Rapid population growth

Since the mid-1990s, family planning efforts have declined precipitously while success in reducing mortality has exceeded earlier expectations. Consequently, the global population has been growing faster than anticipated. Each new revision of the UN's projection since 1998 has seen an upward adjustment. A peak human population in line with the UN's low projection of 8.1 billion would be readily achievable, if attention to family planning were restored (Sinding, 2009). The most important requirement is political will in those nations with rapid population growth both developing and developed. As increasing population growth, farm size is very small and the use of fallow is rapidly disappearing and causing the problem of declining soil fertility and soil erosion. Population growth increases the demand for land and attributes to farming on steep slope and fragile soils also leading to soil degradation problems (Lulseged and Paul, 2008).

2.4.2 Deforestation

Deforestation causes a change in land use and usually in land cover. Common changes include: conversion of forests to annual cropland, conversion to pasturelands, conversion to perennial plants (oil palm, shrubs), and conversion to urban lands or other human infrastructure (GOFC-GOLD, 2013).

2.4.3 Overgrazing

Grazing animals wander over large areas of pasture or natural grass lands eating grasses and shrubs. Grazers expose soil by removing the plant cover for an area. They also churn up the ground with their hooves. If too many animals graze the same land area, the animals' hooves pull plants out by their roots. A land is overgrazed if too many animals are living there (Awulachew *et al.*, 2007).

2.5 Soil Degradation and its Problems in Ethiopia

Land degradation started as early as the human history of animal domestication and control over fire (Lambin *et al.*, 2003). Human activities have resulted in intended and unintended consequences for the environment. Anthropogenic forest fire was practiced during animal hunting in the earlier ages, and forest clearance for agriculture since recent times. These activities have resulted in a considerable impact on the environment beyond the intended extent and depth (Lambin *et al.*, 2003).

The causes of land degradation are complex. Nevertheless, they are similar in many developing countries. Population pressure has been the major driver of the problem (Nana-Sinkam, 1995; Tekle, 1999; Scherr, 2000), and has resulted in extensive conversion of forest and vegetation-covered lands into cultivation and grazing land (Scherr, 2000). The annual topsoil loss due to erosion in the Ethiopian highlands is estimated about 1 billion m³ (Hurni, 1993). The causes and effects of land degradation are complex, and have intermingled environmental impacts (Tadesse, 2001). Deterioration of crop production particularly in the highlands is cited as a major and prime impact of the land degradation, where soil and soil nutrient loss due to erosion is a leading cause (Badege, 2001).

The Country has enormous potential for irrigation and hydropower, but these opportunities are being threatened by environmental degradation, especially by erosion and the removal of vegetation in the highlands (Tadesse, 2001; Awulachew *et al.*, 2007). According to Asefa *et al.* (2003) and Tilahun (2006), degradation has also had a detrimental effect on the microclimate and the richness of the flora and fauna. Another factor contributing to this issue was the reduction in forest cover (Tadesse, 2001).

In recent times, frequent droughts, early end and late onset of the main rainy (Kiremt) season and failure of the smaller rainy (Belg) season are linked with climate change and land degradation, which could develop into desertification (Tilahun, 2006). Soil loss in Ethiopia due to water erosion is a serious economic and environmental problem. Soil and water conservation (SWC) practices provide multiple onsite and offsite benefits. Thus, the present study was carried out to examine the long-term impacts of SWC in improving ecosystem services in general land suitability. Land suitability classes (LSC) were accounted using the multi-criteria analysis (MCA) on bio-physical variables of the environment (Woubet *et al.*, 2013).

2.6 Practices and implications of soil and water conservation in Ethiopia

Soil degradation did not receive the policy attention it deserved prior to the revolution of 1974 (Wogayehu and Lars, 2003). The hunger crises of 1973 and 1985 gave rise to a significant surge in food aid, primarily in the form of imported cereals and oil, which stimulated conservation efforts. The government began an extensive program of land and water conservation after these catastrophic famines, with assistance from donors and non-governmental organizations (Hoben, 1996). For conservation initiatives, the remuneration of work with food aid has supplanted voluntary labor (Campbell, 1991).

People were already aware of the negative consequences of soil erosion on agricultural production and the environment centuries ago. As a result, soil and water conservation practices exist as indigenous knowledge in some areas of Ethiopia (Nyssen *et al.*, 2007).

For instance, the Konso people in southern Ethiopia are known for traditionally well-developed terraces, where the terrace practices are registered by the United Nations Educational, Scientific and Cultural Organization (UNESCO) as a world heritage. The Konso terraces are estimated to be older than 400 years. Some rudimentary and poorly established terraces and lynchets depicted on older aerial photographs and physical remnants can also be observed in different parts of the northern highlands. For example, (Nyssen *et al.*, 2007) reported old lynchets in the Tigray region (northern Ethiopia). This is an indication of indigenous knowledge on SWC practices, and terracing is not only limited to the Konso area but is also found in other parts of the country.

However, the SWC in Ethiopia covered very few areas and most of them, except those in Konso, have limitations in lay out and construction quality (Nyssen *et al.*, 2007).

2.7 Method of soil and water conservation Practices

Farmers can prevent soil degradation and build organic matter by implementing soil and water conservation methods. Numerous universal conservation techniques are effective everywhere. Planning soil-water conservation has the goal (importance) of assembling a system from a collection of discrete elements that are pertinent to the situation and can be integrated into a functional whole (Addisu, 2011).

2.7.1 Agronomic/biological soil and water conservation methods

The biological measures are again divided into agronomic, agrostological, and dry farming methods. In agronomic practices, normally, the land is covered with vegetation to prevent erosion by water and wind. These types of practices are contour farming, mulching, crop rotation, strip cropping, etc. Agrostological measures include the cultivation of grass on land that has been heavily eroded. In lay farming, grass is cultivated in rotation with regular crops. This helps with soil and water protection as well as producing fodder for cattle. Dry farming methods may be practiced where rainfall is low, indefinite, and variable. In dry farming methods, only crops that can sustain very low rainfall can grow. The most important aspects of dry farming are conservation of soil moisture and fertility (Morgan, 1995).

2.7.2 Mechanical soil and water conservation method

The aims of mechanical measures are to maximize soil-water infiltration, minimize runoff, and reduce slope length and gradient. It generally minimizes the force of wind and the velocity of runoff to reduce soil erosion. Mechanical soil and water conservation methods include soil and stone bunds, terracing, and waterways built on farms and other types of land resources. Ponds, terraces, and gully control measures that are suitable for water conservation are to be taken so as to prevent the formation of gullies, and contour terracing is a method used to prevent soil erosion. Other techniques that prevent gullies from forming or growing involve building bunds, dams, drains, or channels to divert excess runoff water (Addisu, 2011).

CHAPTER THREE: METHODOLOGY

3.1. Description of the Study Area

Location of the study site

Meta Robi Woreda is located in West Shoa Zone, Oromia Regional State. The research area is located 114 Km west of Addis Ababa and is bordered to the east by the Adea Berga Woreda, to the west by Jaldu and Abuna Gindebarat Woreda, to the south by Ejere Woreda, and to the north by Meta Wolkite Woreda. There are 20,330 houses in the Woreda, with a total population of 121,983 people, including 59,772 men and 62,211 women (Woreda Health Office, 2022).

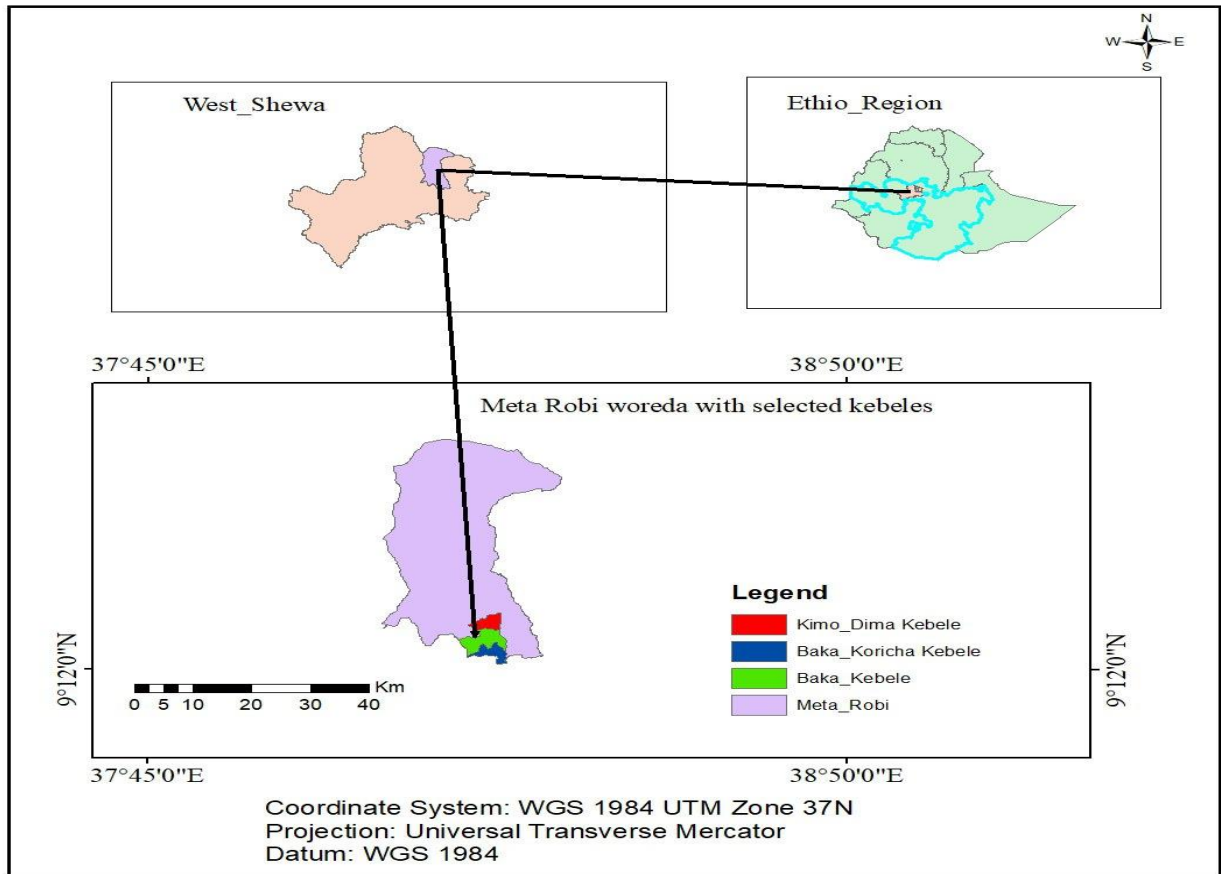


Fig.1 Map of Ethiopia showing the location of study area

Climate

Based on the agro-climatological classification Meta Robi Woreda has Dega (30%), Weinadega (45%) and Kola (25%) climatic condition (WAO, 2022).

Rainfall distribution in the study area is characterized by high temporal and spatial variability with annual precipitation ranging from 750mm to 1300mm. Due to this, uneven distributions of rainfall drought adversely affect agricultural production of the district in each year. According to the woreda's agricultural expert, the annual temperature varies between agro-climatic zones and ranges from less than 15c⁰ to 24 c⁰(WAO,2022).

Topography

The study area has mountainous, plateaus and sloppy land and an elevation ranges from 1500 to 3000 m.a.s.l. (WAO, 2022). The relief of the Woreda comprises of deep gorges (8%), peaked mountains (9%), dissected plateaus (23%) and plains (60%), (Meta Robi Woreda land and environmental protection Office, 2022).



Fig. 2: Partial Topography of Baka Koricha Kebele “A” whereas “B” Kimo dima Kebele (picture by Hundessa T.)

Vegetation

Since the area is situated with the central high lands natural vegetation is composed of semi humid land vegetation type modified by the unique local environment. Today the most dominant plants in the *Dega* and *Woina dega* of the study area are white and red *Eucalyptus* trees and some natural vegetation such as *Podocarpus* (“Zigba”), *Olea africana* (“Woiera”), *Juniperus procera* (“Tid”), *Acacia* (*Acacia spp.*), *Cordial africana* (“Wanza”) and others.

Soil types and land use

The Woreda contains three different soil classes: red (49%), black (32%), and mixed (19%). The major crops grown in the area under rainfed conditions are wheat, sorghum, teff, barley, pea, bean, nug, enset, and lentil. Maize and vegetables such as potato, carrot, tomato, sugar beet, garlic, onion, sugarcane, chills, and cabbage are crops grown in the area under irrigation conditions. The area of Woreda is about 95,445.968 hectares, and from this, arable, grazing, forest, construction, and miscellaneous land are the components (WAO, 2022).

Table1: Different land use type in the study area

Land use	Coverage in hectares	% Coverage
Arable land	54856	57.5
Grazing land	11775.94	12.3
Forest land	6792.75	7.1
Construction	14038.41	14.7
Miscellaneous land	7982.868	8.4
Total	95,445.968	100.0

Source: Woreda Administrative Office, 2022

3.2 Research Design

This study is descriptive in its design. A preliminary survey was conducted in the study area from the first week of November 2022 to January 2023 in order to collect important information such as rain fall, soil type, temperature, topography, agricultural status, and the actual size of the study area, which helped select the representative study sites. The research design employed in this study was mixed, or a combination of both quantitative and qualitative research techniques. Meta Robi Woreda has 23 kebeles, of which 20 are rural and 3 are urban administrative kebeles.

The method of household selection was a systematic random method, and the researcher purposefully limited the study areas to Kimo Dima, Baka, and Baka Koricha Kebeles, which were highly prone to soil erosion (WAO, 2022).

3.3 Sample Size determination and Sampling Technique

There are 1,618 populations living in the selected kebeles and 181 were taken as a sample.

According to (Yamane, 1967), the formula: $n = \frac{N}{1+N(e)^2}$ can be used to draw a sample size

where, n= sample size, N= Number of target population/ population size/

e = margin of error i.e., 0.05(at 95% confidence level).

1 = probability of the event occurring (constant).

Accordingly, the number of sampled household was 321. But due to some factors like time and inaccessibility this study has taken 93% of confidence interval and (0.07 precision level) without compromising the probability of generating reasonable sample which can represent the entire population of the study. The required sample size at 93% confidence level with degree of variability of 7% was used to obtain a sample size required which represent a true population.

This can be written as: $n = \frac{N}{1+N(e)^2} = \frac{1618}{1+1618(0.07)^2}$ Then, n = 181

3.4 Target Population

The purpose of this study is to assess soil and water conservation practices and challenges in Meta Robi Woreda in the purposefully selected kebeles (Kimo dima, Baka, and Baka koricha). Therefore, the population of this study is a stakeholder. The research considers a population of selected kebeles of Meta Robi Woreda in the following table:

Table 2: Target Population of the study area

Name of selected kebeles	<u>No of</u> households	<u>No of</u> respondents
Baka	617	69
Kimo Dima	510	57
Baka Koricha	491	55
Total	1,618	181

Numbers of respondents of each kebele were taken by probability proportion.

Two-stage sampling techniques were employed to select sample Kebeles and respondent farmers. In the first stage, three sample kebeles namely Kimo dima, Baka and Baka koricha selected from the total kebeles purposively based on their ecological location which were highly sensitive to soil erosion.

In the second stage, the sample households (farmers) from the three selected kebeles, which include 1,618 households was selected following mathematical formulas by (Yamane, 1967). The total (181) calculated sample households were considered and used for the analyzed data. Lastly, household heads selections were made from each kebele using systematic random sampling techniques.

- ❖ The sample households were selected systematically at an interval based on the following formula: $K=N/n$ Where, K = the sampling frame,

N = total number of households in the three kebeles, n = the sample size (Burns, 1994).

For this sample $N= 1,618$, $n= 181$ and sampling interval $K= N/n= 1,618/181= 9$ since K is 9 therefore every ninth household from the list of each kebele was selected.

3.5 Data Type and Sources

To achieve the objectives of the research, data were collected from primary and secondary sources. The primary sources of data were generated through questionnaires, focus group discussions, key informants, personal observation, and field observation. Various published and unpublished documents, such as reports, plans, and government documents, were used as secondary sources of information for this study to make it complete. Therefore, to get sufficient information in order to meet the targeted objectives, four kinds of important instruments were used: questionnaires, focus group discussions, key informants, and personal and field observations.

3.6 Method and Procedure of Data Collection

3.6.1 Questionnaires

Closed and open-ended (mixed) as well as simple and contingency-based questionnaires were used to collect data since they were an appropriate data gathering tool for respondents that were scattered over a larger geographical area. The response formats for close-ended items were multiple choice and 'yes' or 'no' types, and open-ended such as writing questions also enabled the respondents to write achievable suggestions, which they thought were included. A formal survey was carried out to gather data formally through structured questionnaires (Appendix 1) that were filled out face-to-face and through direct interviews with respondents.

Primary data was therefore used in order to get first-hand information from respondents, and it helped in providing information for the specific purpose of addressing the issues at hand, so questionnaires were prepared and distributed to sample respondents to gather the necessary information for the study. The copies of questionnaires were distributed to 181 sampled populations. In order to alleviate misunderstandings of the questionnaire, all items were read and interpreted in Afan Oromo languages according to the needs of each respondent.

3.6.2 Field Observation

Field observation was conducted during the process of this study in order to ensure the validity of the information obtained by the questionnaire regarding soil-water conservation practices. It was also employed to observe currently existing conditions regarding conservation practices and problems in the study area. The main advantage of this method was that subjective bias was eliminated, and the information obtained under this method related to what was currently happening; it was not complicated by either past behavior or future intentions (Kothari, 2004).

3.6.3 Key informants and Focus Group Discussion

Six participants for key informants and seven for focal group discussion from local elders, DA expertise, stakeholders, and other educated or experienced persons who had great experiences or awareness of soil and water conservation practices in the study area were discussed on the issue, and their discussions or responses were taken, interpreted, and analyzed in the study.

3.7 Data Analysis

The data was analyzed using SPSS software version 24. Chi-square of an independent test was used to determine if there was a significant relationship between two variables, and additionally, a Microsoft Excel 2010 spread sheet was used to analyze the data and the analyzed data was presented in the form of tables, charts, and graphs.

3.8 Ethical Consideration

By presenting formal documents from the academic department and outlining the study's educational goal, authorization to conduct the research was granted by the district and kebele administrative offices. Respondents were not given access to surveys or interviews that would go against societal norms, morals, or customs. The identities of the interviewees were withheld while the researcher gathered data based on their interests and willingness.

CHAPTER FOUR: RESULTS AND DISCUSSIONS

4.1 Results

4.1.1 Socio-demographic Information of the respondents

From the sample of 181 Households the result indicates that 81.8% of the heads of household were male and 18.2% were female households.

Table 3: Socio-demographic information of the respondents

Item	Alternatives	Frequency	Percent (%)
Kebele	Kimo dima	57	31.5
	Baka	69	38.1
	Baka Koricha	55	30.4
	Total	181	100.0
Sex	Male	148	81.8
	Female	33	18.2
	Total	181	100.0
Age of Household head	< 20	5	2.8
	20-30	29	16.0
	31-40	101	55.8
	41-51	25	13.8
	> 51	21	11.6
	Total	181	100.0
Education Background	Uneducated	71	39.2
	Adult education	39	21.5
	Primary school (1-8)	47	26.0
	Secondary School (9-12)	21	11.6
	College or above	3	1.7
	Total	181	100.0
Household Size	< 2	21	11.6
	2-4	97	53.6
	5-9	52	28.7
	>9	11	6.1
	Total	181	100.0
Livelihood	Livestock rearing	54	29.8
	Crop production	22	12.2
	Both	105	58.0
	Total	181	100.0

As table 3 above reveals, majority of the household respondents were married and only few (6.6 %) of them were single.

These household heads include a wide range of people: decision makers (local administration), younger people, older people, rich farmers, and poor farmers.

Most physical structures in the area require a great deal of labor for construction, which cannot be under taken by females alone. The majority (58%) of the livelihood background of the study area are both crop production and livestock rearing. Throughout their lives, they have been practicing the activities that accelerate the rates of erosion such as in appropriate land use, overgrazing, and deforestation. The average age of the sample household head are 39 years. In the study area, such ranges of age also makes the practices of SWC structures not to be fully implemented since younger households and elder households are not equally participated due to gap of labor forces.

From the result shown in Table 3, the family size of respondents are mainly 2 to 4 (53.6%) and few (6.1%) of them have greater than nine family. Household with larger family size do have greater probability to practice SWC structures. As Table 3, above indicates, majority (39.2%) of the household respondents are uneducated followed by few (1.7%) of them are college educators.

4.1.2 Farm land size of the households

There is a strong positive relationship between land size and the implementation of structural soil conservation measures. Small holders have a negative attitude towards structural soil and water conservation measures. These farmers do not trust structural soil and water conservation measures because they have been poorly involved in planning and designing soil and water conservation programs. Farmers experienced the structural methods of soil and water protection as follows:

First, farmers are afraid of losing land with which to build soil, terraces, protective dams, etc. Almost all farmers with less than a hectare of land consider this the main reason for giving up structural soil and water protection measures. According to them, farmland was lost when they built earth dams, terraces, check dams, etc.

Second, the conversation with other farmers reinforced the previously expressed viewpoint, with them claiming that structural soil and water conservation measures impede field mobility. Prior to the implementation of structural soil and water conservation measures, farmers could traverse up and down the field with ease and had no trouble plowing. Nevertheless, the plot was divided into smaller sections when these structures were added, mostly as a result of the bunds' increasing height and difficulty crossing. Farmers use a pair of oxen to plough their fields in the study area. When the space between the soil bunds shrunk during the process of turning the oxen back, fatigue from the labor intensified and caused problems.

4.1.3 Perception and Attitude of Farmers on soil erosion and its Conservation

Table 4: Types, level, impacts and status of soil erosion

Item	Alternatives	Frequency	Percent (%)	P-value
Types of soil erosion	Gully erosion	27	14.9	.000
	Rill	40	22.1	
	Sheet	51	28.2	
	Splash	63	34.8	
	Total	181	100.0	
Level of erosion	Very high	23	12.7	.000
	High	81	44.8	
	Medium	69	38.1	
	Low	8	4.4	
	Total	181	100.0	
Economic impacts of soil erosion	Decreases productivity	63	34.8	.456
	Food insecurity	29	16.0	
	Extra-use of fertilizer	51	28.2	
	Low economic growth	38	21.0	
	Total	181	100.0	
Status of soil erosion	Increasing	57	31.5	.000
	The same	36	19.9	
	Decreasing	88	48.6	
	Total	181	100.0	

Table 4 indicates that the majority of the household respondents respond that splash erosion (34.8%) is common in the study area, followed by gully erosion (14.9%) present in Baka and Baka Koricha.

About 44.8% of the respondents' level of soil erosion was high, whereas 38.1% of the respondents leveled it as medium, and a few of them (4.4%) leveled it as low.

According to the responses of the participants, the major economic impacts of soil erosion are the reduction of productivity or yields (34.8%), which is statistically insignificant ($p = 0.456$). When flooding came to farmland and eroded the top soil within the fertilizer, farmers were forced to use extra fertilizer. The farmlands of all participants were affected by soil erosion. However, the level, type, and status of soil erosion are not similar at all study sites.

Depending on the ecological and topographical foundation of the study sites, gully erosion is occasionally observed in Baka Koricha kebeles more than in any other kebeles in the study area. Some of the residents of this kebele assumed that soil erosion was still increasing due to poor agricultural land utilization and improper land management. However, splash, sheet, and rill types of soil erosion are the most prominent types of soil erosion that occurred in the study area, respectively.



Fig.3 Gully erosion in Baka koricha kebele (Picture by Hundessa T.)

In contrast to this, the level of soil erosion is low in Kimo Dima Kebeles, where stations of NGOs working on the issues are found and societies are aware of its impact. In a similar way, soil erosion is decreasing in these areas compared to any other kebeles. About 48.6% of the results indicate that the rate of erosion is decreasing from time to time and increasing by 31.5%, followed by 19.9% of respondents who consider the status of soil erosion constant (the same).

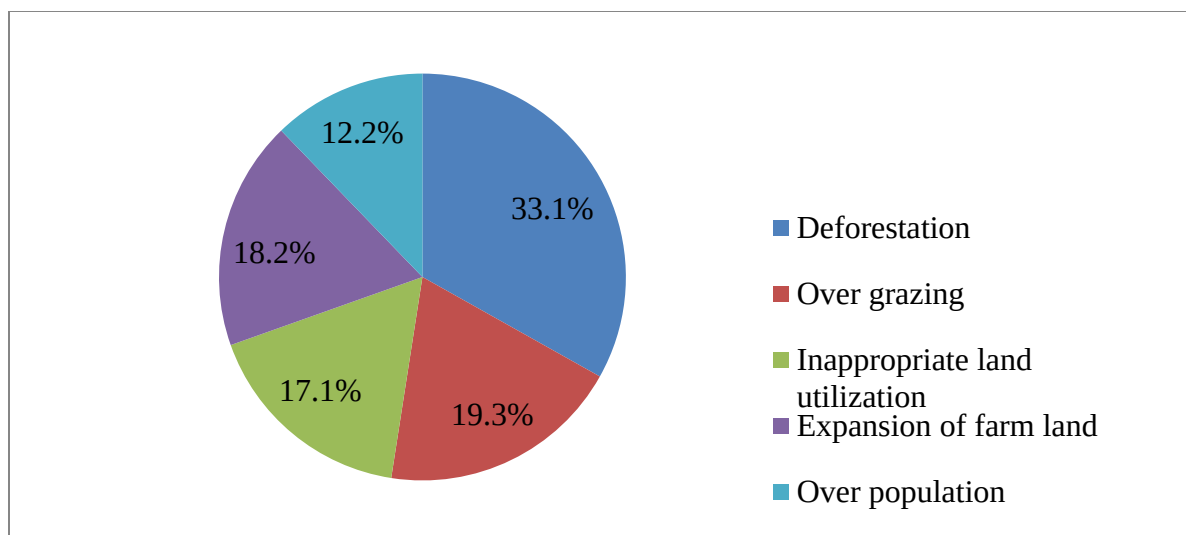


Fig. 4 Responses of respondents regarding causes of soil erosion in farmland

As the above Fig.4 indicates, 33.1% of the household farmers believed that deforestation was the most important cause of soil erosion, followed by 19.3% of the farmers who considered that overgrazing caused soil erosion. Interestingly, only 12.2% found that overpopulation was the most important cause. Additionally, poor agricultural practices, the cultivation of steep slopes, excess rainfall, and poor government policies are other causes of soil erosion. The levels of erosion are very high where gully types of soil erosion happen.

4.1.4 Attitudes Related Training of Households on SWC Construction

In the study areas, training on soil and water conservation structures was primarily (56.9%) provided by NGOs, particularly 'SLM'. This organization is not only providing training but also demonstrating the structures of soil and water conservation. Agricultural extensions (34%), and the Woreda Office of Agriculture also gave training to the farmers in the study area. About more than half (66.9%) of the farmers have moderate contact with agricultural extensions of SWC expertise.

Table 5: Perceptions of Household on SWC structure

Item	Alternatives	Frequency	Valid Percent (%)
Who provided such training and demonstration?	Woreda office of agriculture	34	18.8
	NGOs	103	56.9
	DAs	44	24.3
	Total	181	100.0
Contact farmers have with soil and water conservation experts (DAs, experts natural resource department head etc)	Very high	6	3.3
	High	14	7.7
	Moderate	121	66.9
	Low	31	17.1
	None	9	5.0
	Total	181	100.0
Who constructed the SWC structures?	Community participation	107	59.1
	Family(hired) labor	23	12.7
	Labor exchange	51	28.2
	Total	181	100.0
How often have you obtained extension advice on the problem and solution of land degradation?	Once per year	96	53.0
	Twice per year	47	26.0
	Three times per year	27	14.9
	None	11	6.1
	Total	181	100.0

As Table 5 above reveals, the majority (53%) of the farmers get advice once per year. The more frequently they contact these experts, the more awareness they gain on land use and land management, though only a few individuals (6) have very high contact, and nine (5%) respondents were not totally contacted with these experts. The construction of structural soil-water conservation requires relatively frequent training and appraisal.

In the study area, the training on controlling soil erosion has a significant impact on the application of structures; the level of training was at a higher level.

Farmers who have not accessed training have gained experience from their neighbors' and, traditionally, from their elders, etc. Farmers adjacent to each other can acquire experience in either the strength or weakness of specific soil and water conservation measures from nearby farmers and neighboring kebeles.

Table 5 shows that DAs provided 24.3% of the SWC training. The primary issue that farmers bring up during their group discussion is that they often receive the same training from the same person, which affects their willingness to accept the training because they see the same person twice or three times a year.

4.1.5 Traditional and newly introduced SWC practices

To prevent land degradation, especially soil erosion, in the study area, farmers use a number of traditional and improved soil and water conservation mechanisms. As Fig.5 below indicates, from biological water and soil conservation methods, the majority of the respondents practice bund stabilization.

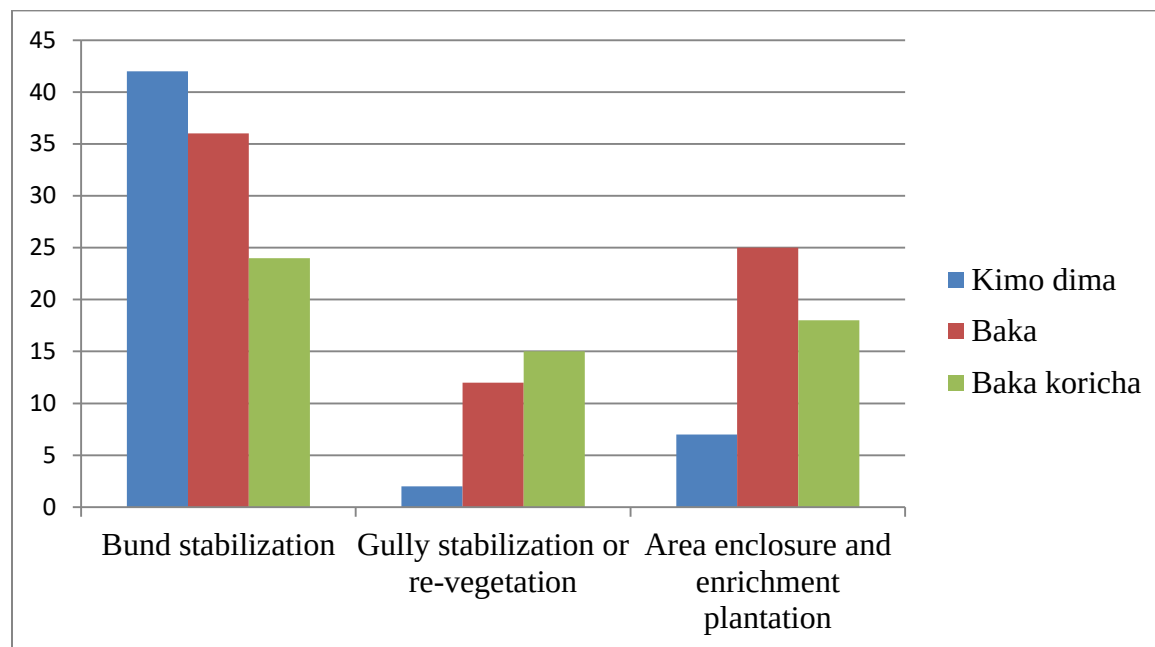


Fig.5 Biological Conservation Practiced Methods

As Figure 6 below indicates, the majority of the farmers at the study site cooperatively practice stone and stone-faced terracing to conserve both soil and water on their farmland.

However, depending on the nature and steepness of the plot slope, various physical SWC techniques such as cut-off drains, waterways, soil bunds, and traditional ditches, in addition to stone bunds, have been practiced at the study site.

Waterways are the most commonly practiced (32.6%), and traditional ditches are the least practiced (9.4%) on a few plots, which is statistically significant ($p = 0.000$).

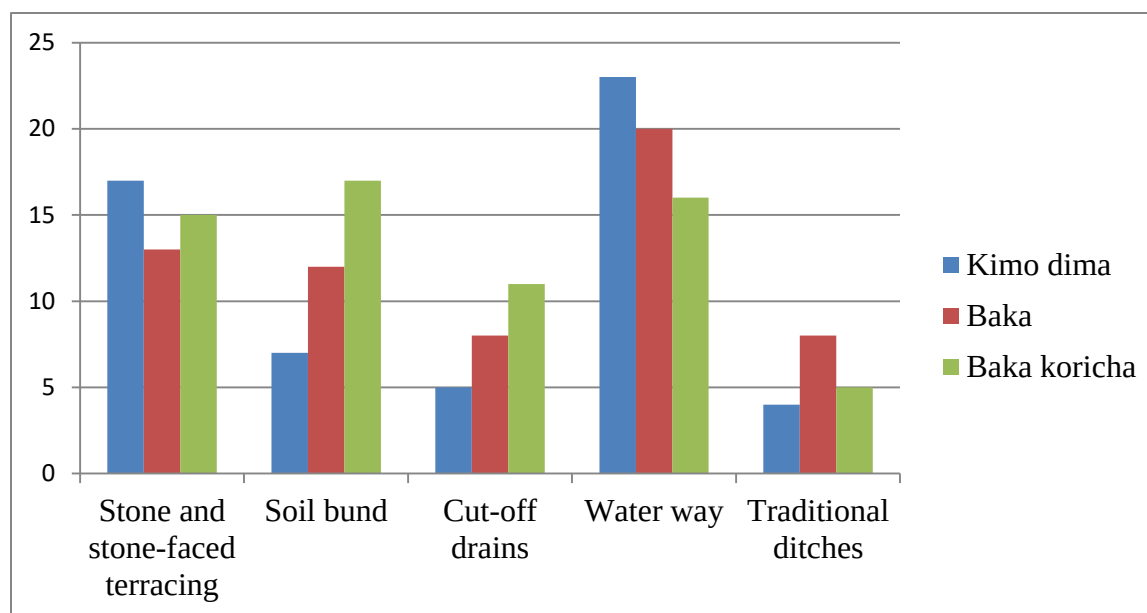


Fig. 6 Mostly Practiced Physical Conservation Methods

4.1.6 Challenges of soil and water conservation practices

Respondents identified a variety of issues, including heavy rainfall, low soil fertility, small size, rainfall variability, most cultivated land's adaptation to inorganic fertilizer and inability to produce it without it, fertilizer's high cost, and its unavailability during cropping. The steep slope, remoteness of the plots from the residence, and crop failure are identified as major issues. It became clear that a single plot could have one or more problems that are interdependent and equally important. The sample farmers were asked to identify the main issues with structural soil-water conservation techniques. Many surveyed farmers repeatedly mentioned age, gender, household size, soil type and depth, topography, overgrazing, over cultivation, farmers' educational status, and land size as major constraints.

Furthermore, a lack of information on the benefits and costs of structural soil-water conservation measures, a lack of technical knowledge in designing SWC-related activities, the level of contact with DA, a lack of technical support, the size of the expert, training on soil erosion and soil-water conservation techniques, and the length of the food secure months all have a significant impact on the implementation of structural soil-water conservation measures.

4.1.7 Destruction of Terraces

The destruction of built terraces by various farmers was one of the issues in the study area. Of the respondents, over half had destroyed the terrace bench at some point, and the other half had never done so. Farmers in the study district, particularly those with small farm plots, disclosed that they demolished the terrace bench after it was built by the campaign due to the cropland's narrowing, which makes farming more challenging.

A few of them claimed that they removed the terrace bench when it grew too large in order to build another where the terrace bund had severely eroded in order to disperse the fertile soils that had accumulated there throughout the plot. In an effort to find fertile soil, the majority of farmers dug terrace risers vertically.

Table 6: Challenges for the practices of SWC structures

Item	Alternatives	Frequency	Valid percent (%)	P-value
Reasons for the destruction of terraces	Search for fertile	77	42.5	.000
	Joining plots	65	35.9	
	Destroy hiding places of rodent pests	31	17.1	
	Destroying bad weeds	8	4.4	
	Total	181	100.0	
Reasons for not to construct terraces	I do not believe in the use of soil and water conservation structures	59	32.6	.000
	There is no one who is to design for me	44	24.3	
	My land do not require these structures	78	43.1	
	Total	181	100.0	
Factors discourages farmers not to maintain SWC Structures	Work is very tedious	40	22.1	.000
	It harbors rodents and moles	23	12.7	
	Inadequate household to labor to maintenance	51	28.2	
	Neighbors are not willing to implement conservation measures	67	37.0	
	Total	181	100.0	

As Table 6 above indicates, 42.5% of the farmers destroy terraces to search for fertile soil, 35.9% join their plot of land, 17.1% destroy hiding places for rodent pests, and 4.4% destroy bad weeds, and it is statistically significant ($p = 0.000$).

4.1.8 Responses from focal group discussions

As per the idea of the participants in the group discussion, soil erosion negatively affects crop yields and may have contributed to the collapse of yield increments. The serious effects of soil erosion are loss of fertile soil, increased pollution, acidification, salinization, and chemical soil contamination. The effective methods of SWC practiced in the area are physical, biological, and agronomic methods. However, agronomic practices are the most effective methods in the study area. In the study area, the communities are involved in the SWC practices, even though the level of participation is very low. The knowledge and practice of the community to control soil erosion in the area are not uniform, and they have low awareness. There was also a skill gap between the farmers. Farmers can play a crucial role in reducing soil erosion in their surroundings by using their land properly (proper utilization of land), by leaving crop residue on the farm land, through crop rotation, simple bund construction, cut-off drains, and waterway construction.

4.1.9 Responses from the key informants

As per the suggestion of the key informants, semi-arid and arid areas are vulnerable to soil erosion. The major reasons for their vulnerability are the presence of thunderstorms in the rainfall and the fact that soils are sensitive to erosion due to their physical and chemical properties. And also, low vegetation coverage is a factor. Soil erosion affects crop yield productivity and its economic value by washing away top soil, depleting fertility of the soil, and increasing acidity, alkalinity, and salinity, which increase chemical contamination of the soil at different levels. Around 78% of farmers in the study area have no awareness about soil and water conservation due to poor agricultural extension services, and DAs are not training them. As the discussion with the key informants reveals, the major reasons why farmers destroy the SWC structures are lack of awareness, poor design of terraces, which hide them from free plowing, serve as hosts of pests, and having old assumptions.

4.2 Discussion

It is important to recognize the soil and water conservation structures. The objective of this research is to assess soil and water conservation practices and challenges in selected kebeles of Meta Robi Woreda. According to the data collected from respondents, deforestation was main cause of land degradation in study area. Most respondents show that the cause of deforestation in the area is for searching additional agricultural land, settlement, increasing in population members etc. and around 56% of the respondents says deforestation rate become high as compared to the past time due to the increase in population. The same to this the finding was supported by Teketay, D. (2001) who states that the use of wood and other biomass for fuel and the expansion of agriculture into forested areas fostered a high rate of deforestation and ultimately stripped the land of vegetative biomass exposing it to high levels of soil erosion.

Theoretically, farmers who perceive soil erosion as a problem having negative impacts on productivity and who expect positive returns from conservation are likely to decide in favor of adopting available conservation technologies (Semgalawe and Folmer, 2000; Gebremedhin and Swinton, 2003).

On other hand, when farmers do not acknowledge soil erosion as a problem, they will not expect benefits from controlling erosion, and it is highly likely that they will decide against adopting any conservation technologies. Every respondent stated that proximity to agricultural fields would be beneficial for regular monitoring and the development of soil and water conservation measures. About 54% of farmers' land is located far from homesteads, and 46% of respondents said their fields are located close to homes. According to a related study by Shiferaw and Holden (1998), if farmland surrounds the homestead and makes it difficult to get to the fields that are farther from the house, some farmers work on SWC in the evening. One plausible explanation is that the closer the cultivation fields are to the homestead, the higher the protection of soil from erosion and the more often the fields are managed. Farmers are prepared to preserve damaged bunds and protect soil when runoff arrives.

During discussions with females headed household, the main reasons why female headed household are not involved in the adoption of SWC practices are that female heads have limited access to the information and that other socio-economic issues related to traditional social barriers limit females resources.

Females are also more involved in regular household activities than men. In the area, a female takes most of the household responsibilities (child care, food processing and harvesting, weeding, and bringing water from long distance). People are often more comfortable doing things as they have always been done, including methods for growing crops, managing land, allocating government resources, and operating programs.

In addition, conservation methods used in developed countries do not always transfer well to developing countries, particularly when farming occurs on small plots and institutions and infrastructure to support the conservation method are not in place (Tekelwold, 2010).

Farmers' awareness is directly related to deforestation, gender bias, household participation in SWC practices, training given on SWC practices, etc. Additionally, providing training on water and soil conservation techniques strengthens bonds between farmers and district agricultural offices, NGO leaders, and other stakeholders will also motivating them to adopt new conservation techniques.

To prevent land degradation, especially soil erosion, in the study area, farmers use a number of traditional and improved soil and water conservation technologies. These technologies include the application of manure, traditional and newly introduced cut-off drains, plantation of both traditional and newly introduced trees, stone bunds, leaving crop residues in the field, and fallowing on the farm.

A few of these factors have had a negative impact on the practice of structural measures, while the remaining factors have had a positive effect. The same findings were reported by Teklu and Gezehagn (2003) in East Wellega, presented at the Conference of International Agricultural Research for Development, and by Kibemo (2011) in the Soro District, Southern Ethiopia. Until recently, traditional soil and water conservation practices have often been ignored or underestimated by development agents, researchers, soil and water conservationists, and government staff (IFAD, 1992). However, surveying both traditional and improved soil and water conservation practices provides an understanding of farmers' ways of thinking about the interventions (Hudson, 1992).

CHAPTER FIVE: CONCLUSION AND RECOMMENDATION

5.1 Conclusion

The experience of Soil-water conservation practices present in the respondents of the three selected kebeles of Meta Robi Woreda was moderate. In the study area, soil erosion is primarily caused by deforestation. The basic goal of soil-water conservation is to apply sustainable conservation methods and strategies. The adoption trend of soil-water conservation interventions in the sampled kebeles has shown fluctuations over time. Although the people residing in the study area had a good understanding of soil and water conservation structures, the state of the SWC constructions is not satisfactory, meaning that soil erosion is still causing land degradation.

Farmers of the study area mostly practiced physical soil and water conservation techniques such as waterway and soil bund terraces though biological methods such as on, below and above bund plantations are also practiced. A common concern raised by various farmers in the study area is the limitations of soil-water conservation structures, specifically with regard to mechanical structures like stone bunds and terraces on farmlands. These structures can reduce the amount of cultivable land, harbor rodents, cause overgrazing or over cultivation, and require a lot of labor.

There are numerous obstacles for farmers to overcome when implementing soil-water conservation structures in Meta Robi Woreda of the three kebeles. These issues are multifaceted and include issues with expertise, finances, technology, infrastructure, and lack of knowledge about the advantages of conservation structures. Farmers choose to implement contemporary conservation techniques because they believe soil-water conservation structures are more effective at preventing soil erosion and guaranteeing production sustainability.

Lastly, in some of the district that was sampled, the gullies were expanding and encroaching on the nearby path, even though farmers had contributed to the prevention gully erosion.

5.2 Recommendation

The research's conclusions lead to the following recommendations being sent out:

- DAs, community leaders, and Woreda agricultural experts need to collaborate closely with farmers who hold negative beliefs about soil bunds, terracing, waterways, and other soil and water conservation structures in order to cultivate positive farmers.
- Farmers ought to be prohibited from letting their animals roam freely for grazing.
- Ensuring the SWC construction is checked and maintained should be the stakeholders' responsibility.
- Responsible organs discharged their responsibility properly by training farmers individually or in groups how to conserve and properly use their lands, farmers would become aware of SWC.

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APPENDICES

Appendix 1: Questionnaires to be filled by farmers

Dear respondents

The aim of this questionnaire is to assess soil and water conservation practices entitled as assessments of soil and water conservation practices and challenges in Mete Robi Woreda which is being studied by Hundessa Tolera for the partial fulfillment of MSc. Degree in Biology.

This questionnaire will be designed to collect data that are intended to investigate the soil-water conservation practices and measures to be undertaken. Your genuine response to the questions below is of paramount importance for the accomplishment of my study.

Therefore, you are kindly requested to answer the following questions accordingly. It is not necessary to write your name on the sheet. Circle the corresponding of your choice and also write your appropriate response on the space provided. You are expected to make a single choice for a single question.

Part I: General Profile

Kebele: _____

1. Sex: A. Male B. Female.
2. Age: A. <20 B. 20-30 C. 31-40 D. 41-50 E. 51 & above
3. Educational background: A. Non educated B. Adult education C. Primary School (1-8)
D. Secondary school (9-12) E. University or College
4. Marital status: A. Married B. Divorced C. Widowed D. Single
5. Livelihood background: A. Livestock rearing B. Crop production C. Both
6. Household size: A. <2 B. 2-4 C. 5-9 D. >9
7. Religion: A. protestant B. orthodox C. wakefanna D. Muslim E. Others_____

Part II. Causes of Soil Erosion

- 1) Is soil erosion is a problem in your farm land or the water shed you are living in?
A. Yes B. No
- 2) If your answer for question number (1) is yes, how do you level the erosion?
A. Very High B. High C. Medium D. low
- 3) What do you think about the economic impacts of soil erosion?
A. Decreases productivity B. Food insecurity C. Extra use of inorganic fertilizer
D. Low economic growth

- 4) Do you believe that the rate of erosion over time is____?
- A. increasing B. same C. decreasing
- 5) Again, if your answer for question number (1) is yes, what type of soil erosion is known in the study area? A. Gully B. sheet C. rill D. splash
- 6) Again, if your answer for question number (1) yes, what do you think is a cause or reason for such soil erosion in your farmland? A. Deforestation B. Livestock browsing (Overgrazing)
- C. Inappropriate land utilization D. Expansion of farmlands E. Overpopulation
7. How the size of your farmland affects you to practice SWC structures?
8. How the closest of your farmlands to your home or not affects you in conservation practices?

Part III. Farmers Perception towards Soil-water conservation and their responses

1. What measure do you take when the productivity of your plot declines?
- A. Change to other plots B. Improve the fertility C. Both
2. If you change to other plot, what kind of plot do you opt? A. Clear forest B. Fallow land
- C. grazed land D. All
3. How do you keep the fertility of soil in your field? A. By using manures B. Gay system (burning) C. Crop rotation D. Fertilizer E. All
4. Where did you get information about the SWC measures?
- A. Traditionally (learnt by self) B. From DAs C. Other NGOs D. All
5. Have you ever attended trainings related to soil and water conservation? A. Yes B. No
6. If your answer is yes for how many times? A. Once B. Twice C. Three D. More than three
7. What advantage you get from the training?_____
8. If you have made any form of destruction of terraces, what is/are reasons for the destructions?
- A. Search for fertile soil B. Joining plots C. Destroy hiding places of rodent pests D. Destroying bad weeds
9. If you are not maintaining terraces constructed in your farmland, what are factors that discourage you from maintaining? A. Work is very tedious B. It harbors rodents and moles
- C. Inadequate household labor for maintenance
- D. Neighbors are not willing to implement conservation measures
10. If you have not constructed terraces, what is the reason behind you? A. I do not believe in the use of soil and water conservation structures B. There is no one who is to design for me
- C. My land do not require these structures

11. Did you or your parents put any traditional SWC structure in the plot of land?
A. Yes B. No C. I do not know
12. Is your farm plot treated with new (improved) soil conservation measures currently?
A. Yes B. No
13. If your response to question No 12 is yes, what are the newly (improved) method of soil-water conservation in your area? List them_____
14. From the following Physical conservation structures which one was mostly practiced in your area? A. Stone-faced terracing B. Soil bund C. Cut-off drains D. Waterway E. Traditional ditches
15. On which plot do you practice specific type of conservation?
A. On Cultivation field B. On grazing field C. On both D. All
16. From the following biological conservation methods practiced in your area which is the most Practiced methods? A. Bund stabilization (on, below and above bund plantation) B. Gully stabilization or re-vegetation C. Area enclosure and enrichment plantation
17. Who constructed the SWC structures? A. Community participation
B. Family (hired) labor C. Labor exchange
18. How often have you obtained extension advice on the problem and solution of land degradation? A. Once per year B. Twice per year C. Three times per year D. None
19. Did you visit demonstration or farm experiment regarding how to conserve soil and water?
A. Yes B. No
20. Who provided such training and Demonstrations?
A. District office of agriculture B. NGOs C. DAs
21. Is such training and demonstration is useful in SWC? A. Yes B. No
22. If your response to question No 21 is yes, how do you express its usefulness?

23. Have you acquired enough technical knowledge, which motivates you to continually use method of soil-water conservation? A. Yes B. No
24. How do you describe the contact you have with soil and water conservation experts (DAs, experts natural resource department head etc).
A. Very high B. High C. moderate D. low E. None
25. How costs of establishment of the SWC structures are considered as challenges?

Thank you !

Appendix 2: Check list format for focal group discussion

Dear Focal Group man,

The aim of this question is to assess soil and water conservation practices entitled as assessments of soil and water conservation practices and challenges which is being studied by Hundessa Tolera for the partial fulfillment of Msc. Degree in Biology. Your genuine response to the questions below is of paramount importance for the accomplishment of my study. You are kindly requested to answer the following questions.

Kebele_____

1. How soil erosion affect the crop yield productivity and its economic value?
2. What is the serious effect of soil erosion in your area?
3. Do you think farmers/community is involved in controlling soil erosion?
4. What is the status of knowledge and practice of the community to control soil erosion in the area?
5. How farmers can play a crucial role in reducing soil erosion in their surrounding?

Appendix 3: Check list format for key informants

Dear key informant,

The aim of this question is to assess soil and water conservation practices entitled as assessments of soil and water conservation practices and challenges which is being studied by Hundessa Tolera for the partial fulfillment of Msc. Degree in Biology. Your genuine response to the questions below is of paramount importance for the accomplishment of my study. You are kindly requested to answer the following questions.

Kebele_____

1. What is your Duty?
2. Which areas are vulnerable to soil erosion?
3. How soil erosion affect the crop yield productivity and its economic value?
4. What is the level of farmer's awareness about soil and water conservation and its effects?
5. What is your contribution for farmers to control soil erosion in the local area?
6. Why farmers destruct the terraces designed for soil and water conservation?

Appendix 4: Questionnaires filled by farmers translated to Afan Oromo

Gaaffilee qonnaan bultootaan guutamuu qaban

Kabajamoo gaafatamtootaa,

Kaayyon gaaffii kanaa, gamaggama eegumsa biyyee fi bishaanii mata-duree gamaaggama yaalii eegumsa biyyee fi bishaanii Aanaa Meettaa Roobitiif rakkoolee isaa kan Hundeessaa Toleeraa tiin sadarkaa barnootaa digrii 2^{ffaa} gosa barnootaa Baayoloojiin guuttachuun qoratamuudha. Gaaffileewwan Kun Kan qophaa`an odeeffannoo waa`ee eegumsa biyyee fi bishaanii akkasumas safartoo isaa funaanuufi. Odeeffannoo sirriin isin gaaffilee armaan gadiitif kennitan qorannoo kootif gahee bu`a qabeessa dha. Kanaafuu gaaffilee armaan gadii gita sirriin akka deebifan kabajaan isin gaafadha. Maqaa keessan barreessun hin barbaachisu. Filannoo dhiyaatan keessaa deebiidha Kan jettan itti maruudhaan akkasumas bakka duwwaa dhiyaate barreeffamaan yaada keessan kennuu dandeessu.

I. Kutaa jalqabaa odeeffannoo nama dhuunfaa fi waliigalaa

Ganda/Araddaa_____

1. Saala: A. Dhiira B. Dhalaa
2. Umrii: A. 1-20 B. 21-30 C. 31-40 D. 41-50 E. 51 fi isaa ol
3. Sadarkaa barnootaa: A. Kan hin baranne B. Barnoota ga`eessotaa
- C. Sad. 1^{ffaa} (1-8) D. Sad. 2^{ffaa} (9-12) E. Yuunivarsiitii ykn koolleejjii
4. Haala gaa`ilaa: A. Kan fuudhe/heerumte B. Kan hike/hiikte
- C. Kan irraa du'e D. Kan hin fuune/hin heerumne
5. Seenaa jireenyaa: A. Loon eeguu fi horsiisuu B. Miidhaan oomishuu C. Lachuu
6. Baay`ina maatii: A. <2 B. 2-4 C. 5-9 D. >9
7. Amantii: A. Pirootestaantii B. Ortodoksii C. Waaqeffannaa D. Musliima E. Kan biraa_____

II. Sababoota dhiqama biyyee

1. Rakkoon dhiqama biyyee lafa qonnaa keessan ykn hara keessa jiraattan keessa jiraa?
- A. Eeyyee B. Lakki
2. Deebiin keessan gaaffii lakk. 1^{ffaa} eeyyee yoo ta'e, dhiqamicha akkamiin sadarkeessita?
- A. olaanaa B. giddugaleessa C. gad-aanaa
3. Dhiqamni biyyee rakkoo inni diinagdee irraan ga`u maali jettee yaadda?_____
4. Akka ati ilaaltutti ammeentaan dhiqama biyyee yeroo dhaa yerooti:-

A. Dabalaa jira. B. giddugaleessa C. Hir`isaa jira.

5. Ammas deebiin keessan gaaffii lakk. 1^{ffaa} eeyyee yoo ta`e, gosa harama ykn dhiqama biyyee isa kamtu naannoo kanatti beekama?

A. Dhiqama biyyee baay`ee guddaa bal`inaa fi gad-fageenya lafa olka`aa irratti qabu.

B. Dhiqama biyyee lafa walqixxaataa irratti yaa`a uumamu.

C. Dhiqama biyyee xiqqaa fi dhiphaa dheerina lafa olka`aa irratti qabu.

D. Dhiqama biyyee coba roobatiin taasifamu

6. Ammas deebiin keessan gaaffii lakk. 1^{ffaa} eeyyee yoo ta`e, sababni dhiqama biyyee lafa keessanii maali jettanii yaaddu?

A. Manca`insa bosonaa B. Marga qorqisiisuu

C. lafa haala malee fayyadamuu. D. Bal`ina lafa qonnaa E. Kanneen biroo_____

7. Bal`inni lafa keessanii hektaara meeqa ta`a?

8. Oyrūun qonnaa keessan qe`ee keessanitti dhiyoodhaa?

III. Ilaalcha fi yaada qonnaan bultootni eegumsa biyyee fi bishaanii irratti qaban

1. Yeroo oomishni qonnaa kee gadi bu`u tarkaanfiin ati fudhattu maali?

A. Lafa qonnaa jijjiiruu B. Biyyicha deebisanii gabbisuu C. lamaanuu D. Mala biraa_____

2. Lafa qonnaa biroo yoo jijjiirte lafa qonnaa akkamii filattaa? A. Lafa qullaa B. Lafa ba`ii

C. Lafa margaa D. Kanneen biroo yoo ta`e ibsi_____

3. Gabbina biyyee lafa kee akkamitti eegda? A. Dikee B. irratti gubuu C. sanyii jijjiiruu

D. Xaa`oo fayyadamuudhaan

E. Kanneen biroo fayyadamuudhaan_____

4. Odeeffannoo waa`ee tooftalee eegumsa biyyee fi bishaanii eenyurraa argattaa? (Yoo tokko ol ta`an kan odeeffannoo sirrii qabu eeri).

A. aadaa duubaan dhuferraa B. Hojjetaa dirree misoomaarraa

C. Dhaabbata miti mootommaa biroo irraa.

D. Gara biraarraa yoo ta`e ibsi._____

5. Leenjii eegumsa biyyee fi bishaanii irratti hirmaattee beektaa? A. Eeyyee B. Lakki

6. Yoo deebiin kee lakk. 5^{ffaa} ta`e yeroo meeqaaf?_____

7. Faayidaan ati leenjiiirraa argatte maalinni?_____

8. Daagaa balleessitee yoo beekte, sababiin balleessuu keetii maali? (Yoo tokko ol ta`an sababa quubsaa kenni?)

- A. Biyyoo gabbataa barbaaduuf B. Lafa qonnaa wal-qunnamsiisuuf
 C. Dawoo bineensotaa kan akka hantuutaa balleessuuf
 D. sanyii aramaa adda addaa balleessuuf E. Kan biraa yoo ta'e ibsi_____
9. Lafa qonnaa kee keessatti daagaaa ijaartee hin beektu yoo ta'e kan si daangesse maalinni?
 (Yoo tokkoo ol ta'e isa sirrii ta'e eeri). A. Hojiin isaa nuffisiisaadha. B. Ilbiisotaa fi ilmaallan
 isaanii waan horaniif C. Ijaaruuf humni waan hin jirreef D. Ollaan koo fedhii ijaarsaa ykn
 eegumsaa hin qaban. E. Kan biraa yoo ta'e eeri._____
10. Daagaa ijaartee hin beektu yoo ta'e sababni isaa maali? (Tokkoo ol yoo ta'an isa sirrii eeri)
 A. Caasaa eegumsa biyyee fi bishaanii hin amanu. B. Namni kallattii na qabsiise hin jiru.
 C. Hojjechuu waan hin barbaanneef D. Lafti koo ijaarsaaf waan hin mijanneef
 E. Kan biraa yoo ta'e ibsi_____
11. Ati ykn maatiin kee lafa qonnaa irratti mala aadaatiin eegumsa biyyee fi bishaanii hojjattanii
 jirtuu? A. Eeyyee B. Lakki C. Hin beeku
12. Yeroo ammaa kana lafti qonnaa kee mala eegumsa biyyee haaraa fudhateeraa?
 A. Eeyyee B. Lakki
13. Yoo deebiin kee gaaffii lakk. 12^{ffaa} eeyyee ta'e, malli haaraan eegumsa biyyee fi bishaanii
 naannoo keessanii maal fa'i? Tarreessi_____
14. Ijaarsa eegumsa armaan gadii keessaa kan naannoo keessanitti hojiirra oole isa kami?
 A. Daagaa dhagaan ijaarama. B. ijaarsa biyyee C. Bishaan irraa jallisuu D. Bo'oo baasuu
 E. Kan biraa yoo jiraate ibsi_____
15. Ooyruu kee kam irratti eegumsa biyyee fi bishaanii kana gaggeessite? A. Lafa qonnaaf oolu
 irratti B. Lafa dheedichaa ykn margaa irratti C. Lamaanuu irratti
 D. Kan biraa yoo ta'e ibsi_____
16. Malleewwan eegumsa baayoolojii ykn saayinsii jiran keessaa malli hojiirra oole isa kami?
 A. Ijaarsa irra irratti haaromsuu ykn biqiltuu dhaabuu B. Bo'ii haaromsuu C. Daangessuu fi
 biqiltuu dhaabuu D. Kan biraa yoo ta'e ibsi._____
17. Ijaarsi eegumsa biyyee fi bishaanii eenyuun hojjatame? A. Hirmaanaa hawaasaa B. Maatii
 mana keessaa C. Dafqaan bulaa ykn hojjetaa guyyaa D. Kan biraa yoo ta'e
 ibsi_____
18. Rakkoo fi furmaata hir'ina eegumsa biyyee fi bishaanii irratti argamaniif gorsa ogeessaa si'a
 meeqa fudhatte?

- A. Ji`atti altakka B. Ji`atti yeroo lama C. Ji`atti yeroo sadii
 D. Kan biraa yoo ta`e_____
19. Agarsiisa ykn daawwannaa haala eegumsa biyyee fi bishaanii daawwattee beektaa?
 A. Eeyyee B. Lakki
20. Leenjii fi agarsiisa sana eenyutu dhiyeesse?
 A. Waajjira qonnaa aanaa B. Dhaabbata miti-mootummaa
 C. Ogeessaa dirree misoomaa D. Kan biroo yoo ta`e_____
21. Leenjii fi agarsiifni eegumsa biyyee fi bishaanii akkasii faayidaa qabaa? A. Eeyyee B. Lakki
22. Deebiin kee gaaffii lakk. 21^{ffaa} eeyyee yoo ta`e, faayidaa isaa akkamiin ibsita?_____
23. Beekumsa ogummaan deeggarama kan akka itti fuftee eegumsa biyyee fi bishaaniif eegdu ykn taasiftu argatteetaa? A. Eeyyee B. Lakki
24. Walitti dhufeenya si`ii fi ogeessa dirree misooma eegumsa biyyee fi bishaani hojjetan gidduu akkamiin ibsita?
 A. Walitti hin dhufu B. Gad-aanaadha C. Haala gaariidha. D. Olaanaadha E. Baay`ee
 olaanaadhaa
25. Gatiin ykn kanfaltiin ati eegumsa biyyee fi bishaaniitiif baastuu dhiibbaa lafa kee irraan ga`e qabaa? Akkamitti? ibsi_____

Galatoomaa!

Appendix 5: Figures of soil and water conservation techniques.



Figure1. Soil bund techniques made in Kimo Dima Kebele, 2023



Figure2. Stone bund SWC techniques made in Baka Kebele, 2023