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SENIOR RESEARCH PAPER ON ASSESSMENT OF INTEGRATED WATERSHED MANAGEMENT PRACTICES ON GASURE KEBELE CHEHA WOREDA ,GURAGE ZONE, CENTRAL ETHIOPIA REGION, ETHIOPIA

RESEARCH SUBMITTED TO COLLEGE OF AGRICULTURE AND NATURAL RESOURCES DEPARTMENT OF NATURAL RESOURCE MANAGEMENT, IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR FIRST BACHELOR DEGREE.

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List of Abbreviation

AHI	African Highland Initiatives
FAO	Food and Agricultural Organization
FGD	Focus Group Discussion
FTC	Farmers Training Center
Ha	Hectare
HHs	Households
IDB	Inter-American Development Bank
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
IWM	Integrated Watershed Management
MOA	Ministry of Agriculture
MoARD	Ministry of Agriculture and Rural Development
NGO	Non-Governmental Organization
SWC	Soil and Water Conservation

Abstract

This study assesses the integrated watershed management practices implemented in Gasure Kebele, Ethiopia, with a focus on understanding community participation, effectiveness, and challenges associated with soil and water conservation initiatives. Rain-fed agriculture is the cornerstone of Ethiopia's economy, yet land degradation due to improper resource management poses significant challenges. Through systematic random sampling of 66 farmers, data were collected using a combination of quantitative and qualitative methods, including surveys and field observations. The findings indicate varying levels of adoption of watershed management practices such as terraces, check dams, and plantations. Although community involvement in conservation efforts is evident, significant barriers persist, including limited education and awareness among farmers. The results underscore the need for a multidisciplinary approach to enhance the effectiveness of watershed management projects in improving agricultural productivity and sustainability in Gasure Kebele.

Keywords: Integrated Watershed Management, Soil and Water Conservation, Community Participation, Land Degradation.

1. INTRODUCTION

1.1. Background

The backbone of the agrarian economy in most developing countries of the world is rain-fed agriculture. The economic development of developing countries depends on the performance of the agricultural sector, and the contribution of this sector depends on how natural resources are managed (Fikru, 2009). In most developing countries, the major factor for land degradation is improper and unsustainable land use and management due to population pressure, small farm sizes, land redistribution, and limited access to credit and education (IFPRI, 2005).

Ethiopia is one of the developing countries where land resources are becoming increasingly scarce, and the quality of resources such as soil, water, plants, and animals is decreasing as a result of improper use and management. Land degradation in the form of soil erosion, sedimentation, depletion of nutrients, deforestation, and overgrazing is one of the major problems facing farmers in Ethiopia, limiting their ability to increase agricultural production and reduce poverty and food insecurity (Temesgen, 2012).

Watershed management is a landscape-based strategy that aims to implement improved natural resource management systems for improving livelihoods and promoting beneficial conservation, sustainable use, and management of natural resources. Integrated watershed management (IWM) has been promoted in many countries as a suitable strategy for improving productivity and sustainable intensification of agriculture (Bekele, 2007).

To address land degradation, extensive watershed management practices were launched in Ethiopia, particularly after the famines of the 1970s. Since then, huge areas have been covered with terraces, bunds, and millions of trees have been planted (Herweg, 1993; Yeraswork, 2000). Even though a number of watershed management techniques were introduced to combat land degradation, the adoption of these practices remains below expectations (Yeraswork, 2000).

In Gasure Kebele, different soil and water conservation practices have been implemented (such as check dams, trenches, terraces, and plantations) to improve natural resources and enhance the livelihoods of local people. Therefore, this study was initiated to assess the integrated watershed management practices implemented and generate recommendations that would assist in the further development and management of the sub-watershed.

1.2. Statement of the Problem

Land degradation, which includes the degradation of vegetation cover, soil degradation, water pollution, and nutrient depletion, is a major ecological problem in Ethiopia (Temesgen, 2012). The degradation of vegetation cover and soil is mainly caused by a lack of effective watershed management practices and the inappropriate use of natural resources. Additionally, the lack of effective community participation appears to be a key factor contributing to land degradation (Bekele, 2007).

Watershed management is one of the most crucial practices for fulfilling the basic needs of human beings, ensuring the survival of animals and plants, and improving the economy of a country by increasing productivity. However, soil erosion and water resource degradation have become pressing issues in many developing countries, leading to severe consequences for livelihoods and environmental sustainability.

In Gasure Kebele, sub-watershed management practices have been implemented, but they have not been thoroughly studied due to various challenges, including farmers' perceptions and other external factors that have impacted their effectiveness. The success of early watershed projects in other areas served as the foundation for major watershed initiatives. As a result, watershed management practices have been conducted in Gasure Kebele for many years, particularly through soil and water conservation (SWC) measures.

However, while watershed management practices have been implemented, the attitudes of the community toward these interventions and their effectiveness have not been adequately studied. Therefore, this study was conducted to assess the integrated watershed management practices implemented in the study area and to evaluate the attitude and participation of the community in watershed management.

1.3. Objectives of the Study

1.3.1. General Objectives

The general objective of this study is to assess the integrated watershed management practices implemented in Gasure Kebele.

1.3.2. Specific Objectives

- ✓ To identify major watershed management practices in Gasure Kebele.
- ✓ To identify factors affecting the implementation of watershed management in Gasure Kebele.
- ✓ To evaluate the effectiveness of watershed management practices in Gasure Kebele.

1.4. Research questions

- Which watershed management practices address different problems?
- What does the people's participation in the watershed look like?
- Which factor affects the implementation of watershed management practice?

1.5. Significance of the Study

This study generates valuable information for various stakeholders, including researchers, policymakers, governmental and non-governmental organizations, and local farmers' organizations. The findings will help in designing and developing effective and sustainable integrated watershed management practices and strategies.

1.6. Expected output

The research will help to find out the most impeding problems and the prospects that the watershed area exposed. It is also expected that with the output of this study will indirectly help to improve the livelihood of the community by implementing what has been suggested and recommended in this study. those helping expected output includes a comprehensive understanding of the effectiveness of current soil and water conservation methods. The research aims to identify which practices, such as mulching, terracing, and agroforestry, have the most significant impact on reducing soil erosion, improving soil fertility, and conserving water resources.

1.7. Scope of the Study

Due to time and resource constraints, it is not feasible to cover all aspects of the study area. Therefore, the study focuses on representative sites within Gasure Kebele, Cheha Woreda, Gurage Zone. The findings can be applied to other areas with similar agro-ecological conditions, problems, and socio-economic situations, with necessary adjustments. The scope of the study focuses on identify the effectiveness of soil and water conservation methods used to address land degradation, soil erosion, and water scarcity. It covers both traditional and modern practices, such as mulching, terracing, stone bunds, and agroforestry, and evaluates their impact on improving soil fertility, water retention, and agricultural productivity. The study is limited geographically to Gasure Kebele and targets smallholder farmers who are directly involved in managing the land.

1.8. Limitation of the study

This study has some limitations and faced some constraints: From these, a financial constraint was the main drawback during conducting this study. The data collection time (March to April) was found to be inconvenient for most of the farming population in the study areas as it was peak agricultural activity season. Most farmers were reluctant to spare their scarce time for interview. The time allocated for the survey was found to be insufficient to arrange and integrate some of the questions in the questionnaire and to make proper follow-up and control of the data collection process. Even though the household questionnaire interviewed to each household was designed to be concise, it was lengthy and in some areas some of the questions were not understood by interviewees. However, we have attempted and took all the best to make study effective and valuable work.

2. LITERATURE REVIEW

2.1. Land Degradation in Ethiopia

High population pressure and livestock pose significant challenges to increasing productivity in the highlands of Ethiopia. These factors contribute to biophysical land degradation and hinder sustainable agricultural development. To compensate for low agricultural productivity, forest lands have been converted into arable land for centuries (EFAP, 1994). As a result, Ethiopia's natural forest cover has significantly declined from approximately 40% in the 1990s to less than 3% at present (Kuru, 1990; EFAP, 1994).

Declining soil fertility and land degradation in the form of soil erosion are among the most serious challenges to agricultural productivity and economic growth in Ethiopia (Mulugeta, 2004). Several studies indicate that large areas of the highlands experience suffer from high rates of soil erosion, with an average soil loss ranging from 21 to 42 tons per hectare per year on cultivated lands (Hurni, 1988; Kebede, 1996). The degradation of agricultural land presents a serious threat to both current and future food production in the Ethiopian highlands (Hurni, 1988; Azene, 2006).

2.2. Watershed Management Practices in Ethiopia

Watershed management practices involve planned changes in land use, vegetation cover, and structural or non-structural interventions aimed at achieving ecosystem-based, multiple-use management objectives. In rain-fed regions, watershed management primarily focuses on rehabilitating degraded lands, conserving soil and water resources, and ensuring the sustainable production of food, forage, fiber, and other products. Additionally, it enhances the availability of high-quality water from upland watersheds to downstream areas (FAO, 1986; Khan, 2002).

The Ethiopian government has long recognized the severe consequences of soil erosion and has implemented large-scale national programs since the 1970s and 1980s to mitigate environmental degradation. However, these efforts have been insufficient in addressing rapid population growth, widespread land degradation, and increasing risks of drought and low rainfall. Since the 1980s, the government has supported rural land rehabilitation initiatives to promote natural resource conservation and development through watershed management (MOARD, 2005).

Historically, Ethiopia had only a few watershed management projects. One significant initiative, the Institutional Strengthening Project implemented by FAO, focused on capacity building for the

Ministry of Natural Resources, training technicians, experts, and development agents in the highland regions. The projects targeted sub-watersheds in areas with severe chronic food insecurity. The GTZ-Integrated Food Security Program South Gondar utilized an Integrated Watershed Management Approach to improve food security through natural resource management, including biological and physical soil conservation, crop improvement, and rural infrastructure development (GTZ-IFSP, 2002). This project successfully rehabilitated gullies and contributed to sustainable land management. Today, various donor and development agencies actively promote watershed development across Ethiopia.

In Ethiopia, watershed management has traditionally been regarded mainly as a soil and water conservation practice. Early watershed projects provided the foundation for major watershed initiatives, but their focus was primarily technological, neglecting critical institutional arrangements. Many newly implemented projects failed to engage local communities or establish collective problem-solving mechanisms. Even when village-level participation was attempted, it was typically limited to a few key individuals, such as village leaders. These projects ultimately failed due to their centralized approach, rigid technological frameworks, and lack of institutional support (MoARD, 2005).

2.3. Community Participation in Watershed Management

Participatory watershed development planning and management will be employed in Gasure Kebele to improve the livelihoods of rural households and optimize the use of existing natural resources (ANRSFRE, 2008). Cooperation between local communities, government agencies, and non-governmental organizations, coupled with effective conflict resolution, can reverse environmental deterioration (Jeffery and Vira, 2001). Governments and NGOs have recognized that protecting watersheds cannot be achieved without the active participation of local people (Pretty and Ward, 2001). Therefore, for successful and sustainable watershed management in Gasure Kebele, community participation is essential. This lesson emerges from past failures of centrally planned watershed projects, where local people were often compelled to construct terraces, bunds, rehabilitate gullies, and implement other technical measures imposed by external experts (IDB, 1995).

The active involvement of farmers in planning and implementing natural resource management programs is crucial, as they are directly affected by these issues and can contribute practical

insights and local knowledge (Stocking, 1996). In many centrally planned projects in Ethiopia, soil and water conservation (SWC) programs have relied on standard technical solutions such as terracing and contour bunding, based on the assumption that these measures are universally applicable and that local farmers are unaware of soil erosion and its causes and consequences (MoARD, 2005).

2.4. Concept of Sustainable Watershed Management

Watershed management implies the wise use of natural resources—land, water, and biomass—within a watershed to achieve optimal production with minimal disturbance to the environment (Swallow, 1996). Historically, the concept focused on managing resources in medium to large river valleys to slow rapid runoff, reduce excessive soil erosion, control reservoir siltation, and mitigate potentially damaging floods (Paul, 1997).

Today, watershed development and management programs view the watershed as a hydrological unit, aiming to implement suitable measures for soil and water conservation, provide adequate water for agricultural and domestic use, and enhance the livelihoods of local communities, including those in Gasure Kebele (Ashby *et* al., 1996). Managing watersheds for sustainable rural development is a multifaceted concept that involves not only stabilizing soil, water, and vegetation but also enhancing the productivity of resources in an ecologically and institutionally sustainable manner (Farrington *et* al., 1999). In regions such as South Asia and sub-Saharan Africa, watershed management is practiced to increase rain-fed agricultural production, conserve natural resources, and reduce poverty, addressing challenges characterized by low productivity, severe resource degradation, and high poverty levels (Kerr, 2002).

The success of watershed projects is often determined by the environmental services provided conditions and processes through which ecosystems sustain and fulfill human needs, including food production and other essential goods (Rosegrant, 2002).

2.5. Integration of Watershed Management Activities

The concept of "integration" in watershed management can take multiple forms. Within the African Highlands Initiative (AHI), integration refers to managing various watershed components such as trees, water, livestock, crops, and soil in a coordinated manner. It also involves bringing

together diverse solutions through a multidisciplinary or multi-sectoral approach (Kindu and Zenebe, 1997).

Integrated Watershed Management (IWM) is a holistic approach to managing human activities within a watershed to protect and rehabilitate land and water resources while promoting sustainable development. The ultimate goal is to enhance the quality of life for people living in the watershed (FAO, 2000). However, the lack of coordination among different sectors and limited stakeholder participation have hindered the success of watershed programs. Farmers' involvement in problem identification, priority setting, planning, and implementation has remained minimal, leading to lower adoption rates and limited effectiveness of watershed initiatives (Zenebe, 2005).

2.6. Importance of Watershed Management for the Community

Watershed management plays a critical role in improving community livelihoods by enhancing water availability, soil fertility, and environmental resilience. Key benefits include:

Improved soil quality and drainage for increased crop production and diversification.

Enhanced access to biomass resources such as firewood, fodder, fruits, and construction materials. Increased resilience to environmental shocks, leading to improved food security and livelihoods. Greater participation in income-generating activities and reduced land development costs (MoARD, 2003).

Additionally, effective watershed management helps reduce erosion, deforestation, flooding, and waterlogging. It increases agricultural productivity, improves access to markets and services, and ensures a more stable and clean water supply for domestic and industrial use (MoARD, 2003).

2.6.1. Environmental Importance

Watershed management contributes to environmental sustainability by acting as a natural sink for carbon emissions, which helps regulate global temperatures and maintain the hydrological cycle. Forests within watersheds absorb carbon released from industries, reducing greenhouse gas effects. Watershed management also improves soil water-holding capacity, which enhances microclimate conditions, prevents desertification, and supports biodiversity conservation (Decksha and Ketewa, 2008).

Moreover, well-managed watersheds help reduce downstream flooding, lower sedimentation in irrigation systems, and protect major infrastructure such as roads and bridges. By stabilizing production systems and ensuring a reliable water supply, watershed management contributes to long-term environmental and economic stability (Purohit and Rajan, 2005).

2.6.2. Importance of Watershed Management for Sustainable Management of Natural Resources

Watershed management has emerged as a sustainable strategy for conserving natural resources, including water, forests, and soil, in an integrated manner, particularly in rain-fed and drought-prone areas (Roy, 2005). Soil, water, and vegetation are vital natural resources for sustainable development, requiring collective and effective management (Kishor, 2000).

Managing natural resources sustainably is crucial in its natural region, where the flow of water influences virtually all environmental fields. Regions are diversified into basins, catchments, sub-catchments, micro-watersheds, and mini-watersheds, each influencing local environmental processes (Nair, 2009).

2.7. Constraints of Watershed Management

2.7.1. Inadequate Community Participation

Top-down, rigid planning approaches have excluded local communities from participating in watershed management. These approaches focused primarily on technical and physical works without considering economic viability and social acceptability. Lack of awareness and integration of indigenous knowledge reduced farmers' willingness to engage, and during political changes, many soil and water conservation structures and forests were destroyed (Sharma et al., 2005).

2.7.2. Policy, Legislation, and Implementation Constraints

Poor implementation of policies and strategies hinders effective resource management practices in Ethiopia. There is weak coordination among various institutions and sectors, and a single-sector focus reduces the effectiveness of watershed management. Additionally, government institutional restructuring results in high staff turnover, institutional capacity loss, and discontinuity of initiatives (Sharma et al., 2005).

2.7.3. **Lack of Professional and Technical Standards**

Technical interventions often lacked proper dialogue and negotiation processes. Soil and water conservation structures were seen as the sole solution to land degradation, yet selection criteria and design parameters were often not aligned with the required standards. Attention was placed on the number of interventions rather than their quality, sustainability, and integration with other practices (Sharma et al., 2005).

2.7.4. **Other Socio-economic and Bio-physical Challenges**

Several socio-economic and bio-physical constraints affect the sustainability of watershed management practices. Issues such as poverty, population growth, land-use change, deforestation, and climate change (e.g., droughts and floods) often hinder long-term success in Ethiopia (Sharma et al., 2005).

2.8. Types of Soil and Water Conservation Measures

Agronomic measures, such as mulching and crop management, are crucial for reducing erosion by water and wind (Morgan, 2005). Practices like strip cropping, intercropping, mulching, contour plugging, grazing management, and agroforestry help intercept rainfall, increase infiltration rates, and reduce surface runoff (Amsalu, 2007). Agronomic measures are often cheaper than structural measures and can be more effective in certain systems (Heathcoat & Isobel, 2008). However, they may be difficult to implement as they require changes in farmers' traditional practices (Heathcote & Isobel, 2008). Materials like crop residues, grass, farmyard manure, and synthetic products are commonly used for mulching to protect the soil (Lal, 2004). Crop residues also reduce soil temperature, conserve moisture, and mitigate the effects of erosion (Agele et al., 2000).

2.8.1. Biological Soil and Water Conservation Measures

Biological soil and water conservation measures involve the use of vegetation to protect and conserve land. These practices include both agronomic methods and forest cover (Amsalu, 2008). The biological method primarily stimulates plant growth, including grasses, bushes, or trees, over

degraded areas. The roots of these plants help to bind the soil, while the crowns of bushes and trees slow down the flow of air or water, providing a natural form of protection against erosion. Dead plant material enriches the soil with organic matter, improving its structure and fertility. This approach effectively reduces soil loss and improves overall soil health (Lal, 2005).

2.8.2. Physical Soil Conservation Structures

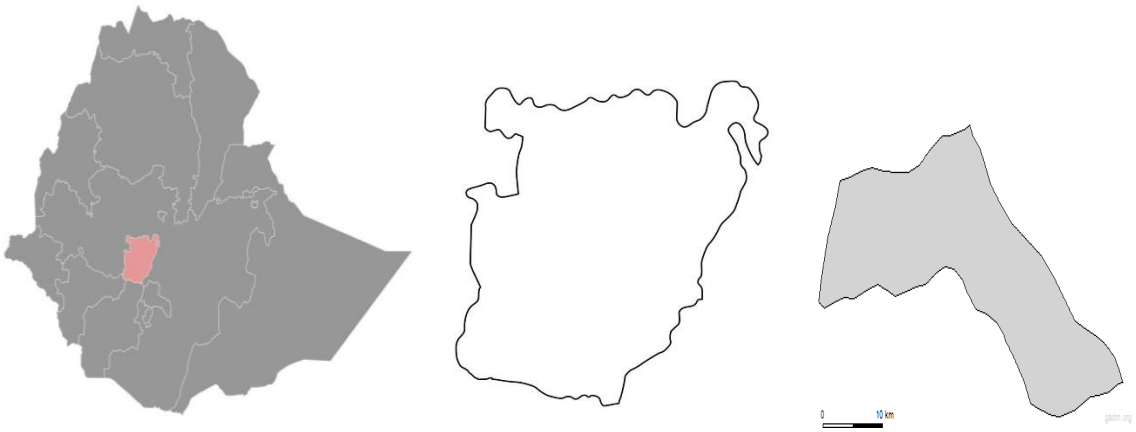
Physical soil conservation structures are permanent features made from earth, stones, or masonry, designed to protect soil from uncontrolled runoff and erosion, while also retaining water where needed. In areas of steep land farming, physical structures such as rock barriers, contour bunds, and waterways like diversion ditches, terrace channels, and grass waterways are essential. Additionally, stabilization structures such as dams, windbreaks, and terraces—like diversion, retention, and bench terraces are often necessary to prevent further degradation and to help manage water effectively (Morgan, 2008).

3. MATERIALS AND METHOD

3.1. Description of the Study Area

3.1.1. Location and Topography

The study area, Gasure Kebele, is located in Cheha Woreda, within the Gurage Zone of central Ethiopia. Gasure Kebele is situated approximately 160 kilometers southwest of Addis Ababa, the capital city. This area is known for its rich agricultural landscape and its strategic position along key transportation routes connecting to different regions in the country. The topography of the region features rolling hills and elevated landforms, with an average elevation of about 2,000 meters above sea level.



3.1.2. Climate and Agro-Ecological Zone

Gasure Kebele falls under Weyna Dega agro-ecological zone, according to Ethiopia's climate classification. The region experiences an annual average rainfall ranging between 800 and 1,200 mm. The temperature ranges from 15°C to 25°C throughout the year, making it suitable for various types of crop production and agro-based livelihoods.

3.1.3. Population

The population of Gasure Kebele is diverse, consisting of various ethnic groups contributing to the area's cultural richness. The 2007 census by the Central Statistical Agency recorded a total population of 28,866 people in the woreda, with a roughly equal distribution of men and women. Gasure Kebele has also seen significant population growth in recent years, driven by migration and urbanization.

3.1.4. Soil Type

The soil types in Gasure Kebele are varied, with the area predominantly characterized by sandy clay and silt soils. The soil colors in the area include black, brown, and red, with black soil being the most dominant. These soil types are vital for agricultural production in the region, particularly for crop cultivation.

3.2. Sampling techniques

Systematic random sampling procedure were use to select 66 farmers' households from the kebele to identify assessment of soil and water conservation practices in the study areas. To facilitate this final stage, lists of names of households in each selected village was obtained from the kebele Chairpersons, the field extension officers and technical support organizations operating in the study areas. Totally 708 HHs is found in this kebele. The sample size for this study was 66 HHs by using Kothere's formula as calculated below.

The numbers of sample households for interview were determined using the formula developed by Kothere (1985).

$n= Z^2pqN/E^2 (N-1) +Z^2pq$

Where, n= sample size

P= maximum possible proportion which is 5% (0.05)

q= 1-p= 0.95

E= allowed error which is now 5%

Z= confident interval which is now 95%, 1.96 from Z- table

N= total number of households

Therefore, $n= (1.96)^2*0.05*0.95*708/ (0.05)^2(708-1) + (1.96)^2*0.05*0.95$

n= 65.8= 66 HHs

3.3. Data Collection Methods

Both quantitative and qualitative data were collected using a combination of methods. These data were gathered from a variety of sources to ensure comprehensive insights into the integrated watershed management practices in the study area.

The data required for this study were collect from both primary and secondary sources. The primary data were generated from systematical randomly selected sample households using a questionnaire from the kebele. To have an overall view of assess soil and water conservation a

reconnaissance survey also have been used to collect primary data from kebele. Secondary data were degenerate from different publication of document which found in the kebele.

The data collections were carried out both at household and plot level by interviewing and field observation, respectively. At household level, the necessary data related to background information, Household characteristics (sex, age, educational status…etc. In field observation the status of conservation measures within watershed were observed. Some physical soil and water conservation measures (soil bunds and mulching) practiced in the kebele was observed. The data was collected during field observation are; the implemented SWC practices, types of crop production, status (degree) of use of improved soil conservation structures, types of livestock and causes of soil erosion.

Various open-ended questions were prepared for Focus Group discussion (FGD). Discussion was made about different features of visible environment, reason for degradation problem, status of watershed management technology, and the conservation interventions that the community has practiced. Through this method, the data was collected from the selected village found in watersheds by considering different independent variables; male and female of different age, educational level, and local position of wealth status.

Secondary information was obtained from Woreda Agriculture and Rural Development Office, Books, study reports, students' theses as well as published and unpublished documents of other organizations.

Materials used during the study were different stationary materials (like pen, paper, ruler, binder) during field observation and interview.

3.4. Methods of Data Analysis

For this particular study we used both quantitative and qualitative data analyzing methods. In the case of quantitative data analyzing methods, the primary data collected from household survey was presented in tables . In the case of qualitative data analyzing, the collected primary data was checked. The information obtained through key informant interview and group discussion were more described and presented qualitatively and used to substantiate and supplement findings from the quantitative analysis of our questionnaires.

4. RESULTS AND DISCUSSIONS

This chapter deals with the analysis of the survey data and interpretation of the analytical findings. As already noted, a structured questionnaire was administered to 66 sample farmers in Gasure kebele and field observation was carried out. The questionnaire was designed in such a way that it enables to collect data on the Household characteristics, Sub-watershed problems and its causes, Watershed characteristics and its management, crop and livestock production in the study area.

4.1. **Demographic Characteristics**

4.1.1. **Sex and age of the respondents**

Table 1: sex structure of respondents

Sex	No of respondents	Percent (%)
Male	41	62.12
Female	25	37.88
Total	66	100

Source: field data, 2017

In the study, the respondents indicated their sex structure as follows:

The majority of the respondents, 41 individuals, were male, which accounted for 62.12% of the total. In contrast, 25 respondents identified as female, representing about 37.88%. Overall, the total number of respondents was 66, with the male respondents significantly out numbering the female respondents. This distribution highlighted a notable gender imbalance in the sample

Due to the above results on the positive side, the predominance of male respondents may reflect a stronger representation of traditional agricultural practices and leadership roles, which can enhance the implementation of watershed management strategies. Men often hold key positions in decision-making processes related to land and water management, allowing for quicker mobilization of resources and collective actions. This can lead to successful initiatives such as soil conservation, reforestation, and sustainable water use, ultimately improving agricultural productivity and ecosystem resilience in the area.

However, with fewer female respondents, poses significant challenges that can limit the effectiveness of these practices. Women typically play essential roles in managing household water resources and agricultural activities, yet their voices may be underrepresented in watershed management discussions.

Table 2: Age composition of respondents

Age	No of respondents	Percent (%)
20-25	8	12.12
26-30	14	21.21
31-40	24	36.36
>40	20	30.30
Total	66	100

Source: field data, 2017

In the survey, the respondents provided their age composition as follows:

A total of 66 individuals participated, with 8 respondents aged 20-25, representing 12.12% of the total. The age group of 26-30 included 14 respondents, making up about 21.21%. The largest group was aged 31-40, with 24 respondents, which accounted for around 36.36%. Finally, 20 respondents were over 40 years old, representing about 30.30%. This distribution illustrated a diverse age range among the participants.

So the result shows that the age composition of respondents in Gasure Kebele significantly influences the effectiveness of watershed management practices. A diverse age range, particularly with active participation from younger individuals, can drive innovation and the adoption of modern techniques, enhancing the overall effectiveness of water conservation efforts.

4.1.2. **Education status**

As educational status of a household head increases, it is assumed to increase the transfer of relevant information and as a result increase farmers' knowledge about the watershed problems and causes, watershed management practices. Education enables farmers to watershed problems and causes using various ways of watershed management practices, traditional and introduced soil

conserving technologies.

Table 3: Distributions of household head by education status

Education status	No of respondents	Percent (%)
Illiterate	19	28.79
Primary 1-4	14	21.21
Primary 5-8	16	24.24
Secondary 9-12th	12	18.18
College/university	5	7.58
Total	66	100

Source: field data, 2017

In the study, the respondents shared their education status as follows:

Out of 66 participants, 19 were illiterate, accounting for 28.79% of the total. Fourteen respondents had completed Primary 1-4, representing about 21.21%. Sixteen individuals were in the Primary 5-8 category, making up around 24.24%. Twelve respondents had achieved Secondary education (9-12th grade), which constituted about 18.18%. Lastly, only 5 respondents had completed college or university, representing approximately 7.58%. This distribution reflected a varied educational background among the household heads (Table 3).

So the higher levels of education among household heads in Gasure Kebele contribute positively to watershed management implementation. Educated individuals are more likely to understand the long-term benefits of conservation practices, adopt modern techniques, and participate in community-based environmental initiatives. This enhances awareness, cooperation, and sustainable resource use. A lack of awareness and understanding can lead to poor participation, resistance to new methods, and unsustainable land-use practices.

Table 4: Years of farming experience

Farmers experience	No- Respondents	Percent %
5-10	11	16.67
10-20	22	33.33
>20	33	50.00
Total	66	100

Source: field data, 2017 EC

Out of 66 participants, 11 had 5-10 years of experience, which constituted 16.67%. The group with 10-20 years of experience included 22 respondents, making up about 33.33%. The largest group, with over 20 years of experience, comprised 33 respondents, representing around 50.00%. This distribution highlighted the extensive experience among the farmers surveyed (Table 4).

So this result indicate that in Gasure Kebele with many years of farming experience often have deep knowledge of local land conditions, rainfall patterns, and traditional soil conservation methods. This practical experience can support the successful implementation of watershed management by encouraging practices that are adapted to local conditions and proven to be effective over time.

However, extensive farming experience can also have a negative impact if it leads to a strong attachment to traditional methods. Some experienced farmers may resist adopting new watershed management techniques, viewing them as unnecessary or unfamiliar.

Table 5: Farmers farm land size (ha)

Farm land size (ha)	No- Respondents	Percent %
1-2	36	54.55
3-4	18	27.27
>5	12	18.18
Total	66	100

Source: field data 2017 EC

Out of 66 participants, 36 had farms ranging from 1 to 2 hectares, accounting for 54.55% of the total. Eighteen respondents reported farm sizes of 3 to 4 hectares, representing about 27.27%. Lastly, 12 individuals had farms larger than 5 hectares, which constituted around 18.18%. This distribution indicated a predominance of smaller farm sizes among the respondents (Table 5).

Due to the above results in Gasure Kebele, farmers with larger land sizes are more likely to implement and benefit from watershed management practices. They have more space to apply soil and water conservation techniques and can afford to set aside land for rehabilitation or tree planting. Conversely, farmers with very small landholdings may struggle to adopt watershed practices, as they prioritize immediate food production over conservation. Limited land size reduces the ability to implement techniques like terracing or buffer zones. This can lead to soil degradation and water loss, negatively affecting the overall success of watershed management in the area.

Table 6: Conservation measures practiced

Conservation measures	No of respondents	Percent (%)
Gully rehabilitation and restoration	21	31.8
Tree planting and agroforestry	17	25.8
Soil bund and mulching	13	19.7
terrace and crop rotation	15	22.7
Total	66	100

Source: field data, 2017

The respondents shared their experiences with various conservation measures. Twenty-one participants mentioned using gully rehabilitation and restoration, which accounted for 31.8% of the total. Seventeen respondents stated they practiced tree planting and agroforestry, representing 25.8%. Thirteen individuals reported utilizing soil bunds and mulching making up 19.7%, while fifteen respondents indicated they implemented terraces and crop rotation, comprising 22.7%. Overall, these insights from the 66 participants reflected a diverse range of conservation practices within the community (Table 6).

The above results show that in Gasure Kebele, the adoption of various conservation measures like rehabilitation, tree planting, and terracing has significantly improved soil and water management in the area. These practices have reduced soil erosion, enhanced soil fertility, and increased agricultural productivity, benefiting local farmers. Additionally, the increased vegetation cover has helped restore the ecosystem and improve water availability. some conservation measures, such as soil bunds, are less commonly practiced, limiting the overall effectiveness of watershed management. The uneven adoption of practices may be due to limited resources, lack of knowledge, or insufficient community engagement. This inconsistency could hinder the long-term success of watershed management efforts, and competition for land may create conflicts among local farmers.

4.1.3 Traditional and newly introduced SWC practices

Traditional methods like soil bunds and mulching (19.7%) and terraces and crop rotation (22.7%) remain significant, reflecting their long-standing use in erosion control. Meanwhile, newer techniques such as gully rehabilitation and restoration (31.8%) and tree planting and agroforestry (25.8%) show higher adoption rates, indicating a shift toward practices that combine structural and biological measures. This suggests that while farmers still rely on proven methods, they are increasingly integrating modern approaches for more effective and sustainable land management. The balance between old and new practices demonstrates a gradual evolution in SWC strategies.

4. 1. 3. 1**. Terrace and crop rotation**

The survey results of terrace in Gasure kebele especially on hilly and steep lands. Terraces are constructed along the contours of the land, reducing water runoff and preventing soil erosion, which is common in the area due to heavy rainfall. Crop rotation by improving soil health, reducing erosion, and enhancing water retention. By alternating different crops, especially legumes, with other crops like cereals, soil fertility is naturally restored, as legumes fix nitrogen, reducing the need for chemical fertilizers.

4. 1. 3. 2. **Soil bunds and mulching**

It is the most preferred physical soil and water conservation practice because of characterized by steep slopes and rugged terrain soil bund when constructed along the contour of these slopes, create a series of terraces this lead to reduce soil erosion , conserving soil moisture, creating cultivable land. mulching by helping to conserve soil and water. The area faces challenges like soil erosion, water runoff, and declining soil fertility due to steep slopes and intensive land use. Mulching, which involves covering the soil with organic materials like leaves, grasses, or crop residues, protects the soil from raindrop impact and reduces surface runoff.

4.1. 3. 3. **Tree planting and agroforestry**

Plantation is the most preferable method of biological soil and water conservation practice in the study area. As the result showed that, it also has a great importance on increasing the fertility of soil and crop productivity and reduces soil erosion by reducing the speed of run-off in the area. agroforestry practice helps prevent soil erosion, particularly on sloped lands, by stabilizing the soil with tree roots, reducing runoff, and improving water infiltration.

4.2. Participation of households in soil and water conservation

4.2.1. Participation on maintenance

Table 7: participation on maintenance work

Who maintenance work	No of respondents	Percent (%)
The community	33	50
Self/family	17	25.8
Hired labour by gov't	16	24.2
Total	66	100

Source: field data, 2017

This result indicated that, self/family participation is about 25.8% were very good on the maintenance work. And also, the communities have a good participation about 50.0% in maintenance work and hired labor by government has less responsibility about 24.2% on maintenance work of conservation measures in the sub-watershed (Table 7).

According to the strong community involvement in maintenance work shows good local ownership, ensuring that conservation measures are well-maintained. This collective effort helps make the watershed management practices more effective and sustainable. Additionally, the contribution of self/family labor and government-hired workers adds further support, enhancing the continuity of maintenance activities. While community involvement is significant, relying on self/family labor and government-hired workers can create challenges. Limited resources, skills, or time may hinder effective maintenance, and government support may not always be consistent. This could affect the long-term sustainability and success of the watershed management practices.

4. 3. Crop and Livestock production

4. 3. 1. Crop production

Crop production in the study area is characterized by rain fed, traditional, small scale, subsistence orientated and labor intensive based on family labor. The cultivated land in Gasure kebele is allocated to 51.1%% of annual crops and 48.9% of Perennial crops cover in this area (Table 8).

Table 8: types of crop production

Types of crop production	No of respondents	Percent
Annuals	36	54.5
Perennials	30	45.5
Total	66	100

Source: field data, 2017

The result showed that the trend for productivity of crop was increasing as a result of implementing conservation measures.

The mix of annual and perennial crop production in Gasure Kebele contributes to a diverse agricultural system that enhances food security and supports sustainable farming. Annual crops,

practiced by the majority, offer quick returns and are well-suited to the local climate, promoting economic stability. Perennial crops, on the other hand, help with long-term soil conservation, reduce erosion, and contribute to the resilience of the ecosystem, aligning well with the watershed management goal. While both annual and perennial crops have benefits, relying heavily on annual crops can lead to soil depletion and increased vulnerability to erosion if not properly managed. The area's focus on annual crop production may also reduce the opportunity for maintaining a more diversified farming system that includes long-term conservation practices. Additionally, managing both types of crops may strain local resources and require continuous effort, which could challenge the sustainability of watershed management practices over time.

4. 3.2. **Livestock production**

Livestock reared include cattle, goat, sheep; donkey, and were kept by farmers in the surveyed watershed. In the sub-watershed the livestock consisted mostly of oxes followed by cows, sheep's, donkeys and horse.

According to key informant of the watersheds and direct observation major grazing areas are available were the non-arable hills, the flat grazing land outside and inside watershed along natural water ways, grazing/browsing/ along the numerous gullies and roads, small grazing near homesteads and crop aftermath (stubble and weeds) together with farm boundaries. The flat land is totally devoted to crop production. In the sub-watershed communal grazing land is available. In general, communal grazing areas, private pastures and crop residues are the principal source of feed in sub-watershed.

In addition, the watershed community was asked about the size of pasture land (an area of the land that is used for gazing livestock) and they replied that it was decreased. According to them the reason for the change was, the grazing land was changed to crop production purpose.

5. CONCLUSION AND RECOMMENDATIONS

5. 1. Conclusion

This study assessed watershed management practices in Gasure Kebele, Gurage Zone, Ethiopia, focusing on identifying major interventions, examining implementation challenges, and evaluating their effectiveness. The findings revealed that gully rehabilitation and restoration (31.8%), tree planting and agroforestry (25.8%), soil bunds and mulching (19.7%), and terraces and crop rotation (22.7%) are the dominant soil and water conservation (SWC) practices in the area. Among these, gully rehabilitation and restoration were the most widely adopted, likely due to their effectiveness in diverting runoff and reducing soil erosion. However, despite their adoption, the study identified several key constraints affecting successful implementation, including limited technical knowledge among farmers, insufficient financial and material support, weak community participation, and land fragmentation. Additionally, inconsistent maintenance and a lack of integration between traditional and modern techniques further reduced the long-term sustainability of these interventions.

In terms of effectiveness, the practices have contributed to reduced soil erosion, improved groundwater recharge, and enhanced agricultural productivity in some areas. However, their overall impact remains moderate, as improper design, poor follow-up, and climatic factors such as heavy rainfall and prolonged droughts sometimes diminish expected outcomes. Community awareness and involvement were found to be critical for success, yet many farmers lacked adequate training and incentives to sustain these practices.

The findings indicate that the local community has implemented various sustainable land and water management practices aimed at enhancing agricultural productivity while safeguarding natural resources. The study highlights the use of traditional techniques such as stone terraces, soil bunds, and agroforestry, which have significantly contributed to reducing soil erosion and improving water retention.

To improve watershed management in Gasure Kebele, the study recommends strengthening extension services, providing continuous technical and financial support, promoting participatory approaches, and integrating indigenous knowledge with modern SWC techniques. Furthermore,

policy interventions should focus on awareness campaigns, capacity building, and better resource allocation to ensure long-term sustainability. By addressing these gaps, the effectiveness of watershed management practices can be significantly enhanced, leading to greater environmental resilience and improved livelihoods in the region.

5. 2. **Recommendations**

Community involvement :- in addition to people participation which is recognized as key to the success of sustainable integrated watershed management plan, all stakeholders, downstream users of watershed resources, concerned government institutions, NGOs and other concerned parties should be involved from the very beginning in watershed management plan.

Watershed management approaches and integration :- the current watershed management practices focuses on soil and water conservation measures, but effective watershed management requires multidisciplinary and innovative approaches based on the local situation. Integration is needed in order to achieve an effective and sustainable watershed management.

Education:- create awareness to the households or societies in order to achieve sustainable watershed management and proper use of land and soil resources by reducing erosions and degradations through appropriate watershed management practices.

Generally, we recommended that:

- Government, NGOs and other concerned institution should participate in watershed management project.
- Watershed management should have long-term vision or commitment.
- Watershed management requires multidisciplinary and innovative approaches based on the local situation.
- The government should give high priority to watershed management activities.
- The government should create awareness about soil and water conservation mechanisms to the farmers.

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7. APPENDIX

Name of respondent_____Kebele _____

Sex: Male ☐ Female ☐

Age: 20 – 25 ☐ 26 – 30 ☐ 31 – 40 ☐ >40 ☐

1. Literacy: Basic Education ☐ Primary 1- 4 ☐ primary 5-8 ☐ secondary 9-12 ☐ > 12 ☐

Years of farming experience : 0 – 5 ☐ 6 – 10 ☐ >10 ☐

Farm land size _____(ha)

Objective One

2. Are you familiar with various soil and water conservation structures used in watershed management?

Strongly Agree

A. Agree

B. Neutral

C. Disagree

Strongly Disagree

3. Which soil and water conservation structures are commonly used in your area? (Select all that apply)

A. Cut of drain

B. Planting tree

C. Soil bund

D. Terrace

Others (Please specify): _____

4. How effective swc do you perceive these structures in preventing soil erosion and conserving water resources?

A. Very Effective

B. Effective

C. Somewhat Effective

D. Ineffective

E. Very Ineffective

5. Have you personally been involved in the construction or maintenance of any soil and water conservation structures?

A. Yes

B. No

6. the challenges like , lack of swc awareness and knowledge, economic constraint , poor infrastructure and accessibility. so what challenges have you encountered in implementing soil and water conservation structures in your region? (Select all that apply)

A. Lack of financial constraint

B. lack of technical skills

C. Limited community participation

D. Environmental regulations

E. Accessibility to materials

Other (Please specify): _____

7. How do you think the effectiveness of soil and water conservation structures can be improved in your area?

Objective Two

1. What do you perceive as the primary factor affecting the successful implementation of watershed management practices?

A. Limited financial resources

B. Inadequate technical expertise

C. Lack of community participation

D. Insufficient policy support

2. Which of the following challenges do you believe hinders the effective implementation of watershed management initiatives? (Select all that apply)

A. Land tenure conflicts

B. Climate variability

C. Population growth

D. Poor infrastructure

E. Socio-economic disparities

Other (Please specify): _____

3. How do you rate the role of stakeholder collaboration in promoting successful watershed management?

A. Essential

B. Important

C. Somewhat important

D. Not important

E. Unsure

4. what do you think about awareness and education programs contribute to the adoption of watershed management practices?

A. Very significantly

B. Somewhat significantly

C. Neutral

D. Not significantly

E. Unsure

Objective Three

1. How would you rate the overall effectiveness of watershed management practices in your region?

A. Highly effective

B. Moderately effective

C. Slightly effective

D. Ineffective

E. Unsure

2. In your opinion, which aspect of watershed management practices has shown the most significant improvement?

A. Soil conservation

B. Water quality enhancement

C. Flood control

D. Biodiversity conservation

C. Unsure

3. What challenges, have you observed in the implementation of watershed management practices applying their effectiveness? (Select all that apply)

A. Insufficient funding

B. Lack of community engagement

C. Inadequate technical expertise

D. Climate change impacts

C. Regulatory hurdles

Other (Please specify): _____

#. Question for key informants

1. in the previous years how was the status of soil, vegetation and other natural resource in this Area?
2. What did you say when is there any continuous assessment of soil and water conservation structures become damaged?
3. What looks like active community participation in watershed management?
4. What type of watershed management practices do you implementing?
5. What factors affecting implementation of watershed management practices as your expectation?
6. What are the effectiveness of watershed management practices?
7. What are the changes watershed management is practiced and after watershed practiced?