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SOCIO ECONOMIC AND ENVIRONMENTAL ROLE OF INTEGRATED WATERSHEDMANAGEMENT PROJECTS: EVIDENCE FROM ZIWAY LAKE SUB WATERSHED, DUGDA WOREDA, OROMIYA NATIONAL REGIONAL STATE, ETHIOPIA

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DECLARATION

I declare that this thesis is submitted for the partial fulfillment of the degree of Master of Art in Environment and Sustainable Development. It is my original work and has not been presented for an award of a degree in any other university.

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Approval Sheet

This is to confirm that the thesis prepared by Abebe Megersa Permitted: 'Socio Economic and Environmental Role of Integrated Watershed development and Management Projects: Evidence from Ziway Lake Sub Watershed, in Dugda Woreda Oromiya Region submitted in partial success of the necessities for the Degree of Masters of Arts (In Environment and Sustainable Development) submits with the regulations of the university and meets the accepted standards with respect to creativity and excellence.

Approved By Board of Examiners

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Internal Examiner ----------------------------Signature ---------------Date ---------------------

External Examiners --------------------------Signature----------------Date ---------------------

Tale of Contents

List of Tables

List of figures

List of Acronyms

ARD	Agriculture and Rural Development
CSA	Central Statistical Agency
CSE	Conservation Strategy of Ethiopia
DA	Development Agent
EPA	Environmental Protection Authority
FAO	Food and Agriculture Organization of the United Nations
FDRE	Federal Democratic Republic of Ethiopia
GDP	Growth Domestic Product
DFID	Development for International Development
GTZ	Gesellschaft Technische Zusammenarbeit
MOA	Ministry of Agriculture
PWM	Participatory watershed management
RVLB	Rift Valley Lake Basin
SLM	Soil and Land Management
SWC	Soil and Water Conservation

ABSTRACT

In Ethiopia, one of the main environmental and socioeconomic problems is land degradation. Numerous watershed-based soil and water conservation (SWC) initiatives have been implemented nationwide, including in the Or Omiya region , in order to address this issue. Although the SWC interventions using watershed approach were undertaken at wider scale and intensity, the role of the practices for socioeconomic and environmental are not sufficiently explored. Therefore, the objective of the study socioeconomic and environmental role of integrated watershed management project in Ziway Lake sub-watershed, Dugda Woreda of Oromiya Region. The study employed a mixed research method using qualitative and quantitative. A survey of 140 households produced the quantitative data, and field observation, nine key informants, and eight focus group discussions (consisting of 10 participants, 5 males and 5 females each) produced the qualitative data. As part of integrated watershed development and management projects, the majority of respondents (95%) used physical and biological soil and water conservation practices, according to an analysis of the quantitative and qualitative data. The study showed that the interventions improved the socioeconomic and environmental situation in the study sites. Results of the study also indicated that the income of the households was higher as compared to their previous livelihood. In terms of the environmental roles of integrated watershed development and management projects data results indicated the improvement of agriculturally productivity, increased animal feed as well as positive environment change through planting trees, soil conservation, and increase of surface water harvesting that in turn used for small scale irrigation. Accumulation of soil behind soil bond on farmland was also observed. Thus, in carrying out an integrated program for the development and management of watersheds, entities like the Ethiopian Ministry of Water and Energy, the Ministry of Agricultural Office, and non-governmental organizations (NGOs) must increase the scope of this type of project practice and promote a quicker and more widespread adoption of methods for conserving soil and water.

Key words: *households, roles of watershed development, biological and physical soil and water conservation structure, socio-economic and the environment.*

CHAPTER ONE: INTRODUCTION

1.1 Background of Study

The idea of integrated watershed development is spreading throughout the world, and concerns about bettering the soil and water quality are giving way to concepts of overall socioeconomic and environmental welfare. Walie (2015) claims that watershed management takes into account issues with soil, water, forests, people, and integrated knowledge in the management of resources. According to Mulugeta (2004), soil erosion and decreasing fertility brought on by watershed degradation represent a serious danger to Ethiopia's agricultural output and economic growth.

Overgrazing, population expansion, increasing food consumption, and environmental degradation growth are all causes of deforestation (Gashaw, 2015; Worku and Tripathi, 2015).(Dalhatu and Garba, 2012; Tilahun and Bedemo, 2014). As watersheds deteriorate, output declines, poverty and food insecurity rise. Tesfa and Mekuriaw, (2014) claim the reduction in agricultural productivity is related current existing environmental problems.

Estimates indicate that the country loses 1,493 metric tons of soil annually, or 12 hectares per year. The severity is increased by the fact that 85% of the population depends on agricultural land for their subsistence (Authority, 2012).

As a result of watershed degradation, Ethiopia's natural resources' capacity to provide food security and other benefits, like fuel wood and fodder, is drastically decreasing (Bishaw, 2005; Tesfa and Mekuriaw, 2014). The International Academy of Ecology and Environmental Sciences seeks to guarantee that people have access to a consistent and adequate food supply (Bishaw, 2005). An effective, efficient, and sustainable strategy to combat erosion is essential to natural resource management in order to achieve productive agriculture, food security, and ecological restoration (Shiferaw, 2015; Tamene et al., 2006). Watershed management techniques have also been proposed as a tactic to safeguard the lives of rural residents who are faced with delicate ecosystems and resources, according to Arya et al. and Jonson et al. (2013).

The Ethiopian government has implemented various watershed management techniques throughout the country in order to achieve environmental restoration and food security, including the Rift Valley

Lake Integrated Watershed Management Project in Ziway Lake Duguda Woreda, focusing on Mukuyu leman and Wedesa horgocho watershed project sites. According to Shiferaw (2015) and Bewket (2003), farmers in Ethiopia are frequently forced to take part in conservation efforts without having their needs clearly identified or given top priority. According to Amsalu and De Graaff (2007), proper identification of degradation-prone areas and site-specific watershed development strategies are in the interests of users because watershed resource degradation is strongly linked to the interests of farmers. Unquestionably, the best method for ensuring the long-term success of watershed development initiatives is to ensure that farmers are aware of and understand the practices involved (Daba, 2003). The key elements of effective watershed development methods in a sustainable manner are site-specific problems identification, local knowledge integration, and raw material availability (GTZ, 2005). Degradation issues and watershed development strategies can therefore not be identified without taking into account how farmers choose to use their land (Mazzucato and Niemeijer, 2000).

The rift valley lake integrated watershed management project in DugdaWereda with particular reference to Mukuyu leman and Wedesa horgocho sites in which this study was conducted is located in West east parts of Omiya Regional State which has a distance of about 134 km from Addis Ababa. As a result, the socioeconomic and environmental roles that played by integrated watershed management projects were examined in this thesis. Therefore, researching the socioeconomic and environmental functions of watershed management initiatives essentially means researching socially vulnerable groups. On the other hand, households' socioeconomic activities and environmental roles of a project is one of the problematic issues concerned as profession and ethics in the environment and sustainable developmental studies. This untouched area of the study of the research topic. If there are any, they are studies that were conducted on government and NGOs sponsored focusing on causes of watershed degradations, participations of community and natural resource conversations. To this end, this study focused on filling information gaps on the socio economic and the environmental roles of integrated watershed development and management at Lake Ziway Dugda woreda specific site Mukuyu leman and Wedesa horgocho watershed project sites.

1.2 The Problem Statement

In the Ethiopia, soil and watershed degradation is a significant issue that endangers rural lives and agricultural growth (Bewket, 2003). Sertse (2007) and Darghouth et al. (2008) claim that, in addition to reducing land productivity, watershed degradation also worsens socioeconomic problems. A major threat to agricultural productivity and economic growth is watershed degradation, which shows up as increased soil erosion and declining fertility (Lemenih, 2004). Land clearing for agricultural expansion and irrigation projects, bush burning for pasture, and an increase in demand for wood for construction over the past few decades have significantly altered the landscape and impacted the water quality of lakes in the basin (Teklemariam and Wenclawiak, 2004, Teffera, et al., 2017).As erosion and improper use of rainwater also harm efforts to increase output, unstable watersheds lead to unstable production systems and inefficient resource use (FAO, 2014).

Thus, in a drainage area that is geographically distinct, watershed development entails the coordinated use of land, vegetation, and water (Darghouth et al., 2008). Moreover, Wani et al. (2008) assert that a watershed is an ecological, socio-political, and hydrological unit that plays a critical role in defining environmental services like food, social, and economic security. Gebrehiwot et al. (2014) and Haregeweyn et al. (2016) state that one of the main factors contributing to Ethiopia's land degradation is soil erosion brought on by water, which also has a significant effect on ecosystem services. As per Adane's (2010) perspective, participatory watershed management is perceived as a management approach that aims to reduce poverty, safeguard natural resources, and promote positive institutions, social bonds, and economic benefits.

According to the World Bank (2003), Ethiopia is among the poorest countries in the world. The country's economy is based mainly on agriculture, which employs over 80% of the labor force and accounts for slightly more than 50% of its GDP. Economic expansion, food security, reducing poverty, and social welfare are all directly impacted by the state of the watershed. But as Kassie et al. (2012) note, the sector's growth has been disadvantaged by output fluctuates and market instability. The agricultural industry is more relevant, especially in rural areas where households mostly depend on agriculture for a living (Kansiime, 2018). According to Mucamele (2013), watershed management is also considered to be the foundation of development. For the great majority of people, this industry provides their means of living. The economy is susceptible to issues associated with the degradation of watersheds (Ayalneh, 2003).

The Ziway Lake DugdaWereda Specific sites of Mukuyu leman and Wedesa horgocho integrated watershed project is one of the integrated watershed development practiced sites. Numerous governmental and non-governmental entities have initiated integrated watershed management initiatives aimed at addressing these general issues (Yoganand and Tesfa, 2006). The conservation of both soil and water is the primary goal of the majority of watershed projects in developing countries (Swami et al., 2012). Few comprehensive studies (Assefa, 2011; Yaebiyo et al., 2015; Pathak et al., 2007) have, in fact, reported that community-based watershed development interventions in Ethiopia have had the intended effects. However, such conservation natural resource studies do not typically included the detailed socio-economic and environmental components of watershed development (Hadush, 2015). Moreover, as soil erosion deteriorates agricultural land and sediment clogs irrigation reservoirs and infrastructure, developing countries are paying more attention to participatory watershed development (Kenge, 2009). Even though participatory watershed approaches are now essential to any developmental endeavor, particularly when it comes to managing natural resources, there are still significant obstacles that prevent them from being successfully implemented in developing nations (Mireku et al., 2015).

Therefore, this research is aimed at identifying the socio-economic and the environmental roles of soil and watershed development practices in Ziway lake Duguda Wereda with particular reference to watershed project sites. Mukuyu leman and Wedesa horgocho

1.3 The overall objectives of study

1.3.1 General objective

This study aimed to explore the role that integrated watershed development and management projects have on the environment and socioeconomic conditions in the Lack Ziway sub-watersheds of Mukuyu leman and Wedesa horgocho

1.3.2 The study's particular objectives

- To examine the socioeconomic role of project interventions related to integrated watershed development and management
- To identify the current income levels of households in the integrated watershed development and management project intervention area as compared to the previous status

- To discover the principal biological and physical measures for conserving water and soil within the study areas.
- To examine how soil and water conservation techniques affect the environment
- To study level and challenges associated with implementing integrated watershed development and management projects.

1.4 Investigative queries

- What are integrated watershed development and management projects' primary socioeconomic functions for households?
- What is the difference between the previous and current income levels of households in the integrated watershed development and management project intervention area?
- Which are the principal biological and physical soil and water conservation structures built at the research site?
- What are the main roles that conservation practices for water and soil play in the environment in the study area?
- What are the present and previous biggest obstacles to carrying out the integrated watershed development and management project's activities?

1.5 Relevance of the research

This research can add to the corpus of knowledge, by identifying multiple sets of socio-economic and the environmental role of soil and watershed development study sites. The results of this study will also be used to inform funding agencies at the national and international levels about the environmental and socioeconomic aspects of soil and watershed development projects. It can also be used as input for the government and other stakeholders in formulating appropriate policies, strategies, and directives that may improve the current state of household’s socio economic activities and environmental protections. Furthermore, the research aims to redirect the focus of pertinent local authorities, institutions, and society towards addressing outcome-driven grassroots initiatives that emphasize enhancing capacities and providing technical support for the creation of both biological and physical soil and water conservation structures. Moreover, the study's results may serve as a basis and a point of reference for further research in the fields.

1.6 Study scope

The socioeconomic and environmental roles of integrated watershed development were the exclusive focus of this study, despite the fact that integrated watershed development and management projects encompass a broad range of issues. However, one of the theme issues pertaining to the profession, ethics in the environment, and sustainable developmental studies is the role that integrated watershed development plays in protecting households' socioeconomic standing and the environment.

The spatial scope of integrate watershed development and management project study influences on household's socio economic and the environmental roles covers a wide range of spaces. However, this study is delimited to the Ziway lake Dugda wereda with particular reference to Mukuyu leman and Wedesa horgocho integrated watershed development and management project sites which is found in west of lake Ziway Oromiya National Regional State.

The study's unit of analysis was the size of the household. The first institutional scale in this study is the household scale, which is made up of the smallest units of analysis. In order to respond to the socioeconomic and environmental roles of integrated watershed development and management projects, symbolic elements, social activities, and material resources are crucial. This is the fundamental social and economic entity.

1.7 Structure of the thesis

The research was divided into five sections. The introduction, which comprises the proposal's introduction and covers the study's background, problem statement, goal, and significance, makes up the first section of the work. Review of related literature is the subject of the second section. The data source and data analysis for the study are included in the third section, which is the research methodology. The findings and discussion are also covered in the fourth section. A conclusion and a recommendation are included in the fifth and final section.

Chapter Two: Overview of Literature

2 A review of theoretical and conceptual works

2.1.1 Definitions of concepts and terms

According to Bani et al. (2008), a watershed is an ecological, social, political, and hydrological entity that supports the livelihood needs and other social and economic requirements of rural residents. As an idea for managing water resources, watershed development poses difficult problems because it is a resource that connects various ecosystems and user groups and is a common pool. To take into account these complexities, a significant shift has occurred away from the traditional technical approach and toward concentrating water resource development on the watershed scale (Lisa, 2007). This shift has led to the emergence of watershed conservation groups and the increased importance and recognition of participatory management of common-pool resources. As already mentioned in Chapter 1, PWM is a management approach that seeks to engage the public in the decision-making process (Rowe et al., 2000; Conley et al., 2003). Similarly, according to Sharma (1999), sustainable integrated watershed management is defined as a process of utilization, development, and conservation of land, water, and forest resources for continually improving the livelihoods of communities in a given hydro logically independent geographic area. FAO (2002) further stresses that watershed management is a coordinating framework for management that attempts to focus public and private, community, and individual efforts toward addressing high-priority land and water-related issues within a hydro logically defined geographic area. PWM is therefore geared towards the management of natural resources in a given watershed that enables communities to overcome problems and gain more control over their livelihoods. It places local people in the development process as ‘stewards' of the environment.

A watershed is the entire area above a point on a stream or river that drains past it; it is a topographically defined area that is drained by a stream system. In addition, a watershed functions as a biophysical unit, a hydrological response unit, and a comprehensive ecosystem due to the materials, energy, and information that pass through it. Consequently, it can serve as a useful socio-economic-political unit for management planning and implementation in addition to being a useful unit for physical analyses. In order to provide the right goods and services while minimizing the impact on the soil and watershed resources, watershed development is the process of allocating and managing the soil, water, and other natural resources utilized in a watershed. It encompasses the relationship between upland and downstream regions as well as the socioeconomic, human-institutional, and biophysical interactions among soil, water, and land use (Folliott et al., 2002).

2.1.2 Sustainable livelihood framework

The hypothetical underpinning of study is important as it is used as a lens for the researcher to view his/her research procedures, methods, identify the research gaps and research questions. Consequently, a framework for sustainable livelihood served as the basis for this study.

Robert Chambers served as an inspiration for the concept of sustainable livelihoods, which has since been expanded upon by numerous others (Petersen and Pedersen, 2010). In order to reduce poverty and vulnerability, development should prioritize creating sustainable livelihoods, as defined by the sustainable livelihood framework. Amartya Sen's theories about titles and capabilities served as the theoretical basis for the sustainable livelihood concept (Anyanzu, 2017). A livelihood comprises an individual's capacity, resources, earnings, and activities necessary to ensure the basic needs of existence. It is essentially composed of three concepts: capacity, equity, and sustainability, all of which are interconnected (Chambers & Conway, 1992). The ability to find and take advantage of opportunities for employment as well as the capacity to handle stress and shocks are components of capability. Generally speaking, equity refers to the elimination of discrimination against.

Although a livelihood is defined as making a living, the combination of the three terms can also refer to sustainable development. After modifying the definitions of other panelists, Chambers and Conway (1992) proposed the following definition of sustainable livelihood:

A livelihood consists of the activities, stores, claims, resources, and capabilities needed to support one. A livelihood is considered sustainable when it can withstand and bounce back from shocks and strains, preserve or improve its resources and capacities, offer future generations opportunities to make a living that is both sustainable and profitable, and generate positive net effects on other livelihoods both locally and globally, both in the short and long term. (p.6).

The SLF method emphasizes the abilities, knowledge, and skills that earlier societies possessed and places people at the center of development (Scoones, 1998). In order to assist the creation of more effective ecological safeguards and livelihood growth plans, livelihood studies are generally linked to the micro-level of an individual's livelihood and the preparation and implementation of macro-policy (Pour et al., 2018; Scoones, 2009).

There are various sub-components within SLF, such as livelihood assets, vulnerability context, livelihood strategies, livelihood outcomes, and transforming structure and process (DFID, 1999). The use of livelihood assets and livelihood strategies in this study to investigate the topic under investigation is perhaps the most significant of all the components of a sustainable livelihood framework. Hence, livelihood assets which fall into five categories: physical, social, human, financial, and natural are regarded as one of the main components of SLF. These assets also include a household's circumstances, ability to respond to shocks in dynamic and exposed situations, and likelihood of actively choosing a livelihood strategy (DFID, 2000; Bebbington, 1999). According to Champers and Convey (1991), a sustainable livelihood is one that can repair itself, withstand shocks, hold onto capital, and expand while protecting the environment.

In addition, a livelihood strategy is a programmatic intervention that enhances individuals' capacity to generate income by building on their assets and abilities through training, market-enhancement initiatives, and support services (Yan et al., 2009; Karen and Yoko, 2018). These are taken into account when assessing a household's circumstances, ability to adapt to multiple compressions in dynamic and vulnerable situations, and likelihood of firmly choosing a viable course of action (DFID, 2000; Babington, 1999).

According to DFID (2000), a sustainable livelihood also permits coping mechanisms for stress, consequences, and self-repair without causing harm to the environment, the tribe, or even the advancement of households' present and future assets and capacities. The impact of livelihood assets on livelihood coping strategies can vary from place to place and among diverse social groups. Researchers have given this topic a great deal of thought, particularly in relation to the kinds of livelihood assets that can generate different kinds of influences to switch to another livelihood (Milad et al., 2018; Fang et al., 2014; Hua et al. (2016)).

Therefore, a precise and practical understanding of people's strengths, or "assets," is necessary to address the socioeconomic and environmental roles of integrated watershed development and management issues. It is critical to examine the efforts people make to translate these assets into productive livelihood endeavors and results. The method is predicated on the idea that individuals need a variety of resources in order to attain successful livelihood outcomes. Moreover, livelihood is determined by an individual's activities, assets, and abilities, which in turn establish the relationship between that individual and their physical surroundings (Liu, 2020; Steffen et al., 2011; Scoones, 2009). Accordingly, over the course of the last 20 years, SLF's interdisciplinary has greatly influenced ideas about community development and grown to be an essential tool for understanding poverty, livelihood activities, natural resource management, and environmental protection (Liet al., 2019; Pour et al., 2018; Hua et al., 2017). Therefore, in the Mukuyu leman and Wedesa horgocho integrated watershed management project sites selected, respectively, the livelihood activities of households and the environmental roles of integrated watershed development and management projects are primarily explained by livelihood asset concepts, procedures, assumptions, and the human environmental resource interactions mentioned overhead in SLF.

2.1.3 Socio economic role of integrated watershed development and management

Watershed development is the rational and socially acceptable use of all available natural resources for maximum output in order to meet current demands and lower risks in the future by making well-defined use of resources like the environment, water, and land (MOAR, 2005). With land-use management strategies that integrate multiple sectors and take local population socioeconomic concerns into account, watershed management effectively restores and maintains the agro-ecological viability and production potential of different watersheds around the world. Similarly, managing watersheds is regarded as risk management, primarily in relation to floods, storms, and landslides (FAO, 2006). Owing to the benefits of the watershed management approach, a few regional states have started a number of watershed management projects. The success of these will determine the start of other development projects of a similar nature. The hydrologic effects, variations in soil erosion rates, productivity of land and water, land cover and land use, degree of community involvement, and local sustainability of the process are used to evaluate the approach's efficacy (Oloro V., 2006).

Reducing soil and water erosion, improving and maintaining soil fertility (Sikka et al., 2000; Ramasamy and Palanisami, 2002; Palanisami and Suresh Kumar, 2002), and improving soil conservation are all benefits of the watershed treatment activities. Watershed intervention has resulted in a 37 percent increase in organic carbon (Sikka et al., 2000), and the majority of studies have shown a notable decrease in soil and water erosion.

2.1.4 Physical and biological soil and water conservation development

According to World Bank (2006), soil erosion is one of the main factors contributing to the global depletion of resources, especially on slopes. Ethiopia is one of the hilly and most populated countries in the Rift Valley. Its high ratio of cultivated land to total arable land, high agricultural yields, and soil erosion all contribute to the highest negative values (Biruk, 2012). Therefore, in order to address the problem of soil erosion and its effects, effective physical and biological solutions for soil and water management are required. From this vantage point, it is believed that various on-farm SWC techniques in the farmlands and hillside enclosures are effective in repairing damaged farming lands and hillside. Therefore, starting in the middle of the 1970s, the Ethiopian government started implementing them nationwide (Betruet et al., 2005; Eleni, 2008).

2.1.4.1 Physical soil and water conservation structures

A range of constructions, such as gully rehabilitation, hillside terracing, micro-basins, check dams, ponds, and farm dams as water harvesting structures, spring development, reforestation, area closure, and management, were the primary physical components of the soil conservation efforts (Heyi and Mberengwa, 2012). The bulk of soil and water conservation techniques introduced to the Anna watershed Hadiya zone, according to Ertiro (2006), are mechanical techniques used on croplands, such as soil bunds, fanyajuu terraces, and cut-off drains. Generally speaking, biological conservation initiatives improve soil fertility, which reduces soil erosion (Gemechu and Kitila, 2015).

According to Gemechu and Kitila (2015), the main goal of physical SWC measures is moisture conservation. In highland areas with heavy rainfall, these measures help to prevent soil erosion. Gradated contour bunds or terraces on sloping highlands slow runoff velocity and increase the amount of time it takes for water to seep into the soil system. Building physical obstacles to obstruct overland flow in order to reduce soil erosion and increase soil fertility by applying compost (Wolka et al., 2011). The key to solving these problems is determining the proper land use and management techniques. The technologies (soil bund, fanyajuu) that effectively halt soil erosion can lead to increased land productivity and crop yields.

Getachew (2014) asserts that in contrast to other interventions, soil bund structures are more crucial for halting soil erosion and its consequences in agricultural land because they are technically simple to build. Moreover, it can preserve the soil resource, raise soil moisture, and boost yield production. Eventually, they built by tossing dirt excavated from the basin downslope. This technique was used to reduce the slope length of the field, which in turn decreased and stopped the velocity of runoff, thereby controlling runoff and erosion from cultivation fields (Atnafeet al., 2015). Farmers who felt conservation technologies were beneficial but thought they had less of an impact on crop productivity (Gebreet al., 2013). In actuality, a variety of structural conservation strategies selected in accordance with.

Combining physical and biological conservation methods generally reduced soil loss and increased the availability of organic inputs for soil improvement (Amede, 2003). In addition to other soil and water conservation measures, physical conservation measures such as soil bunds are acknowledged as effective land conservation mechanisms on the crop land in the Lemo District. According to Aberha (2008), soil bunds a kind of introduced soil and water conservation measure—are also known to be a highly successful means of halting soil erosion and to have the potential to boost land productivity. Furthermore, physical SWC practices are crucial for long-term structural stability and are more affordable than biological structures, provided that farmers in the Lemo District follow the expected practices. It is widely accepted that a piece of land that has undergone physical SWC practice.

2.1.4.2 Biological soil and water conservation

Biological soil and water conservation measures include planting tree seedlings, agro-forestry methods, farmyard and green manures, vegetable barriers, agronomic and soil fertility improvement techniques like alley cropping, the establishment of grass strips (like elephant grasses) in farmlands or degraded land, and more. By lowering soil losses and increasing productivity, these methods aid in the management of surface runoff (WOCAT, 2007). The first line of defense in erosion control exercises is agronomic measures; physical measurements are the primary control measure and are often viewed as reinforcing measures (MoA, 2005).

Biological SWC measures combine suitable land use and management techniques to minimize productivity and sustainable land use, prevent soil erosion and water degradation, and maximize sustainability (Anne, 2009). Basically, it's about making the appropriate decisions about how to use and maintain the property. Crops planted in the voids created by the grass strips may yield more fruit as a result. The seven acres of land left between the strips can benefit from improved soil fertility and reduced erosion by using the grasses collected from the strip as a mulch cover (ICCD, 1999).

2.1.5 Environmental roles of integrated watershed development

Ethiopia faces a significant environmental challenge, and, similar to sub-Saharan Africa (SSA), this problem is mostly caused by the current agricultural production system, which is a "resource-poor" system marked by unpredictable rainfall, low intrinsic land productivity, a lack of capital, insufficient support services, and poverty (Mekuria, 2005). One of Ethiopia's biggest environmental issues is land degradation (Abebe et al., 2013). According to Temesgen (2012), land degradation is happening at a startling rate in Ethiopia and is a major source of social and economic issues (Hurni et al., 2005; Menale et al., 2007; Moges and Holden, 2008; Bewket and Sterk, 2009). The Ethiopian highlands, which make up over 56% of the country, are severely degraded and gradually but steadily becoming unusable for farming (Tesfaye & Tripathi, 2015).

In Ethiopia, particularly in the heavily populated highlands, deficiencies in soil nutrients and a growing decline in the quality of the soil are widespread occurrences that have a variety of effects on the country's total agricultural output (Kassa G. et al. 2019). Ethiopia's tree cover has been decreasing annually for the past 17 (9) (2020) 4530 years. The primary cause of this reduction in resource availability is the growing amount of land used for livestock and crop production (Azene, 2007b). Many nations have pushed watershed management techniques as a viable approach to raising agricultural productivity and fostering sustainable intensification (Azene, 2007a). According to Darghouth et al. (2008), watershed management is the integrated use of land, vegetation, and water in a geographically isolated drainage area for the benefit of the local populace. The goals are to reduce or prevent adverse effects on groundwater or downstream systems and to preserve or protect the hydrologic services the watershed provides.

The Ethiopian government has been implementing watershed management primarily through a public campaign to restore the degraded lands in order to address these issues. The soil and water conservation program was initiated nearly 50 years ago in response to the rapidly increasing rate of degradation in Ethiopia's highlands; however, the results obtained did not show much promise (Tasfaye & Tripathi, 2015). According to Daniel Jaleta (2020), the main reason was that the stakeholders were not included in the program. At many micro-watershed levels across the nation, its effects haven't been assessed, though (Kebede, 2015). However, the effectiveness all government and non-governmental sponsored implemented watershed development and management project impact is not detailed studied. Thus, the advantages of incorporating Environmental Impact Assessment (EIA) have been noted at every project stage, from planning and exploration to building and operating to decommissioning and beyond (Sinha, 1998). As a result it very necessary to clarify the information gap about the detailed impact of the integrated watershed management projects.

2.1.6 Policy, laws and proclamations related to environment

Therefore, the key essence of reviewing policies, laws, legislations, and proclamations regarding environmental issues is to understand the right and responsibility the rural community. Moreover, it can aid the researcher in comprehending the duties of each agency and the legal protocols that must be adhered to when implementing projects such as integrated watershed development and management. Likewise the review also enables to know the pre-conditions required for any development project or program expected to accomplish before its implementations like EIA. A review of those documents serves as a foundation for understanding the fundamentals of responsible resource management and utilization for the sustainable socioeconomic development of natural resources, cultural resources, and the surrounding environment. Consequently, the following is a summary and presentation of the review of each document:

Articles 43 and 44 of the FDRE (1995) Constitution establish the principles of sustainable development and environmental rights, stating that individuals have the right to development and to live in a clean and healthy environment, among other things. Additionally, citizens have the right to take part in national development and, in particular, to be consulted regarding projects and policies that have an impact on the community, according to Article 43(2), which deals with the rights to development.

Ethiopia's Land Policy, in general, is very supportive of the notion that project plans should incorporate strategies for watershed development that are appealing and sustainable for the local population, and that local residents should be fully persuaded and involved in all stages of the project's implementation.

To summarize shreds of evidence, to get her with scores of other statistical studies, firmly underlines that there is a great popularity of integrated watershed management, which aim to transform livelihood and the environment of rural community. However, still there are a lot of environmental problems like drought and human livelihood difficulties. This needs a more rigorous course of study and intervention until livelihood of households in the watershed is aim proved as well as a sustainable environment is insured. It is a basic human right to live safely in any place without starvation; nobody is deprived by watershed degradation. There is still work to be done in the area of household socio-economic and environmental impacts of integrated watershed development and management until this goal is accomplished.

As a result, this study was methodically evaluated for the overall transformation of the households' livelihood and environmental in sustainable ways. It combined the socioeconomic dimension of households with the environmental roles of integrated watershed development in the study area.

2.2 Empirical literature review

In a watershed, various treatment activities are implemented, such as crop demonstration, horticulture plantation, afforestation, and drainage line treatment measures (movable boulder check dam, farm pond, minor check dam, major check dam, and retaining walls). The objective has been to guarantee the availability of fuel wood, fodder, and drinking water while increasing the income and employment opportunities for farmers and landless laborers through increases in agricultural productivity and output (Rao, 2000). The ecosystem has been negatively impacted in a number of ways, such as the decline in water quality, the spread of the parasitic worm disease bilharzia, the loss of wetland habitat, and biodiversity loss. Additionally, because of the links between the watershed's economy and environmental condition, poverty has been hard to eradicate even as it has increased in tandem with the ecosystem's degradation (Huanget et al. 2012).

The Ethiopian government has launched a public campaign to restore the degraded lands in order to address these issues by implementing watershed development and management initiatives. The program to conserve soil and water was initiated nearly fifty years ago in response to the rate of degradation in Ethiopia's highlands, but the results were not very encouraging (Tasfaye & Tripathi, 2015). These were the targets that were not met. Daniel Jaleta (2020) reported that the primary reason for the issue was the program's inability to include the stakeholders. According to Kebede (2015), numerous micro-watersheds across the nation have not had its effects assessed. As a result, the purpose of this study is to evaluate how integrated watershed development and management projects affect the socioeconomic and environmental conditions of households.

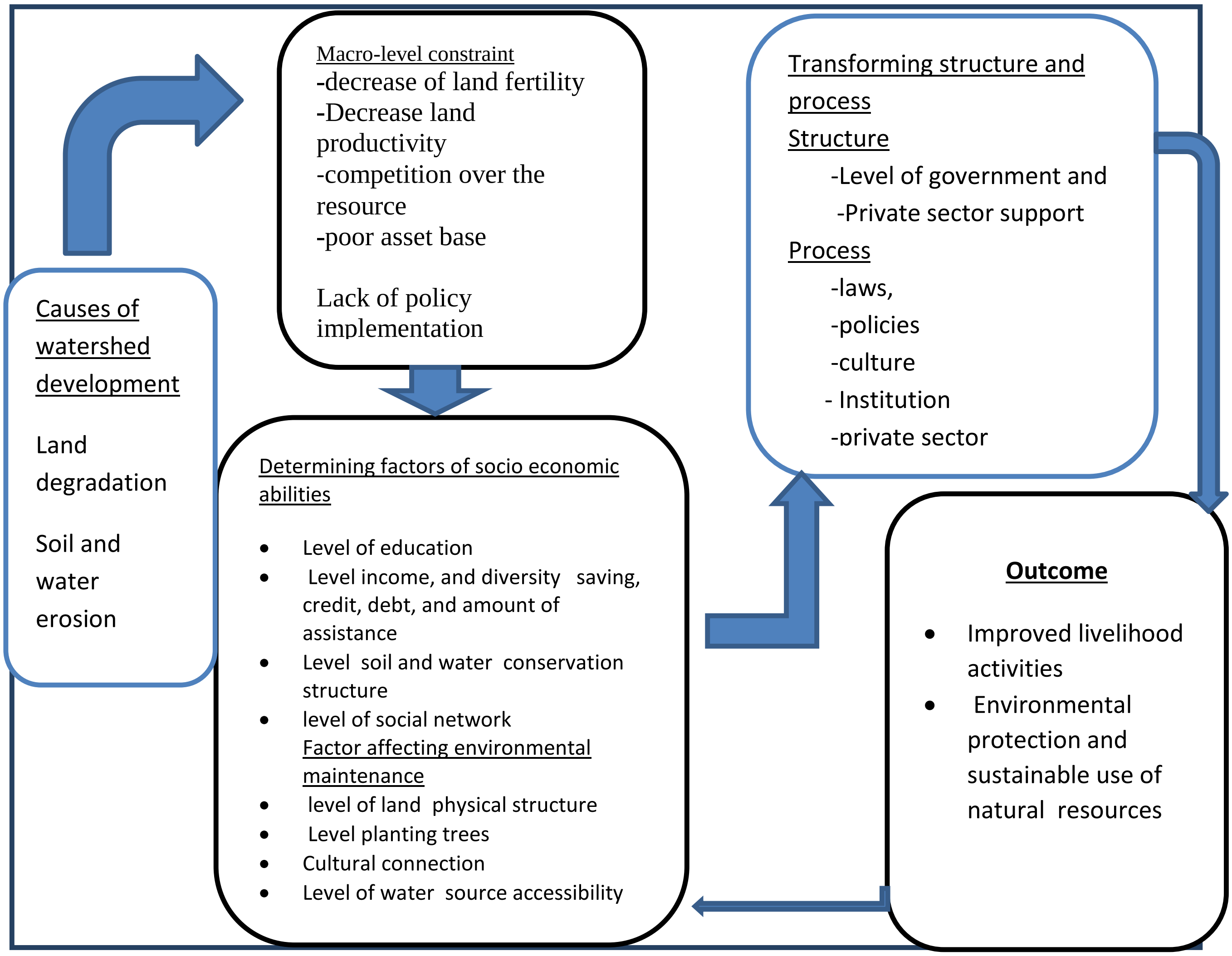
2.3 Conceptual framework

According to earlier research (Ramaswamy and Palanisami 2002; Palanisami and Suresh Kumar 2002), watershed treatment activities enhanced soil and moisture conservation, improved and maintained the fertility status of the soil, and decreased soil and water erosion. Sikka et al. (2000) also noted that the majority of studies showed a significant decrease in soil and water erosion, and that the intervention of watersheds increased organic carbon.

In addition, physical measures for conserving water and soil include bench terraces, check dams, cut off drains, Fanya juus, stone bunds, and soil bunds (Tadesse, 2010).The physical characteristics of s oil, such as its pH, bulk density, organic matter content, structure, ability to hold water, and workabi lity, can all be altered by soil conservation efforts (Jijo, 2005; Demelash and Stahr, 2010). For instance, Ayalew (2011) reported that in the Gununo area of southern Ethiopia, physical structure (soil bund) and biological measures were introduced as soil conservation measures, and that by combining the two, soil productivity was improved.

Numerous factors are identified in order to assess the current state of the socioeconomic and environmental roles of the integrated watershed management project in the watershed kebeles of

Mukuyu leman and Wedesa horgocho . The following are the extent of the physical and biological changes to the soil and water conservation structures; the level of awareness and technical support; the level of soil fertility and productivity; the diversity of products; the income level; the gender; the background asset level of the household; the amount of savings; the accessibility of credit; the level of education; and the social connection status.



Source: modified by the researcher from (Degafa, 2008 andDFID, 1992)

Figure 1: Conceptual framework of the study

CHAPTER THREE:

3. MATERIAL AND METHOD

3.1. Description of the study area

The study area with particularly reference to Mukuyu leman and Wedesa horgocho sites are found Western Lake Ziway Sub basin which is originated North West of the Rift Valley Lakes sink which extends from the Gurage Highlands in the west of the shores of Lake Ziway.Geographically the Woreda is located between 80 01’N to 80 10’North latitude and 380 31’E to 380 57’E longitude. The total area of DugdaWoreda is 959.45 km^2. The Woreda has 36 rural Kebele Administrations and Meki, the main capital of the Woreda, is located 134 km to the South East of Addis Ababa on the main asphalt road to Ziway town. The sub-basin is characterized by hills and mountains and the drier flatter plains to the east. The sub-basin is mountainous in the west and north but it is flat to gently undulating in the east with a line of volcanic hills and ridges running through the center. The altitude the sites range from 1,450m in the east, close to Lake Ziway and rises to 3,400m on the western escarpment.

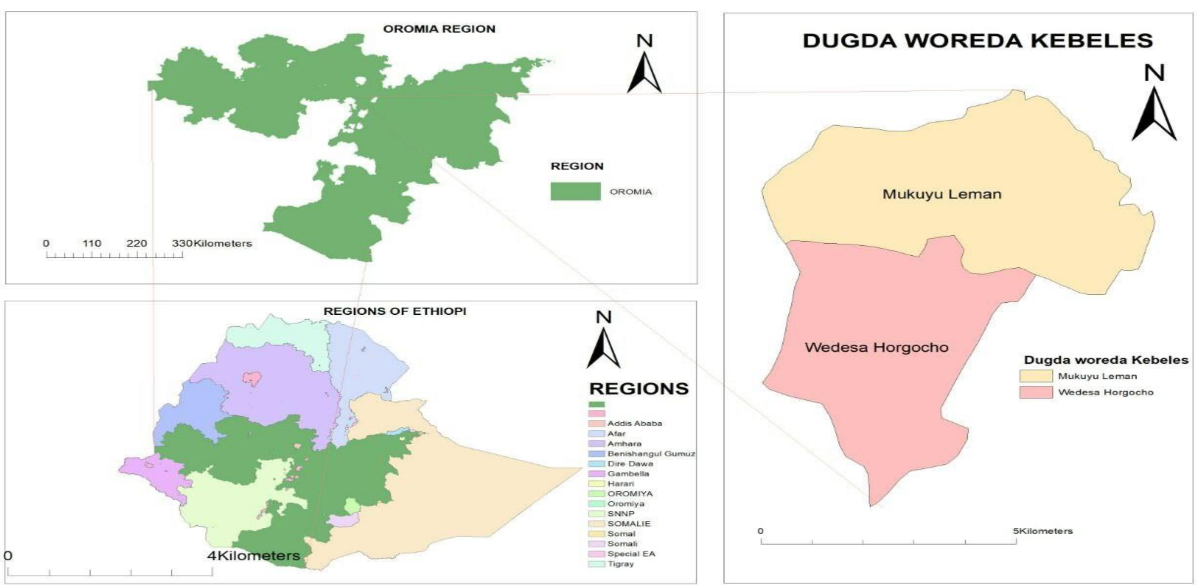


Figure 2: Location map of the study area

3.2 .Study method

An explanatory sequential mixed method is one in which the researcher first collects quantitative data, analyses the results, and then builds on the results to explain them in more detail with qualitative research (Creswell and Plano-Clark, 2007). It is considered explanatory because the initial quantitative data results are explained further with the qualitative data. This type of design is popular in fields with a strong quantitative orientation, but it presents challenges in identifying the quantitative results to further explore and the unequal sample sizes for each phase of the study. According to Creswell, (2014), this is a mixed-methods strategy that involves a two-phase project in which the researcher collects quantitative data in the first phase, analyses the results, and then uses the results to plan (or built into) the second, qualitative phase.

In terms of methodology, research designs have three forms. These are quantitative, qualitative, and mixed research designs (Creswell, 2009). These designs have their strength and weakness. Features of each approach are summarized as follows to select the best-fit research plan to achieve research purposes. Creswell (2009) defined qualitative research tactic as the means for exploring and understanding the meaning individual or group of people assigned to a social or human problem. The procedure of the research involves developing the questions and procedures, data collected in the participants setting, data analysis inductively building from particulars to general themes, and the researcher interpreting the meaning of the data. Those who are involved in this form of research inquiry care systems observing at the research that respects an inductive style, focus on the individual meaning, and the importance of rendering the complication of the situation (Creswell 2007). Dunn (1999) stated qualitative data are not numerical nor are they usually subjected to a statistical method of analysis. Rather they are investigative in their raw form.

There foremost advantages of using the qualitative method are the evidence gathered is not fixed varieties; hereafter, it signifies an open scheme view, which allows premises in the initial phases of exploring the research theme. Nevertheless, the disadvantage of qualitative research is the fact that it is neither rapidly, easily, and efficiently summarized nor often generalized from a given qualitative observation to another situation (Dunn, 1999).

The quantitative research approach is one in which the researcher primarily uses the postpositive claims for developing knowledge. Post positivism assumes that causes determine the outcome (Creswell, 2009). These approaches involve the generation of data in the quantitative or numerical procedure that can be exposed to hard quantifiable investigation in an inflexible style (Kothari, 2004). Similarly, (Creswell, 2009) states that in a quantitative research approach in which the researcher survey or experiments to gather data wanted to understand reason and consequence association among variables of interest. Unlike qualitative researchers, those who engage in quantitative research examination have an assumption about testing the theories deductively, building in protection against bias, controlling alternatives, explanation, and being able to generalize and replicate the finding.

A mixed research method is an approach to inquiry that combines or associates both qualitative and quantitative forms. It involves philosophical assumptions to use qualitative and quantitative approaches in a study. It integrates the two methods for gaining better insight into a social phenomenon (Baker, 2010). Furthermore, Baker (2010) stated that the mixed method approach is better than either method alone because it provides not only more information but also better-quality information. Therefore, in the mixed research method approach, the researcher uses both the qualitative and quantitative approaches together at the same time or sequentially. As indicated by Baker, (2010), and Creswell and Plano Clark, (2007) summarized advantage and disadvantage of mixed research methods approaches are presented as follow. (1) the capability to select from among all quantitative and qualitative apparatuses to perform an all-inclusive study of the research problem, (2) the ability to respond to more in-depth research questions, (3) the capacity to organization both inductive and deductive reasoning. They also stated disadvantages of using mixed methods include: (1) more funds wanted to implement the study and to collect the essential data. (2) Mixed research methods can be complicated to perform and difficult to sort out the results, and (3) the researcher must be skilled in both quantitative and qualitative techniques to use this method.

Consequently, mixed research designs believed to enable me to collect reliable data, and to gain an in-depth analysis of my thesis project. Supporting this idea Carvalho and White, (1997) clarified the advantages of combining qualitative and quantitative research methods as follows "(i) integrating methodology; (ii) confirming, disproving, enriching, and explaining the finding of one approach with those the other; and (iii) merging findings of the two methods into one set policy recommendation". To this effect, it will be appropriate and suited to use a mixed research design to study the socioeconomic and environmental roles of integrated watershed management project in the Mukuyu leman and Wedesa horgocho integrated watershed development and management project site.

Hypothesis

Null hypothesis- there is similarity in income level before and after integrated watershed development and management project intervention in study sites. Alternative hypothesis-there is the difference in income level before and after integrated watershed management project intervention in Mukuyu leman and Wedesa horgocho study sites.

Conclusion, the finding of this study confirmed that the null hypothesis rejected and the alternative hypothesis accepted because of the fact the income level of the household after the intervention indicated higher than the income of household before the project implementation.

3.2.1 Sampling techniques and sample size determination

Among the total number of watersheds sanctioned under the system of community integrated watershed development and management program, two watersheds were purposely chosen for the study based on accessibility / availability of information, intervention experiences or year of program sanctioning (2006-2010) and cost. The table 1 presents the list of sample watersheds selected for the study.

Table 1:List of sample integrated watershed development and management project sites

S/N	Names of study selected study sites	Specific sites of the study	area of the study sites by hectare	Number of house hold
1	Mukuyu leman integrated watershed development and management project site	Mukuyu leman	505	241
2	Wedesa horegocho integrated watershed development and management sites	Wedesa horgocho	467	229

S/N	Names of study selected study sites	Specific sites of the study	area of the study sites by hectare	Number of house hold
3	**Total**	**2**	**972**	**470**

(Source: Dugda Woreda Office of Agriculture and Natural Resource Department)

The researcher adopted stratified sampling techniques. Regarding the stratified sampling technique, the researcher segmented the entire study sites into two strata i.e., the first section concerned with the households in site while the second strata are households of the Mukuyu leman and wedesa horgocho respectively. Accordingly, this segmentation is necessary because the nature of socio economic and the environmental situation of these segments or units are different by their nature. .

According to the Dugda Woreda report, the total population in the two study watershed project sites 2350 in terms of sex is 1134male and 1216female individuals. Furthermore, the total target population of the two study sites contains 470 households. Representative sample sizes are selected by using the statistical formula as follows.

According to Corbetta (2003), the sample size of a finite population can be determined as

n=z2*p*q*e2 if the f=n/N 0.05 and

n=z2*p*qe2 (1-n/N) if the f=n/N >0.05

To simplify the second formula no = n/ (1-f) = n/ ((1-(n/N)).

If the value of sample size (n) calculated in this way proves to be smaller than 5% of N, it can be regarded as definitive. If, however, it proves to be higher than 5% of N; the finite population correction factor is introduced, and the correct value of n=no/ ((1+ (no /N)). According to Kothari (2004), it is possible to take the value of p = 0.5 as an estimate in which case 'n' is the maximum and the sample yield at least the desired precision, and this was the most conservative sample size. At a 7%, significance level the calculated result of the following formula was used.

Sample size n =N/ (1+ Ne2), where:
N = Target population/ population size

n = Desired sample size

z = Confidence level (93%= standard value is 1.81)

p = Estimated characteristics of study population (0.5)

q = 1-p which is 1-0.5 = 0.5

e = level of statistical significance set or margin of error (standard value is 0.07)

$$n=N/(1+N*e^2)$$

$$n= 470/(1+470*(0.07)^2)$$

$$n =470/1+470*0.0049$$

$$n= 470/1+2.303$$

$$n = 470/3.303$$

$$n = 142.294 \sim 142$$

The total households' sample sizes were proportionally selected from both Mukuyu leman and Wedesa horgocho integrated watershed development and management project sites

Table 2: Mukuyu leman and Wedesa horgocho integrated watershed development and management project site households proportional sample size **Mukuyu leman and Wedesa horgocho**

Place residents	Total number of households	% of households	Proportion of sample size
Mukuyu leman	241	51.3%	73
Wedesa horgocho	229	48.7%	69
Total	470	100%	142

3.2.2. Techniques and tools of data collection

In this thesis, the primary and secondary data was collected. The primary sources of data collection include survey questionnaires, Key Informant Interviews, Focus Group discussions, and observations data collection techniques were used. Prepared questionnaires were distributed to each selected household by enumerators to collect response data regarding households' socioeconomic and environmental roles of integrated watershed development and management projects in the study sites. Concerning qualitative data collection FGD, KII, and observation methods of data collection with flexibility and ethics was given due attention to getting actual reality and active participation during FGD discussion and KII an interviewee by probing questions.

Households survey questionnaires

Households' consistent survey open-ended and close-ended questionnaires were prepared with the major intent to achieve the stated objectives of the research and to answer the research questions. The questionnaire includes all techniques of data collection in which each person was asked to respond to the same set of questions in a predetermined order. Survey Questionnaires was pretested (pilot test) to test the questionnaire is to check for accuracy, and completeness of questionnaire that enables to gather accurate data, and to ensure the quality of data going to be collected through questionnaire and interviews guides.

Furthermore, two enumerators (from community) were selected and trained for two days on the following issues: (1) how to approach the respondents, (2) data confidentiality, (3) how to secure consent from the respondents, (4) risk management, (5) the overall data collection techniques and procedures to ensure data quality. Trained enumerators were assisted all the respondents, including those who have no reading and writing skills. Each word in the questionnaires was customized to the local contexts and wordings for clarity reasons and to avoid technical jargon. The questionnaire were translated into local languages of study sites

Finally, survey questionnaire data were collected using a Kobo Toolbox which is a free open-source tool for mobile data collection. It allows collecting data in the field using mobile devices such as mobile phones or tablets, as well as with paper or computers. It is being continuously improved and optimized particularly for use in emergencies and difficult field environments to support data collection. The mobile data collection system allowed minimizing errors in the data collection process as data validation can be set up in the mobile system. In addition, it is possible to remotely monitor the data collection process and ensure the quality of data. The questionnaire will be uploaded to the Kobo toolbox to be accessed by enumerators on their mobile phones. Once data is collected, enumerators synchronized the data so that it was accessed by the researcher remotely and can be downloaded in different formats for analysis.

Key informant interview

The key informant interview guide was designed to collect data that supplement aspects that may not necessarily be covered by the questionnaires. The key informant interview guide was prepared in the language of project site community. A comment about the interview guide was incorporated to understanding sufficient information from households about socioeconomic and the environmental role of integrated watershed development and management project. The interview guide was focused on households' socioeconomic roles like a land productivity situations, source of income, job opportunity, product diversity, a social capital and work values of community, and the environmental role of soil productivity, biodiversity conservation in terms of infrastructure, water source accessibility, and land use. The interview guide will be administered mainly through face-to-face interview approaches from a total of 9 key informants 5 from community, 2 from community elders, and 2 from Woreda administrators. The total participants of the interview guide contain five (5) male and (four) female participants. The main points of discussion will be socioeconomic situations (kind of work, income, job opportunity, responses implemented by the government, and other sections of society. The other points of discussion were the environmental roles of integrated watershed development and management projects in terms of the socioeconomic of households and environmental protections. Key informant interviewees were selected using a purposive sampling method. The interview aimed to enlighten the subjective views of interviewees about their socioeconomic and the environmental role of integrated watershed development and management project situation was continued until its data reached data saturation.

Focus Group Discussions

Coenen et al. (2012) defined saturation as a point at which linking concepts from two consecutive focus group discussions or individual interviews reveals no additional second-level categories. Using the same method of estimation of saturation, it was found that saturation was reached after conducting eight FGDs (Kirchberger et al., 2009). Therefore, eight FGDs were conducted to gather some qualitative information from the respondents. The FGD was conducted for with integrated watershed development and management project sites community members in small groups containing six (6) persons per each FGD.

A draft FGD guide was prepared and commented on by the advisor and the selected households. Then it was used as an important guide for each FGD in the study sites. The eight discussants' groups will be selected from different age and sex compositions were taken into account. The total discussant's groups contain 48 participants of which twenty-seven (27) male and twenty-one (21) female participants were purposively selected. The sample discussants were purposively selected from the rural community where the integrated watershed development and management project implemented.

Field observation

Through observation of integrated watershed development and management project sites, socioeconomic and environmental roles were observed in the sites critically and recorded. Under observation sources of secondary like the official report was used as the source of information. However, some of the shortcomings of these data are that they may be liable to alterations. It may not be in the required state as it may be from the wrong source. As much as possible the study tries to use secondary data very extensively to data from reliable sources.

Secondary data

Secondary sources focused primarily on a literature review of the topic. The researcher goes through the literatures were focused on the integrated watershed development and management project roles on the socioeconomic and the environment of the study sites as well as on technical data relevant in the country and outside the country. The existing literature was used to gain an understanding of the issues and also to compile the theoretical chapters. It also used as a reference point to determine what other authors have discovered on this subject, which may or may not be similar to the author's findings. As pointed out by Gupta (2005:146), the chief sources of secondary data may be broadly classified into the following two groups:

These include books, journals, articles, published government and non-government policy documents, publications of research institutions, reports of various committees and commissions appointed by the government, newspapers, periodicals, etc. These may be used both before and during the fieldwork, and the write-up of the thesis. These various secondary sources were used to establish a theoretical framework from which the analysis was made.

Unpublished sources include any paper or publication that has not yet been released or is considered to be a draft. These include activity reports, study reports, and government reports on topics such as socioeconomic role of integrated watershed development and management and environmental roles.

2.3.1 Data analyses

The design employed to analyses the data for this research is an explanatory sequential approach. The explanatory research design enables to use of qualitative data to explain quantitative data that needs further exploration. It also helps to explain the relationship between variables on socioeconomic and the environmental role of integrated watershed development and management in a sensible way. The majority of the quantitative data are analyzed by the using of statistical software known as SPSS (Statistical Package for Social Sciences). Statistical techniques such as mean, percentage, the measure of dispersion (variance and standard deviation), paired sample t-test, was used in the analysis socioeconomic and environmental roles of integrated watershed development and management project implementation characteristics description. Similarly, qualitative data was incorporated by the establishment of themes, classification, and summaries were merged with the information provided by the KII, FGD, and Observation. Through this process, the researcher wrote it in a separate book memo that includes ideas, feelings, interpretations, or reactions. Once the analyst felt comfortable knowing the issues, data was divided into chunks of text that represent units of meaning. Finally, the result of both quantitative and qualitative analysis was merged to get holistic and reliable outcomes. Data from qualitative sources was used as a supplement to quantitative data.

3.2.4. **Ethical consideration**

Along with knowledge and diligence, research demands honesty and integrity. According to David and Resnik (2010), conduct rules that distinguish between acceptable and inappropriate activity are referred to as ethics in research. The rights of the participants and academic disciplines shall be protected by the compilation of this study in compliance with Addis Ababa University's anti-plagiarism policy. A permission form created in the participants' native tongue, and it will include comprehensive information regarding the study's goal, the time allotted, confidentiality concerns, and the participants' rights during the data collection procedure. Throughout the research process, the researcher was kept strict ethical norms and privacy in mind. The AAU University Anti-Plagiarism Policy (2023) was also be taken into consideration at every stage of this research.

CHAPTER FOUR

4. RESULT AND DISCUSSION

Result

4.1.1 Demographic features of respondents

Respondents' socio-demographic characteristics of respondents in watershed intervention sites contain different backgrounds in terms of age, gender, place of residence, level of education, family size and marital status. As indicated in Table 3: most of the respondents were at an young matured workingagegroupbetween36-45years comprising71(50.7%)of the total respondents though 45(32.1) of the total respondents were age group of 26-35 categories. In addition, around 24(17.1%) the total respondents failed under age category above 46 years. In general the majority of the respondents were at young matured potential working stages.

In terms of respondent's residence area 72(51.4%) of the total respondents were from Mukuyu leman While 68(48.6%) of the respondent were from Wedesa horgocho sites. In relation to level of education 43(30.7%) of total respondents learned elementary (1-8) level of education while 44(31.4%) of the respondents only have read and write skills. Furthermore, around 41(29.3%) of the total respondents are illiterates. The minimum level of education attended covers only 12(8%) of the total respondents high school (9-12) level of educations. In survey data participants there is no respondents who completed diploma and above level of educations.

Table 3: Respondent's residence place, age, family size, level of education, distributions

Type of residents	**Frequency**	**Percentage**
Mukuyu leman	72	51.4
Wedesa horgocho	68	48.6
Total	140	100
Age groups	Frequency	Percentage
26-35 years	45	32.1
36-45 years	71	50.7
above 46 years	24	17.1
Total	140	100
Gender	Frequency	Percent
Male	97	69.3

Type of residents	**Frequency**	**Percentage**
Female	43	30.7
Total	140	100
Level of education	Frequency	Percent
Illiterate	41	29.3
read and write	44	31.4
Elementary(1-8)	43	30.7
High school(9-12)	12	8.6
Total	140	100.0
Status in household	Frequency	Percent
Husband	97	69.3
Wife	43	30.7
Total	140	100
Marital status	Frequency	Percent
Married	140	100%
Total	140	100

Source: Household survey,(2023)

Concerning the gender of the respondents as indicated in Table 4 :from Mukuyu leman about 70(50%) of the respondents participated in soil and water conservation while 63(45%) of respondents from Wedesa horgocho Participated in soil and water conservations. In general the sum total participants from both sites indicated that 133(95%) of total respondents participated in the soil and water conservation while only 7 respondents stated not actively participated in the integrated watershed development and management implementation projects . In terms of participants' status in their households indicated 97(69.3%) of the total participants were husband whereas 43(30.7%) of total participants have wife status in the households. In terms of marital status all 140(100%) where married and there is no single or divorced marital status in both Mukuyu leman and Wedesa horgocho integrated watershed development and management project implementation sites.

Participants were asked to explain their current family size, and the result indicated that about 63(45%) of the total respondent have 4-6 family sizes. Secondly, about 48(34.3%) of the total respondents have 7-8 family size whereas 17(12.1%) a family size between 1-3 family sizes while 12(8.6%) of total respondents have above 10 family sizes. Furthermore, the participation respondents from the Mukuyu leman and Wedesa horgocho sites were tried to present in comparison and the result indicated from the primary site 70(97.2%) of the respondents actively participated watershed development and management project implementation . From the second site, about 63(92.6%) of the participants were actively participated in soil and watershed development and management. in general from both study sites 133(95%) of the total respondents actively participated in the watershed development while only 7(5%) of the total respondents were not participated in the soil and water conservation practice in the integrated watershed development and management project.

Furthermore, an attempt was made check paired samples t-test of income of both Mukuyu leman and Wedesa horgocho integrated watershed development and management project area household before and after the intervention. Accordingly, as it is indicated in table 4: survey data result showed that the majority of crop productions (teff, maize and wheat) showed great difference before and after soil and water consevation intervention. The households whose means of livelihood depends on farming activities have the highest crop production as compared to before integrated watershed development and management project. In general, the summary of quantitative data displayed even if the households are becoming beneficiaries and start some irrigation like productions of tomato and onion in the intervention site.

Accordingly, one of the key informant's interviewees from Mukuyu leman (male) supported the statistical figure stated as follows:

> *I started irrigation on my land as the result of integrated watershed development and management project. I got a lot of awareness through the training and the actual soil and water conservation ignited me to start irrigation on my land through preparation of ponds through the irrigation work, I was making sufficient money with in a years. Which mean the wealth I have accumulated over years was very few as compared the current. Now in the soil and water developed site, I earn very good amount of money by production of tomatoes and onion and supply to the market.*

These imply that the crop production level of households is currently better as compared to before watershed development intervention which in turn indicates the increase level of income the households. Furthermore the households become warred enough to see the opportunity to be exploited from their land and the market advantage they from crop production and fruit and vegetable production.

Table 4: Residence type and participation in soil and water conservation structure distribution

Residence type	Respondents Participation			family size				Total
				1-3 family	4- 6 family	7-10 family	above 10	
Mukuyu leman	participation in soil and water conservation	Yes	n	11	37	19	3	70
			%	15.3%	51.4%	26.4%	4.2%	97.2%
		No	n	0	2	0	0	2
			%	0.0%	2.8%	0.0%	0.0%	2.8%
		Total	n	11	39	19	3	72
			%	15.3%	54.2%	26.4%	4.2%	100.0%
Wedesa horgocho	participation in soil and water conservation	Yes	n	4	23	27	9	63
			%	5.9%	33.8%	39.7%	13.2%	92.6%
		No	n	2	1	2	0	5
			%	2.9%	1.5%	2.9%	0.0%	7.4%
		Total	n	6	24	29	9	68
			%	8.8%	35.3%	42.6%	13.2%	100.0%
Mukuyu leman and Wedesa horgocho	participation in soil and water conservation	Yes	n	15	60	46	12	133
			%	10.7%	42.9%	32.9%	8.6%	95.0%
		No	n	2	3	2	0	7
			%	1.4%	2.1%	1.4%	0.0%	5.0%
		Total	n	17	63	48	12	140
			%	12.1%	45.0%	34.3%	8.6%	100.0%

Source: household survey, (2023)

4.1.2 The Socio-economic role of integrated watershed development

As it indicated in table 5, the soil and water conservation intervention at both Mukuyu leman and Wedsa horgocho sites are significantly changed households' level crop production and their income level. However, the result does not provide information with regard to the magnitude of watershed intervention effect on income/ crop production level of households. One way to know this effect is to calculate an effect size statistics known as Eta squared calculations. Eta squared calculation is one of the statistical tools helps to determine the income effect size of integrated watershed development and management project implementation site community households by comparing mean crop production of households before and after soil and water interventions. The procedure for calculating and interpretation of Eta squared is one of the most commonly used effects size statistics desired here.

$$\text{Thus, Eta squared} = \frac{t^2}{t^2+(N-1)}$$

Where

t= refers to t-statistics shown in table labeled paired samples test,

N= refers to the number of responses provided in table paired samples statistics.

The guideline prepared by Cohen, (1988) for the interpretation this value of eta square result is:0.01=smalleffect,.0.06=moderate effect and 0.7 and above large effects.

1. Eta squared for teff production =$(-52.432)^2/(-52.432)^2$

   Eta squared =2749.11462/2888.11462 ≈**0.95187172 ≈0.95**

2. Eta squared for maize production= $(-43.721)^2/ (-43.721)^2+ (140-1)$

   Eta squared=1911.52584/2050.52584+139=0.93221=0.93

3. Eta squared for wheat production =$(-50.910)^2/(-50.910)^2+(140-1)$

   Eta square =0.94909969 ≈ **0.94909969≈0.95**

Given our eta squared values are above **(0.72) and we** can conclude that there were large effects, with a substantial difference in level of crop production earned after soil and water conservations structures intervention than before. Accordingly, a paired sample t-test for teff, maize and wheat production were evaluated before and after the integrated watershed intervention and concluded that it has a roles on crop productions of households. The result showed a significance increase in the crop production in both Mukuyu leman and Wedesa horgocho after integrated watershed development and management project intervention. Statistical test confirmed that teff production before intervention (Mean= 1.81, SD=0.804) while after soil and water conservation intervention mean of teff production showed (M=5.58, SD=1.399**)**,t(139) = -52.432, P < 0.001(two-tailed). The mean of teff production increased by 3.77 with 93% confidence interval ranging from -3.914 to -3.629. Similarly, the statistical test for maize production before intervention showed (mean= 2.71, SD= 0- 627) whereas after intervention mean of maize production (M=5.74, SD= 1.2009), t(139) = -43.721, P <0.001(two-tailed).

The maize production mean increased by -3.01 with confidence interval ranging from -3.158 to -2.885. In addition, the wheat production test before intervention showed (M=3.06, SD=0.639), whereas after intervention the mean of wheat production showed (M=6.05, SD=1.052), t (139) = -50.91, p<0.001 (two tailed –test). The wheat production increased by-2.99 with confidence interval ranging from -3.102 to -2.87. Therefore, the eta square statistics of the three productions (teff, Maize and Wheat) showed above (0.72) which means that the soil and water conservation intervention has a large effect size on the crop production level of both Mukuyu leman and Wedesa horgocho sites. Here the researcher rejects the null hypothesis. Therefore, it was concluded that there is the significant evidence to reject the research proposal which states there is no crop production level difference before and after soil water conservation intervention because of the fact that the value of sig 0.00 is < 0.07 which means there is great difference in crop production level before and after the intervention.

Table 5: Paired Samples Test of crop production in quintals before and after Soil and Water conservation

Paired samples test of crop production of household before and after interventions	Mean	Std deviation	Paired Differences					t	df	Sig. (2-tailed)
			Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
						Lower	Upper			
Pair 1 Average teff production before	1.81	0.804	-3.771	.851	.072	-3.914	-3.629	-52.432	139	.000
Pair 1 average teff production after intervention	5.58	1.399								
Pair 2 Average maize production before	2.71	0.627	-3.021	.818	.069	-3.158	-2.885	-43.721	139	.000
Pair 2 average maize production after intervention	5.74	1.209								
Pair 3 Average wheat production before	3.06	0.639	-2.986	.691	.059	-3.102	-2.870	-50.910	139	.000
Paired 3 average wheat production after intervention	6.05	1.052								

(Source: Household survey, 2023)

The households in the Mukuyu leman and Wedesa horgocho integrated watershed development and management project sites' have different kinds of source of livelihood incomes. As shown in Table 6, the source of means of livelihoods of households in the Mukuyu and Wedesa horgocho integrated watershed development and management project sites are divided into two main categories. Accordingly around 68(48.6%) of the total respondents source of livelihood was farming (crop production) while 69(49.3%) of the total respondent source of livelihood depends on both crop production and animal rearing while only 29(1.4%) of total respondents source of in income depend on animal husbandry. Lastly, only 1(0.7%) respondents stated their means of livelihood depend on trade activities. The overall FGD result source of livelihood income of households in the Mukuyu leman and Wedesa horgocho sites were summarized by the statement bellow.

Even though households source of income before and after intervention largely depend on both farming and rearing animals. However the current is very different from previous level crop and animal productions. Especially after integrated watershed development and management intervention households was not sufficient awareness and skills to maintain their own land to make more productive. They earned the knowledge and skill to conserve soil and water through participation in the intervention. This entire situation helped them to increase their level source of income by producing crops and production of animal feeding for animal rearing. The households developed great moral to change their livelihood to work actively fruits and vegetable production and supply for the markets. In terms of participation in soil and water conservation intervention, about 133(95%) of the respondent actively participated in the intervention while 7(5%) of the total participants are not actively participated in the interventions.

Table 6: livelihood source and participation of household in SWC

Source of livelihood and participation of household in watershed intervention			participation in soil and water conservation		Total
			yes	no	
	farming(cop)	n	66	2	68
		%	47.1%	1.4%	48.6%
	husbandry (animal)	n	2	0	2
		%	1.4%	0.0%	1.4%
	both crop and livestock husbandry	n	64	5	69
		%	45.7%	3.6%	49.3%
	trade and services	n	1	0	1
		%	0.7%	0.0%	0.7%
	Total	n	133	7	140
		%	95.0%	5.0%	100.0%

Source: household survey, (2023)

As it can be illustrated in table 7: In terms of land ownership given the fact that the level of their land farm size difference from one another about 136(97.1%) of the total respondents have their own farm land while only 4(2.9(%) of the total respondents have no their land but participated in farming through contractual bases. On the other hand respondents were asked the trends of their farm land treatment during and after the treatment. The result of survey study showed that 133(95%) of the total respondent stated the existence of increasing level soil and water conservation while about 4(2.9%) of the total respondents were stated the treatment situation is decreasing and finally about 3(2.1%) of the total respondents stated there is no difference in land treatment before and after the intervention.

One of the key informants stated the source of livelihood and their participation as follows

> *In the Mukuyu leman soil and water conservation intervention, I was got a lot of skills that helped me to care of my land and water conservation enabled me to produce more crops and rear animals. Before the intervention, I was earned 6 quintal maize per hectare but after soil and water conservation due to increase of soil fertility, soil water holding capacity and reduction of soil erosion in integrated watershed*

development and management site, enable me to produce 20 quintal maize per hectare. Furthermore, after project phase out, I continued to conserve soils and water conservations on my own land.

This implies that a household participated in integrated watershed development management project implementation sites have gained a lot of benefit of producing more crops and animal rearing. Furthermore this intervention further can enable the sustainable use of natural resources for sustainable development.

Table 7: Farmland own and trend of its treatment distributions

			what is trend of your farm land treatment			Total
			decreasing	increasing	no difference before and after intervention	
Do you have farm land	ye	n	3	131	2	136
		%	2.1%	93.6%	1.4%	97.1%
	no	n	1	2	1	4
		%	0.7%	1.4%	0.7%	2.9%
	Total	n	4	133	3	140
		%	2.9%	95.0%	2.1%	100.0%

Source: household survey (2023)

4.1.3 Physical and biological integrated watershed development

Under this topic the researcher tried to understand the status of soil and water conservation intervention like stone bund, soil bund, fanyaajuu, crop rotation, planting trees, bench terraces, and gully construction by gabion and check dam before the implementation of the project, during the project implementation process and the situation of physical soil and water conservation

4.1.3.1 Physical soil and water conservation before, during and after intervention

As it indicated in table 8: respondents were requested what kind of soil and water conservation mechanism they used before the intervention program. Data result indicated that about 4(23.5%) of the respondents indicated they were using stone band, soil band and Gulley construction by gabion check dam each respectively whereas only 1(5.9%) of the respondents stated they now and use ditches. In instantaneous, from Mukuyu leman , 8(47.1%) of the respondents and 9(52.9%) of respondents from Wedesa horgocho stated they were using stone band, soil band structure to maintain their own land respectively. The rest almost all 123(87.9%) respondent stated they have no any idea and experience of method soil and water conservation mechanisms before the project interventions.

Table 8: Physical soil and water conservation mechanism before intervention

			Residence type		Total
			Mukuyu leman	Wedesa horgocho	
physical soil and watershed treatment system before the project	stone bund	n	3	1	4
		%	17.6%	5.9%	23.5%
	soil bund	n	4	0	4
		%	23.5%	0.0%	23.5%
	Fanyaajuu	n	0	3	3
		%	0.0%	17.6%	17.6%
	Bench Terraces	n	0	1	1
		%	0.0%	5.9%	5.9%
	Ditches	n	0	1	1
		%	0.0%	5.9%	5.9%
	Gulley construction by gabion check dam	n	1	3	4
		%	5.9%	17.6%	23.5%
Total		n	8	9	17
		%	47.1%	52.9%	100.0%

Source: - household survey, (2023)

In addition, qualitative data result from FGD also exhibited the Mukuyu leman and Wedesa horogocho sites were summarized by the statement bellow.

Before soil and water conservation structure development intervention program residents both area have any idea about different methods of soil and water conservation. Each *farmer was used only like slop farming and some other traditional conservation mechanism. At that time residents were also have great challenge of crossing from one sites to another due the occurrence of gulley on the land created by massive soil erosion.*

Before introduction of soil and water conservation, there were only a sum total of 15 respondents who know and practice very few method of soil and water conservation mechanisms. The rest 125 respondents were not known and practices various mechanisms listed in table 9: for soil and water conservation and development approaches. As it can be seen from table 9:(40%) of respondents were used to practices soil bund mechanisms of soil and water conservation structure while only 4(26.7%) of the respondent stated used to practice stone bund methods of conservation while only 2(13.3) of total respondents confirmed practiced trenching methods. Similarly, rest each 1(6.7%) of the respondent of the respondents stated used to practice Fannujju, bench terrace, ditches, and gulley construction respectively.

Table 9: Physical soil and water conservation system during intervention

Physical soil and water management system during intervention		Residence type		Total
		Mukuyu leman	wedesa horgocho	
stone bund	n	3	1	4
	%	20.0%	6.7%	26.7%
soil bund	n	5	1	6
	%	33.3%	6.7%	40.0%
Fanyaajuu	n	0	1	1
	%	0.0%	6.7%	6.7%
Bench Terraces	n	1	0	1
	%	6.7%	0.0%	6.7%
Ditches	n	0	1	1
	%	0.0%	6.7%	6.7%
Trenches	n	0	2	2
	%	0.0%	13.3%	13.3%
Gulley construction by gabion check dam	n	0	1	1
	%	0.0%	6.7%	6.7%
Total	n	9	6	15
	%	60.0%	40.0%	100.0%

Source: household survey, (2023)

As it illustrated in table 10: respondent were requested what kind of soil and water conservation methods were used during the implementation the project. The result data showed that about 128(20%) of the total respondents were confirmed implementing soil bund while 120(18.8%) of the total respondents explained practiced gulley construction by gabion check dam during intervention. Furthermore, 119(18.6%) of the respondents were practiced stone bund soil and water conservations methods. similarly, 117(18.3%) of the total respondents quantify practiced fanyaajuu whereas 114(17.8%) of the total respondents answered practiced bench terraces. In addition, of the total respondents 22(3.4%), and 19(3%) stated practiced ditches and terraces soil and water conservation method respectively.

Furthermore, qualitative data from FGD also exhibited at Mukuyu leman and Wedesa horgocho sites were summarized by the statement bellow.

During the implementation of soil and water conservation intervention, they acquired a lot of knowledge and skills of maintaining methods of soil and water conservation that in turn increased soil fertility and better accessibility of water for irritation as well as developing more animal feedings. The implementation of integrated watershed development and management project also literally created a sense competition among land owner households to more maintaining their land and watershed development using different mechanisms of conservation for better crop production, animal and bees keeping.

Table 10: Physical soil and water conservation methods during implementation

hysical soil and water conservation method during the implementation of the integrated watershed development and management project implementation.		Responses	
		N	Percent
Types of soil and water conservation	stone bund	119	18.6%
	soil bund	128	20.0%
	Fanayajuu	117	18.3%
	bench Terraces	114	17.8%
	Ditches	22	3.4%
	Trenches	19	3.0%
	Gulley construction by gabion check dam during intervention	120	18.8%
Total		639	100.0%

Source: - household survey, (2023)

As it illustrated in table 11, physical soil and water conservation after project phase out showed reduced after the project phase out. To make more clarification, respondents were asked to about the situation of integrated watershed development and management project after phase out. The result showed that in same methods of soil and water conservation, it continued to have similarity with the period of implementation while in very few methods of intervention it confirmed the reductions. To make clear, stone bund and soil bund showed 127(90.7%) and 131(93.6%) of the cases of the respondents were using it after the project phase out respectively. Similarly, fanyaajuu, bench terrace, and ditches indicated 121(86.4%), 129(92.1%) and 117(83.6%) of cases of the respondents confirmed practicing fanyajuu, bench terrace and ditches correspondingly. However, 97(69.3%) and 88(62.9%) of cases of the respondents using trenches and gully construction by gabion check dams which relatively showed decreased after project phase out respectively .

To triangulate data from FGD regarding the situation soil and water conservation after the project phase out an excessive discussion were made with each group and the summary report was shortened by the declaration bellow

> *The implementation integrated watershed development and management project makes them more beneficiaries. Consequently, they continued to maintain soil and water development after the project phase out. Especially using method like soil bund and stone bund, bench terrace and ditches were simple technique that they use to construct their land by applying slopping around their residence area. However, in some cases like watershed development by gabion and check dam showed decrease as it need industrial products means gabion to conserve soil and watershed. They tried to buy from the market and the price was so expensive. Because of these gully construction by gabion and check dam showed decease after the project phase out.*


Table 11: Physical soil and water conservation structure management after project phase out

Physical soil and water conservation structure management after project phase out	Responses		Percent of Cases
	N	Percent	
stone bund	127	15.7%	90.7%
soil bund	131	16.2%	93.6%
Fanyajuu	121	14.9%	86.4%
bench Terraces	129	15.9%	92.1%
Ditches	117	14.4%	83.6%
Trenches	97	12.0%	69.3%
Gulley construction by gabion check dam during intervention	88	10.9%	62.9%
Total	810	100.0%	578.6%

(Source: household survey, 2023)

4.1.3.2 Biological soil and water conservation structure before, during and after project

As it observed from table 12: before the intervention 21(9.6%) of the respondents' planting trees whereas crop rotation and cover crop confirmed 8(3.7%) and 17(7.8%) respectively. Furthermore grass stripping, mixed crop and alley cropping indicated 16(7.3%), 13(5.9%) and alley cropping 10(4.6%) of the respondents respectively. Before the intervention afforestation indicated only 5(2.3%) of the respondents while counter planting and agroforestry counts each 9(6.6%) of the respondents respectively.

Still, data from FGD regarding biological methods of soil and water conservation structure were shortened by the declaration bellow.

> *Even though there is very few planting tries only for other purpose there was no organized method of soil and watershed development aimed to increase crop productivity. Other methods like crop rotation, alley cropping, grass tripping, cover crop and wind break was not known before the implementation of the project other than simply tradition doing of soil fertility keeping like crop rotation, plant cover and grass stripping were some of them the major problems mention by households.*

Table 12: Biological soil and water conservation structures before intervention

biological soil and watershed development before intervention		Responses	
		N	Percent
Biological soil and watershed development before.	Alley cropping	10	4.6%
	planting trees	21	9.6%
	Agroforestry	13	5.9%
	grass stripping	16	7.3%
	crop rotation	8	3.7%
	Mixed crop	13	5.9%
	cover crop	17	7.8%
	Wind break	5	2.3%
	contour planting/ farming	9	4.1%
	Reforestation	10	4.6%
Total		219	100.0%

(Source:-household survey, 2023)

As it illustrated in table 13, respondents were requested lists of question whether the biological soil and watershed development during the implementation of the project continued after the project phase out.

The result showed 135(24.8%) of the responses confirmed continued plating trees whereas 122(22.4%) and 100(18.4%) of the responses reported reforestation and contour planting respectively. Furthermore, 58(10.7%) of the responses indicated practices mixed cropping while 33(6.1%) of the responses were used crop rotation methods. In addition, the rest other 23(4.2%), 19(3.5%), 18(3.3%) and 16(2.9%) of the responses indicated that cover crop, agroforestry, alley cropping, and wind break apply biological soil and water conservation methods respectively.

One of the key informants (male) elaborated the biological method of soil and water conservation of the Wedesa horgocho site as follows.

> *Households of Wedesa horgocho have passed a lot of problems related soil and water conservation issue. All around the area was known by gulley's land and extreme soil erosion and water scarcity. However, I got theoretical and practice based knowledge and skill of conserving soil and water. I planted varieties of plants that were granted me by project at various time. This biological conservation method saved my land from erosion as I panted it at up stream of my land. Furthermore, area is now completely covered by plants and I currently trying rearing bee on that area. In general I have got a lot of benefits during the implementation and after the implementation of the project.*

These indicate that there is biological soil and water conservation helped them to link to their means of livelihood and other skills to promote sustainable development.

Table 13: Biological soil and water conservation after the project

biological soil and water conservation after the project phase out	Responses		
	N	Percent	
Alley cropping	18	3.3%	
planting trees	135	24.8%	
Agroforestry	19	3.5%	
grass stripping	20	3.7%	
crop rotation	33	6.1%	
Mixed crop	58	10.7%	
cover crop	23	4.2%	
Wind break	16	2.9%	
contour planting/ farming	100	18.4%	
Reforestation	122	22.4%	
Total	544	100.0%	

Source:-household survey, (2023)

As it can be seen from table 14: about 120(85.7%) of the respondents stated both biological and physical soil and watershed development started during the implementation of the project while 18(12.9%) total respondents confirmed they begin soil and watershed development before the beginning of the project. Furthermore, only about 29(1.4%) of the total respondents stated the begin soil and watershed development after the phase-out.

Similarly, respondents were requested to rand the soil and watershed development intervention in reducing soil erosions. Accordingly, about 75(53.6%) of the total respondents ranked it as very good which means the intervention brings a big change though 32(22.9%) of the respondents' stated as the intervention created good impacts whereas 17(12.1%) and 16(11.4%) of the total respondents reported an excellent and poor level of raking respectively.

Table 14: Time of soil and water conservation start and ranking its effect in reducing soil erosion

Period of beginning soil and water conservation and ranking its effect in reducing soil erosion.			How do you rank the intervention in reducing erosion				Total
			poor	Good	very Good	an excellent	
when do you started using soil and water conservation method	before the project intervention	n	3	1	14	0	18
		%	2.1%	0.7%	10.0%	0.0%	12.9%
	during project implementation	n	13	31	59	17	120
		%	9.3%	22.1%	42.1%	12.1%	85.7%
	after project phase out	n	0	0	2	0	2
		%	0.0%	0.0%	1.4%	0.0%	1.4%
	Total	n	16	32	75	17	140
		%	11.4%	22.9%	53.6%	12.1%	100.0%

(Source: Household survey, 2023)

4.1.4 Environmental Roles of integrated watershed Development and management project

The Environmental and Climate change commission working directive laid an obligatory to make screening before conducting a full-sized environmental influence assessment of development project. Screening is the processes of determining whether the development project, in this case of Mukuyu leman and Wedesa horgocho integrated watershed development management project, requires EIA or not. The screening process considered the Environmental Effect Assessment Proclamation no.299/2002andDirectiveNo.2/2008.Accordingtotheproclamationallprojectsinenvironmentally sensitive areas should be considered for full EIA prior to implementation. Therefore, the integrated watershed development and management project intervention area **972**hectors of land which is huge projects where470 household were involved.

Environment situation before and after intervention

4.1.4.1 Analysis of environmental roles of interventions

This analysis covers wide ranges environmental issues likes land rehabilitation by plantation and physical conservation as well as socio-cultural and economic aspects of the households in the Mukuye2 and Wedesa horgocho studies sites.

Another positive role of the Mukuyu leman and Wedesa horgocho integrated watershed development and management project intervention created a good opportunity to gain high-level of awareness and practical skills in soil and water conservation which in turn enabled the farmers begin farm pond construction, agro forestry practice ,small scale irrigation and increasing forest area protection. Furthermore, due to the general improvement of soil fertility, crop production per hectare also showed increment.

Before the intervention the entire sites' lands were eroded with much valley area that completely disconnects one keeled from another area. Land productivity per hectare in both sites was very small and planted trees in the area were played very important roles in improving the environmental situations of the sites. Even though the very damaged before the intervention, the whole area is flat and suitable for production of agricultural crops that are based on rain-fed agriculture. However currently in addition to crop production improvement, a lot of farmers started onion and tomato though small scale irrigation also started change the livelihood of the farmers. .

Before the intervention there were small amount of plantation and agricultural activities. However, as it indicated in table 15: data from survey questionnaire indicated that about 119(85.0%) of the respondents confirmed that after the intervention there was an increase improved soil fertility and small scale irrigation of varieties of fruits and vegetables in the area. The increase of plantation also partly connected with the current government green legacy implementation.

Role of Soil and water conservation intervention on air pollution- No impact is anticipated air pollution during all phases of the project cycle.

Road and transportations- The rural residents in Mukuyu leman and Wedesa horgocho of DugdaWoreda was very far from main asphalt road and have no accessibility to concrete roads before the intervention however, currently all gulley area were repaired as well as concrete roads are infrastructure for the two sited along sides of the implementation of the project. Now the sites farmers can simple transport their agricultural products to the markets.

Table 15: Environmental roles of integrated watershed development and management project

Environmental roles soil and watershed developments.		Residence type		Total
		Mukuyu leman	wedesa horgocho	
improved soil fertility	n	61	58	119
	%	43.6%	41.4%	85.0%
planting tree increased	n	67	61	128
	%	47.9%	43.6%	91.4%
increased soil and water conservation structure	n	66	65	131
	%	47.1%	46.4%	93.6%
Decreased area affected by gully	n	64	59	123
	%	45.7%	42.1%	87.9%
Decreased temperature of hottest month	n	58	56	114
	%	41.4%	40.0%	81.4%
Decreased flood	n	66	63	129
	%	47.1%	45.0%	92.1%
better knowledge about soil and water conservation	n	71	65	136
	%	50.7%	46.4%	97.1%
improved rain characteristics	n	30	19	49
	%	21.4%	13.6%	35.0%
increased protected forest area	n	70	32	102
	%	50.0%	22.9%	72.9%
increased grass production for animal feed	n	50	51	101
	%	35.7%	36.4%	72.1%
Better adoption of technology of watershed intervention	n	71	68	139
	%	50.7%	48.6%	99.3%
Total	n	72	68	140
	%	51.4%	48.6%	100.0%

(Source: household survey, 2023)

Respondents were asked the environmental roles of Mukuyu leman and Wedesa horgocho integrated watershed development and management implementation project. As one can understand from table 16: data result indicated the intervention has positive roles in improving the environments of sites in terms of planting trees which counts 128(91.4%) of the total respondents. Similarly, improved soil fertility 119(85%), decreased area affected by gully 123(87.9%), increased grass production for animal feed 101(72.1%), decreased flood 129(92.1%) and increased protected forest area 102(72.9%) of the total respondents respectively. Furthermore, due to the introduction of soil and watershed intervention in the two sites the respondents gained better knowledge about soil and water conservation counting

136(97.1%) of the respondents whereas better adoption of technology of soil and watershed development showed 139(99.3%) of the total respondents.

As one can understand from table 16, the major challenges during the implementation of the project was limited skills/capacity to maintain integrated watershed development and management project implementation with 117 (83.6%) of the total respondents while the respondents who stated only lack of facilities counts about 10((7.1%). Similarly, the major challenges after the project phase out was reported lack of facilities, limited capacity and over grassing counted about 102(72.9%) of the total respondents

The challenges during the implementation and after the project phase out were presented to FGD and the summaries of the discussions compressed by the declaration bellow.

Even though all-king of support given to farmers were paramount important, one cannot compare the training, facilities like gabion and cement and plant seeds for biological soil and watershed conservations. This situation in turn able to increase soil fertility, improvement crop productivity and protected forest area. The challenges during the implementation of the project was the existence of limited capacity to implement the soil and water conservation structure whereas after phase out of the project there was lack of facilities like lack of gabion, cement. Even it was very hard to get from the market because of its expansiveness

4.1.5 Challenges of implementing integrated watershed development

At the beginning of the project there were households' knowledge, awareness and skill in implementing. Once these problems were solved through training and practicing soil and watershed development then the challenges changed to other phases to scarcity of facility like gabion, cement and other materials helps to soil and water conservation. Even if the some of the materials were available on the market its price very high that cannot be expected be afforded at household level.

Table 16.Challenges of integrated watershed development and management project during and after intervention

Major challenges of soil and watershed development after the project phase out.		major challenges during the implementation of the project				Total
		lack facilities	free grazing	Limited capacity to maintain	both lack of facilities and capacity to maintain	
over grazing	n	0	0	3	0	3
	%	0.0%	0.0%	2.1%	0.0%	2.1%
lack of maintenance	n	2	0	10	2	14
	%	1.4%	0.0%	7.1%	1.4%	10.0%
lack of awareness	n	1	0	1	0	2
	%	0.7%	0.0%	0.7%	0.0%	1.4%
lack of facility	n	0	1	9	1	11
	%	0.0%	0.7%	6.4%	0.7%	7.9%
both lack of facility and repair	n	0	0	5	1	6
	%	0.0%	0.0%	3.6%	0.7%	4.3%
lack of repairs and awareness	n	0	0	2	0	2
	%	0.0%	0.0%	1.4%	0.0%	1.4%
Alternative 2,3,and 3 are answers	n	7	1	87	7	102
	%	5.0%	0.7%	62.1%	5.0%	72.9%
Total	n	10	2	117	11	140
	%	7.1%	1.4%	83.6%	7.9%	100.0%

(Source: household survey,2023)

4.2 Discussion

Depending on the major findings from the study of integrated watershed development and management project implementation at both Mukuyu leman and Wedesa horgocho sites, the socio economic and environmental role of the intervention were critically discussed through connecting it with relevant related literature reviews, and important theoretical perspectives. Accordingly, this study integrated and concluded the following core discussion points following specific objectives of the study.

4.2.1 The socio-economic roles of integrated watershed development intervention

According to the household survey, focus group discussions and key informant interview data result, the finding of this study confirmed the existence of annual rain feed depending farming resident in both Mukuyu leman and wedesa horgocho with low level of crop production before the implementation integrated watershed development and management project. However, after the implementation integrated watershed development and management project, residents of Mukuyu leman and Wedesa horgocho have started various source of income generating activities like irrigation and bee keeping. Hence, the entire intervention areas household's livelihood depends on different kinds of farming and animal rearing activities. Even though, the existence of some differences in a proportion of households participating in each types soil and water development is certain, the livelihoods of households in the both sites improvements in terms crop production level, animal rearing through increasing animal feed production, and other additional activities that were not seen before the implementation of the project. After the implementation of the project, farmers of the area able to produce more crops, start small scale irrigation, due to presence of water it was constructed by farm pond and animal feeding, farmers started rearing more animal and bees than before.

Consequently, the characteristics of the finding indicated would be assumed as multiple sets of livelihood activities performed in Mukuyu leman and Wedesa horgocho sites based natural resource conservation of soil and water to improve agricultural productivity as a means of living.

Therefore, the result validates the thought and assumption indicated in the sustainable livelihood framework (Scoones, 1998; DFID, 2000; Bebbington, 1999), which focuses on manifoldcirclesoflivelihoodactivitiesaccomplishedbyindividualsorgroupsasameansofliving. Similarly, supporting this idea,(Liu,2020,2011;Scoones,2009)also confirmed that livelihood activities is various means of living that are essential to the everyday life of households to support their livelihoods. Therefore findings of this study indicated that integrated watershed development and management project implementation substantially improved household crop productivity, irrigation and increment protected forest area.

4.2.2 The physical soil and water conservation in the two study sites

The physical conservation of soil and water in Mukuyu leman and Wedesa horgocho centers on the restoration of land features such as soil bunds, stone bunds, and fanyaajuu. Bench Terraces, Trenches, Ditches, and Gulley are built with gabion dams during intervention. Through physical land repair, households can preserve previously severely eroded lands, gorge-like areas, and the physical structure of the land to preserve water for irrigation. The physical development of soil and water plays a major positive role in a number of physical aspects, including investment in conservation measures for soil and water, soil fertility, soil erosion, crop productivity, and changes in cropping pattern, intensity, and expansion of cropped area.

Supporting the above idea previous studies stated watershed treatment activities improved conservation of soil and moisture, improvement and maintenance of fertility status of the soil (Ramaswamy and Palanisami 2002; Palanisami and Suresh Kumar 2002) and reduced soil and water erosion. In addition, Sikka et .al (2000) stated an organic carbon increased by 37% due to watershed intervention and most studies revealed that there was a significant reduction in soil and water erosion.

Furthermore, study evidence showed that soil conservation appears to have had a positive impact on retention of moisture, reduced soil erosion, and change in land use pattern and yield. This study further confirmed that improvement in soil fertility coupled with increased water resources in the watershed area led to expansion which in turn cropped area and cropping intensity, and increase in production and productivity of crops. The cropping pattern changes have taken place both in additional area brought under well irrigation from the fallow lands and in the area under rain-fed cultivation.

Concerning physical assets, Mahmud and Sawada (2015) argued that access to basic supporting natural resource utilities, water, and social infrastructures affects the revenue generation options of community. Examining the recovery of communities from the previous residence due to natural disasters (Jha and Duyne, 2010) also highlighted the importance of essential support of facilitation to economic growth and reduces poverty among the natural disaster attacked populations. The finding of this study showed the provision of the practical training, support materials for better soil and water development and supply different kinds plant seeds for biological conservation soil and water conservation and forest coverage which currently changed physical lands of the sites.

The result of this study partially looks like previous studies outcomes more specifically on the necessity of natural resource conservation in mostly drought prone area. However, in contrary, the finding of this study clearly illustrated natural resource conservation not only the issues of environmental protection rather it is a means of livelihood improvement and income generating activities that created hope and capability to make land more productive.

The shared sound heard from each participant is the practical skills and knowledge of soil and watershed development household earned were very necessary to improve households' Livelihood. Different methods of integrated watershed development and management implementation opened up an opportunity for different intensity level of agricultural production like increase of level of crop production, use of irrigation, development of animal feeding and bees rearing are some of the livelihood activities experienced in the study sites.

This situation created strong- self-confidence within the Mukuyu leman and Wedesa horgocho residents in changing the livelihood of households. The finding indicated that the function of soil and water development is not only used for maintenance of natural resources but also directly related livelihoods of households practices like improved crop production, production fruits and vegetables using irrigation from increased well-preserved water.

4.2.2.1 Biological soil and watershed development in the sites

One of the primary techniques utilized to conserve soil and water at the Mukuyu leman and Wedesa horgocho intervention sites was biological soil and water conservation practices.

Alley cropping, tree planting, agroforestry, grass development, crop rotation, contour planting, reforestation, and other practices are examples of these. The implementation of biological conservation practices at the sites resulted in notable alterations to the surrounding environment and enhanced household livelihoods.

The study highlights the primary functions of soil water conservation (SWC) measures, which include reducing soil erosion and its associated effects on surface water recharge, improving crop diversification, and increasing crop yields of fruits and vegetables. Particularly, structures can mitigate the loss of vital plant nutrients in addition to soil and water. When surface runoff water encounters obstacles, the physical SWC measures are identified as the first line of defense and primarily function as a barrier.

Major biological barriers that were erected on gullies and in structural embankments made it possible to reduce soil erosion during long gully rehabilitation projects. These barriers also decreased the amount of water runoff, which in turn decreased soil loss. The majority of structures progressively become benching, lowering the runoff velocity and slope gradient. As part of the watershed development, trees were also being planted on both common and private farmlands. As a result, the environment became greener and there was a greater area of protected forest.

Biological soil and water conservation techniques are less labor-intensive, more efficient than physical structural techniques, and offer multifunctional stabilizers that lower soil loss, increase the availability of organic inputs for soil fertility improvement, and provide animal feed, all of which lead to an increase in income of households.

4.2.2.2 Environmental roles of integrated watershed development intervention

The integrated watershed development environmental roles includes environmental risk reduction, lessons learned, planting trees with expanding protected forest area, land feature repairman by gabion and gully construction and increasing soil fertility and surface water for irrigation were some the issues related to environmental issues investigated in these study. Supporting these ideas (Sinha, 1998) confirmed that promoting household's participation to reduce antithetical environmental effects, informs decision-makers, and helps lay the base for environmentally sound projects. Similarly, Misganaw, (2005) also stated to avoid the division of Social tensions and arisen competition among community over resources proposed rehabilitating target peoples and natural resources at their residence area as an alternative by implementing massive quantity of cash devoted in the package to escape the environmental challenges.

Accordingly, the result showed almost all of the households around the project were pre-informed about the Mukuyu leman and Wedesa horgocho watershed development and management intervention program before the implementation of the project. Findings of this study revealed positive environmental change in terms of massive amount planting tree on farm land and common in which part of them now become protected forest area as well as the majority of gulley and eroded land changed to better soil fertility and started bring access grass for the animal feeding which in turn created conducive environment for animal and bee keeping.

On the other hand, regarding the increase of temperature, dust, storm and wind both quantitative and qualitative datahavenotindicatedanobservableenvironmentalchangeintheprojectsites. However, in terms soil reduction of soil erosion, planting trees, increase of surface water and repairing gulley land area showed a significant improvement.

4.2.3 Challenges of integrated watershed development project implementation

After the project was phased out, households were expected to carry out the integrated watershed development and management interventions in similar setting as during implementation. The knowledge, awareness, and implementation skills of the households were insufficient at the start of the project. After training and hands-on soil and watershed development techniques were used to address these issues, the challenges shifted to other phases, such as a lack of facilities such as gabions, cement, and other materials that aid in soil and water conservation. Challenges regarding this issue related to accessibility and price problems. Even if some though some of materials were sometimes available on the market, its prices were so high that was not afforded by household level. In summary, the majority of respondents acknowledged and clarified a number of issues, such as lack gabion's accessibility and its skyrocketing price, which is beyond the means of most households. That being said, phase out does not imply that households stopped implementing the project entirely.

CHAPTER FIVE

5. CONCLUSSIONS AND RECOMMENDATIONS

5.1 Conclusion

In Wedesa horgocho and Mukuyu leman of Dugda woreda, this study examined the socioeconomic and environmental roles of integrated watershed development and management project. To investigate, a mixed-methods explanatory research design was used. The results of the study are determined by means of household survey questionnaires, key informant interviews, focus group discussions, and observation of the impact of integrated watershed development and management intervention approaches on households' socioeconomic status and their contribution to environmental enhancements. Additionally, it was found that the majority of SWC practices in the watersheds significantly improved the amount of water availability, the fertility of soil and productivity of the soil, and the coverage of protected forest areas. The two locations' combined integrated watershed development and management interventions have, overall, led to more sustainable.

One of the main factors influencing the success of integrated watershed development and management intervention activities was strong household participation through training and practice on the path of soil and water development, which created a demand-driven approach. The project was carried out with success. The committees, local expertise, resident households, and project coordination office staff have all fulfilled their roles in terms of problem identification and prioritization. Demand-driven and technically feasible approaches were combined during the implementation process because community priorities were determined by the evaluation of technical and financial feasibility. An externally driven or general approach to creating and putting into practice watershed management strategies may be inappropriate, in general, given the positive outcomes of community involvement and demand-driven approaches. Watershed development and management approach linking natural resource conservation with livelihood improvements by facilitating the practice of various additional IGAs. This study has also confirmed that the implementation of the project certainly enabled the farmers to gain enormous endogenous knowledge and creativity, which many externally driven development programs often fail to consider; hence, it is apparent that the knowledge and efforts of local households need to be encouraged and recognized with adequate technical and tools support.

The biophysical characteristics of soil and water conservation are some of the most important factors that affect the success of integrated watershed development and management intervention activities. For example, natural resource conservation with pervious of biological and physical soil and water conservation measures have resulted in good water percolation, a stable aquifer leading to surface and groundwater recharge and then an increased in irrigated agriculture. Therefore, the micro-watersheds are more flexible and effectively integrated conservation activities with natural resource maintenance which in turn lead to households' livelihoods improvement.

An enabling environment for scaling up and sustainability of best integrated watershed development and management practices can be provided by the existence of a favorable policy framework. However, there are several challenges that pose a risk to the success of integrated watershed development. One of the most important challenges at the beginning of the project implementation was low level of households' awareness. Once the challenges of awareness solved through training and participation expertise, the implementation process completed successfully with the improvement of household socio economic and positive environmental changes. However, the other challenge created after project phase out were only lack of accessibility of gabion and other materials necessary for soil and water conservation nearby but also stated it cost sky rocketed that not expected to be afforded by rural households. Therefore, ensuring a fair and justifiable benefit and cost sharing system may be of principal importance. Addressing this challenge also requires an innovative institutional setup to address watershed externalities and collective action.

In terms of the environmental roles the implementations of the project have positive contribution to socio economic and natural resources of the two sites. Especially it contributed maximum amount of contribution to repairing previous gulley and highly eroded land area as well as plantation trees and grass in the sites significantly improved the land physical structure and household livelihoods.

5.2 Recommendations

Investigating the socio-economic and environmental effects of integrated watershed development and management project implementation has improved household livelihoods and improved the conservation of natural resources, according to research findings. This study suggests the following for successful development of soil and water conservation and efficient up scaling of best practices:

(i) In the process of implementing integrated watershed development and management program , households in the two locations were crucial in developing strong wisdom of unity and communal spiri t, which included shared relationships. These kinds of settings must be encouraged.

(ii) The integrated watershed development and management program is being worked on by government agencies such as the Ministry of Water and Energy Ethiopia, the Dugda Woreda Agricultural Office, the Natural Resource Department, and other internal and external NGOs. These agencies should concentrate on providing materials such as gabion and other resources for soil and water conservation structures.

(iii) Create technologies that are appropriate for a particular watershed and smallholder farmers, placing a focus on innovations that enhance natural resource base conservation and yield immediate advantages for the community;

(iv) In implementing integrated watershed development households, expertise of the area and committee should focus improve surface and subsurface water management to increase water productivity;

(v) In an integrated project for watershed development and management, it is crucial to guarantee community participation with sufficient financial and technical support needs to be encouraged in similar setting

(vi) connecting agricultural and livelihood improvement initiatives with physical and biological soil and water conservation initiatives

(vii) In order to better understand the benefits of integrated watershed development and management intervention practices, better understand watershed degradation reduction technologies, and improve soil fertility and productivity status, more research is needed to evaluate the role of integrated watershed development and management intervention of Mukuyu leman and Wedesa horgocho sites for reducing soil and water erosion.

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