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COLLEGE OF SOCIAL SCIENCES

DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL STUDIES

MANAGEMENT PRACTICES ON GIMARA SMALL SCALE IRRIGATION SCHEME: THE CASE OF AYEHU GUAGSA WOREDA, AWI ZONE, AMHARA REGION, ETHIOPIA

By:

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August, 2024

Addis Ababa, Ethiopia

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BY

Alemu Yenew

A Thesis Submitted to School of Graduate Studies Addis Ababa University in Partial Fulfillment of the Requirements for the Degree of Master of Arts in Geography and Environmental Studies

Advisor: Muluneh Woldetsediq (PhD)

August, 2024

Addis Ababa University

LETTER OF APPROVAL

This is to certify that the thesis prepared by Alemu Yenew entitled: Management Practices on Gimara Small Scale Irrigation Scheme: the case of Ayehu Guagsa Woreda, Awi Zone, Amhara Region, Ethiopia and submitted in partial full filament for the degree of master of arts in Geography and Environmental studies in the collage of social science in Addis Ababa university and merits with the accepted standards in respect to original and quality.

Approved by the Board of Examiners

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DECLARATION

This is to certify that the thesis entitled "Management Practices on Gimara Small Scale Irrigation Scheme: the Case of Ayehu Guagussa Woreda, Awi Zone, Amhara Region, Ethiopia", submitted in partial fulfillment of the requirements for the degree of Master of Arts in Geography and Environmental Studies in the Department of Geography and Environmental Studies, Addis Ababa University, is a record of original work carried out by me and has never been submitted to this or any other institution to get any other degree or certificates. The assistance and help I received during the course of this investigation have been duly acknowledged.

By Alemu Yenew

Signature __________________________ date __________________

Approval of Thesis for Defense

I hereby certify that I have supervised, read and evaluated this thesis titled "Management Practices on Gimara Small Scale Irrigation Scheme: the Case of Ayehu Guagussa Woreda, Awi Zone, Amhara Region, Ethiopia", prepared by Alemu Yenew, under my supervision. I recommend the thesis to be submitted for oral defense.

Muluneh Woldetsedik (PhD) Signature ______________________ Date ______________

Advisor name ________________________ Signature ________________________ Date _______________

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Abbreviations

ADLI:	Agricultural Development Leading Industry
ADB:	African Development Bank
AGWAO:	Ayehu Guagussa *Woreda* Agricultural Office
AGWCO:	Ayehu Guagussa *Woreda* Communication Office
EWRMP:	Ethiopian Water Resource Management Policy
FAO:	Food and Agricultural Organization
FGD:	Focus Group Discussion
FTC:	Farmer Training Center
GTP:	Growth and Transformation Plan
IWMI:	Irrigation Water Maintenance Institution\
KAO:	Keble Administration office
LSI:	Large Scale Irrigation
MDA:	Model Drive Architecture
MOA:	Ministry of Agriculture
MOFED:	Ministry of Finance and Economic Development
MOWR:	Ministry of Water Resource
MSI :	Medium-Scale Irrigation
SPSS:	Statistical Package for Social Science
SSI:	Small Scale Irrigation
SSIS:	Small Scale Irrigation Schemes
USAID:	United States Agency for International Development
WARDO:	Woreda Agricultural and Rural Development Office

Abstract

Agriculture in Ethiopia is primary rain fed and depends on erratic rainfall, characterized by frequent failures of production. The survey gap was to fill the management problem in the study area the challenges that hinder the managements of irrigation practice and the major determinant factors that affect farmers to practice irrigation. The study employed mixed research approach. The required data for the study was collected from both primary and secondary sources Simple random sampling method was used to select three sampled villages from the total of six villages in the irrigation area. From a total of 540 households 130 respondents were selected as sample households by using Kothari formula. Chi-square test was employed to examine the relationship between categorical variables. Binary logistic regression model was mainly employed to identify factors affecting small scale irrigation practices. The study clearly revealed that scarcity of irrigation water and increasing number of irrigation users from time to time were the major challenges which hindered effective irrigation management practices. The binary logistics regression result indicated that, access to extension services; experience, sex, credit and training were found to be statically significant factors to determine irrigation practices. Water user's association committee and other concerned bodies should control illegal water users in the upper course of irrigation area who are the major sources of water scarcity for downstream communities and they should distribute irrigation water adequately, timely and fairly for irrigation users.

Key words*:* *Small scale irrigation, irrigation practice, Gimara Irrigation Scheme*

CHAPTER ONE: INTRODUCTION

1.1 Background of the Study

Agriculture is the major economic sector in Africa, providing about two thirds of the employment in the continent (Lebdi, 2016). Most of the agriculture in Africa is rain fed and subject to erratic rain fall and re current drought (Birdsall, 2018). Globally rain-fed agriculture is practiced in most climatic zones covering 83% of cultivated land and supplying more than 60% of world food. In water scarce tropical region rain fed agriculture is practiced in more than 95% of crop land (Moffitt & Cajas, 2014) and 55%of the gross value of food is produced under rain fed condition on nearly 72% of the world's harvested crop land (Hamdy *et al.,* 2019). According to the report of Baquedano *et al*. (2021), food demand in 2030 is expected to be 55% higher than in 1998.

Agro climatic conditions in low-rainfall places and seasons have traditionally prompted the development of irrigation systems. According to Abeba (2018), the issue of food security can be resolved and agricultural development might be significantly aided by the expansion of irrigated lands. Irrigated land has grown globally from 50 million hectares in 1900 to 267 million hectares in 2009, with emerging nations accounting for the majority of this growth (75% of all irrigated land).Because there is less irrigated agricultural area in Africa than there is worldwide, irrigation agriculture there has a smaller impact than it does in other regions. According to estimates, there are around 42.5 million hectares of irrigated land in Africa. Of this number, nearly 75% is found in six countries: Egypt, Madagascar, Morocco, Nigeria, South Africa, and Sudan (Canton, 2021). More than 70% of the underprivileged people in Africa live in rural areas and depend mostly on agriculture for their subsistence. The influence of irrigation on development in Africa has been minimal and less than anticipated, notwithstanding certain noteworthy expansions (Inocencio, 2007). There is a contention that Africa's low rate of poverty alleviation can be largely ascribed to its reduced dependence on irrigation farming.

According to recent research, Africa's dependency on rain-fed agriculture and low adoption rates of irrigation are major contributing factors to the continent's difficulties in reducing poverty. Research has demonstrated, for example, that although efforts have been made to increase the area under irrigation, institutional challenges, limited financing availability, and inadequate infrastructure have limited the overall effectiveness of these initiatives in raising agricultural productivity and reducing poverty (Canton, 2021; World Bank, 2022 cited by Wegren, 2013). Therefore, it is believed that upgrading irrigation techniques is a vital first step toward raising food security and decreasing poverty throughout the continent.

Sub-Saharan African nations have increased their irrigation investments as a result of realizing the critical role that irrigation plays in food production. Furthermore, small-scale irrigation is readily accepted because it fits well with the socioeconomic and environmental circumstances of the area (Ilumba, 2015). For instance, Tanzania boasts more than 1,000 irrigation schemes and 289,245 hectares of enhanced irrigated agriculture, the majority of which are operated by smallholders. Although the various types of irrigation schemes and management approaches result in a range of 1-6 tons per ha, crops like rice are routinely produced on these schemes, and yields can be as high as four times those of rain-fed areas (Kaswamila, 2012).

Irrigation had been taken into consideration by Ethiopia's Agricultural Development Led Industrialization (ADLI) program as a way to boost agricultural output and national food security. Ethiopia's five-year Growth and Transformation Plan (GTP) (2011-2015) had ADLI as its central tenet (MoFED, 2012). The nation has not accomplished enough irrigated agriculture to address the food crisis and end poverty, despite the government's vigorous attempts to expand irrigation (Haile & Kasa, 2015). The Ethiopia is thought to have the capacity to develop 5.1 million hectares of land for irrigation because of its abundance of water resources. However, irrigation is currently only applied to three to five percent of this irrigable land. Irrigation is seen in Ethiopia as a key tactic for improving food security and lowering poverty. It is essential to the shift from an agricultural system that relies only on rainfall to one that incorporates both irrigation and rainfall. Irrigated agriculture is becoming more and more important since it helps to alleviate poverty, promotes rural development, produces jobs, and meets the requirement for food security (Jemal, 2019). Furthermore, a large number of poorly designed and managed irrigation techniques in Ethiopia jeopardize efforts to enhance livelihoods and put vulnerable populations at danger (Yilak, 2013). As a result, a number of actions must be done to assist farmers in operating and managing small-scale irrigation systems.

1.2 Statement of the Problem

The Ayehu Guagussa Woreda Agricultural and Rural Development Office (WARDO, 2020) provided the information that shows that the Gimara small-scale irrigation system was constructed in 2016 with the intention of providing irrigation for an estimated 95 hectares. Due to a variety of issues, including disputes among irrigation users, the unlawful use of water in the Lay Mender, and management system issues, the farmers in the irrigated region are unable to profit evenly.

In most rural areas, it is evident that summer crop failures and declining soil productivity are occurring. Furthermore, droughts happen too frequently for food security to be maintained in its entirety. For food security and rural transformation to be achieved sustainably at the national level, irrigation must be implemented (Awulachew et al., 2007). The nation has not accomplished enough irrigated farmland to address the food crisis and end poverty, despite the government's significant efforts to expand irrigation (Haile, 2008). However, in several instances, the collapse of irrigation projects has been primarily attributed to inadequate management and low beneficiary engagement. Due to the inadequate effectiveness of irrigation in the nation, irrigation management in general and small-scale irrigation in particular need to evolve in a methodical and comprehensive manner (Ayele, 2011).

Studies with a focus on small-scale irrigation are available. The effects of small-scale irrigation on income and food security were evaluated in earlier research (e.g., Birhanu, 2016; Tedros, 2014), but the particular managerial issues with small-scale irrigation systems were not well examined. More targeted research is required on the operational and administrative difficulties, like illicit water use, ineffective management systems, and disputes amongst users.Although the role of local institutions and water users' associations in irrigation management has been studied in studies like those by Girmaw (2007) and Habtamu (2011), there doesn't seem to be much thorough research on the precise ways in which these institutions affect the management practices in small-scale irrigation schemes. Prior studies, including Habtamu's (2011), have brought attention to the disparities in engagement between male and female heads of households. On the other hand, it appears that not enough research has been done to fully examine how gender dynamics affect irrigation management strategies and choices. Woldemariam & Gecho (2017) identified various factors affecting small scale irrigation practices but did not focus extensively on the determinants of effective management practices. Further research could explore how specific determinants, such as access to resources and institutional support, influence the success of management practices. The studies reviewed have pointed out various challenges, but a more comprehensive assessment of how these challenges interact and affect the overall management of small scale irrigation schemes is needed. This includes evaluating the effectiveness of sanctions, coordination among water users, and the role of the water users' association committee. By addressing these gaps, this research can provide a more understanding of the management practices and challenges in small scale irrigation schemes, particularly in the Gimara area, and contribute to more effective and sustainable irrigation management strategies.

1.3 Objective of the Study

1.3.1 General Objective

The general objective of this study is to examine the problems of irrigation management practices in Gimara small scale irrigation scheme.

1.3.2 Specific Objectives

The specific objectives of the research are the following:

1. To assess the irrigation management practices activities in Gimara small scale irrigation scheme.
2. To identify major challenges that hinder sustainable management of Gimara small scale irrigation scheme.
3. To examine the determinants of farmers' adoption of irrigation management practices in Gimara small scale irrigation scheme area.

1.4 Research Questions

1. How do local communities undertake management of Gimara small scale irrigation scheme?
2. What are the major challenges in the management of Gimara small scale irrigation scheme?
3. What factors determine farmers' adoption of irrigation management practices in Gimara small scale irrigation scheme?

1.5 Significances of the Study

The result of this study can serve as a source of information for policy makers and planners during design and implementation of irrigation development programs. Furthermore; the study is very significant because it will serve as a basis for other researchers who have a great interest to conduct a research in other irrigation schemes in the study area. Finally, the findings of the research may be useful for other *Woredas* which have similar management practices in the management of different irrigation schemes.

1.6 Scope of the Study

In order to make the study easily managed, the researcher delimited it to investigate in the Amhara Region of Awi Zone, Ayehu-Guagussa woreda in Ambera kebele, in the case of the management practice on Gimara small scale irrigation scam. However, the study's scope is restricted to a purposefully chosen irrigation scam and for these aspects the study was not be adequately researched and not possible to deal with other problems to cover in every parts of all kebeles. Due to the quality of information gathered through structured questionnaires depend on the willingness, and knowledge of the respondents, and limitations of time, finance and resources.

1.7 Limitation of the Study

Any research study has its own limitations. However, measures were put in place to safeguard against any conducts that might have negative effect the validity of the study. This study had been focused on the management practice on Gimara small scale irrigation scheme in very small ranges of geographical area of Ayehu Guagsa Worda in Ambera kebele. This study has its own short comings, during the research work, the researcher faced to the following problems related to lack of internet, computer service, concerns regarding peace and security in the study area, adequate and up to the specific places due to time, finance, unwillingness of respondents to give genuine information and language barriers between the researcher and respondents.

1.8 Organization of the Proposal

This thesis is organized in five chapters. The first chapter comprises the introduction part consisting of background of the study, statement of the problem, objectives of the study, research questions, significance of the study, scope of the study and operational definition. The second chapter is a review of the literature on different concepts and empirical studies. The third chapter provides the methodology of the research which consists of description of the study area, research design, sampling techniques, data sources and collection techniques and data analysis and interpretation. The fourth chapter presents the results and discussion part of the research, and finally conclusion and recommendation were presented.

CHAPTER TWO: REVIEW OF RELATED LITERATURE

2 Concepts and Theoretical Review

2.1 History of Irrigation and Irrigation Management

Applying water to the soil to augment natural rainfall and supply moisture for plant growth is known as irrigation (Uphoff, 2019). It is the study of applying water to soil or land artificially. Agricultural output that uses irrigation water in addition to rainfall is known as irrigated cultivation. Artificial irrigation of crops is made possible by water pipelines, canals, reservoirs, and pumps. Groundwater or surface water are the sources of irrigation water. The global irrigated area increased to 94 million hectares till the 1950s. Irrigated land increased at an average annual rate of 2.8 percent between the 1950s and 1978, far faster than population growth (FAO, 2011). The Nile Valley has been using irrigation for thousands of years; it is an ancient technique. The oldest dam in the world, according to Egypt, was constructed about 5,000 years ago for agriculture and drinking water supply. Basin irrigation was implemented at that time and continues to be important to Egyptian agriculture. For a very long time, it has been used in Egypt, China, India, and other Asian countries. Irrigation has been used to raise rice for around 5000 years in India and the Far East.

For 4,000 years, the Sumerian Empire relied on irrigation to sustain itself, with the Nile valley in Egypt and the Euphrates and Tigris plain in Iraq serving as its food source (Dittoh, 2002). In arid areas and during periods of insufficient rainfall, irrigation is utilized to support crop growth, maintain landscape features, and reforest damaged soils. The most significant investment in rural development that can directly affect output and income is irrigation farming. When crops are grown under irrigation, a portion or all of the water they require comes from human innervations. Water is pulled from sources such as lakes, rivers, and aquifers and transported to the field using suitable conveyance equipment.

Irrigated crops rely on irrigation water as well as sometimes unpredictable natural rainfall to meet their water needs. Strong management tools against different rainfalls are provided by irrigation, which also makes it economically desirable to cultivate high-yield seed varieties and apply sufficient plant nutrients, insect control, and other inputs, allowing for a jump in production (FAO, 2003).

Growing populations have historically been fed in large part by irrigation, which will surely continue to be the case in the future. In areas with dry seasons, it not only extends the growing season and increases the yields of particular crops, but it also allows for multiple cropping growing two, three, or even four crops annually where formerly only one could be cultivated. Furthermore, the assurance that irrigation offers makes it economically possible to add more inputs like fertilizer, pest management, improved varieties, and better tillage that are required to boost production. By preventing crop failure brought on by a lack of water, irrigation lowers the likelihood that these costly inputs would be squandered (FAO, 2011).

Irrigation can be categorized as small-, medium-, or large-scale depending on the area that is watered, the duration of the operation, and the type of control or management employed. However, each country may have different standards for this group. In India, for example, a 1000 hectare irrigation project is regarded as small-scale, but the largest irrigation scheme in Ghana is 3000 hectares (Smith, 1998).

2.2 Irrigation Management Activities

Numerous interrelated tasks are carried out in the production of irrigated crops, from crop irrigation and water supply to irrigation system design and installation. Three primary categories of irrigation management and organization apply to these responsibilities. Water-related activities such as distribution, drainage, allocation, and acquisition fall under the first category. The second category deals with irrigation system design, construction, operation, and maintenance. Decision-making, communication, resource mobilization, and conflict resolution are all covered in the third category (Dittoh, 2002).

The management of irrigation is sometimes neglected in favor of creating irrigation infrastructure, even though there is a significant interaction between physical and human components in this field. The practice of efficiently implementing operations and maintenance to meet the objectives of a specific irrigation system while keeping an eye on things to make sure those objectives are reached is known as irrigation management. For irrigation professionals, this management component presents a great deal of obstacles. It is essential for the timely and effective distribution of water in canal command regions, considering crop requirements and the requirement for precise and current information (Weldeab, 2003).

Crucial element of efficient irrigation water management is water irrigation scheduling, which involves choosing when and how much water to use. Farmers who make irrigation decisions might use scheduling tools to create strategies for each field. These tools offer useful information. Tailored irrigation scheduling requires careful consideration of various factors, including crops, soil, climate, irrigation system performance, and management objectives. These factors can be reflected in long-term data or they can change during the season based on real-time information (Pinstrup-Andersen & Pandya-Lorch, 1995).

2.3 Irrigation Water Management

An essential component in the development of irrigated crops is water management. Effective water management techniques and irrigation systems can also support farm profitability in areas with scarcer and more expensive water supplies. The quantity and quality of off-site water may be less affected by irrigated farming if water management is done effectively. However, without other changes within the irrigated sector, initiatives to improve water use efficiency could not be enough to meet environmental goals. Water resources are preserved, effects on water quality are minimized, and producers' net profits are increased through the management of irrigation water (FAO, 2021).

Giving irrigators a thorough grasp of water conservation principles is one of the main goals of irrigation water management. This entails adapting current methods to suit particular requirements by showing them how to assess the efficiency of their own irrigation techniques and arrive at well-informed decisions regarding water management. Irrigators who want to make a profit on their investment in irrigation equipment must use water efficiently. Lack of understanding of the quantity of water available for application is a major element in inadequate irrigation water management (Zhang et al., 2021).

Precision irrigation technologies are critical because they allow farmers to more precisely monitor crop water requirements and soil moisture levels, according to recent studies. Irrigators can maximize agricultural yields, minimize waste, and improve water application by employing these technologies. In addition, the incorporation of real-time data analytics into irrigation management techniques facilitates enhanced decision-making and resource distribution, hence improving agricultural operations' water efficiency and sustainability (Smith et al., 2022). Generally speaking, efficient irrigation water management equips farmers with the skills and information they need to increase output while preserving water, in addition to emphasizing the economical use of resources (Jones & Robinson, 2023).

2.4 Maintenance of Irrigation Scheme

There are three types of irrigation system maintenance tasks. These include regular upkeep, urgent repairs, and plan enhancements. For an irrigation system to remain operational over its lifetime, routine maintenance tasks must be undertaken. Certain daily tasks, like clearing plants from embankments, canals, and drains and clearing silt from these same channels, drains, and buildings, don't call for specialized talents. Whenever feasible . To stop or lessen the effects of unforeseen disasters, irrigation workers and farmers must act quickly and cooperatively in emergency situations (USAID, 2006). Periodic actions are necessary for irrigation scheme maintenance in order to guarantee the long-term proper operation of the irrigation system. Frequent maintenance makes a system more sustainable by lowering the likelihood of malfunctions (Byrnes, 1992). Irrigation system maintenance can be broadly divided into three categories: regular maintenance, urgent repairs, and system enhancements. For the irrigation infrastructure to continue operating effectively and efficiently throughout time, each of these categories is essential (Smith & Johnson, 2004).

To encourage local participation and lower operating costs, these responsibilities should ideally be carried on by the water consumers themselves (Taylor, 1998). When dealing with unanticipated problems that need to be addressed right away, emergency measures are essential. To lessen or avoid harm from unforeseen occurrences like natural catastrophes or system failures, irrigation professionals and farmers must work together in these circumstances.

It is imperative to act quickly and efficiently. The third type, known as system upgrades, entails recurring enhancements or adjustments meant to raise the irrigation system's effectiveness and efficiency. These updates fix bugs in the system, incorporate new technologies, or increase its capacity to accommodate changing requirements. Maintaining the system's long-term performance and adaptability requires regular examination and application of this upgrade (Harrison, 2001).

Implementing a systematic approach to routine maintenance, emergency response, and system upgrades is necessary for an irrigation plan to be sustainable. Frequent maintenance prolongs the infrastructure's lifespan and averts potential malfunctions, ensuring that the system keeps working efficiently to supply water for agricultural uses (Wilson, 2007).

2.5 Irrigation Management practice theory

Irrigation management is a critical aspect of agricultural practices, as it directly impacts crop yield, water usage efficiency, and overall farm profitability. The theory of irrigation management involves the planning, implementation, and monitoring of irrigation systems to ensure optimal water distribution to crops while minimizing water wastage. This paper will discuss the key principles of irrigation management theory and its importance in sustainable agriculture.

One of the fundamental principles of irrigation management theory is the determination of crop water requirements. Different crops have varying water needs at different growth stages, and it is essential to tailor irrigation schedules accordingly. This involves considering factors such as soil type, climate, crop type, and stage of growth to determine the optimal amount and timing of water application. By accurately estimating crop water requirements, farmers can avoid under or over-irrigation, which can lead to reduced crop yields and water wastage.

Another key aspect of irrigation management theory is the selection and design of irrigation systems. There are various types of irrigation systems available, including surface irrigation, sprinkler irrigation, and drip irrigation. The choice of system depends on factors such as crop type, soil type, topography, and water availability. Proper design and installation of irrigation systems are crucial for efficient water distribution and uniform crop coverage. Regular maintenance and monitoring of irrigation systems are also essential to ensure optimal performance and prevent water losses due to leaks or malfunctions.

Monitoring and control of irrigation systems play a vital role in irrigation management theory. Advances in technology have made it possible to automate irrigation scheduling and control systems based on real-time data such as soil moisture levels, weather forecasts, and crop water requirements. This allows for precise water application and efficient water use, leading to improved crop yields and reduced water wastage. Regular monitoring of soil moisture levels and crop health can help farmers adjust irrigation schedules as needed to prevent water stress or water logging. In conclusion, irrigation management theory is essential for sustainable agriculture practices. By understanding and implementing the principles of irrigation management, farmers can optimize water use efficiency, improve crop yields, and reduce environmental impacts. Proper crop water requirement estimation, selection and design of irrigation systems, and monitoring and control of irrigation systems are key components of irrigation management theory. Adopting these practices can help farmers achieve long-term sustainability and profitability in their agricultural operations.

2.6 Overview of Irrigation in the Developing Countries

When it comes to improving food security and agricultural output, irrigation is a vital part of agricultural growth in developing nations. Irrigation systems are necessary in these areas to convert agriculture from rain-fed to regulated water management, which lessens the impact of droughts and erratic rainfall (FAO, 2011). Irrigation helps farmers achieve larger and more consistent agricultural yields by supplying a steady stream of water, which enhances both food security and economic stability.

Irrigation infrastructure differs greatly in different developing nations; it can range from more contemporary, large-scale projects utilizing advanced technology to more ancient systems like little canals and water gathering methods. In areas with limited access to modern infrastructure, traditional irrigation techniques including furrow systems and basin irrigation are frequently used (Molden, 2007. Some emerging nations are adopting more and more modern irrigation technologies, such as sprinkler and drip irrigation. By supplying water directly to plant roots or distributing it evenly throughout the crop area, these devices are intended to conserve water and improve efficiency (Pereira et al., 2002).These systems can have a large upfront cost, but they have significant advantages in terms of crop productivity and water efficiency, which makes them a desirable choice for regions with adequate funding or backing from foreign aid.

Notwithstanding the advantages, there are a number of obstacles to the growth and development of irrigation systems in developing nations. These difficulties include a lack of technological know-how, inadequate infrastructure, and restricted financial resources. Funding constraints affect many irrigation projects, which can make them more difficult to implement and maintain (Kijne et al., 2003). Furthermore, inefficient usage of the irrigation infrastructure and inefficiencies might result from local farmers not receiving the necessary training.

One major problem influencing irrigation in emerging nations is water scarcity. The struggle for water resources among home, industrial, and agricultural usage is fierce in many locations. In order to maintain irrigation and ensure that water resources are managed effectively, effective water management techniques are essential (Bates et al., 2008). For irrigation systems to be successful over time, rules that encourage water conservation and efficient use must be put into place. Another issue with irrigation techniques is their effect on the environment. Inadequate irrigation management can result in issues like water logging and soil salinization, which can lower agricultural production and damage nearby ecosystems (Rengasamy, 2006). In order to mitigate negative environmental effects and guarantee the sustainability of irrigation practices, addressing these challenges will require rigorous planning and management. In addition to increasing local users' sense of accountability and ownership, this participatory method can improve irrigation systems' sustainability. The development of irrigation in underdeveloped nations is greatly aided by international aid and development organizations. To help overcome the difficulties involved in developing irrigation infrastructure, these organizations offer financial support, technical assistance, and capacity-building support (World Bank, 2010). Their participation is essential to the effective execution and expansion of irrigation projects.

In underdeveloped nations, irrigation systems are more vulnerable to the effects of climate change. The supply of water and irrigation requirements may be impacted by modifications in precipitation patterns, an increase in the frequency of extreme weather events, and rising temperatures. To overcome these obstacles, adaptation techniques are required, such as creating robust irrigation systems and enhancing water management procedures (Mandel & Lipovetsky, 2021).

2.7 Overview of Irrigation Development and Management in Ethiopia

While modern irrigation was initiated in the 1950s by government and private projects in the middle Awash valley, home to large cotton, fruit, and sugar estate farms, water harvesting irrigation is an ancient practice that has been a vital component of Ethiopian agriculture for several centuries (Yihdego & Ghosal, 2016). Knife et al. (2012) state that of the 4.5 million ha of potentially irrigable land in Ethiopia, just 0.16 million ha, or around 5%, are covered by irrigation. Since the majority of farmers in the nation rely on rain-fed agriculture, the agricultural economy of the nation is particularly fragile and susceptible to the effects of weather and climatic variability.

Despite the country's four main river basins, Lake Tana, and relatively abundant surface and ground water resources, Wagnew (2014) has observed that over 95% of the agriculture in the Amhara Region both the crop and livestock sectors is dependent on erratic and unpredictable rainfall. Additionally, there is a strong correlation between the growth of irrigation and the decrease of poverty because it raises output levels and security while also generating jobs and business opportunities (Hussien, 2004). One of the most important agricultural investment options and a major contributor to Ethiopian agriculture's growth is irrigation (Wester et al., 2013).

The bilateral arrangement between the Ethiopian government and the Dutch corporation known as HVA Ethiopia sugar cane plantation launched modern irrigation in the early 1950s (Dawit & Balta, 2015). In Ethiopia, surface water sources provide the majority of the traditional irrigated land, with ground water usage having only recently begun on pilot projects in the east Amhara area. In the past, a pressured spray irrigation system was used on some private farms in the Rift Valley, eastern Amhara, southern Tigray, and Fincha State Farm, according to Etissa (2014).

In 1973, work on creating contemporary small-scale irrigation systems began. Compared to typical schemes, they have a more permanent construction and an enhanced water control system. The majority of them are built by water users associations (WUAs) or governmental or non-governmental organizations (NGOS). Nevertheless, when irrigation development is prioritized, the administrative components of irrigation are rarely given as much thought or consideration (Woldeab, 2003). Reducing the hazards associated with unpredictable rainfall and increasing food crop yields are two major benefits of small-scale irrigation management techniques, which are often seen as critical steps toward rural development and poverty alleviation (Pinstrup and Pandya, 1995).

2.8 Current Status of Small Scale Irrigation in Ethiopia

According to Bekele and Ayana (2011), Small Scale Irrigation Schemes (SSIS) are those that service a command area of less than 25 hectares in the hills and less than 200 hectares in the Tarai. SSIS irrigation is typically used on small plots of land where small farmers have the majority of the controlling influence. It makes use of technologies that are manageable and effective for them to run (Dawit & Balta, 2015). One savvy agricultural strategy that helps farmers boost their income and strengthen their resilience is small-scale irrigation. One of Ethiopia's top priorities for reducing rural poverty, promoting rural development, and preparing for climate change is the construction of small-scale irrigation systems (less than 200 Hectars) (Girmaw, 2007).

Ethiopia's agricultural sector has placed a great deal of emphasis on small-scale irrigation (SSI), primarily because of its potential to increase agricultural output and improve food security. According to recent estimates, a significant amount of the nation's overall irrigated area roughly 600,000 hectares is covered by small-scale irrigation (Etissa, 2014). Ethiopia, a country where smallholder farmers oversee 90% of the country's agricultural land, greatly depends on this industry to reduce the dangers brought on by irregular rainfall.

Traditional techniques like surface irrigation, which make up the majority of small-scale schemes, and more contemporary strategies like drip and spray irrigation, are the main components of small-scale irrigation systems in Ethiopia (Molden et al., 2007). Conventional systems, such furrow or basin irrigation, are very straightforward technologies and methods that are frequently customized to the specific needs of the region. Despite their potential for inefficiency when compared to more current approaches, these systems are often used because of their low startup costs and simplicity of deployment. The use of contemporary irrigation technologies is growing, albeit more slowly, according to quantitative statistics. Roughly 15% of small-scale irrigation projects use sprinkler or drip systems as of 2020, compared to roughly 10% in 2010 (Bekele et al., 2016).

This steady transition to more contemporary irrigation practices is a reflection of initiatives to improve crop yields and water use efficiency. However, because of things like expense and restricted access to technology, most small-scale systems continue to operate using conventional methods.

Small-scale irrigation projects have seen substantial funding from the Ethiopian government as part of a larger plan for agricultural development. The Small-Scale Irrigation Development Project (SSIDP), the government's flagship initiative, is notably focused on developing and enhancing small-scale irrigation infrastructure throughout the nation (Federal Democratic

Republic of Ethiopia, 2010). In addition to renovating and modernizing current systems, this effort entails building new irrigation schemes. Ethiopian small-scale irrigation nevertheless faces a number of difficulties in spite of these efforts. One major obstacle is the lack of access to funding; as many smallholder farmers cannot pay the upfront expenses of contemporary irrigation system (World Bank 2010).Capacity and technical expertise are other important factors. According to Molden et al. (2007), a large number of smallholder farmers lack the knowledge and expertise needed to manage and maintain irrigation systems, which leads to less-than-ideal performance and inefficiencies. To tackle these obstacles, specialized training initiatives and assistance are needed to improve the technical proficiency of nearby farmers and irrigation supervisors.

The management of water resources is another important issue. Due to competing demands for water from home, industrial, and agricultural applications, small-scale irrigation systems frequently encounter problems with distribution and availability of water (Hussein et al., 2019). Small-scale irrigation systems must be able to operate as efficiently and sustainably as possible, which requires equal distribution and effective management techniques. Ethiopian small-scale irrigation is further endangered by climate change and variability. The nation experiences erratic rainfall patterns and recurring droughts, which can have a big influence on the amount of water available for irrigation (Mandel & Lipovetsky, 2021). Water-saving technology must be put into place, together with better water storage and conservation techniques, in order to adapt small-scale irrigation systems to these climate problems.

Participation from the community has been shown to be advantageous for small-scale irrigation system management and sustainability. Better maintenance and more efficient use of irrigation supplies have resulted from participatory techniques that involve local farmers in the planning and management processes (Beekman et al., 2018). Promoting increased community involvement is essential to small-scale irrigation projects' lifespan and success.

2.9 Sustainable Development Goals Related to Irrigation management in Ethiopia

Sustainable Development Goals (SDGs) related to irrigation in Ethiopia play a crucial role in addressing the country's water scarcity and food security challenges. Ethiopia, a landlocked country in the Horn of Africa, is highly dependent on agriculture, with over 80% of its population engaged in farming. However, the country faces significant challenges in terms of water availability and irrigation infrastructure, which hinders its agricultural productivity and food security.

One of the key SDGs related to irrigation in Ethiopia is Goal 6, which aims to ensure availability and sustainable management of water and sanitation for all. Ethiopia is known for its erratic rainfall patterns, with prolonged droughts and unpredictable rainfall leading to water scarcity in many parts of the country. This has a direct impact on agricultural productivity, as farmers rely heavily on rain-fed agriculture. By investing in irrigation infrastructure and promoting sustainable water management practices, Ethiopia can improve its water security and enhance agricultural productivity.

Another important SDG related to irrigation in Ethiopia is Goal 2, which aims to end hunger, achieve food security and improve nutrition. Irrigation plays a crucial role in increasing agricultural productivity and ensuring food security, especially in regions with limited access to water. By expanding irrigation infrastructure and promoting sustainable irrigation practices, Ethiopia can increase its agricultural output and reduce food insecurity among its population.

In order to achieve these SDGs related to irrigation, Ethiopia needs to invest in modernizing its irrigation infrastructure, promoting water-saving technologies, and improving water governance. The government of Ethiopia has already taken steps towards achieving these goals, with initiatives such as the National Irrigation Development Strategy and the Sustainable Land Management Program. However, more efforts are needed to scale up these initiatives and ensure their sustainability in the long run.

In conclusion, sustainable development goals related to irrigation in Ethiopia are crucial for addressing the country's water scarcity and food security challenges. By investing in irrigation infrastructure, promoting sustainable water management practices, and improving water governance, Ethiopia can enhance its agricultural productivity and ensure food security for its population. It is imperative for the government, development partners, and other stakeholders to work together towards achieving these goals and building a more sustainable future for Ethiopia.

2.10 The National Irrigation Policy for Small Scale Irrigation in Ethiopia

Under local community management, small-scale and traditional irrigation techniques like spate, diversion, and extremely small storage systems have become commonly used throughout

Ethiopia. The agricultural landscape of the nation is centered around these techniques. A move toward a more thorough and integrated approach to water management may be seen in the federal government's recently released three-volume draft water resources policy. The objective of this strategy is to steer the water sector's development in the future while conforming to the recently established federal governance framework.

Optimizing crop yields and making sure that water resources are used efficiently depend on efficient irrigation. Sustainability, which includes preserving and enhancing soil fertility and protecting water resources for future generations, is also a major priority. In order to ensure that irrigation promotes agricultural growth without jeopardizing the availability of resources or the health of the environment, the strategy is intended to strike a balance between these goals (Agerie, 2013).

2.11 Institutions and Organization for Irrigation Management

An association is created when people come to agreements among themselves in order to accomplish a common objective. The task of putting the agreements into action then falls to one or more groups of people. The executive bodies of the established association are these groups. While the word "associations" refers to a group of people's desire to act together, the phrase "institution" usually refers to a government's wish to accomplish a particular objective. The government frequently assigns power to a team of people tasked with accomplishing this objective.

In Ethiopia, the responsibilities of irrigation water user entities are frequently restricted to the provision of irrigation services and activities. According to (Tesema, 2022), IWUAs should be required to oversee the operation and upkeep of irrigation infrastructure within the hydraulic boundaries of irrigation systems, as well as to assist in financial decision-making and decision .making processes.

In general, Azemer (2016) divides the work of irrigation institutions more especially, IWUAs into three divisions: financial management, operation and maintenance, and governance. The way in which the water institutions carry out these duties is demonstrated in the section that follows. Committees for irrigation water users have the following responsibilities: distributing water to customers on a scheduled basis, monitoring it, and disciplining users who do not follow the rules

Irrigation Experiences in Ethiopia. According MoWR, (2002) irrigation schemes in Ethiopia are classified into three on the basis of size of land area irrigated.

2.11.1 Large and medium scale irrigation

In Ethiopia, an irrigation project is classified as medium-scale if its command area is between 200 and 3,000 hectares, and as large-scale if it is larger than 3,000 hectares. Despite the importance of these kinds of irrigation plans, there haven't been as many of them in the past ten years. They are linked to the development of beneficial infrastructure, generate employment, and support the macroeconomic and agricultural growth. There is a noteworthy endeavor on to create master plans for different river basins in tandem with the program for the development of the water sector. In fact, detailed master plans have already been created for five basins.

2.11.2 Small scale irrigation schemes

It consists of both contemporary communal schemes up to 200 hectares and traditional small-scale schemes up to 100 hectares. There may also be unique situations, as the 400 hectares that Tigray's traditional spate irrigation system covers. Farmers build these kinds of programs on their own, with little help from the government. Through committees or associations representing their own water users, the farmers oversee it. The farm is between 0.25 and 0.5 hectares in size. Water user associations have long been in place to administer conventional schemes. WUAs are efficiently run and well-organized. Information asymmetry is not an issue because the associations of water users have a high social capital. Members typically consist of up to 200 people who share either a main canal or a branch canal. According to IWMI (2005), the associations manage operations, maintenance, construction, and water allocation

2.11.3 Micro-irrigation

Distinct regions of the nation have distinct understandings of this structure. Rainwater harvesting is one example of a small-scale domestic project that falls under this category and is sometimes referred to by this phrase. Others think about micro irrigation in terms of the used technology. For instance, tiny power pumps and treadles are required for drip irrigation in order to raise the water level. Other irrigation application technologies include sprinkler systems and small bucket and drip systems. The following are some of the benefits of micro irrigation: it is inexpensive both in terms of initial investment and ongoing farm operation expenses. The government, several

NGOs, and universities have made some attempts to address this relatively new situation (IWMI, 2005).

In general, irrigation methods are characterized as approaches that allow fields to be irrigated with water. It can also mean the methods for obtaining water from its sources for irrigation. The topography, water resources, plants grown, land tenure structure, growing seasons, and patterns of rain and watering all influence irrigation techniques (Dupriez and De Leener, 2002). Regarding methods of water delivery for the farm, the four types of irrigation listed below are recognized:

Furrow irrigation: The method known as "furrow irrigation" involves directing water through channels or furrows that run the length of the field.

Flood irrigation: The entire surface of the field that will be watered with this method is covered in water. With this method, water is moved through a trench in the upper part of the plot and allowed to spread out throughout the ground in a manner dictated by the geography of the surrounding area.

Sprinkler irrigation: Sprinkler watering creates the illusion of rainfall. Overhead irrigation is another term for it. This method involves spraying water onto the soil using a network of pipelines and pumps.

Drip irrigation: In areas that are severely dry and have a limited supply of irrigation water, this most recent irrigation technique is used. Using this technique, water is given to the plant's root zones gradually and directly. There are three forms of irrigation based on the area under irrigation size (Awulachw et al, 2007). These are the following: Typically, small-scale irrigation (SSI) programs encompass an irrigated region of up to 200 hectares. Schemes for medium-scale irrigation (MSI) typically encompass 200–300 hectares of land. An irrigation system that covers three thousand hectares or more is referred to as a large scale irrigation (LSI) scheme.

2.12 Challenges of Irrigation Schemes

It is believed that institutional organization and management issues, both globally and specifically in South Africa, are typical barriers to the implementation and profitability of irrigation projects. The most significant effects of institutional and organizational decreases are seen in the regular maintenance of the water distribution system, which includes cleaning and small repairs. Scheme management have been trying to control farmers instead of promoting the growth of entrepreneurship. The institution of land tenure was consistently found to be a significant determinant for irrigation development in assessments of small-holder irrigation systems. Farmers were unable to establish a land exchange market due to tenancy constraints (Ulsido and Alemu, 2014).

Demand for land and excess land coexisted because poorly run land exchange markets made it impossible for plot holders to adjust the size of their farming operation to their production capacity (Woldeab, 2003). Insufficient ability to manage; insufficient knowledge of how to instruct farmers in irrigation use and management. According to Mesifin (2020), there is an improper organization of the terms related to water use for irrigation management, users have poor social relations, and the land water rights institution's water legal system is nonexistent at the operational level.

The problems associated with freshwater scarcity have gotten worse as a result of changing climate patterns, expanding economies, rising populations, and increased agricultural production. Furthermore, there are a variety of obstacles that make it difficult to use the current water resources inappropriately for the current irrigation practices in various locations (Morris, 2012).

2.13 Irrigation Management and Organizations

Activities related to irrigation management include both social and technical aspects. These comprise water use activities (acquisition, allocation, distribution, and drainage), control structure activities (design, construction, operation, and maintenance), and organizational activities (decision making, resource mobilization, communication, and conflict management).Four categories of irrigation management functions exist: organizing, leading, controlling, and planning (MoA, 2011a). In an irrigation system, these jobs and activities need to be effectively managed and coordinated. Water control in irrigation management is essential to agricultural and food production. It alludes to the organizational structure and administrative control of the irrigation system's water distribution (MoA, 2011b).

According to estimates, just 3% of West Africa's total crop production is thought to come from irrigated agriculture, and there is no indication that this percentage has increased over time (Dittoh, 2002).

The high value of irrigated agriculture on the continent and the vast number of rural poor who stand to gain from the high productivity as a result of irrigation investment, in addition to the availability of agricultural water resources, make irrigation development in Africa a priority. Irrigation investments have surged in Sub-Saharan Africa as more nations, including Ghana, recognize the critical role irrigation plays in food production. According to You et al. (2010), Africa's average rate of irrigated area expansion over the previous 30 years was 2.3%.

An estimated 12.2 million hectares of land are irrigated in Africa, with six countries Egypt, Madagascar, Morocco, Nigeria, South Africa, and Sudan making up about 75% of this total (FAO, 2012). The influence of irrigation on development in Africa has been modest and less than anticipated, notwithstanding some noteworthy expansions (Innocencio et al., 2007).

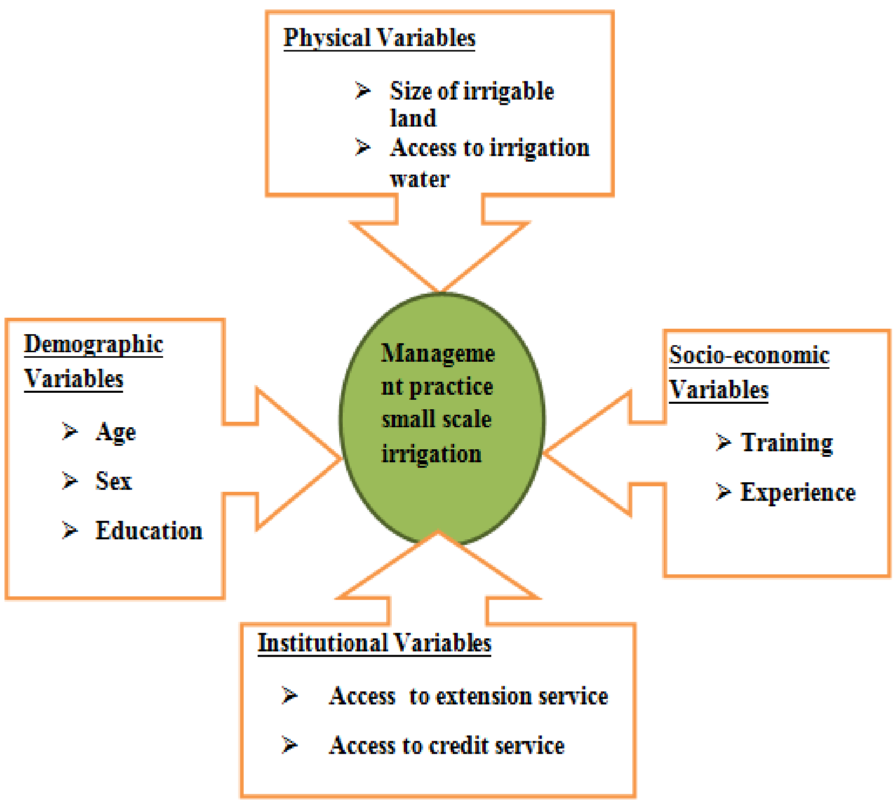
2.14 Conceptual Framework

This proposed research's conceptual framework illustrates the relationship between the independent and dependent variables. Farmers' adoption of small-scale irrigation practices was the dependent variable, and the independent variables that affected irrigation practice in the study area were demographic, socioeconomic, institutional, and physical.

The predictor variables in the study's conceptual framework are as follows:

- Adoption of small-scale irrigation practices was expected to be influenced by demographic parameters, including age, sex, marital status, household size, and education. Farmers with more education are thought to participate in irrigation activities more actively than farmers without education (Mandel & Lipovetsky, 2021). Regarding sex, it is anticipated that men would participate more actively in irrigation practices than women, and that younger family heads will be more likely than older household heads to participate in irrigation practices.
- It is anticipated that social-economic and institutional factors, such as training, credit availability, and irrigation experience, will increase household heads' awareness of small-scale irrigation practices. Additionally, farmers with credit access are expected to actively participate in irrigation practices. The cost of irrigation technology has a positive and significant impact on the likelihood of obtaining formal financing (Dejene et al., 208).

- Expected to carry out active participate on irrigation practice. The probability of accessing formal credit was positively and significantly affect by cost of irrigation technology (Dejene *et al.*, 208)
- Other physical elements that influence small-scale irrigation methods include the area of irrigable land, access to irrigation water, and the distance of the farm from the river (Abebe, 2017). It is anticipated that farmers with smaller irrigable land areas will implement irrigation practices more so than those with larger irrigable land areas. Moreover; farmers having enough access to irrigation water are believed to practice irrigation farmers who owned limited land size they use effectively and frequently.



Source: my own survey

Figure 2:1 Conceptual framework

CHAPTER THRE: RESEARCH METHODOLOGY

3.1 Descriptions of the Study Area

Ayehu Guagussa *Woreda* was established as a new Woreda from Ankesha Woreda and openly started providing service since (2015) fiscal year. Establishment of Ayehu as a new *Woreda*, makes Awi zone to have eleven *Woredas*.

Ayehu Guagusa *Woreda* is found in the Awi zone of Amhara National Regional state. The *Woreda* has area coverage of 68,432 hectares. Its elevation ranges from 1000 meter above sea-level in the lowland areas and 2000m above sea level in Dega region of the *Woreda*. Astronomically, Ayehu Guagussa *Woreda* is found between 10°31’3”N to 10°50’59”N and 36°36’50”E to 36°56’59”E. Relatively, the Woreda is found east of Guangua *Woreda*, North of Zigem *Woreda*, and west of Womberima *Woreda* and south of Ankesha *Woreda* (AGWAO, 2018).

Ayehu Guagussa *Woreda* has prominent rivers that have a great potential for irrigation. There are five major river basins which general flow from the northern highlands of the *Woreda* to the southern peripheries of the *Woreda*. Whereas the smaller rivers generally, flow towards the Western edge of the *Woreda*. These rivers include Ayehu, Kulanti, Gimara, Suri, Zingini, Ankuri, and Kulanti. Ayehu River has the largest catchment Area (AGWAO, 2018).

The relief of the *Woreda* is characterized by plain (66%), mountain (28%), valley (3%), wetland (2%) and water cover (1%). The most important soil of the *Woreda* is black (Vertisols) (10%), red (Nitisol) (15%) and brown soil (75%). The Agro climate of the *Woreda* is 75% sub-tropical (*woina-dega*), 20% Tropical (*kolla*) and 5% Temperate (*dega*) climate (AGWAO, 2018).

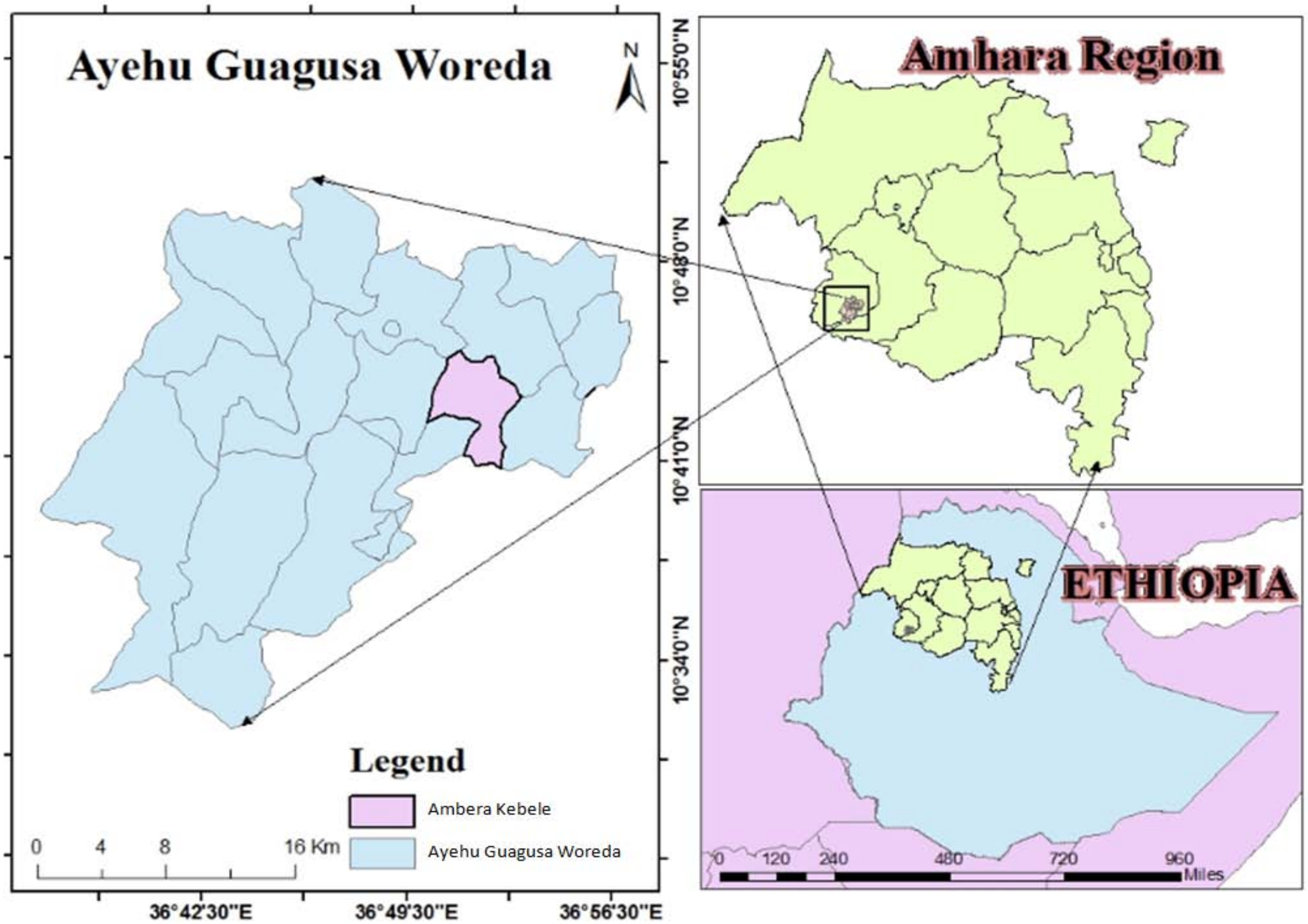


Figure 3:1 Map of the Study area

3.1.1 Demographic and Socio-economic Profile

The development plan office report from 2018 states that there were 132,363 people living in the *Woreda* as of 2018, with 64,182 males (48.5%) and 68,181 females (51.5%) making up the total population. In the *Woreda*, there are more females than males. The vast majority of people reside in rural settings. Approximately 122,472 (92.5%) of the population live in rural areas, with 59,866 males and 62,606 femalse; the remaining 9, 402 (7.5%) reside in the three urban centers, with 4,316 males and 5,575 females (AGWCO, 2019). In terms of the *Woreda* language group, Agewugna speakers make up 78% of the population, followed by Amharic speakers (21%), and Gumuzegna speakers 1%. The two major religions in the region are Islam and Christianity (AGWCO) .The majority of rural households reside in wooden homes with mud plaster and iron sheet roofs. Most rural households live in quarters that are shared by their family pets. The main sources of water (for use by humans and animals) include wells, rivers, and springs.

The majority of people living in rural areas work on small, dispersed parcels of land for subsistence farming. The most significant and appropriate crops that are farmed in the *Woreda* are wheat, barley, teff, millet, and maize. Grains such as soybean,chickpea, and pea; oil seeds such as sunflower, sesame, and nigger. The two main basic crops grown in the Woreda are maize and millet. Weir River water is used for small-scale irrigation to grow a variety of crops and vegetables from fall through mid-spring (AGWAO, 2018).

3.2 Research Design and Methodology

3.2.1 Research Design

The study used a combination of research methods and a cross-sectional, explanatory research design. A cross-sectional survey has the advantage of collecting data from a selected individual at a particular point in time and is successful in providing a picture of the present behavior, attitude, and belief in a group. It also provides data relatively rapidly (Klassen et al., 2012). Because quantitative or qualitative research methods alone are insufficient to handle complex social phenomena, mixed research approaches were employed symbiotically to counteract the drawbacks of utilizing a single methodology (qualitative or quantitative).

In other words, subjectivity occurs during data collection and analysis, and qualitative methodologies have difficulties generalizing the conclusions outside of the particular study region. On the other hand, the quantitative approach is never able to fully capture the dynamics within and between households, particularly in situations where the head of the household has the authority to speak for his neighbors or family (Hayati et al., 2006).

In order to gather information from the chosen households, key informants, and experts about the difficulties impeding the management of Gimara small-scale irrigation practices through focus groups, key informant interviews, and field observations, a qualitative approach was also used in this study. The quantitative approach was primarily used to show the determinant factors of Gimara small-scale irrigation practices, such as the socioeconomic, demographic, physical, and institutional characteristics of respondents as well as concerning the obstacles which hindered Gimara small-scale irrigation management practices.

3.2.2 Sample Size and Sampling Technique

A multi-stage sample approach was used in this investigation. Due of its widespread usage of small-scale irrigation, *Ambera Kebele* was purposefully chosen for the first phase of development. Three villages, *Lay Mender, Kes Mender, and Tach Mender*, were chosen at random from the upper, middle, and lower stream courses, respectively, out of the six irrigation user villages in the second stage. The next step was obtaining the sampling frame from the *Kebeles* administrative office, which provided comprehensive listings of village homes. There were 146, 188, and 206 households in total across *Lay Mender, Kes Mender, and Tach Mender*.

This experiment employed a multi-stage sample strategy. The first phase of development was specifically designed to include Ambera *Kebele* because of its extensive use of small-scale irrigation. Out of the six irrigation user villages in the second stage, three villages, *Lay Mender*, *Kes Mender*, and *Tach Mender*, were randomly selected from the higher, middle, and lower stream courses, respectively. The sampling frame was then obtained from the *Kebeles* administrative office, which supplied thorough inventories of village residences. The total number of households in *Lay Mender, Kes Mender*, and *Tach Mender* was 146, 188, and 206 respectively collected by using Taro yemane (1969) formula, as it is shown bellow:

$$\frac{N}{1+Ne^{2}}$$

Where N=total population=540

e = allowable error (0.05) = 5%

Table 3.1 Sample villages and size of sample respondents

NO	Name of Villages	Total Household heads		Sample household heads		Total	
		Practiced irrigation	Not practiced irrigation	Practiced	Not practiced	Frec.	Percent
1	Lay Mender	120	36	50	15	65	28.3
2	Kes Mender	124	64	52	27	79	34.3
3	Tach Mender	135	71	57	29	86	37.4
Total		369	171	159	71	230	100

Source: Irrigation Development Office of Ayehu Guagussa Woreda (2019).

Ultimately, utilizing a systematic random sampling technique based on the sampling frames acquired from the *Keble* Administration offices, a total of 230 sample houses were chosen. Samples of qualitative data were purposefully chosen for focus group discussions and key informant interviews. Development agents, the elderly, very experienced irrigation users, and

Woreda agricultural experts who, because of their expertise, know the course and consequences of conflict were among the key informants.

3.3 Data Sources and Data Collection Instruments

Additionally, seven people were interviewed: three irrigators with expertise, two non-irrigators, one water user's association committee leader, and officials from Keble. Nine people participated in focus group discussions (FGDs): three high experience irrigators, two irrigation users, two non-irrigator, and two members of the water user's organization committee.

3.3.1 Primary Sources

The primary data for this study was collected from sample households by using survey questionnaire, key informant interview, focus group discussion (FGD), and field observation.

Questionnaire

Open-ended and closed-ended questions were included in a questionnaire that was used to gather information about the small-scale irrigation scheme management practices in Gimara. Additionally, it recorded data on the socioeconomic, institutional, and demographic aspects of the irrigators as well as their physical attributes and other factors that influence small-scale irrigation practices. To make the questionnaires easy for the respondents to comprehend, they were first produced in English and then translated into Amharic, the local language. The survey was conducted by skilled data collectors that have a thorough understanding of the idea.

Figure 3:2 Interviews with Households in Ambera Kebele

Source: My Own Survey

Focus Group Discussion

Focus group discussion (FGD) was conducted with irrigation users to obtain more reliable and relevant data as well as to make the process of data collection more effective and reliable. FGD assisted in gathering information about the obstacles to Gimara's small-scale irrigation management practices, the functions and shortcomings of the water user's association committee, the reasons behind disputes over irrigation water, the main sources of water scarcity, the factors that influence small-scale irrigation practice, the reasons why irrigation is not practiced, and the circumstances surrounding maintenance activities. For the purpose of the focus group discussion, three elderly non-irrigators, three water user's association committee members, and three irrigation users from each hamlet and stream course were purposefully chosen .These irrigators were chosen from each village and stream course according to their level of education, length of farming experience in the three *Kebeles*, and active participation in irrigation

Key Informant Interview

To gather more important information about the general irrigation practice situations, key informant interviews were held. These interviews covered topics like significant managerial issues, factors influencing small-scale irrigation practices, the main causes and effects of water scarcity, maintenance tasks, the reasons behind conflicts, and the main shortcomings of the water users association (WUA) committee. Therefore, three elderly people from each village and stream course, three irrigators from each village and stream course with higher educational status, development agents (DAs), and a *Woreda* agricultural expert were included.

Figure 3.3 Interview with Woreda Agricultural Expert and Development Agents at Azen town

Source: My Own Survey

Field Observation

Field observations were conducted throughout the study process to verify the overall state of irrigation management practices and to increase the reliability of data collected using alternate methods. The physical infrastructure of the irrigation projects was examined, as well as the socioeconomic amenities of the selected communities. Evaluations of the effectiveness of irrigation plans, building layouts, load bearing capacities, distribution network conditions, issues with flooding, erosion, siltation in canals, weed growth in farms and canals, water logging, salinization, irrigation techniques, crop types, and other pertinent field data were also included in the observations.

3.3.2 Secondary Sources

Secondary data, which was gathered from many published and unpublished documents acquired from various sources, was added to the original data and is anticipated to support it. The information gleaned from the aforementioned source may pertain to reports on irrigation techniques, project evaluation documents, laws, rules, and regulations.

3.4 Data Analysis and Techniques

Both qualitative and quantitative data analysis techniques were used by the researcher. Qualitative analysis was used to examine data that did not need to be calculated numerically. This type of data analysis included field observations, focus groups, and interviews with important informants. On the other hand, data that required numerical analysis was investigated quantitatively. After being coded and modified, the gathered data was imported into SPSS version 23, the statistical package for the social sciences. Two types of statistics were used to analyze the data from household surveys: inferential and descriptive. The study utilized descriptive statistics, specifically percentages and frequencies, to ascertain the irrigation management practices of households and to underscore the principal obstacles they encounter in this domain. A chi-square test was used to determine the relationships between different variables and small-scale irrigation techniques. This test was used to investigate associations between categorical or dummy factors, including marital status, sex, educational background, training program participation, access to credit, and availability of irrigation water. In addition, the association between disputes over irrigation water and farmland's closeness to water sources was examined using the chi-square test in respect to categorical variable

In contrast, binary logistic regression analysis was utilized to pinpoint the factors influencing small-scale irrigation practices. This method was chosen because the dependent variable in the study whether a household is practice or not practice of irrigation within the Gimara small-scale irrigation scheme is categorical. The binary logistic regression model is particularly appropriate for situations where the dependent variable consists of two categories, allowing for a thorough examination of the determinants that may affect irrigation practice. Based on a variety of independent variables, researchers can evaluate the probability that households will use irrigation methods by using binary logistic regression. The model contributes to a better understanding of small-scale irrigation dynamics in the examined area by examining these interactions and offering insightful information about the factors that either encourage or hinder the adoption of irrigation (David et al., 2000).

However, in order to determine the factors of small-scale irrigation practices that were most likely to have an impact on irrigation practice, binary logistic regression analysis was used. Because the dependent variable in the Gimara small-scale irrigation project is categorical and dummy adopters and non-adopters of irrigation a binary logistic regression model was mostly employed. A model like this works well when the dependent variable is dummy.

3.5 Definitions of Variables and Working Hypothesis

3.5.1 Dependent variable:

The dependent variable (Y) in this study is small-scale irrigation practices. There is a dummy variable that takes one for non-adopters and zero for irrigation adopters..

3.5.2 Independent variables:

The factors influencing Gimara small-scale irrigation practice served as the study's independent variables (Xs). The following variables (X) (independent variables) were anticipated to have an impact on Gimara River small-scale irrigation practices..

Age of household head: It's an ongoing variable. It shows the head of the household's age in years at the time of the survey. Despite having more knowledge of irrigation techniques, the elder home heads are unable to fully participate in the practices as younger household heads can. The hypothesis for this study was that there should be a negative correlation between household age and irrigation practice. This indicates that the likelihood of irrigation practice declines with the age of the head of the family

Sex of Household: Males and females in the household make up the dummy variable, "sex." It is also anticipated that differences in gender will have an impact on irrigation management. Compared to female-headed households, male-headed households engage in irrigation practices more. Male-headed families have greater access to extension services and are more experienced in irrigation techniques than female-headed households, but female-headed households struggle with irrigation because they lack experience and extension services. Women were found to be relatively little involved in irrigation management methods (Kinfe et al., 2012; Girmaw, 2007

Educational Background of Households: It is a categorical variable that measures in the group of category of the household heads (1=cannot read and write, 2=those who have attended grades 1-4, 3=those who have attended grades 5-8, 4=those who have attended grades 9–12, and 5=those with diploma and above). Farmers who receive formal education are better able to recognize, evaluate, and react to novel events in the context of risk. Additionally, education gives farmers the ability to look for innovative irrigation technology. The adoption of irrigation techniques is positively correlated with the head of the household's literacy (Getaneh, 2011).

Year of Farming Experience: This was a continuous variable with a yearly measurement. This is a reference to how long the heads of the households had been farmers. The hypothesis behind this study was that the likelihood of small-scale irrigation practices is positively correlated with the years of farming experience held by the households. This is due to the fact that farmers with longer farming seasons were more likely to use irrigation than household heads with shorter growing seasons. The findings of Ziba (2015), who said that household farming experience has an impact on participation in small-scale irrigation in the upper east region of Ghana, conflict with the conclusions of this study.

Training It is yet another crucial element that influences small-scale irrigation techniques. Farmers can become more knowledgeable about the application of irrigation practices through training. Thus, a positive correlation between farmers participating in training and small-scale irrigation practices was theorized in this study. The findings of Petros and Yeshak (2017), who confirmed that better training attended farmers had better likelihood to practice irrigation than non-attended farmers, are presented as a categorical variable (1=attended, 2=not attended).

Size of farming land: This variable is continuous. One significant aspect influencing the adoption of irrigation practices is the amount of irrigable land. The size of irrigable land and irrigation practice were therefore thought to be positively correlated.

Household Size

The number of families is a continuous variable that was measured. This is a reference to how long the heads of the households were involved in farming. Another significant demographic factor influencing the adoption of irrigation practices was household size. Gimara irrigation project on a small scale. Based on the size of the household heads at 5% significance, the chi square analysis findings clearly showed that there was a significant difference in the adoption of irrigation practices between irrigation users and non-users.

Access to Credit Service: The purpose of this categorical variable is to indicate whether or not the heads of the households have access to credit services (1=yes, 2=no). In addition to facilitating irrigation, irrigators with credit services available would contribute significantly more to the upkeep and operation of irrigation schemes than irrigators without such services. The hypothesis of this study was that small-scale irrigation practices and credit service accessibility are positively correlated. The results According to Haile (2008), a household head's ability to obtain financial services has a significant favorable impact on irrigation practices.

Access to Extension Service: The purpose of this categorical variable is to determine if the heads of the households have access to Extension services or not (1=yes, 2=no). The availability and presence of technical guidance, trials, and demonstration for irrigation users is referred to as "access to extension service." It is crucial that extension services increase the household heads' understanding of small-scale irrigation techniques. As a result, it influences irrigation practices positively.

3.6 Goodness of fit of Model

It's crucial to evaluate the binary logistic regression model's quality of fit. The two (binary response) and contingency tables are shown using the Pearson x^2 statistic, which is based on the observed (o) and the predicted (e). This demonstrates that the degree to which the observed values agree with the expected or predicted values determines the logistic model's fitness. The model's fit to the data versus the alternative hypothesis, which was also assessed using the Hosmer-Lemeshow Test, is the null hypothesis. Hosmer et al. (1997) state that when the Hosmer-Leme show goodness of fit value is close to or greater than one, the binary logistic regression model fits the data the best. The model's "likelihood" of accurately classifying the observed data (in the classification table) or determining how "likely" the sample results are given the estimations of the model parameters are additional methods of evaluating the model's goodness of fit.

The presence of multi-co linearity issues was examined for each of the proposed explanatory factors. The model summary's Cox and Snell R-square displays the coefficient of determination. There is no difference between the observed frequency and predicted frequency values, according to the Homer-Lemeshow test of the model coefficient, which yielded a Chi-square coefficient of 3.23 on 8 degrees of freedom, which is insignificant at p=0.92. As a result, estimates of the model fit the data were within an acceptable range.

The model's indictor variables showed a high joint effect in predicting small-scale irrigation practices, according to the omnibus test of the model coefficients, which produced a Chi-square value that was strongly significant at $p < 0.00$.

Table 3.2 Description of the dependent and independent variables use

Independent variables	Measurement	Type of variable	Expected sign
Age	Number of years	Continuous	-
Years of experience	Number of years	Continuous	+
Education	1= Cannot read and write 2.=>4 3.=5-8 4=.9-12 5= diploma and above	Categorical	+
Sex	1=Male2=female	Dummy	+
Size of irrigable land	Size of farmland in hectare	Continuous	+
Access to credit	1.=yes 2.=no	Dummy	+
Attending to training	1=.yes 2.=no	Dummy	+
extension contact	1.=yes 2=.no	Dummy	+
Household size	Number of household members	Continuous	+

CHAPTER FOUR: RESULTS AND DISCUSSIONS

This chapter deals with the practice of small scale irrigation management in Gimara small scale irrigation scheme using data collected from 230 sample household. First the descriptive statistics that focus on sample households' characteristics including demographic, physical, socio-economic and institutional elements followed by the major challenges which hindered effective irrigation management practices and the overall management activities of Gimara small scale irrigation practices. Secondly the results of inferential statistics are presented which focus on determinants of Gimara small scale irrigation practices.

4.1 Demographic and Socio-economic Characteristics of Households

One of the main factors influencing small-scale irrigation management techniques is the demographic makeup of the families. This is because demographic factors have an impact on irrigation management practices, either directly or indirectly. Age and sex are two demographic factors that have an impact on Gimara small-scale irrigation management techniques. These are explained below:

4.1.1 Sex of Household Heads

One of the factors influencing Gimara small-scale irrigation practices is sex. Approximately 78 percent of the 230 responders were males and 22 percent were females. Approximately 80% of irrigation practitioners who responded were males and 14% were females. Consequently, a higher percentage of respondents with male heads than those with female heads engaged in small-scale irrigation. To investigate the relationship between sex and irrigation practice, a chi-square test was conducted. The findings demonstrated a substantial correlation (at 1 level of significance, p =.001) between the sex of household heads and irrigation practices (chi- square = 10.857a, df=1, p =.001).

Table 4.3: Sex of Household Heads

	Practiced		Not practiced		Total				
Sex	Freq.	%	Freq.	%	Freq.	%	Chi	df	P=
Male	137	86	50	70	187	78			
Female	22	14	21	30	43	22			
Total	159	100	71	100	230	100	10.857^{a}	1	=.001

Source: My own Survey

4.1.2 Educational Status of Household Heads

A bout 35.9% of the sample household heads cannot read and write, whereas the remaining 64.1% household heads were educated. Out of the total household heeds that practiced irrigation, 37.8 % were illiterate, 62.2% were educated while out of the total household heeds that did not practice irrigation, 34 % were illiterate.

Table 4.4: Educational States of House Holds

	practiced		Not practiced		Total				
Education	Freq.	%	Freq.	%	Freq.	%	Chi	df	P=
Cannot read	60	37.8	24	34	84	35.9			
1-4	38	24	21	29.5	59	26.75			
5-8	27	17	16	22.5	43	19.75			
9-12	22	13.7	7	10	29	11.85			
>diploma	12	7.5	3	4	15	5.75			.
Total	159	100	71	100	230	100	4.162[a]	4	.385

Source: My own Survey

4.1.3 Marital Status of Household

The marital status of a household is a significant demographic factor that has influenced the irrigation practice. A little over 18.8% of the sample's total households were single, compared to 48.48% married, 20.09 % widowed, and 18.87 % divorced. Of all the homes that used irrigation, 60.37% of them were married, and 16.37% of them were single. Among the total respondents who did not practice irrigation, 21.3% were single, 36.6% were married, 38 were widowed and 29% were divorce. The results of this survey showed that married households were more likely than single, divorced, or widowed households to practice irrigation. The chi-square test result showed that, at 1% (chi-square=13.813, df= p<0.000), there was a significant difference in the marital status of household heads between irrigation practitioners and non-practitioners.

Table 4.5: Marital Status of Household

Total	practice		Not Practiced		Total	Total			
Marital	Freq.	%	Freq.	%	Freq.	%	Chi	df	P=
Single	26	16.37	15	21.3	41	18.8			
Married	96	60.37	26	36.6	122	48.48			
Widowed	17	10.69	21	29.5	38	20.09			
Divorce	20	12.57	9	12.6	29	18.87			
Total	159	100	71	100	230	100	13.813[a]	3	0.003

Source: My Own Survey

4.1.4 Age of Household Heads

Under the Gimara small-scale plan, age was another significant demographic factor that influenced households' irrigation practices. The household respondents ranged in age from 26 to 67, with an average age of 41.87 years and a standard deviation of 11.194. The average age of respondents from houses that used irrigation was 40.77 years, with a standard deviation of 10.542, whereas the average age of households that did not use irrigation was 44.44 years, with a standard deviation of 12.350. With a mean difference of 3.667 years, the mean age of irrigation-practicing households was found to be marginally lower than that of irrigation-non-practicing households, meaning that the former were nearly 4 years older than the latter. The mean age difference between the two groups' sample households was found by the independent t-test analysis, and it is statistically significant at 10% (t=1.724; p=.087).

Table 4.6 Age of Household Heads

Total	practiced		not practiced		Total				
Age category	Freq.	%	Free	%	Freq.	%	Chi	df	P=
25-40	84	52	32	45	116	48.5			
41-59	62	39	33	46	95	42.5			
>60	13	8	6	9	19	8.5			
Total	159	100	71	100	230	100	T=_1.72	62.85	0.019

Source: My Own Survey

4.2 Household Size

Another significant demographic factor that influenced households' irrigation practices under the Gimara small-scale plan was household size. The sample houses had an average household size of 3.62 with a standard deviation of 1.586. The smallest family size was 1, and the biggest was 9. The average household size of those who used irrigation was 3.81 (standard deviation = 1.45), while the average household size of those who did not practice irrigation was 3.18 (standard deviation = 1.760). Compared to households that did not practice irrigation, the average size of the irrigation-practicing households was less than one. The mean difference in the respondents' sizes of the two sample households was found to be statistically significant at 5% significance, according to the results of the independent t-test analysis (t=2.11; p=.036).

Numerous studies have shown that household size has a similar impact on irrigation techniques, especially in small-scale schemes. Adoption of irrigation techniques may be aided by larger households' increased ability to participate in labor-intensive farming activities. Your findings suggest that larger households are more likely to implement irrigation in the context of the Gimara small-scale irrigation plan because they can mobilize manpower for tasks like building canals and applying water.

Larger families can supply a more substantial labor force, which is essential for efficiently maintaining irrigation systems, according to research. For example, Adesina and Baidu-Forson's (1995) study showed that households with more members are better equipped to manage irrigation and other labor-intensive agricultural operations. Similarly, Shiferaw et al. (2009) discovered that as bigger families may divide the effort involved in these activities, household size positively correlates with the adoption of advanced agricultural technologies, including irrigation. Moreover, the labor-intensive nature of irrigation requiring efforts for both infrastructure development and ongoing water management underscores the importance of having sufficient household members. Focus group discussions often reveal that community members recognize the necessity for adequate labor to implement and maintain irrigation systems effectively (Kassie *et al.*, 2012). From this it can be understood that larger household sizes facilitate greater engagement in irrigation practices due to enhanced labor availability, thereby improving agricultural productivity.

4.3 Farming Experience of the Households

Among all household heads, 19 % performed irrigation, and 22 % did not; these individuals had experience ranging from one to ten years, whereas 28 % of irrigators and 22.5 % of non-irrigators had experience spanning from eleven to twenty years. 14 % of non-irrigators and the remaining 36 % of irrigators had more than 21 years of experience. This demonstrated the differences in farming experiences between households with and without irrigation. At a 1% significance level, the independent t-test result showed a statistically significant difference between the year of farming experience and irrigation practice (T-value=-286 (df) =112, $p<0.002$). The results of Ziba (2015), who said that household farming experience had little bearing on involvement in small-scale irrigation in Ghana's upper east, conflict with the conclusions of this study.

Table 7 Farming Experience

Total	Practiced		Not practiced		Total				
Farming experience	Freq.	%	Free	%	Freq.	%	Chi	df	P=
1-10	31	19	14	20	45	29			
11-20	45	28	16	22.5	61	25			
21-30	55	36	10	14	65	25			
31-40	28	18	31	4.5	59	11			
Total	159	100	71	100	230	100	-286,	112	0.002
Source : My Own Survey									

4.4 Access to Training

40 percent of irrigation users among all household heeds had participated in irrigation practice training. Of the participants who had gone through training, 66 % used irrigation, whereas 14% did not utilize it. However, it was discovered that 60 % of the respondents used irrigation despite never having attended instruction. At the 1% significance level, access to training and irrigation practice were found to be statistically significantly correlated (chi-square=33.163, df=1, P =0.000). The results of this study were found to be in line with those of Petros and Yeshak (2017), who had established that farmers with greater instruction who were also attended to had a higher likelihood of practicing irrigation than farmers without such assistance.

According to the interview conducted with the *Woreda* agricultural experts, the training on the irrigation practices had significant contribution on the application of irrigation activities. Irrigators who had access to training were found to be active participants on small scale irrigation practice. As a result, irrigators who had attended training were better practitioners of small scale irrigation than those irrigators who did not attend training.

Table 4.8 Access to Training

	practice		Not Practiced		total				
Training	Freq.	%	Freq.	%	Freq.	%	Chi	df	P=
Yes	105	66	10	14	115	40			
No	54	34	61	86	115	60			
Total	159	100	71	100	230	100	33.163[a]	1	0.000

Source: My own Survey

4.4.1 Size of Farm land

Between 0.5 and 1 hectare was the land size for 19.08% of all household heads who did not implement irrigation, whereas 80.02% of those who did practice irrigation had land sizes in the same range. With a t-test value of 7.596 (df=128, p<0.029), your independent t-test revealed a statistically significant difference in the mean size of farmland between households that practiced irrigation and those that did not. Although prior research has typically established a positive association between land size and the adoption of irrigation practices, this study suggests that land size has an impact on the decision to adopt irrigation practices. This implies that economies of scale in irrigation investments could be advantageous for larger farms. Due to the possibility of higher yields and returns on investment, farmers with larger plots are more likely to invest in irrigation infrastructure, according to Petros and Yeshak (2017). Their findings suggest that larger landholdings yield greater economic benefits from irrigation. Larger landholdings enable farmers to apply irrigation techniques, enhancing agricultural productivity and food security, as mentioned by Kinfe et al. (2012). Households with smaller farms were found nearer water sources and had easier access to communal irrigation systems, according to field observations. Smallholders find it easier to apply irrigation measures due to their proximity than larger farmers who might need to make considerable infrastructural investments.

Table 4. 9 Size of Farm land

Total	Practiced		Not Practiced		Total				
Size of land	Freq.	%	Freq.	%	Freq.	%	Chi	df	P=
0-0.25	16	11	28	39	44	25			
0.26-0.50	26	16	21	30	47	23			
0.51-0.75	45	28	15	21	60	24.5			
0.76-1	72	45	7	10	77	27.5			
Total	159	100	71	100	230	100	27.153[a],	3	0.000

Source: My Own Survey

4.4.2 Access to Credit

The results showed that 61 % of the sample families that did not implement irrigation had access to credit service, compared to 62 % of the sample households that did use irrigation. Conversely, 38.5% of irrigation households that did not practice irrigation did not have access to credit, and 61.5 percent of irrigation user households from non-irrigation households reported having access to credit services, compared to 39 % of irrigation user households who regretted not having credit. The results of the chi-square test indicated that, at p>10%, there was a statistically significant difference in the decision to practice irrigation between farmers who had access to financing and farmers who did not (chi-square value=.072, df=1, p.788). At p>0.1, a hypothesis that claimed there is a high correlation between farmers' access to loans and irrigation practices was rejected. This finding runs counter to studies by Azemer (2006) and Wagnew (2004), who reported a favorable correlation between small-scale irrigation practice participation and availability to credit services.

Table 4.10 Access to Credit

	Practice		Not Practiced		Total				
Credit	Freq.	%	Freq.	%	Freq.	%	Chi	df	P=
Yes	98	62	43	61	141	61.5			
No	61	38	28	39	89	38.5			
Total	159	100	71	100	230	100	34.429[a]	1	0.000

Source: My Own Survey

4.4.3. Extension Contact

The results of a descriptive analysis on the households' access to extension services showed that, while 37.36% of the households with irrigation practices and 92.3% of the households without irrigation practices had no close contact with development agents, 62.63% of the irrigation-practicing households and 7.69% of the non-practicing households had. A statistically significant correlation between extension contact and irrigation techniques was found by the chi-square test, and the correlation was significant at 1% (chi-square value=33.163df=1, p<0.000).

The study's findings were found to be in line with those of Petros and Yeshaq (2017), who unequivocally demonstrated that farmers who had greater interaction with DAs were more likely to employ irrigation than farmers who did not.

Table 4.11 Extension Contact

	Practiced		**Not Practiced**		**Total**				
Extension	Freq.	%	Freq.	%	Freq.	%	Chi	df	P=
Yes	100	63	7	10	107	36.5			
No	59	37	64	90	123	63.5			
Total	159	100	71	100	230	100	33.163[a]	1	0.000

Source: My Own Survey

4.5 Irrigation Management Practices in Gimara Small Scale Irrigation Scheme

There are 159 and 71 families in the research region that practiced irrigation and did not practice irrigation, making up 69 % and 31% of the households, respectively. Of the 159 houses that practice irrigation, 64.1% were engaged in actions aimed at acquiring water for their members, while the remaining households, or 35.9%, were less involved in such activities

Participants in the focus group discussion (FGD) stated that water irrigation scheduling, which includes choosing when and how much to apply, is an essential component of effective irrigation water management. The scheduling committee informs the irrigators about the best times and amounts of water to use on the farm.

Participants in the focus group discussion disclosed that homes failing to find routine maintenance, emergency repairs, and scheme canal upgrades during the day were initially fined 500 Birr, a penalty that doubled as the household's absenteeism increased. Because of this rule, the majority of households found for regular upkeep, urgent repairs, and canal improvement schemes.

The following issues were brought up in the conversation with the *Woreda* irrigation specialist. Irrigators can attend workshops and training sessions to learn about the fundamentals of effective water usage and the value of water resource conservation. Topics including irrigation canal design and maintenance, irrigation event scheduling, and water loss minimization strategies are covered in these seminars. In accordance with best management practices, the initiative encourages irrigators to evaluate and modify their present irrigation methods. This could entail altering canal layouts to minimize seepage, putting in place suitable leveling methods to guarantee uniform water distribution, and making use of innovations like sprinkler or drip systems, which can greatly improve water efficiency. The expert summarizes his remarks by saying that the goal of the Gimara irrigation scheme is to empower irrigators by educating them and helping them make useful changes to their irrigation systems. The initiative aims to improve the overall effectiveness of irrigation systems, which will lead to increased crop yields and better economic benefits for farmers while supporting sustainable resource management. It does this by fostering a deeper awareness of effective water use and conservation strategies.

4.6 Major Challenges of Management of Gimara Small Scale Irrigation Scheme

4.6.1 Function of Water Management Committee

Descriptive statistics on all household heads who practiced or did not practice irrigation showed that a major managerial obstacle to effective and efficient irrigation management practices on the Gimara small-scale irrigation scheme was the committee's inability to coordinate well (45%), while 32 % of irrigation users said that sanctions against illegal water users were unfair, and the remaining 13 % said that irrigation management practices are hampered by rotation that is not carried out equally and strictly.

The *Tach Mender* communities are experiencing significant water scarcity concerns as a result of unapproved water usage in the *Lay Mender* section of the irrigation zone, as revealed by the results of focus group discussions and key informant interviews. As a result, disputes have emerged between irrigation users, creating a major management difficulty for the small-scale Gimara irrigation network .The fact that these unlawful water users have received light punishment partly due to the absence of formal legal norms and policies, as well as to the committee of the water user association's incompetence and objectivity. Despite the imposition of a 150 ETB penalty, the committee's impartiality made it useless. The responders also underlined that one of the biggest obstacles to managing the Gimara irrigation project is the lack of among the water users' association committee.

Table 4.12 Function of Water Management Committee

	Practiced		**Not practiced**		**Total**	
Management problems	Free	%	Free	%	Free	%
Sanction not imposed against illegal water users	51	32	11	16	62	40
Rotation is not accomplish equally	20	13	30	42	50	27.5
Poor coordination of water user committee	71	45	10	14	81	27.5
Others	17	10	20	28	37	19
Total	159	100	71	100	230	100

Source: My Own Survey

4.6.2 Conflict among Water Users

It was typical for irrigators *in Lay Mender, Kes Mender*, and *Tach Mender* to argue or clash over who gets to utilize irrigation water. Irrigation users reported conflict stemming from water theft or utilizing water beyond one's turn, based on survey data. Water theft and unauthorized use are revealed to be the primary causes of conflicts over irrigation water in the research area. Compared to *Tach Mender* and *Kes Mender* irrigators, the *Lay Mender* population frequently utilizes larger volumes of water. Because of this, there is friction between the *Lay Mender* villages, who frequently utilize more water than the *Tach Mender* and *Kes Mender* irrigators. This suggests that there is a lack of coordination and impartiality towards the users in the water users' association committees, which impacts the equitable distribution and appropriate distribution of water in the study's schemes.

Out of all family heads using irrigation, 63% reported experiencing conflict over irrigation water, whilst 37 % reported no conflict at all. The reasons of conflict over irrigation water were determined to be water scarcity due to supply (30.5%) and the periodic dramatic increase in irrigation users (37%), respectively.

Table 4.13: Conflict among Water Users

	Practiced		**Not Practiced**		**Total**		
Conflict	Freq.	%	Freq.	%	Freq.	%	
Yes	100	63	7	10	107	36.5	
No	59	37	64	90	123	63.5	
Total	159	100	71	100	230	100	

Source: My Own Survey

These findings clearly indicated that conflict over irrigation water had become more intense. According to focus group discussants and informant interviews, conflicts resulting from water allocation and distribution are a common occurrence among irrigation users. The major causes of conflict over irrigation water were increasing number of irrigation users, water scarcity due to supply, and water theft (illegal users) by some illegal irrigators.

Irrigation users in the *Tach Mender* of the irrigation area faced severe conflict over irrigation water whereas irrigators in *Lay Mender* as distance decreased to the source of river of the irrigation area faced less conflict over irrigation water. This clearly revealed that conflict over irrigation water becomes more and scarcer as we go away *Lay Mender* to *Tach Mender* as distance increased from the irrigation area. As a result, *Tach Mender* irrigation users responded as they faced severe conflict over irrigation water. When the irrigator’s farmland is located far from the water source, the probability of getting enough water is low. This in turn results in the water scarcity which was the major cause of water conflict.

This finding suggests that the water users’ association committee failed to provide prompt resolution to disputes arising from the usage of irrigation water, hence impeding the development of efficient irrigation management techniques. Poor coordination and impartiality toward the users impair the role of water user association committees, which has an impact on the equitable distribution and proper allocation of water in the study's schemes.

Table 4.14 Cause of conflict

Total	Practiced		Not Practiced		Total		
Couse of conflict	Freq.	%	Freq.	%	Freq.	%	
Water theft	43	27	18	25	51	26	
Water scarcity due to supply	47	30	22	31	69	30.5	
Water scarcity due to increase number of user	59	30	26	37	85	37	
Other	10	6	5	7	15	6.5	
Total	159	100	71	100	230	100	

Source: My Own Survey

4.6.3 Water Scarcity

It is a significant obstacle to the Gimara small-scale irrigation scheme's management practices of all household heads using irrigation, 70 % were able to obtain enough water, 24 % were unable to do so, and more than 34% of non-users were unable to obtain enough water, with fewer than 7% managing to do so.

30% of respondents stated that the study area's water scarcity was mostly caused by an increase number of irrigation users. This was followed by the presence of illegal water users in the *Lay Mender* of the river, which caused severe water scarcity for the *Tach Mender* communities due to a decline in water from the source.

The key informant interviews and focus group participants made it abundantly evident that the main causes of the Gimara small-scale irrigation practices' water scarcity were the growing number of irrigation users, the drop in the volume of water from the source as a result of several illegal users in the *Lay Mender* of the river, and the irresponsible use of irrigation water for longer than necessary. These factors have severely impacted the *Tach Mender* communities' water supply.

4.6.4 Water distribution

The participants in the focus groups disclosed that the irrigation scheme's allocation and distribution of irrigation water was predominantly determined by the area of land that could be planted with crops. However, it was discovered that irrigation users with smaller amounts of irrigable land were passive irrigation practitioners and that their farmland belonged to other crop types that relied on rainwater, which takes longer than eight months to produce.

4.6.5 Maintenance of the irrigation scheme

Based on data gathered from the Water Users Association Committee (WUAC), the plan was maintained by mass mobilization twice a year, around the end of summer when irrigation starts and in the middle of the year when irrigation is done. The penalty for irrigators who missed the maintenance days was 500ETB, in accordance with WUAC rules and regulations. A significant portion of irrigation users (51%) said that the scheme's maintenance was in good condition, while almost 24 % reported that the scheme's maintenance was in really poor condition. As key interview and focus group discussion lack of irrigators on maintenance days, siltation, lack of raw materials for maintenance activities like cement, breaking of canals by some illegal irrigation users, lack of raw materials for maintenance activities like cement and animal damage, were the main causes of the poor maintenance activities. This outcome is in line with the discovery made by Tesema (2012) that the biggest obstacle to irrigation management practice, as identified by Gashaye Chekol and Tenaw Alemiraw (2007), was the absence of household heads on the maintenance day.

Table 4.15 Maintenance of the irrigation scheme

	Practice		**Not practiced**		**Total**	
Maintenance scheme	Free	%	Free	%	Free	%
Very poor	15	9	6	8.5	10	7.69
Poor	38	24	25	35	44	33.84
Good	81	51	34	48	64	49.23
Very good	25	16	6	8.5	12	9.23
Total	159	100	71	100	130	100

Source: My Own Survey

4.7 Determinants of Households’ Adoption of Small Scale Irrigation Practices

The results of the regression analysis used to calculate the explanatory variables' influence on irrigation practices are discussed in this section. To determine the impact of proposed explanatory variables on the likelihood of irrigation practice, a binary logistic regression model was constructed. A binary dependent variable, with a value of "0" for non-irrigation households and "1" for those that do, represents the state of irrigation practice. Before executing the logistic regression model for analysis, all assumptions are confirmed. Using pairwise correlation and contingency coefficients for dummy variables and the variance inflation factor (VIF) for continuous independent variables, the explanatory variables were examined for the presence of multi co linearity. As a general rule, variables with a VIF larger than 10 are problematic and ought to be removed from the model; on the other hand, variables with a VIF less than 10 and a tolerance value greater than 0.1 are thought to be multi-co linearity-free (Field, 2009). The appendix 1 highlights that there is no significant correlation between the three independent variables that are continuous. As a result, every explanatory factor was included in the final analysis. To determine whether one categorical variable is associated with another, pair wise correlations between the variables were conducted. As a result, there is a strong correlation between two variables if their pair wise association is larger than 0.8. There is no link between the variables; hence none of the category variables should be removed from the model, according to the results of the Contingency Table for Hosmer and Lemeshow Test analysis.

Table 4.16 Contingency Table for Hosmer and Lemeshow Test

		irrigation catagory = practiced		irrigation catagory = not practiced		
		Observed	Expected	Observed	Expected	Total
Step 1	1	13	13.000	0	.000	13
	2	13	12.998	0	.002	13
	3	13	12.988	0	.012	13
	4	13	12.955	0	.045	13
	5	13	12.857	0	.143	13
	6	12	12.150	1	.850	13
	7	11	9.244	2	3.756	13
	8	2	4.069	11	8.931	13
	9	1	.699	12	12.301	13
	10	0	.040	13	12.960	13

Source: The result of Contingency Table for Hosmer and Lemeshow Test Modal

The goodness of fit test by Hosmer and Lemeshow demonstrates how closely the anticipated values match the observed ones. According to this test, the model's fitness will increase with the degree to which the observed and predicted frequencies agree. For the binary logistic model, this test is better suitable (Hosme rand Lemeshow, 1980). Additionally, the model's goodness of fit was assessed by evaluating how effectively it classifies the observed data (found in the classification table) or by assessing the sample findings' real likelihood in relation to the estimated model parameters. The model is sound since the p-value is higher than the significance (0.05) value, according to the results of the Hosmer and Lemeshew significant test. As a result, the model is a good predictor since the result as Hosmer and Lemeshow test modal, which is higher than the P value, displays the outcomes as (0.928).

Table 17: Hosmer and Lemeshow Test Modal

Step	Chi-square	Df	Sig.
1	3.095	8	.928

The institutional determination of irrigation practices was examined using the binary logistic model. The Nagelkerke R^2 was 0.829, as shown in the model description .

Table 4.18 Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	44.603	.585	.829

Source: Nagelkerke R Square

This indicates that 82.9% of the variation in irrigation practice can be attributed to the nine variables that were entered into the model, with the remaining variation coming from factors that were not included in the model.

Table 4.19: Determinants of Households' Irrigation Adoption

Variables	B	S.E.	Wald	Df	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
sexofhd(1)	2.537	1.122	5.118	1	0.024	12.644	1.404	113.907
Ageofhh	-0.007	0.059	0.013	1	0.908	0.993	0.884	1.116
Mstatus			5.229	3	0.156			
mstatus(1)	-1.362	1.396	0.953	1	0.329	0.256	0.017	3.947
mstatus(2)	3.547	1.661	4.559	1	0.033	34.703	1.338	900.158
mstatus(3)	1.643	1.78	0.852	1	0.356	5.172	0.158	169.356
Edustathh			6.015	4	0.198			
edustathh(1)	2.445	1.516	2.6	1	0.107	11.532	0.59	225.247
edustathh(2)	2.208	1.425	2.4	1	0.121	9.096	0.557	148.538
edustathh(3)	3.157	1.873	2.839	1	0.092	23.495	0.597	924.022
edustathh(4)	5.3	2.255	5.523	1	0.019	200.309	2.411	16643.15
Hhs	-0.743	0.403	3.392	1	0.066	0.476	0.216	1.049
Howmuchfmld	-0.943	0.468	4.064	1	0.044	-0.389	0.156	0.974
training(1)	3.774	1.317	8.205	1	0.004	43.544	3.292	575.896
crt(1)	-0.172	0.955	0.032	1	0.857	0.842	0.13	5.47
extension(1)	4.901	1.513	10.489	1	0.001	134.414	6.924	2609.426
Constant	-5.246	2.537	4.276	1	0.039	0.005		

a. Variable(s) entered on step 1: sexofhd, ageofhh, mstatus, edustathh, hhs, howmuchfmld, training, crt, extension.

4.8 Significant Explanatory Variables in the Model

4.8.1 Sex of Household Head:

At the 5% level of significance, the results of the logistic regression analysis showed that, at p=0.024, the sex of the household head significantly and favorably affected households' probability of adopting irrigation. Male-headed families are more likely to use irrigation water than female-headed households because they had a 12.644 increase in the estimated probability of adopting irrigation practices compared to female-headed households. This is a result of the numerous household responsibilities placed on female-headed households, which may have prevented them from working to irrigate their farms. In addition, men have more farming experience than women.

According to Kinfeet al.'s (2012) study, women headed households in Northern Ethiopia with poor irrigation practices. Women's participation in irrigation management methods was found to be extremely poor, according to Girmaw (2007). Furthermore, according to a study by Habitamu (2011), a significant portion of Ethiopian women's time is spent on household reproduction activities like gathering firewood, obtaining water, cooking, tending to children, and other household chores. Their role as household heads in the irrigation practice is also severely limited.

4.8.2 Size of Farming Land

At a 5% significance level, p=0.044, the logistic regression result shows that farmers' irrigation practices were negatively and significantly impacted by the size of their farmland. It was proposed that the possibility of adopting irrigation practices would be positively impacted by the size of farmland and irrigation practices. Nonetheless, the beta coefficient finding shows that while agricultural size increases, households are less likely to conduct irrigation (Exp=-0.389). One possible explanation for this could be because farmers with smaller farms employ irrigation in addition to summer planting to produce food for their families.

This result was explained by the fact that farmers with smaller plots are more inclined to use irrigation to supplement summer crops and ensure adequate food supply for their households (Smith, 2023).

4.8.3 Training

At a 5% significance level, p=0.004, the logistic regression result shows that farmers' irrigation practices are significantly impacted by the training they receive in their homes. The logistic regression result also shows that expert-led training for the head of the household positively influences the likelihood that irrigation would be practiced by the household. The odds value of the household heads who participate in irrigation-related training is 43.544 times higher than that of their counterparts.

Farmers with more training had a higher likelihood of using irrigation practices than farmers without training, which was found to be in line with Petros and Yeshak's (2017) findings.in the 5% significance level, attendance in irrigation-related training sessions significantly improved the usage of small-scale irrigation. Strong extension services have been another obstacle to small-scale irrigation in Ethiopia. Keeping all other factors equal, the odds ratio favoring irrigation use increases the likelihood by a factor of 151.389 for the respondents who attended irrigation and related trainings, such as support services in improved seed (Teshome et al, 2017).

4.8.4 Extension Contact

At the 5% significance level, p=0.001, the logistic regression result shows that farmers' irrigation practices are significantly impacted by households that have an extension contact with Das. The outcome of the logistic regression analysis also shows that the likelihood of irrigation practice is positively impacted in families having extension contact with experts. The odds ratio between the heads of the household with the extension contact in irrigation-related extension contacts and their counter heads is bigger by 134.414. This outcome was in line with the research conducted by Getaneh (2011), which found that agricultural extension services were crucial in motivating farmers to use irrigation.

4.8.5 Educational Background of Households

Farmers who receive formal education are better able to recognize, evaluate, and react to novel events in the context of risk. Additionally, education gives farmers the ability to look for innovative irrigation technology. The logistic regression was conducted using reference homes that are illiterate in order to investigate which educational level influences a household's irrigation practices under the Gimara small-scale irrigation system.

According to the results of the logistic regression, households in the fourth category—those with education above a diploma had a much higher likelihood of practicing irrigation than households without literacy. At the 5% significance level, p=0.019, the chance of households that learnt from grades 9 to 12 is higher by an odds ratio of 200.309 compared to those that cannot read and write in farmers irrigation practices.

CHAPTER FIVE: SUMMERY, CONCLUSION AND RECOMMENDATION

This part provided recommendations for future development of small-scale irrigation management practices based on the study's findings.

5.1 Summery

In 2016, the Gimara small-scale irrigation scheme was constructed to provide irrigation for an estimated 95 hectares of land. Examining the issues with irrigation management techniques in the Gimara small-scale irrigation project is the main goal of this study. The research's specific goals were to evaluate the irrigation management practices activities, pinpoint the main obstacles to sustainable management, and investigate the factors that influence farmers in the Gimara small-scale irrigation scheme area to embrace irrigation management practices

The study used a combination of research methods and a cross-sectional, explanatory research design. A cross-sectional survey has the advantage of collecting data from a selected individual at a particular point in time and is effective in providing a snapshot of the present behavior, attitude, and belief in a population. It also provides data relatively rapidly.

Field observation, focus group discussions (FGD), key informant interviews, and survey questionnaires were used to gather primary data from sample households for this study. In order to support the original data, secondary data was gathered from various published and unpublished documents that were acquired from various sources. The information gleaned from the aforementioned source may pertain to reports on irrigation techniques, project evaluation documents, laws, rules, and regulations.

Both qualitative and quantitative data analysis techniques were used by the researcher. The information that doesn't need to be calculated numerically was examined and understood qualitatively. Qualitative analysis and interpretation were done on the data that was gathered through field observation, focus groups, and key informant interviews. Conversely, quantitative analysis and interpretation were done on the data that needed to be computed numerically.

The information gathered from 230 representative homes. Ninety-one of those household heads used irrigation, while the remaining ones do not. The major obstacles to effective irrigation management practices and the overall management activities of Gimara small-scale irrigation practices are listed first, followed by descriptive statistics that concentrate on the characteristics of sample households, including demographic, physical, socioeconomic, and institutional elements. Second, the findings of inferential statistics which center on the factors influencing Gimara small-scale irrigation practices are showcased. There are three categories for practices in irrigation management. Water distribution, allocation, and acquisition fall under the first category. The second is devoted to upkeep and operation. The third is devoted to handling conflicts.

Conflicts over irrigation water have been shown to be mostly caused by water theft and illicit use. The *Lay Mender* community frequently uses more water than the *irrigators Tach Mender and Kes Mender* combined. This leads to friction between the Lay Mender villages, who frequently use more water than the irrigators who are *Tach Mender and Kes Mender*.

5.2 Conclusions

The study highlights notable differences and difficulties faced by various demographic groups and offers valuable observations on irrigation methods inside the Gimara small-scale irrigation scheme. It was clear that homes headed by men made up the vast majority of irrigation users, with female-headed households using irrigation techniques at a significantly lower percentage. This discrepancy can be ascribed to the fact that female-headed households often bear more domestic duties, which restricts their time for farming. The data indicates that households headed by men had a greater amount of farming experience than households headed by women, highlighting a gender disparity in agricultural participation. The substantial impact of gender on irrigation techniques highlights the necessity of focused measures to rectify these disparities and assist female farmers. The Water User's Association Committee's efficacy and performance turned out to be a key component of the irrigation scheme's operation. A significant proportion of participants believed that the committee was unsatisfactory in rapidly resolving disputes connected to water, which could affect irrigation methods and total agricultural output. The disparity in answers about the committee's function points to a crucial area where conflict resolution and water distribution need to be improved. Improving the committee's ability to resolve conflicts and respond to user requirements are necessary to address these problems and enable more equal and seamless irrigation operations.

Numerous important aspects impacting irrigation practice are revealed by the analysis of the irrigation practices in the Gimara small-scale irrigation scheme. In comparison to female-headed households, male-headed households are substantially more likely to use irrigation, mostly because women are limited in their ability to participate in farming activities by additional domestic responsibilities. Furthermore, as farmers with limited land frequently rely on irrigation to improve productivity, smaller farms are linked to a higher likelihood of using irrigation. Households with formal training or contact with extension personnel are substantially more likely to practice irrigation; training and extension services play a crucial role in greatly increasing the possibility of doing so.

Sustainable Development Goals (SDGs) related to irrigation in Ethiopia play a crucial role in addressing the country's water scarcity and food security challenges. Ethiopia, a landlocked country in the Horn of Africa, is highly dependent on agriculture, with over 80% of its population engaged in farming. Irrigation management is a critical aspect of agricultural practices, as it directly impacts crop yield, water usage efficiency, and overall farm profitability. The theory of irrigation management involves the planning, implementation, and monitoring of irrigation systems to ensure optimal water distribution to crops while minimizing water wastage.

Lastly, as knowledgeable farmers are better able to make use of new technologies, there is a favorable correlation between formal education levels and irrigation practices. In order to improve irrigation techniques and overall agricultural output, these findings highlight the significance of focused support and resources that address gender imbalances, offer sufficient training, and expand educational opportunities.

5.3 Recommendation

A crucial development endeavor to guarantee food security is the use of small-scale irrigation management practices. The researcher's analysis of the data from the descriptive and inferential statistical methods led to the following policy recommendations, which should be taken into consideration and improved in the future for the Ayehu Guagussa *Woreda,* especially in the Gimara small-scale irrigation scheme.

- The local (Woreda) government should play a leading role in educating and strengthening the management practice of small scale irrigation scheme to make them in a position to improve their performance by providing training and facilitating technological machines to the farmers
- Community level training should be implemented in order to create motivation to solve the challenges of irrigation management practice in small scale scheme to water users.
- Different household responsibilities for women may have an impact on their willingness to work in the field irrigating their farms. This sends a positive message to funding agencies, program designers, and implementers, encouraging them to take the necessary steps to boost female participation in small-scale irrigation techniques.
- Organizations, both government and non-government, ought to prioritize training farmers on the development and use of irrigation technologies. This will enhance farmers' knowledge and proficiency with these tools and expand their ability to utilize irrigation water in the research area.
- Strong institutional organization and training, which would build awareness for WUA regarding water distribution, should be established.
- WUA and other concerned bodies should give immediate solutions for conflicts occurred over irrigation water very soon.
- Water user’s association committee and other concerned bodies should control illegal water users in the upper course of irrigation area who are the major sources of water scarcity for downstream communities and they should distribute irrigation water adequately, timely and fairly for irrigation users.
- As a way of punishments to reduce water conflict, rules and policies should be placed in place and be equal to all water users and the water user committee should be impartial and free from bias.

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Appendixes

ADDIS ABABA UNIVERSITY
FACULTY OF SOCIAL SCIENCES
DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL STUDIES

Survey questionnaire to be filled by households around Gimara small scale irrigation project areas in Ayehu Guagusa Woreda

Appendix One Questioners

This questionnaire is prepared as an instrument to collect data for a research conducted for fulfillment of Master of Degree (MA) in Geography and Environmental Studies, at Addis Ababa University. The main objective of the research is to study the management practice of Gimara Small Scale irrigation in Ayehu Guagsa *Woreda*. Therefore, the information you will provide is very important for the research. Furthermore, the information you give will be used for only this research purpose.

Instructions:

- Circle your responses for close ended questions
- Write your answer for open-ended questions
- Do not write your name on the question paper.

1. Determinants of Gimara small scale irrigation practice

Part I: Demographic data of the respondent

1. Sex of household head: 1. Male 2. Female

2. Age of household head ___________

3. Marital Status of HH. 1. Married 2.Single 3. Divorced 4.Widowed

4. Educational Status of household heads.

A. Cannot read and write D. Grade 9-12
B. Grade 1-4 E. Diploma and above
C. Grade 5-8

5. Household size: ____________

Part II: Physical and socio-economic data of the respondents

6. Irrigation categories: 1.Practiced 2.not practiced

7. Your main occupation

1= Farming 5= Fishing
2=Animal husbandry 6= Civil servant
3= Trading 7= House wife
4= Daily/Casual Labor 8= If other, please specify

8. If your main occupation is 'Farming', for how long have you engaged in this activity? _______ Years

9. If your main occupation is faming, does your household gain income from Non-farm or off-farm activities apart?

1. Yes 2. No

10. Does your household have farmland?

1. Yes 2. No

11. If your household has farmland, how much is the size of your farmland? ______ Hectare

12. If your household has farmland, do you practice irrigation?

1. Yes 2. No

13. If your answer for question number 12 is 'No', What is /are the major reasons for not practicing irrigation?

1. Water scarcity
2. Shortage of oxen
3. Lack of awareness about irrigation
4. Shortage of labor

14. If your household has farmland, do you have access to irrigation water?

1. Yes 2. No

15. If your answer for question number 14 is "yes", how do you obtain irrigation water for your farm land?

1. Based on your interest
2. Based on the size of irrigable land
3. Based on the time limit/scheduling
4. If other specify------------------------------

16. How many hectares of irrigable land do you have?

1.0-0.25 ha

2.0.026-0.50 ha

3.0.51-0.75 ha

4.0.76-1 ha

5. If other specify------------------------------------

17. Based on the question number 16, which farmers more participated on the small scale irrigation practice?

1. Farmers with small size of irrigable land
2. Farmers with medium size of irrigable land
3. Farmers with large size of irrigable land
4. If other specify

18. Is there irrigation water users association/cooperative/ in your locality?

1. Yes 2. No

19. If your answer for question number 18 is 'Yes', have you benefited from being a member of the association?

1. Yes 2. No

20. How many years of irrigation experience do you have? _________ Years

21. Do you think that experienced irrigators highly practice small scale irrigation?

1. Yes 2. No

22. If your answer for question number 21 is "yes" please justify your reason.

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23. If you irrigate your land, how often do you get irrigation water?

1. Once a week
2. Twice a week
3. Three times a week
4. If other specify-------------------------------

24. If you irrigate your farmland, do you get enough water for irrigation?

1. Yes 2. No

25. If your answer for question number 24 is 'No', what is the cause for not getting enough irrigation water? (Multiple responses is possible)

1. Water scarcity
2. Water theft
3. Poor coordination of water committee
4. Large number of irrigation users
5. If other specify-------------------------------------

26. Have you attended training concerning irrigation practice?

1. yes 2.No

27. If your answer for question for number 26 is "yes", please explain the areas of training?

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28. Where is the location of your farm land from water source?

1. Lay Mender
2. Kes Mender
3. Tach Mender

29. How long does it take to go from your farmland to the sources of irrigation water? ________ minutes?

Part III: Institutional data of the respondents

30. Does your household have access to credit?

1. Yes 2. No

31. Do you have access to extension service?

1. Yes 2.No

Management activities and challenges of small scale irrigation management practices.

32. Have you ever faced any conflict over irrigation water use?

1. Yes 2. No

33. Have you ever seen other people being in conflict over the use of irrigation water?

1. Yes 2. No

34. If your answer for question number 32 and/or 33 is "yes" what are the causes of the conflict? (Multiple responses is possible)

1. Water theft/taking water out of turn
2. Water scarcity due to the declining supply from the source
3. Water scarcity due to increasing number of users
4. If other specify---------------------------------------

35. In which course of the irrigation area is conflict more pronounced?

1. Upper course
2. Middle course
3. Lower course

36. What is/are the major management problems related to water distribution? (Multiple Responses is possible)

1. Sanction not imposed against illegal water users.
2. Rotation does not accomplish equally.
3. Rotation is not strictly implemented
4. Poor coordination of water user's committee.
5. If other, please specify---------------------------------

37. Is there scarcity of irrigation water in your locality?

1. Yes 2. No

38. If your answer for question number 37 is 'Yes', what are the major causes of water scarcity?

1. Water theft
2. Increasing number of irrigation users
3. Decline of water from the source
4. Poor scheduling distribution

39. Which farmers get more irrigation water?

1. Farmers with large family size
2. Farmers with large farmland.
3. Farmers who grow more crops.
4. If other specify--------------------------------

40. Is there any maintenance to irrigation scheme?

1. Yes 2, No

41. If your answer for question number 40 is 'Yes', how would you evaluate the maintenance of the scheme?

1. Very poor
2. Poor
3. Good
4. Very good

42. If your answer for question number 41 is poor/very poor, what are the major causes of the Problem?

1. Lack of maintenance materials.
2. Absenteeism of some members on maintenance days.
3. Breaking of canals by illegal water user
4. Siltation.
5 Animal damage
6. If other specify--------------------------------------

VI. Roles of water user's association committee

43. Who are the responsible bodies for water distribution in irrigation scheme?

1. DAs
2. Elderly persons
3. Water user's committee
4. If other specify---.

44. How do you evaluate the roles of Water Users Association Committee in water distribution?

1. Enough water is not received due to miss utilization of water/adequacy
2. Water is not received when it is needed/timeliness
3. Water distribution is unfair/equality
4. Water scheduling program is poor
5. If other specify-------------------------------------

45. How do you evaluate the performance of water user's committee in resolving conflicts?

1. Taking immediate actions
2. to the problems.
3. Suspending the cases.
4. Improving the conflict management.
5. If other specify...

46. If you are member of water user's association committee, please justify your roles on the irrigation management practices?

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Appendix Two Questions for Focus Group Discussion

1. What are the major obstacles which hindered Gimara small scale irrigation practices?

2. What are the roles of water user's association committee?

   Are there criteria to be a member of water users association? If yes, what are the criteria?

3. Does the water users' association committee have weakness? If yes, what are the weaknesses of water user's association committee?

4. What are the major causes of conflict over irrigation water?

5 What are the major causes of irrigation water scarcity?

6. What are the determinants of Gimara small scale irrigation practice?

7. Please explain the major challenges for not practicing irrigation?

8 **.**How do you evaluate the maintenance of the irrigation scheme

Appendix three for interview

1. What are the major challenges of Gimara small scale irrigation management practice?
2. What are the roles of water user's association committee in irrigation management practice?
3. What are the contributions of DAs and *Woreda* irrigation offices for irrigation management practice?
4. What are the weaknesses of water user's association committee?
5. What are the causes of water scarcity and conflict over irrigation water?
6. Please explain the conditions of the maintenance activities?