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THE SUSTAINABILITY OF RURAL POTABLE WATER SCHEMS: THE CASE OF DANDI WOREDA, ETHIOPIA

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ADVISORS' APPROVAL

This is to certify that Mr. ASFAW KASSA TESEMA has conducted a thesis entitled *"THE SUSTAINABILITY OF RURAL POTABLE WATER SCHEMS: THE CASE OF DANDI WOREDA, ETHIOPIA"* has been carried out under my supervision. The thesis submitted in partial fulfillment of the requirement for defiance's in Water Resource Management; the graduate program at College of Development Studies, Center for Environment and Development Studies. Therefore, I recommend that the student has fulfilled the requirements and hence hereby can submit the thesis to the Center for Environment and Development Studies.

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ADDIS ABABA UNIVERSITY EXAMINER'S APPROVAL

This is to certify that the thesis prepared by Mr. ASFAW KASSA TESEMA, entitled" *THE SUSTAINABILITY OF RURAL POTABLE WATER SCHEMS: THE CASE OF DANDI WOREDA, ETHIOPIA* "submitted in partial fulfillment of the requirement for the degree of Master of Science (MSc) program in Water Resource Management; complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

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ABBREVIATION AND ACRONYMS

ADF-African Development Fund
CBOs –Community Based Organizations
CDD - Community Driven Development
CL - Community Leaders
CMP - Community Managed Project
CSA - Central Statistical Agency
CWUC - Chairman of Water User Committee
FGD - Focus Group Discussion
GTP - Growth and Transformation Program,
IRC - International Water and Sanitation Center
JMP - Joint Monitoring Program
MDG -- Millennium Development Goal
MoWIE—Ministry of Water, Irrigation and Energy
MOWRs - Ministry of Water Resources
NPC - National Program Commission
PM -Project Management
RWSS - Rural Water Supply Systems
SC - Supportive Collaborator
SPSS - Statistical Package for Social Studies
UNDP - Unite Nation Development Program
UN - United Nation
WHO - World Health Organization
WHO --Woreda health officer
WSSD—Water supply and sanitation
WSE—Water supply engineer
WUC -- Water User Committees
WWREO—Woreda Water Resource and Energy Officer,

ABSTRACT

Ethiopian government has implemented the community-based water supply system management policy and strategy in the rural water supply sector since 2001. Because community participation is essential for the continued operation of water supply schemes, This paper assesses the sustainability of the rural potable water supply system Empirical Evidence from rural kebeles households, water user committees, and supportive collaborators. of Dandi Woreda Oromia Region. The study concerned mainly investigating pre-implementation factors, financial factors, social factors, and problems related to the functionality and access of water schemes. To this end ,descriptive survey design was employed The study involved both quantitative and qualitative methods. Descriptive statistical analysis was done using means and standard deviation, while inferential statistical analysis was done using ANOVA at critical points $F<3$ and $P\underline{\geq}$ 0 .05 to show a significant level difference between and within the three group means of responses of households, WUC and SC.

The result obtained in the finding indicated that; the quality of the construction of water schemes was low, most of the water supply schemes were un-functional, and the amount of service and coverage ease of water supply was low, satisfaction of society with the supply and purity of water was low. The overall work activities and capacities of WUC to control and manage the project were found to be at very low level. If urgent solutions are not given to the existing problems, all the water schemes will stop functioning. Therefore, prioritization should be given to immediate maintenance of the failed water scheme that would be accompanied by overall activities that improve the effectiveness of management of portable water projects.

Key words: Accessibility, Financial factor, Functionality, Pre-implementation, social factor, Sustainability and Water scheme.

CHAPTER ONE

1. INTRODUCTION

This chapter covers the study's background, a problem statement, research questions, and objectives as well as its significance, delimitations, limitations, operational definition of important terminology, and organization.

1.1 Background of the Study

Access to safe drinking water and sanitation is a basic human right. Hence, necessary measures must be taken by the government to ensure access to drinking water. (kumar, 2018). Water is used as a coolant and a medium for metabolic activities in the body, as a means of disease prevention, and for economic and social purposes (MOH 2011). The multifunctional and multipurpose nature and uses of water cause an increasing demand for water due to the rapid population growth, increased agricultural needs, and industrial revolution; water resources are continuously getting depleted. Thus, there is a need for conceited efforts to conserve the scarce commodity that meets the needs of the current generation without compromising the ability of future generations to meet their own needs (Li, 2019).This raises concerns about the long-term viability of portable water supplies for community use. Although the sustainability of a water project has been defined in various ways by a number of scholars, how we define sustainability is important for selecting parameters important for measuring and understanding the factors that affect prospects of sustainability.

Therefore, the study that was conducted adopted the definition of sustainability in terms of infrastructure as "the design of human and industrial systems to ensure that humankind's use of natural resources and cycles does not lead to diminished quality of life due to either loss of future economic opportunities or to adverse impacts on social conditions, human health, and the environment."Additionally, sustainability is not limited to these elements. Institutions, public participation, social awareness, capacity building, operation and maintenance, technical, and financial issues are some of these factors. (Dhakal, 2018)

Even though studies showed that improvements had been made worldwide, 90 percent of the world's population used improved drinking water sources in 2015, and coverage in rural areas had increased from 69 to 82 percent between 2000 and 2020 (UNICEF/WHO 2021), there were geographic disparities because half of the 771 million people who did not have access to basic services in 2020 lived in sub-Saharan Africa (WHO and UNICEF, 2017). Ethiopia, as a highland country, receives a large amount of rainfall. But, the periods of severe drought and rainfall variability brought a measure of urgency to the delivery of sustainable water supplies in most of the rural areas (80% of the country's population) where there was a high suffering of scarcity of portable water that made the country in the fourth place out of ten worst countries for access to clean water (World Vision, 2020). The critical nature of the problem of rural water supply in Ethiopia is acknowledged at both the national and regional levels, and this is reflected in both national rural development strategy and program s for poverty reduction.

In 2016, with financial and technical support from Development Partners, the Ministry of Water and Electricity (MoWE) developed a framework named "National Rural Water Supply Operation and Maintenance Management Strategic Framework for Ethiopia." (MOWE, 2016). The Woredas are expected to use this framework to choose the best support and tracking methods for the nation. This is done to ensure that institutions and communities properly operate and maintain rural water delivery systems in order to ensure the long-term viability of the current water supply systems. Even if the Ministry of Water, Irrigation and Electricity has been actively involved at the grass roots level to improve the situation, potable water supply coverage is still at a low level in many parts of the country, particularly in rural areas, where 84% of the population lives (Fikrte and Fitsum,2014).

Overall, Dandi woreda is organized into 35 rural kebeles served by different water sources (hand dug well, shallow well, motorized spring, and public standpipes connected to springs or deep well-based schemes). The service delivery model is community-managed schemes are estimated to serve 85.2 percent of the rural population and, in Ginchi town, utility-managed piped schemes are estimated to serve about 14.8 percent of the population. For each scheme, WUCs consisting of 7-9 members elected by and from

the local community are responsible for the operation, maintenance, and daily management of these schemes. (Report of the Dandi Woreda Water Resource and Energy Office, 2019).

1.2 Statement of the Problem

Studies show that to ensure the sustainability of rural water supply services, there must be community participation and social participation, assured cost recovery, and development of distributed services (Horecha 2018). However, that alone would not solve every issue, particularly in rural areas. Water project qualities that must be integrated in order to reap benefits include functionality, utilization by intended beneficiaries, and resilience (Harvey and Reed, 2007). Factors that influence the sustainability of rural water supply systems are categorized into two main categories. There are pre-implementation and post-implementation factors. Community participation, technology selection, site selection, demand responsiveness, and construction quality are some of the pre-implementation factors along with post-implementation factors; technical support, community satisfaction at household level, institutional and financial management, training, and community willingness to participate in sustaining the water project (Abebe, 2012).

Research in this field indicates that a large percentage of water projects end in premature failure. A leading cause of these failures is that organizations tend to misunderstand or ignore the concept of sustainability, and community opinions are not always considered with regards to system design and management both before and after the system's construction. (Domnguez, 2019). The research conducted by Banks and Furey (2018), indicated that the sustainability and continuous delivery of water services were partly functional. Other studies (Tincani. L and Ross. I, 2018), (Beshah M. Behailu, 2016). were also able to point out that the causes of the failure of the sustainability of water projects were technical and financial factors. Specifically, water point failures are connected to poor quality of construction, poor availability of spare parts for repairs, lack of on-time maintenance, and poor post-implementation management that similar to the undergone study.

In Ethiopia, a number of scholars have conducted research on the functionality of water supply schemes, and their findings show different results. According to Esra (2018), a study indicates that a quarter of rural water points are non-functional by the time they reach a quarter of their design life time. Research conducted in Amhara, Oromia SNNPR, and Tigray regions indicated that about 80 percent of rural water supply schemes in Ethiopia are fully functional and 20 percent are not. Lack of funding for operations and maintenance, insufficient community involvement, and ownership of installed water systems are the main causes of non-operational water systems (Carmen, *et.al.*2018).

The lack of community participation in decision-making before and after the implementation of the water supply systems has a negative influence on ownership and the inability to obtain spare parts near user groups, which is another factor causing the infrastructure to work intermittently. Even if Ethiopia used a community-managed strategy follow the global trend communities were lacked a sense of ownership in their water supply management and were dissatisfied with donor, humanitarian, and public program implementations. Community-based water project management, which emphasizes community ownership and authority for the construction, operation, and maintenance of their water supply facilities, is a major foundation for the operation and maintenance of rural water supply systems (MoWE.2016). In rural areas, the application and general maintenance of rural water points have historically been accomplished with the aid of the government's technical expertise, minimal engagement, and target community possession. Such approaches, however, have failed to consider regional assets that could be used to more effectively monitor the installation of rural water delivery systems (MoWE, 2016). To solve the problem, the end user needs to be involved in the problem identification, planning, implementation, and management of their water supply systems (Beshah M. Behailu, 2016).

Dandi Woreda had many problems with water supply accessibility due to the non-functionality of constructed water supply schemes, generally in the woreda water supply schemes challenge were poorly community participation at the per-implementation phase, high level of illiteracy rate (low level of community mobilization to participate on water

supply schemes implementation, the installed hand pumps are broken and displaced from their position by users, no spare parts had been available. For instance, users had not been motivated to repair the pump; there was the poor quality of construction. There is no operation and maintenance most of the schemes were not maintained and used less water supply technology. Now a day users are restored to unsafe water sources that are exposed to health hazards and a large number of people, especially children were dying due to waterborne diseases. (Dandi woreda health office,2020). Based on the researchers has good knowledge of the woreda and had observed a considerable number of potable water projects failing to function after some time of operation, which made the woreda a good choice for the study.

In view of the aforementioned problems, the undergone study was able to assess the extent of sustainability of rural potable water projects through the identification of the major factors affecting sustainability. But this study was different from the existing study in the way that it comprehensively analyzed the sustainability of potable water projects in terms of appropriate determinants such as pre-implementation, financial, functionality, and access of water schemes and socio-environmental factors affecting the sustainability of potable water schemes to answer the fundamental need and a human right of getting potable water.

1.3 Basic questions

1. What are the major pre-implementation factors affecting the sustainability of rural potable water supply schemes?
2. To what extent does project financing affect the sustainability of rural potable water supply schemes in the study area?
3. How do functionality and access of water schemes affect potable water supply schemes in the study area?
4. What is the effect of socio-environmental factors on the sustainability of rural potable water supply schemes?

1.4 Objective of the study

1.4.1 General objective

The main objective of the study was to assess the sustainability of the rural potable water supply system of Dandi woreda in the West Shewa Zone of Oromia Regional State, Ethiopia.

1.4.2 Specific objectives

The specific objectives of the study include

1. To analyze the major pre-implementation factors affecting the sustainability of rural potable water supply schemes.
2. To assess the extent project financing affects the sustainability of rural potable water supply schemes in the study area.
3. To study how functionality and access of water schemes affect potable water projects in the study area.
4. To assess the effect of socio-environmental factors on the sustainability of rural potable water supply schemes

1.5 Significance of the Study

By assessing factors hindering the sustainability of rural potable water supply schemes, the study might provide mitigation actions to tackle those hindering factors. This study contributes to the better understanding of problems and factors related to sustainable management of rural water supply systems. Moreover, to provide inputs to the regional and Woreda water supply sector and regional government to consider or take into account the results of the study for the future water project implementation in Dandi Woreda. The findings of the study will serve as an input to collaborating NGOs, community-based organizations (CBOs), and other parties involved in the delivery of rural water supply service activities with a concrete understanding of water supply system scenarios and contribute to the rural water supply framework. In addition, the research findings and recommendations may be used as a guide for decision-makers and other academics who do additional research on the subject.

1.6 Delimitations (Scope of the study)

The study was delimited to in three Kebeles out of 35 Kebeleof Dandi Woreda of West Shewa Zones. It could be more comprehensive and reliable, if the study included all the Kebeles found in the Dandi Woreda, while using a variety of data gathering tools is highly productive, the current study was limited to questionnaires, interview, FGD, Personal observation and document analysis. In connection with delimitation of the variables of the study, only most widely used factors of sustainability of water project and the most valuable pre-implementation factors and post-implementation factors, project financing affect sustainability, functionality and access of water scheme and Socio-Environmental Factors were treated. Moreover, the participants of the study were restricted to water user committee, household and educated collaborator (questionnaires), community leaders and Woreda water resources and Energy officers (Interview) and chairman of water user committee, Woreda water supply engineer and Woreda health officer (FGD). The reasons for delimitations of all the above cases were to make the data collection and analysis more manageable, and complete the study within specified available resources and time.

1.7 Limitation of the study

The researcher might face some constraints while doing the research. The prominent limitations that have been encountered include

1. There is no exact parameter to assess the sustainability of water supply system. Therefore, the researcher used the most effective indicators of sustainability such as per-implementation and post-implementation of rural water schemes.
2. Since field data gathering from a distant area requires a long time and intensive observation to get the actual data to the problem. To this end, the researcher was forced to rely on colleagues (Teachers & Health workers) for data collection and other support.
3. Most of the household respondents might not genuinely give their opinion on all questions present in the questionnaire and interview. The researcher, however, tried to solve the problem by frequently checking whether the respondents understood the question raised or not and giving clarity on the item.

4. The settlement of the rural residents, where the study was conducted made the data gathering process inconvenient restricting providing orientation for all respondents at one center. This problem was solved by face to face orientation and interview with individual in dispersed way and used open space for FGD to keep social distance to minimize CVD-19 treat.

1.8 Operational Definitions of Key Terms

Community participation*;* is the process through which stakeholders influence and share control over development initiatives and the decisions and resources that affect them (Kinyashi, 2008; Ofuoku, 2011).

Household perception*;* is defined as the organization, identification, and interpretation of sensory information in order to represent and understand the presented information about water supply schemes.

Potable water, in this case, is the water that is protected from pollution and suitable for drinking purposes. That includes things like pipe water, spring water after development or safe, borehole, hand pump, etc.

Social economic factors; refer to household's economic and social position based on income, education, and occupation that influence their participation in community projects

Sustainability*:* is the maintenance of water supply infrastructure in a way that assures a consistent and sufficient supply of potable water over an extended period of time. It is typically described by many sources as the capability of a system to endure and maintain itself. This term may be used differently in different disciplines (Silva, et.al., 2020).

supportive collaborators; in this case, the educated personnel working at kebele level (teachers, health professionals, and agriculture development agents).

water scheme is the entire facility (Hand pumps) established to extract water from a water source and distribute it to (close to) people. (M oWE, 2016)

1.9 Organization of the study

There were five chapters in this study. In the first chapter, the introduction, which covers the study's background and problem statement, objectives, significance, delimitation,

limitations, definition of important terminology, and study organization, is covered. It was provided with an overview of the study and offered rationale around the topic, particularly the reasons why the topic is worth exploring. The second chapter was a review of related literature, and it was in this chapter that the research questions began to be clarified, using the literature review as a vehicle. It assisted in giving a clear picture of what to expect in the investigation.

Therefore, the purpose of this chapter is to give a clear understanding of the topic of the research. Whereas chapter three discussed the design and methodology, under which the design of the study, the research method, data sources, sample population and sampling techniques, the type of instrument and data analysis techniques used were discussed. Chapter four provided presentation, analysis, and interpretation of the gathered data by discussing the sample population and its characteristics in order to understand the nature of the research findings. And in the last chapter, the whole research project is considered. In this regard, the researcher has given the summaries, conclusions, and recommendations of the study. Finally, lists of reference materials used in the study, questionnaires, interview guides the status of existing water schemes and the location of the schemes were attached to the research document.

CHAPTER TWO

2. REVIEW OF RELATED LITERATRE

A literature review relates a study to the larger ongoing dialogue, filling in gaps and extending the prior studies (Rossman, 2010). It also provides a framework for establishing the importance of the study as well as a benchmark for comparing the results with other findings. Thus, in this section, the review was presented with both theoretical and empirically relevant reviews on the work that seems to be relevant to the research topic and bears significance in providing the researcher with deeper insight. The first segment of the literature review deals with the theoretical framework of the study that includes many subtopics under it, and the second part presents the empirical review followed by the conceptual framework of the study, mitigation actions, and a literature summary of the study.

2.1 Water as Valuable Natural Resource

Access to clean drinking water and sanitation services is a worldwide priority and the basic foundation of human health, well-being, socio-economic development, and human dignity. In addition, they serve as crucial pillars of human development, a means of reducing poverty, and a part of primary health care. By reducing the mortality from diarrheal disease by an average of 65% and the morbidity that goes along with it by 26 %, the provision of an adequate and clean water supply thus represents an effective health intervention (Carmen, *et.al*.2018).

The human body's basic water requirement depends on climate, work-load, and environmental factors. If the work load is high and the season is dry, the family uses a large amount of water per day. However, as the family size increases, the amount of water consumed by one person per day decreases relative to the one that small number of family sizes. However, Gleick (2006) defined the minimum requirement for the human body and found that it is between 3 and 10 liters per day. The amount of water needed for other purposes, including cooking or hygiene, is more variable and depends on cultural habits, socio economic factors, and the types of water supply in terms of quantity, quality,

and availability. (Gleick, 2006).Water supply coverage for rural areas of Ethiopia by the standards of GTP I was 15liter consumption per day per person (l/c/d) within 1.5 km radius (Mekuria B. G., 2019, pp 3)

2.2 The Concepts and Characteristic of Sustainability

The concept of sustainability has taken its root from the debate on sustainable development during the early 70's. It arose within the environmental movement and attempts to protect natural resources and ecological systems from over-extraction, shocks, or stress. Many scholars attempted to define sustainability in various ways based on the type of project, sector of organization, and nature of an object whose continuous supply was required. In the context of the water supply and sanitation sector. The widely used definition of sustainability is that reported by (Li. 2019, pp 1), the term "sustainability development" refers to development that satisfies current demands without jeopardizing the capacity of future generations to satiate their own wants. This being the case, different organizations used to produce their own adaptation of definition in line with addressing their deliberate objective. It includes environmental, economic, and social dimensions with the concept of stewardship. As the study focused on the functionality or service status of water supply schemes, the researcher preferred to adopt the following water supply sustainability definition.

> "*Sustainability is the ability of the system to provide benefits over time to the user, such as improved lifestyle and human health, and enhanced quantity, quality, convenience, and continuity of water supply." According to this definition, the achievement of sustainability engrosses the realization of enduring 'beneficial' changes in rural water services. Thus, the sustainability of water supply projects has been defined as the maintenance over time of the project benefits that consist of maintenance and operation as well as access to prolonged "* (Isabel D. 2018).

2.3 Theories of sustainable Water Supply system

In this section, the researcher reviews theories and empirical studies that border on sustainability of water supply schemes. The researcher's aim is to understand the pertinent theories that can be used to explain water sustainability. He also purposes to have an in-depth assessment of related studies with a view of trying to establish potential

research gaps. The review of the empirical literature enables the researcher to formulate a conceptual framework in respect of the study objectives.

2.3.1 Sustainability Theory

Theories of sustainability attempt to prioritize and integrate social responses to environmental and cultural problems (Mwnaqi, 2014). They confirm this by suggesting that the origin of sustainability, alternatively referred to in literature as "*sustainability refers to the capacity to maintain some entity, outcome, or process over time."* As a general perspective of different scholars, water is a natural resource deemed sustainable development if and when various activities do not tire out the material resources on which it depends are un-functioned. The concept of sustainability frames the ways in which environmental problems influence the conditions of healthy economic, ecological, and social systems.

2.3.2 Theory of Community-Based Natural Resource Management

The dynamic idea of Community Based Natural Resource Management (CBNRM), which emerged in Southern Africa in the 1980s as a strategy for integrating rural people into the conservation process, offers little advantages to households (Paul Andre, 2009). The philosophy of community-based natural resource management (CBNRM) contends that the best approach to manage natural resources is for local people to use their local knowledge and practices. However, research claims that most CBNRM plans fail since this principle is not used in reality. CBNRM works to promote both community development and environmentally sustainable management. This hypothesis makes a number of important points. Local management is argued to mean that the local people have power and make decisions, thereby producing accountable. CBNRM is viewed as a better solution to conservation than fencing off natural resources and excluding people from them; the use of resources is further enforced locally by people who have a stake in their protection, which is more effective than, say, government enforcement; and finally, the use of resources is further regulated locally by people who have a stake in their protection.. (Mwnaqi, 2014). According to CBNRM theory, landowners acquire access to and ownership of natural resources, participate in resource use planning and management

in a collaborative and transparent manner, and reap financial and other advantages from good stewardship.. (Lyman, 2005)

2.3.3 Water and Sustainable Development

United Nations Sustainable Development Goal 6 states Sustainable rural water supply and sanitation in sufficient quantity and quality for all fresh water. It is essential for all aspects of life and sustainable development. The human rights to water and sanitation are widely recognized by member states. Water resources are embedded in all forms of development (e.g., food security, health promotion, and poverty reduction), in sustaining economic growth in agriculture, industry, and energy generation, and in maintaining healthy (UN, 2018).

In a sustainable world that is achieved in the near future, water and related resources are managed in support of human well-being and ecosystem integrity in a robust economy. Sufficient and safe water is made available to meet every person's basic needs, with healthy lifestyles easily upheld through reliable and affordable water supply and sanitation services, in turn supported by manageable infrastructure Yedemie et al., 2017) Water resource management, infrastructure, and service delivery are sustainably financed. Water is duly valued in all its forms, with wastewater treated as a resource that avails energy, nutrients, and fresh water for reuse. Human settlement develops in harmony with the natural water cycle and the ecosystems that support it, with measures in place that reduce vulnerability and improve resilience to water related disasters and hand over through integrated water resource management. Water is governed in a participatory way that draws on the full potential of all professionals and citizens, guided by a number of capable and knowledgeable organizations, in a just and transparent institutional framework (UN, 2015)

2.3.4 Global status of community managed water supply systems

Since the 1980s, the concept of community-managed water supplies has grown, and water stations have been constructed over the years. However, despite significant intensification of efforts to improve coverage and access to potable water supply and

sanitation worldwide, the situation in Sub-Saharan countries has not improved significantly; governments lacked the capacity to manage and retain their economic and human resources. National governments and donors alone cannot meet the water demands of the rapidly growing population, and the sector's multifaceted challenges in developing countries are critical for long-term service (Beshah M. Behailu, 2016).

A water supply can only be maintained for the duration of the system if the rate of withdrawal does not outpace the rate of resource replacement. In Ethiopia, access to safe drinking water supplies and sanitation services is among the lowest in sub-Saharan Africa. In 2005, the government of Ethiopia approved the Universal Access Program with the objective of providing safe drinking water to all citizens of the nation. Subsequently, the government, along with its development partners, has exerted a great deal of effort and substantial progress has been made. At the end of the first phase of the Growth and Transformation Program (GTP I), access to potable water for urban areas was 91% and access in rural Ethiopia was about 82% by the standards of GTP I (NPC, 2016).

In its domestic water implementation method, the national community-managed strategy follows the global trend of community-managed water delivery systems. This community-managed project method (CMP) makes use of a participatory community mobilization technique, whereby the local community provides labor, funds, and in-kind materials during the execution process, particularly during the construction stage. In five regions of Ethiopia, the strategy has been put into practice with assistance from UNICEF (MoWIE, 2016). With financial and technical support from Development Partners, the Ministry of Water and Energy developed a framework in 2016 named "National Rural Water Supply Operation and Maintenance Management Strategic Framework for Ethiopia" in addition to the CMP strategy. The Woredas are expected to use this strategy framework to choose the best support and tracking methods for the nation. This is accomplished to ensure that rural water delivery systems are properly managed and maintained by the communities and institutions to ensure the long-term viability of the current water supply schemes. (MoWE, 2016).

2. 3.5 Community Water Supply Schemes Management

Community management is the management option whereby communities, rather than government institutions or the private sector, have control over the management of their water supplies. The actual responsibility for the management lies ideally with a representative group of community people, often referred to as a water committee, chosen to take up this task. Although this group may opt for the involvement of local caretakers or small entrepreneurs, the committee remains in charge of ensuring a sustainable service and is accountable to the community at large. Supporting community management means taking into account that communities are made up of men, women and children of different socio-economic and cultural backgrounds, with sometimes-conflicting interests and ideas. In water supply and sanitation projects, community management refers to the fact that community exercises its responsibility of decision-making and becomes in charge of controlling the subsequent execution of these decisions during project development (Fonseca & Bolt, 2018).

In Ethiopia, the concept of community management in rural water supply was first perceived in the Amhara region in 2003, under a Finnish-Ethiopian bilateral Rural Water Supply and Environmental Program. Rural water supply expansion program has been supporting the expansion of rural water supply services in Amhara since 1994, At large, community management refers to power and control on behalf of the beneficiaries, where its ultimate goal is not maximizing users‟ participation but rather optimizing it to achieve sustainability through human development (Beshah M. Behailu, 2016).

2.3.6 Sustainability of Portable Water Project

In its domestic water implementation method, the national community-managed strategy follows the global trend of community-managed water delivery systems. This community-managed project method (CMP) makes use of a participatory community mobilization technique, whereby the local community provides labor, funds, and in-kind materials during the execution process, particularly during the construction. Over the decades, experience has shown that water and sanitation initiatives are most successful and long-lasting when they take a participatory approach that responds to genuine

demand, develops capacity for operation and maintenance and cost-sharing, directly involves community members in all major decisions, fosters a sense of collective ownership of the project, and makes use of appropriate technology that can be maintained at the village level. (USAID, 2009). Sustainability might be defined as management responsibility in its meaning that consists of maintenance and operation as well as access to prolonged water service (Hodgkin 1994).

The functionality of a water supply system is about the number of water supply facilities that are operational at any given time, and the significance of functionality is reflected in the reliability of those systems (IRC,2012). Indicators for sustainable rural water supplies are functionality, reliability, accessibility, and water fetching time in round trips, operation and maintenance fund allocation of tariffs and fees, the raising of funds to support the system as needed, environmental impact of technology, beneficiary ownership, and the existence of a functional water management committee (Isabel, D. et. al., 2019).

As Water Aid described, key conceptual factors affecting rural water supply sustainability, such as demand and relevant needs, program design and implementation, existence of a water supply management committee, revenue collection and record keeping, and external support (Water Aid, 2011). The rate of rural water supply can increase or decrease depending on community demand and the habit of owning and managing their water supply schemes, According to National wash Inventory the range 17%-47 % across the regions, with an average of 19% of water supply projects are non-functional after completion in Ethiopia. This is associated with problems in spare part supply chain, poor performance of service providers and under-capacity of service, lack of funds for operation and maintenance and inadequate community participation and commitment (Lamecha, 2022)

2.4 Empirical Review

In this section, empirical studies are reviewed in line with the study objectives and variables. The review is from a global perspective, a national and regional perspective, and eventually, an Ethiopian perspective. A good number of community-based projects in

the water and sanitation sector fail to deliver benefits to society over the long term in developing countries. According to Niyi (2007), research report indicate that hand pumps in particular are frequently not sustainable in sub-Saharan Africa's rural water supply systems. The absence of technical safeguards; the fluctuation of the ground water table caused by climate change, inadequate institutional support, insufficient financing sources; ineffective management structures, and inadequate policy or law are some of the major contributing factors. Adopting a comprehensive planning and execution strategy will be necessary to address these issues, as opposed to focusing solely on one issue. (Niyi, 2007). It is asserted that inadequate construction standards and a lack of sufficient and efficient administration may have contributed to the development of these unsuccessful initiatives. One could argue that maintaining an appropriate level of service for the duration of the system's design life is what makes a water supply network sustainable. Following project completion, ownership and management of the project are transferred to the community. (Mwnagi, 2014)

As Abebe (2012) made assessment, rural water supply management and sustainability in Ethiopia is poor due to providing local materials, labor, cash and involvement in consultative discussions constitute the major forms of participation in the area. The fundamental nature of community participation is understood as a onetime social mobilization and support package focused at pulling the required community inputs towards materializing the intended water supply scheme (Abebe, 2012).

Belay and Almayehu (2016) did a study on the factors influencing household engagement in the management of water sources in Ethiopia; the review looks at socioeconomic, institutional, and demographic aspects that have an impact on household participation. The findings demonstrate that engagement of water users in the planning and execution of the project, the advocacy offered by the initiative, and higher household income all have a beneficial impact on households' demand for sustainable water resource services. Therefore, while planning water supply projects, these elements should be taken into account in order to ensure a sustainable drinking water system (Belay and Alemayehu 2016). On the other side, inadequate post-construction management results in a system's

failing components seldom being replaced in a timely manner and prevents individuals from contributing to its upkeep and appropriate use. (Beshah M. *et.al*. 2016 pp,16).

2.5 Factors Affecting sustainability of water supply system

Factors that affect sustainable rural water supplies are pre-implementation and post implementation factors that, community participation, project organization management practice, community training, environmental conservation and the existence of a functional water management committee (Bhattarai, 2008).

2.5.1 Pre-Implementation Factors

Water supply schemes sustainability are affected with different indicators, such as Community participation, technology selection and contraction quality, site selection, demand responsiveness, construction quality, population and training, Demand responsive and Managerial task and skills.

2.5 1.1 Determinant of Sustainability

Implementation of water supply projects should not be an end to them, but in community management projects, users are the planners, implementers, and owners of the project from the very beginning. Operation and maintenance have been handed over to the community (MoWE, 2016). Sustainable water supply systems are characterized by the infrastructure in terms of design and construction; quantity and technology deficits; and a lack of knowledge or experience among those operating and maintaining the systems. Different scholars' studies in this field indicates that a large percentage of water projects end in premature failure. The cause of water project failures is that water sectors tend to misunderstand or ignore the concept of sustainability, and community opinions are not always considered with regards to system design and management both before and after the system’s construction (Isabel D. et. al., 2019). In practice, sustainability is represented in assessment processes through the use of certain sustainability indicators, (Li et al., 2019).

The determinant factors for the sustainability of rural water supply systems are categorized into two main categories. These are pre-implementation factors and post-implementation factors. Community participation, technology selection, site selection, demand responsiveness, construction quality, population, and training are some of the pre-implementation factors. One of the pre-implementation factors for rural water supply systems is the demand responsive approach. Demand in this context is understood to refer to the quantity and quality of water that a communities will choose to drink at a specific price (Gizachew, 2005). Beneficiaries should sense the need for a supply of safe drinking water under a demand-responsive strategy in order to identify safe drinking water supply projects. Water projects are more or less demand-responsive to the degree that beneficiaries make choices and carry out resources in support of those choices (Misgina, 2006)

2.5.1.2 Managerial task and skills

Tasks and competencies for managers indicate that the technical tasks carried out by water resource project managers include studying water supplies, constructing distribution systems, and keeping an eye on water quality. In order to increase ownership and enable efficient service delivery, project management requires better alignment of development projects with the interests of the host communities. It also entails coordinating aid initiatives at all levels (local, national, and international budgets); ascertaining and managing risks within a project, and preparing risk mitigation measures.
Defining project scope and gathering requirements are just two examples of project management activities. Other activities include managing resources and pertinent training issues within a project, providing advice on technical architecture, identifying specific and general project management practices and escalation procedures, estimating project schedule and budget, identifying and managing risks.
Other general project management profile features, like past exposure to the methodology experience, as well as the technical abilities listed above also play a role in how well a Project management and a project match or fit (Beath, 2000) As the most senior member of a project, a Project Management is frequently seen as a sounding board for judgments on the project's technical and architectural specifications. Additionally, the project manager must show that they have a thorough understanding of the project's business goals (Bloom, 2006).

According to Tefera (2013), both hard and soft skills are necessary for project management success. Hard skills include technical proficiency, knowledge, experience, project management expertise, and project management competencies like planning, monitoring, risk management, and scheduling. (Tafara, 2013). Therefore, Since the overall activities of the project implementation are handled by the water user committee because it is a community-based project, the per-implementation of the water project/schemes is negatively impacted by the WUC's inadequate managing skills.

2.5.2 Post- implementation Factors

post-implementation factors are including technical support, community satisfaction, institutional and financial management, training, and willingness to sustain the water project (Misgina,, 2006). This study focused on Financial factors , Accessibility and functionality, Social factors, community water supply Schemes management community Training and Environmental conservation.

2.5.2.1 Financial factors

The economic factors that influence sustainability include the establishment of an O&M fund, regularity of making financial contributions by water users, adequacy and transparency in managing O&M funds contributed by water users, and rules on making financial contributions.(Tendai Kativhu,2016). The financial sub-category of sustainability includes issues of community financing and the cost of operation, maintenance and repairs (WESS, 2013) The failure of community revenues to generate sufficient funds for required repairs informing their view that communities should chose technologies and set tariffs that are affordable and commensurate with their economic status and the inability of communities to collect sufficient budget for repairs could reduce the life expectancy of installed water (Awol**,**2021). Sustainability of rural water supply schemes are financial ability to meet the cost of maintenance that is the Presence of tariff structure covering O&M and replacement cost willingness and ability to pay and financial management system (Mavhura, 2018) found the majority of communities willing to pay, but not all were able to cover the true cost of repairs and maintenance.

Whittington notes that rural communities are not progressing toward a financially viable future due to their extremely seasonal income flows and lack of available spare cash. The necessity of practical and open funding structures, where contributions are carefully monitored and invested in upkeep and repair, was highlighted (Awol, 2021) argue that communities' ability to form such funding channels is undermined by a lack of understanding of maintenance costs, insufficient tariffs, high default rates, ineffective collection methods, and poor financial management. Income source.

In the other hand Communal revenue levies are often appropriate for communities that share public water supply facilities and where there is a source of community income. As with the estimation of capital cost, it is important to keep operation and maintenance costs incurred in foreign and local currency separate. The level of support that can be provided in the form of contributions in kind should also be determined .and effectively recorded by WUC. To manage the project finance, the arrangements for the mobilization of all the financial, physical, and human resources necessary during the construction and operation phase of the WSS scheme should be made after the methods of financing construction and operation have been decided upon and cost-recovery mechanisms have been identified. An accounting system should be used along with the design and implementation of reporting systems. The reports will be used to track project progress and evaluate how effectively resources are being use (WHO, 1994).

2.5.2.2 Social factors

A number of studies in the sustainability dialogue have assessed water supply systems using social factors. Community participation is one of the sub-factors under social factors besides conflict management, representation of men and women and participation of vulnerable groups in water projects. In Ethiopia, Jiménez et al., (2019) also concluded that due to limited participation in planning and decision making at different stages of the project cycle, the water supply systems were not sustainable. Their conclusion contradicts the findings of (Jiménez et al., 2019) that community participation in making technical decisions had a positive relationship with sustainability. Successful community participation that goes beyond mere consultation and includes a dialogue on technology options has been recommended for sustainability to be achieved (U-Dominic & Godwin,

2018).Development practitioners have advocated for the representation of women and poor households in decision making for sustainability to be achieved (Tendaai Kativhu, 2016).

2.5.2.3 Community Training

Water project funds and resources need to be allocated with community, government, and agency consultation. Post-implementation support such as scheme caretakers' training, community awareness creation, and periodic visits can have a positive association with water supply project sustainability. In relation to the relevance of training and capacity building, training is one factor for rural water supply sustainability. It includes not only training of the management bodies, but also the community level (Tenaw, 2014). At the time of training, community and/or water supply management committees need to have three things: a safe environment, effective communication, and frequent practice (USAID, 2011)

2.5.2.4 Community Participation

Community participation is the process through which stakeholders influence and share control over development initiatives and the decisions and resources that affect them. A study carried out in Ethiopia by Tadesse, and Gebresenbet (2013) investigating rural water supply systems found that there was weaker community participation in regards to technology choice that is to be adopted in a project. The low participation could be so since the government and NGOs are the main decision-makers concerning technology type to be used for any water scheme (Justus, O., 2019). The opportunity for the community to choose the service level based on an "informed choice" will influence the community's sense of ownership of the project and will ensure that the project will meet the community's needs at this point in time. (WASH sustainability forum, Amsterdam, 2014).Community participation is implemented through participatory indicators that are used as parameters in ascertaining whether a project has been implemented and or is being operated through a participatory approach. (Sara J. et al. 2012). These revised the major indicators which have been used to measure community participation in the community water services provisioning sectors. These include, participation in decision

making, economic contribution, responsibility, authority, informed, choice (site selection); and partnership. (Yitagessu, 2019).Unless the end users are given the opportunity to be involved in the development of projects designed to improve their livelihood, they will continue to miss the benefits of any projects (Sonowabo, 2009). The community should be able to organize itself in relation to projects in a sustainable manner (Persoon, 2016).

2.5.2.5 Project Organization Management Practice

There is widespread evidence to suggest that after a number of years of operation, or less in some cases, many rural water supply systems were facing a variety of problems. These can include technical failures as well as management challenges. It is recognized that there is a limit to sustained community management and that a majority of communities will require some form of external assistance in the long term (Harold, 2002). Continued and ongoing external support to community organizations contributes both to an increase in the impact of interventions and to the length of time over which these impacts will be sustained (Water Aid, 2000).

Management of rural water supply can be successful at empowering communities and improving their involvement. It is increasingly being adopted in countries' national policy and legislation framework as the preferred method to operate and maintain rural water supply systems. community management is seen as a solution to the widespread failure of water supply systems and governments' failure to either provide potable water themselves or devise a system in which other agencies supply it reliably and consistently (Ton. et al., 2003). Water supply management theoretically puts responsibility in the hands of all stakeholders. Baseline survey assessment of hydrogeology, geophysics, engineering, developmental planning, and sociology helps determine the appropriate type of water supply source and the potential yield of water at a specific depth availability can provide information for sustainability of rural water supply (Elellan, 2015). Monitoring routines of rural community water supply systems have shown a positive impact on the motivation to properly manage, operate, and maintain their water supply systems to achieve the objective of water supply sustainability (Koestler, 2009).

2.5.2 6 Environmental Conservation

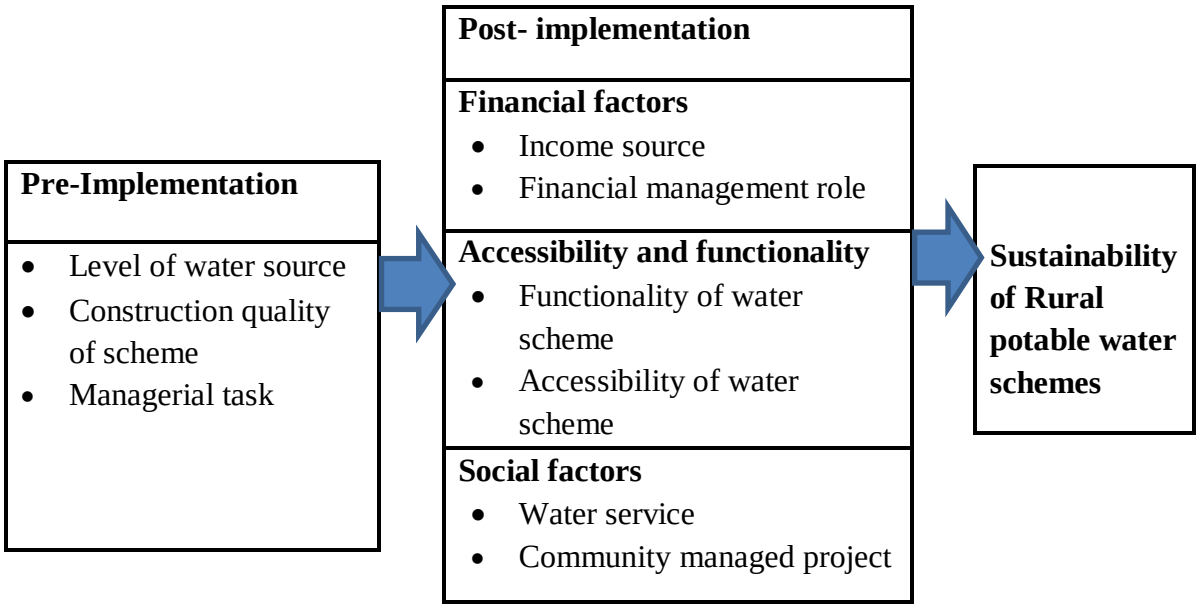
Water has been identified as one of the most important natural resources and is somewhat different from other resources because it is viewed as a key to prosperity and wealth. Water reduction and contamination are among the main environmental problems faced worldwide. In the 21st century, water conservation represents an important environmental protection strategy (Maria C. and Damiano F., 2016). Environmental sustainability refers to the capacity of the source to continue to supply the same quantity and quality of water over time. In this case, the process of drawing the water from the source must be analyzed. Along with economic development, population growth, and urbanization, inappropriate disposal of waste water and air pollution have become serious problems in many developing countries. (JICA annual report, 2016).

2.6 Conceptual Frameworks of Sustainability in Rural Water Supply System

A conceptual framework, according to (Imenda, 2014), is a collection of interconnected components and variables that aid in the solution of a real-world problem. It is a graphical representation of the relationship between dependent and independent variables that serves as the ultimate lens through which to examine the deductive resolution of a problem (Zackoff, et.al..,2019).

In this study, the researcher aligned the conceptual framework with the research objectives, and accordingly, the major pre–implementation factors (water source condition and scheme construction quality), project financing (income source & capability of financial management), functionality and accessibility of water schemes, and social factors (water service satisfaction and social-based management of water schemes). All three major factors were considered as independent variables, and the sustainability of water schemes was taken as a dependent variable. Project financing, functionality of water schemes, and social factors were put under the category of post-implementation factors. As demonstrated in the picture below, the relationship between the dependent and independent variables can be stated. Figure 1: Conceptual Framework Schematic Diagram.

Figure 1: Schematic Diagram of Conceptual Framework



Source: own conceptualization, based on literature review, 2022

2.8 Literature Summary

A massive amount of literature has been proposed and used based on differences in time, place, and type of water supply system, extent of sustainability problem, concept and practice gaps, and so on. Furthermore, several researchers have documented various regional and theoretical experiences and suggested different factors identified as affecting the sustainability of safe water supply systems. In summary, all the literature reasonably has the same consensus. Thus, the findings of the study are expected to contribute additional knowledge and practice dimensions in understanding of factors affecting sustainability of water supply projects among beneficiary communities and district and zonal officers, and the gaps in relation to pre and post implementation of water projects are expected to be filled.

CHAPER THREE

3 RESEARCH DESIGN AND METHODOLOGY

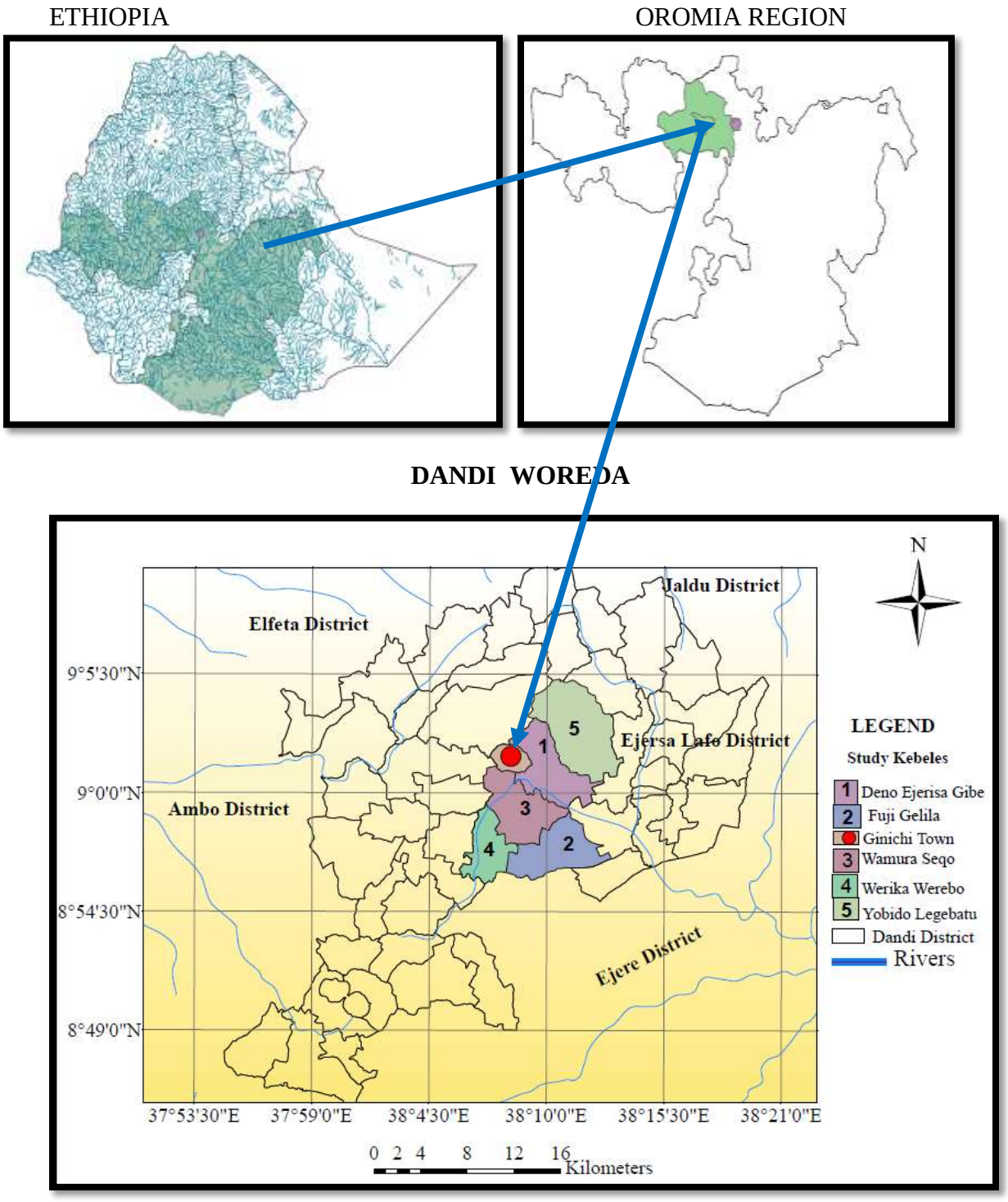
This section of the thesis deals with a description of the study area; research design; method; sources of data; the population of the study; sample size and sampling techniques; data gathering instruments; procedures of data collection; method of data analysis; validity and reliability of the instruments; and ethical considerations.

3.1 Description of the Study Area

This research was conducted in Dandi Woreda of the West Showa Zone of Oromia Regional State. It is located 78 km from Addis Ababa in the west direction and at 9°02' 18" Latitude North and 38°09' 35" East. Dandi Woreda has a total area of 79,939.29 hectares and borders Jeldu to the north, South West Showa to the south, Ejersa Lafo to the east, and Ambo Woreda to the west. Dandi woreda administration map (2019). Woreda is known for its productive crops, especially Teff and wheat in the zone. (Dandi woreda Agricultural office Annual report,2019). According to the summary and statistical report of the 2007 Population and Housing Census, the total population of Dandi Woreda was 212,230 as at 2007 (CSA, 2008). But by projection, with the population growth rate of 2.61 per year, today the total population is estimated at about 289778. This data excludes the residents of Ginchi town as it has got its own separate administration. The rural population accounts for 85.2% and the urban population accounts for 14.8% of the total population in the same year.

The Woreda is endowed with mediums to small rivers and the starting points of Awash river.. The water potential includes rivers are, Dabis Awash and Kerensa rivers natural spring ,Deep well, shallow well and hand dug well, The community were using from unprotected sources for domestic use from surface and ground water sources. The dispersed nature of the settlements and schemes source extraction systems are not appropriate. In this woreda, there are 310 water points of which only 80 % are functional whereas, 20 % water points are not functional (Dandi woreda administration report, 2020). In the study area There are are 35 rural kebeles of which three were selected.

Figure 2 Map of Dandi Woreda



Source: Extracted by the researcher from Google map December,2020

3.2 Research Design

A descriptive survey is used because it is a form of planned collection of data from a large population for the purpose of analyzing the relationships between variables (Creswell, 2014). The method also helps to provide adequate information that enables the researcher to suggest some valuable alternatives. Additionally, this research strategy emphasizes what is genuinely true, such as current facts, practices, circumstances, or any phenomenon. In order to achieve the aforementioned goals, it was necessary to gain a thorough understanding of how the study's participants perceived the sustainability issue with water systems based on their personal experiences.

3.3 Research Approach

Generally, explanatory research approaches were employed, which means two kinds of research methods in scientific studies: qualitative and quantitative approaches. In order to benefit from the relative strength of the two approaches and for the purpose of validating the researcher's employed mixed method (Creswell and Clark, 2007). The method is also preferable when the researcher is interested in concurrently collecting and analyzing both quantitative and qualitative data in order to draw valid general conclusions from the facts observed. Thus, both quantitative and qualitative data were gathered and analyzed in an integrated way so as to produce acceptable conclusions. In the quantitative approach, close-ended questionnaires were prepared and used, where as in the qualitative case, open-ended items in the interview focus group discussion and document analysis were prepared and utilized. The basic assumption of using a combination of both quantitative and qualitative methods is to provide a better understanding of the research problem and question than either method by itself.

3.4 Sources of Data

The sources of data for this research were both primary and secondary sources.

3.4.1. Primary Sources of Data

The primary sources of data of this study were collected through questionnaires from

households, water user committees (WUC), and supportive collaborators (SC), interviews with Woreda water resource and energy officers (WWREO) and community leaders (CL), and focus group discussions with the Chairman of the water user committee (CWUC), water supply engineers (WSE), and Woreda health officer (WHO), because they are the direct implementers/supporters and the beneficiary of water schemes.

3.4.2. Secondary Sources of Data

Secondary source of data were gathered from documents such as human resource plans, written documents, attendance and minutes of meetings, various check lists and formats, and reports written on the performance of water schemes and WUC at the kebele level, with the expectation that they have better information and experience in relation to the study and different documents related to the study.

3.5. Population, Sample Size and Sampling Techniques

3.5.1 Target Population

Data source of the study includes household, water user committees, supportive collaborators, Woreda water resource and energy officers (WWREO), community leaders (CL), water supply engineers (WSE), chairman of water user committees (CWUC) and woreda health office head. From the total 35 rural kebeles found in Dandi woreda, 3 sample kebeles were selected purposive sampling techniques. Those target kebeles of this study are Fajigalila, Danoejersa gibe and Wamura sako. From those 3 target kebeles 138 (65.4 %) household, 120 (70.17 %) water user committees, and 81 (80.19 %) supportive collaborators, from the total number of 483 population 339 sample were selected using simple random sampling technique through lottery system/ method, for the questionnaire. 3 Woreda water resource and energy officers (WWREO) and 3 community leaders (CL), for interviews, where as 5 water supply engineers (WSE) and 3 chairman of water user committees (CWUC) was selected by using availability sampling techniques.

3.5.2 Sample size

According to Dawson (2002), there are no established rules for determining an adequate sample. The type of population, the methods employed, the time and resources at hand, the goal of the study, the tools employed, and the expertise of the researchers all frequently have an impact on the sample size of a specific study. As a result, Yeman's formula was used to establish the sample size. (Yemane, 1967).

The justification for the determination of this sample size is mainly to minimize research errors using internationally accepted standards and to make data management easier while conducting the study. Thus, the sample size was determined by the following scientific calculation (formula).

n = $\frac{N}{1+N\ (e^2)}$ Where n = is the sample size, N = total population,

e = margin of error (0.05)

The level of confidence in this research was 95% where 5% is going to be taken as margin of error.

The total population of the households was 211 then the sample size was determined to be as follows

Households N = 211, $n = \frac{211}{1+211(0.05)^2} = 138$

The total population of the water user committees was 171 then the sample size was determined to be as follows

Water user committee: N = 171, $n = \frac{171}{1+171(0.05)^2} = 120$

The total population of the supportive collaborators was 101 then the sample size was determined to be as follows

Supportive collaborator N = 101 $n = \frac{101}{1+101(0.05)^2} = 81$

The sum total population for questioner from three categories, 339 respondents was selected.

3.5.3 Sampling Techniques

According to Best and James (2004), every member of a population has an equal and independent chance of being selected as a sample from the total target, 211 households,171 water user committee and 101 supportive collaborators, total of 483 population. Therefore, from the total population, 138 household, 120 water user committees, and 81 supportive collaborators were selected using simple random sampling technique through lottery system/ method, for the questionnaire. 3 Woreda water resource and energy officers (WWREO) and 3 community leaders (CL), for interviews, where as 5 water supply engineers (WSE) by using availability methods and 3 chairman of water user committees (CWUC) was selected by using availability sampling techniques.

Table 1: The summary of population, sample size of respondents and sampling techniques

No	Sample Kebele	Questionnaire								Interview				Focus group	
		Households		Water user committees (WUC)		Supportive collaborator (SC)		Total		Woreda water resource and Energy office		Community leaders (CL)		CWUC, WSE, WHO	
		N	n	N	n	N	n	N	n	N	N	N	N	N	n
1	Fajigalila	65	43	53	37	31	25	149	105	1	1	1	1	11	11
2	Wamurasako	72	47	56	39	34	27	162	113	1	1	1	1		
3	Dano-ejersa gibe	74	48	62	44	36	29	172	121	1	1	1	1		
Total		211	138	171	120	101	81	483	339	3	3	3	3	11	11
Sampling Techniques	Purposive sampling technique	Simple random sampling								Purposive sampling technique				Purposive & Availability sampling technique	

Remember: N =population; n = Sample

Source: Dandi Woreda unpublished statistical Abstract, 2014 E.C

3.6 Data Gathering Tools

The study included both quantitative and qualitative data. Both types of data were gathered by using appropriate data collection tools in order to obtain sample information from respondents and the Thus, questionnaires, interviews, FGD document analysis, and personal observation were the major data collection tools used in this study.

3.6.1 Questionnaire

The questionnaire was designed as both close-ended and open-ended items and was distributed to the sample participants. The questionnaire was compromised of two parts. The first part is for demographic information, which seeks respondents' age, sex, educational qualification, and experience to analyze if there is any link with the issue. Similarly, the second part includes items that are constructed to gather information about the basic questions raised in the study.

3.6.2 Interview

The interview was conducted to gather data from Woreda water resource and energy officers (WWREO) and community leaders (CL). The interviewees had more than adequate knowledge and experience of the topic under study. Semi-structured questions were used to guide the interview in the study.

3.6.3 Focus Group Discussion

Three focus group discussions (FGD) check point guides were prepared and administered in the cluster of the three sample kebeles, and the researcher had saturated the data with interview results and stopped further focus group discussion in another cluster of kebeles. The guiding points were used in conducting FDGs in Afan-Oromo Language, which is the rural community (residents) communication language..

3.6.4 Personal Observation

To assess the types of rural water projects, the standard of construction, the status or functionality of the existing water supply schemes; the way of conservation (protection), and the distance of the water source from the user community's home. A field visit was

conducted at 47 water schemes at three (3) sample kebeles using an observation checklist and data coordination GPS, as well as an informal discussion with the water users who were present during the observation and information was obtained by taking short notes.

3.6.5 Document analysis

The purpose of the document analysis in this study was to investigate the number of non-functional water schemes and analyze the water management reports in the sample Kebeles. The secondary sources of data include documents that show the non-functional water schemes and their maintenance, minutes of meetings, various checklists and formats, and reports of the woreda water resource and energy office, water user committees, and community users.

3.7 Validity and Reliability of the Instruments

Before the final questionnaires administration, pilot testing were conducted in two kebeles, Yubdo-lagabatu and Warka Warabo.which is out of the researcher population area. It was help to ensure that the respondents understand what the questionnaire wants to address and it was done with the objectives of checking whether or not the items contained in the instruments could enable the researcher to gather relevant information, to identify and eliminate problems in collecting data from the target population. The draft questionnaires was distributed to 8 households, 6 water user committee and 6 supportive collaborators total of 20 respondents those selected by simple random techniques and go through validation and reliability procedures in order to make clearer and check about the validity and the reliability of the instrument.

According Orodhon (2008) validity is concerned with establishing whether the instrument content is measuring what it is supposed to measure. It is the accuracy of a measure whether the results really do represent what they are supposed to measure. Validity of instruments which is improved through expert judgment. Reliability refers to the extent the instrument would be consistent in measuring what they are expected to measure (Mugenda, 1999), senior colleagues were invited to provide their comments. The participants of the pilot test were also first informed about the objectives and how to fill, evaluate and give feedback on the relevance of the contents, item length, clarity of items,

and layout of the questionnaire. Based on their reflections, the instruments were modified and improved before administering to the main participants of the study to reduce errors. As a result of the pilot test, three irrelevant items were removed; two lengthy items were shortened, and many unclear items were made clear.

Furthermore, the reliability of the survey instruments was tested to determine the manner in which items in each domain effectively grouped together. To this end, Cronbach's coefficient alpha was used to measure internal consistency of items. The results of all reliabilities in each domain were 0.86 and hence the instruments were considered to produce reliable data. The questionnaire with sufficient number (339 copies which were 138 for households,120 for water user committee and 81for supportive collaborators) of items addressing all objectives of the study were administered and then, 339 copies were collected with high return rate of 100%. Triangulation of data gathering tools was executed by using interview FGD, observation note and document analysis in each sample kebeles.

The Afan-Oromo language is the working language of the study area, so the questionnaires, interview and focus group discussion guides were translated into the Afan-Oromo language. This helped the respondents to have an easy understanding of the questions and give reliable information in a proper manner. On the other hand, the views of an experienced professional in the field of water supply and consumption systems on the tools to be used in the study were taken so as to ensure their validity.

3.8 Procedure of data collection

Through written letters of cooperation from Addis Ababa University and Dandi woreda Admiration, the researcher described himself and his goal. The researcher then discuses with the questionnaire respondents in person about the study's goal. Once the respondents' willingness was confirmed, they were oriented to avoid confusion, and the questionnaires were presented through the reading and filling in of answers by households and water user committees who were illiterate. On the other hand, the question was distributed to supportive collaborators (SC) and they were filled out by themselves. On the other hand, the interview questions was presented for key informants through reading and the answer was obtained by taking a short note and was recorded

with a mobile telephone, which helped to take all expressions as they were from the interviewee and FGD.

3.9 Method of Data Analysis

The study included a mixed research method of both quantitative and qualitative analysis. The information gathered through the various instruments was categorized into logical workable units and patterns that suggest generalization and a conclusion. The researcher used a quantitative method, which involves analysis of numerical data to explain the questions' role in the study. More briefly, quantitative data collected through close-ended questions of the questionnaires was coded, tabulated, organized, and computed by using statistical software known as the statistical package for social science (SPSS) version 20.00 program, in which descriptive statistics such as arithmetic mean, standard deviation, and weighed mean were used.

One-way ANOVA analysis is used to calculate F-value and alpha value of critical points $P > 0.05$ and F 3 in order to investigate the existence of significant differences between and within the three groups of respondents: households, water user committees (WUC), and supportive collaborators (SC) in questionnaires. The weighted mean numerical value obtained translates word expressions with a five-point Likert scale interpretation. guild lineas1=Very Low, 2=Low 3=Moderate, 4=High 5=Very High

The study also included a qualitative data analysis method for the data obtained through open-ended items from the questionnaire's interviews, personal observation, and document analysis. In the case of the interview, the presentation of qualitative data was done by reading a short note, listening through each interviewee's response, and reducing the data to only those answers and themes relevant to the research basic questions and putting them under each basic questions category. Then, the researcher narrated the qualitative data and interpreted it by triangulating with quantitative data.

3.10 Ethical consideration

In conducting this study, emphasis was given to every important ethical issue. First, before entering into the actual data collection, a formal letter was received as a letter of confirmation from Addis Ababa University, College of Development Studies and Dandi woreda Administration. Then, the letter was given to Dandi Woreda water resources and energy office for the selected sample kebeles for the purpose of the study. In addition, if people were participating with their full consent, every effort would be made to keep participants anonymous and maintain their confidentiality. Besides, all the resources used for this research were appropriately acknowledged.

CHAPTER FOUR

4 PRESENTATION, ANALYSIS AND INTERPRETATION OF DATA

This chapter discussed how to present, analyze, and interpret data gathered using various instruments. Two sections make up the chapter, and the first section provides background data on the sample population used in the study. The second session dealt with presentation, analysis, and interpretation of the information obtained through different data collection instruments such as questionnaires, interviews, FGD, field observation, and document analysis. In this major part, data presentation, descriptive discussion of the perception of respondents and their corresponding interpretation were given through explanatory mixed-methods, which are characterized by an initial qualitative phase of data collection and analysis, followed by a phase of quantitative data collection and analysis, with a final phase of integration or linking of data from the two separate strands of data (Berman, 2017).

4.1 Socio-Demographic Description of Participants' Of the study

The description of the background of the respondents provides some basic information about the sample population involved in the study. This part includes information related to the demographic characteristics of respondents. Accordingly, the variables of sex, age, educational background, work experience, and marital status of the respondents were summarized and described in the subsequent table**.**

Table 2: Demography of Participants

Variable	Level	Respondents					
		Household		WUC		SC	
	N	N	%	N	%	N	%
Sex	Male	85	61.6	75	62.5	53	65.4
	Female	53	38.4	45	37.5	28	34.6
	Total	138	100	120	100	81	100
Age level	≤ 30 Years	12	8.70	10	8.33	-	-
	31- 40 years	18	13.0	15	12.5	18	22.2
	41- 50 years	35	25.4	28	23.3	25	30.9

	51- 60 Years	42	30.4	37	30.8	32	39.5
	> 60 years	31	22.5	30	25.0	6	7.4
	Total	138	100	120	100	81	100
Educational qualification	Uneducated	45	32.6	18	15.00	-	-
	High school	23	16.7	21	17.50	-	-
	Certificate	32	23.2	30	25.00	21	25.9
	Diploma	28	19.6	31	25.83	32	39.5
	Degree/BA/BS	11	7.9	20	16.67	23	28.4
	MA/MSc	-	-	-	-	5	6.2
	Total	138	100	120	100	81	100
Marita status	Unmarried	28	20.3	12	10	10	12.4
	Married	95	68.8	90	75	60	74.1
	Divorce	20	14.5	18	15	11	13.6
	Total	138	100	120	100	81	100
Work Experience	≤ 5 years	14	10.1	17	14.17	12	14.8
	6 - 10 years	25	18.1	23	19.17	19	23.5
	11-15 years	42	30.4	35	29.17	24	29.6
	≥16 years	57	41.3	45	32.61	26	32.1
	Total	138	100	120	100	81	100

Source: own survey January, (2022)

4.1.1 Sex distribution

The above table shows the characteristics of respondents in terms of sex. Accordingly, 85 (61.60%) of the households, 75 (62.50%) of WUC, and 53 (65.43%) of SC, were males respectively. Among the remaining 53 (38.840%) households, 45 (37.50%) of WUC and 28 (34.57%) of SC were females, respectively.

Generally, the majority of the respondents were male dominant. In view of this fact, in particular, the number of water user committees was 60%. This low proportion of female water users' committee is a problem for the sustainability of the rural water scheme. Because, women in rural communities play an integral role in water supply as they are often connected to traditional roles of water collection, cooking, cleaning, and child-care. Consequently, practitioners aiming to improve access to and use of quality water supply in rural areas must engage women to ensure that the impacts of improved supply are fully

ensured (Feijoo & Furst, 2021). This implies that it seeks further efforts in empowering females as water users' committees in the study area.

4.1.2 Age distribution

Regarding the age distribution of the participants, only 12 (8.70%) households and 10 (8.33%) WUC were less than 30 years old. While 18 (13.04%), 15 (12.50%), 18 (22.22%), 1 (33.3%), and 3 (27.27%) of households, WUC, SC, WWREO, and WHO, respectively, are between 31- 40 years of age, On the other hand, 35 (25.36%), 28 (23.3%), 25 (30.86%), 1 (33.3), 1 (33.3), and 1 (33.3) of households, WUC, SC, WWREO, WSE, CL, and CWUC, respectively, are between 41- 50 years of age. On the other hand, 42 (30.43%), 37 (30.83%), 32 (39.51%), 1 (33.3%), 1 (33.3%), 1 (33.3%), 1 (33.3%), and 1 (33.3%) of households, WUC, SC, WWREO, WSE, WHO, CL and CWUC, respectively, are between the age 51- 60 years. Lastly, 31 (22.46%), 30 (25.0%), 6 (7.41%), 1 (33.3%), 1 (33.3%), and 1 (33.3%) of households, WUC, SC, WSE, WHO, CL, and CWUC, respectively, are above 60 years of age. From this, one can say that the majority of the respondents were old enough to deal with possible questions starting from the pre-implementation phase of the water scheme.

4.1.3 Educational back ground

Regarding the educational level of respondents, only 45 (32.61%) of households and 18 (15%) were uneducated, and 23 (16.67%) of households and 21 (17.5%) of WUC were high school completed. 32 (23.19%), 30 (25%), and 21 (25.93%) of households, WUC and SC were certificate holders, respectively. 28 (19.6%), 31 (25.8%), 32 (39.5%), 1 (33.3%), 1 (33.3%) and 1 (33.3%) of households, WUC, EC, WHO, CL, and CWUC were diploma holders, respectively. On the other hand, 11 (7.9%), 20 (16.67%), 23 (28.4%), 3 (100%), 2 (66.6%), 2 (66.6%), 2 (66.6%), and 2 (66.6%) of the household, WUC, SC, WWREO, WSE, WHO, CL and CWUC were degree holders, respectively.
Lastly, 5 (6.2%) of EC and 1 (33.3%) of WSE had second degrees. The proportion of WUC who had an educational background certificate was 51 (42.5%). Because the development and operation of rural portable water scheme projects necessitate project management and water engineering knowledge, it is recommended that water user

committees be educated as much as possible. Therefore, the Woreda water resource department officers are expected to propose more educated users to be selected as WUC members or else give comprehensive training for WUC.

4.1.4 Marital status distribution

In the case of the marital status of households, 28 (20.29%), 95 (68.84%), and 20 (14.49%) are unmarried, married, and divorced, respectively. As for the marital status of WUC, 12 (10%), 90 (75%) and 18 (15%) are unmarried, married or divorced, respectively. EC 10 (12.35%), 60 (74.07%), and 11 (13.58%) are unmarried, married, and divorced, respectively. The remaining WWREO, WSE, WHO, CL, and CWUC are all married. As discussed here, most of the participants in the questionnaire were married. Participating larger families help to get more information on the study as they are more water-efficient and give more information (water per capita utilization has a significant association with the family size).

4.1.5 Work Experience distribution

In the case of work experience service years, the data on the part of households indicates that 14 (10.14%), 25 (18.12%), 42 (30.43%), and 57 (41.30%) of households have work experience below 5 years, between the ages of 6-10 years, 11-16 years, and above 16 years, respectively. On the other hand, 17 (14.17%), 23 (19.17%), 35 (29.17%), and 45 (32.61%) of WUC have work experience below 5 years, between the ages of 6-10 years, 11-16 years, and above 16 years, respectively. 12 (14.81%), 19 (23.47%), 24 (29.63%), and 26 (32.10%) of EC have work experience below 5 years, between the ages of 6-10 years, 11-16 years, and above 16 years, respectively. 2 (66.7%) and 1 (33.3%) of WWREO have work experience of between 11-15 years and above 16 years. On the other hand, 2 (66.7%) and 1 (33.3%) of WWSE have work experience of between 6-10 years and 11-15 years. The remaining WHO, CL, and CWUC all have work experience of more than 16 years. The majority of participants were more experienced, so they had enough know-how to deal with the issue raised.

4.2 Analysis of Quantitative and Qualitative Data

In this section, the quantitative and qualitative data from the items used to answer the fundamental research questions are presented, analyzed, and interpreted. The researcher posed 32 items with four basic questions about the research in the questionnaire, which was administered to household, WUC, and SC respondents. The collected data was then entered into a computer running SPSS version 20 software to compute one-way ANOVAs, with statistical values for mean, standard deviation, p = value, and F = value being computed and tabulated. The analysis and interpretation of the findings were given in a short and precise way. The calculated p= value and F-value were used to determine whether there existed significant variation between and within the averages of the three group responses. Below the quantitative analysis of each item, qualitative analysis of open-ended items in questionnaires, interview questions, FGD, and document analysis were integrated to triangulate, substantiate, and supplement the quantitative data. The literature review is also included in the discussion section of the argument.

4.3 Pre- Implementation Phase of Water Scheme Project

Based on the specific objective (pre– implementation factors, functionality and access of water scheme financing, affecting the sustainability and the effect of social factors of rural potable water supply schemes), to answer the research question quantitative data analysis was employed by using One Way ANOVAs Statistical analysis to calculate Mean, Standardization(S.D), F-value and alpha value of critical points $P > 0.05$ and $F<3$ in order to ascertain whether there are any appreciable differences between and among the three groups and on the variable significance difference between and within the means of three group of respondents were observed at F value and F value the investigation made in the interview, FGD and personal observation data, indicate qualitative data analysis to triangulate the data.

Table 3: One Way ANOVAs Statistical Values of Pre- Implementation Phase

N	Variables	Respondents	N	Mea	S. D	F	Sig
1	The extent of scarcity of	Households.	138	3.82	0.84	0.05	0.9
		WUC	120	3.82	0.82		

	portable water before implementation of water	SC	81	3.85	0.81		5
		Total	339	3.83	0.82		
2	The presence of sufficient water supply as source of water scheme.	Households.	138	2.83	0.85	0.51	0.60
		WUC	120	2.77	0.86		
		SC	81	2.89	0.85		
		Total	339	2.83	0.85		
3	The goodness of the water scheme project design.	Households.	138	2.91	0.85	2.37	0.095
		WUC	120	2.69	0.86		
		SC	81	2.90	0.87		
		Total	339	2.83	0.86		
4	The level of users participated on the Site Selection of the water schemes.	Households.	138	3.00	0.97	2.39	0.0
		WUC	120	2.83	1.03		
		SC	81	3.14	1.03		
		Total	339	2.97	1.01		
5	The construction quality Standards of the water scheme.	Households.	138	2.12	0.57	0.09	0.9
		WUC	120	2.14	0.68		
		SC	81	2.15	0.55		
		Total	339	2.13	0.60		
6	The quality of materials used for water schemes construction	Households.	138	2.52	0.96	2.25	0.1
		WUC	120	2.64	0.90		
		SC	81	2.36	0.93		
		Total	339	2.53	0.93		
7	The presence of protection system (guard and fence etc.) at the water schemes to from breakdowns or addition of impurities.	Households.	138	2.71	1.01	1.69	0.1
		WUC	120	2.82	1.03		
		SC	81	2.98	1.07		
		Total	339	2.81	1.03		
8	The degree the water schemes placed or constructed at proper site.	Households.	138	2.55	0.91	1.00	1.0
		WUC	120	2.54	0.89		
		SC	81	2.54	0.92		
		Total	339	2.54	0.90		
9	Project Pre-implementation capacity building training given to the water committee members.	Households.	138	2.84	0.86	5.44	0.0
		WUC	120	2.83	0.95		
		SC	81	2.79	0.90		
		Total	339	2.83	0.90		

Source: Field survey, 2022

4.3.1 The level of Access potable water supply

Concerning the scarcity of potable water before the implementation of the water scheme project, the outcomes showed that the mean value and standard deviation of households,

WUC and SC were found to be (= 3.82, S.D = 0.84), (= 3.82, S.D = 0.82) and (= 3.85, S.D = 0.81), respectively. The weighted mean score was 3.83 and all the means of the three types of respondents fall in the interval (3.41-4.20) of the five level Likert Scale that is interpreted at a high level. The means of the three groups of respondents do not significantly differ from one another. At F = 0.05< 3 and P = 0.95 > 0.05, Consequently, the numerical figure showed that there was a high scarcity of potable water before the water scheme project was launched and during the period the source was interrupted.

With respect to the presence of sufficient water supply at the source of water scheme, the mean scores and the standard deviations of households, WUC, and SC were (= 2.83, S.D = 0.85), (= 2.77, S.D = 0.86), and (= 2.89, S.D = 0.85), respectively. The weighted mean score was 2.65 and all the means of the three types of respondents fall into the interval (2.61-3.40) of the five-level Likert Scale that is interpreted at a moderate level. The P and F values of the three means are, (F = 0.51, P = 0.60), respectively. This indicates that there is no significant difference between and within the responses of the three group respondents at P > 0.05 and F <3. Thus, the statistical value indicated the existence of moderate surface water and underground water that serve as sources of water scheme.

Figure 3: Illustration of unsafe water sources

Source: Field Observation photo taken from wamura sako kebele, January 21, 2022

As it is described in Figure 3 above, the water source is not adequate enough to deliver a continuous supply of potable water throughout the year. This thought is also supported by WWREO and community leaders (CL) interviewees who claimed that during winter, a large number of water schemes were interrupted due to the lack of potable water supply at water schemes. This implies that some sources of water schemes are non-functioning or not very sufficient to deliver potable water supply to the users all the time. As a result, the users are forced to use unsafe water sources.

4.3.2 Issues related to construction of water scheme

Regarding the goodness of the water scheme project design, the results obtained indicated that the mean value and standard deviation of households, WUC and SC were (= 2.91, S.D = 0.85), (= 2.69, S.D= 0.86) and (= 2. 90, S.D = 0.87), respectively. The weighted mean score was 2.83 and all the means of the three types of respondents fall in the interval (2.61-3.40) of the five-level Likert Scale that corresponds to a moderate level. Between and within the means of the three groups of respondents, there are no significant differences. for F = 2.37 and P = 0.095 at the critical value P > 0.05 and F < 3.Supporting the numerical description, the participants of the focus group reached agreement that, except for the drawbacks such as lack of provision of well treated pure water service, what consumers are willing to pay, less participation of female WUC, lack of strategic collaboration work with Woreda health office, and continuous training of WUC on water scheme project, in general, one can conclude that the water scheme project design is more or less good.

Regarding the level of users, participative in the site selection of the water schemes, the result indicated that, the mean value and standard deviation of households, WUC and SC were (= 3.00, S.D = 0.97), (= 2.83, S. D= 1.03) and (= 3.14, S.D = 1.01) respectively. The weighted mean score was 2.97 and all the three groups of means fall in the interval (2.61—3.40) of the five-level Likert scale that are interpreted at a moderate level. Between and among the three group respondents' means, there is no significant difference at (F = 2.39, P = 0.09) at P > 0.05 and F <3**.** The quantitative value signified that the practice was carried out to a moderate extent. Supporting this fact, one of the interviewees from Dandi Woreda WSE reported her experience as follows.

> *Once upon a time in the past, in the place around Danisashono, we were running a portable water scheme project in the rural area. We held our first meeting with the community and informed them about the importance of the project to them and their roles in keeping the project sustainable. The dwellers became excited about the project, and they showed their belonging and ownership of the project. But when we started constructing the water schemes, disagreements were created between us and them that they did not like the location of three of the water schemes. Soon some of them forced us to stop construction, and they reasoned out that the water schemes would be too far to fetch water. Finally, we informed the local policemen of the situation, and the policemen stopped them from interruption, and we constructed the three schemes. Amazingly, when we returned back to the constructed water schemes, none of them existed (Dandi WSE, interview conducted on January 23, 2022).*

The interviewee concluded that if water schemes were constructed at the place without the will of the users, they would not like to give proper protection.

Regarding the construction quality standards of the water scheme, the result obtained indicates that the mean value and standard deviation of households, WUC and SC were (= 2.12, S.D = 0.57), (= 2.14, S.D= 0.68) and (= 2.15, S.D = 0.55), respectively. The weighted mean score was 2.13 and all the means of the three types of respondents fall into the interval (1.81-2.60) of the five levels of the Likert Scale that are interpreted at low level. There is no significant difference between and within and between the means of the three group respondents at [F = 0.09, P = 0.91], the critical value P > 0.05 & F <3. The numerical figure indicates that the quality standards of the water scheme were low.

Figure 4: The Quality Standards of the Water Scheme

Source: Field Observation photograph taken from Fajigalila kebele on, January15, 2022

The data obtained by the researcher from field observation indicated that the floor concrete is cracking due to water moisture effects. The basement slab has no length above ground surface, which makes it susceptible to being cracked by the roots of plants and grass. The long Jerikan frequently breaks the tap of the water scheme. The photo on the right hand shows that, the well is open and exposed to different contamination practices. This demonstrates that the building was of poor quality, there was ineffective management, and there was no fence to protect the scheme from danger.

In terms of the quality of materials employed in the building of water schemes, the result obtained reveals that the mean value and standard deviation of households, WUC, and SC were (= 2.52, S.D = 0.96), (= 2.64, S.D = 0.90), and (= 2.36, S.D = 0.93), respectively. The weighted mean score was 2.53 and all the three group means fall into the interval (1.81-2.61) on the Likert Scale that is interpreted at a low level. There is no significant difference between and within and between the means of the three groups of respondents for (F = 2.25, P = 0.11) at the critical value P > 0.05 and F < 3. The quantitative figure showed that the quality of raw materials was low. This fact could be supported by document analysis of a water scheme project manual that shows that the materials used were cement, concrete, stone, still rod, hand pump handling, and rope. Their quality is

assumed to be poor because of the use of low-quality standard materials data obtained from the annual report of the Woreda water resource department office that indicates almost half of the schemes' buildings were cracked and some of the water points were non-functional.

4.3.3 Practice of protection for water schemes

With respect to the presence of protection systems (guards and fences etc.) at the water schemes to prevent breakdowns or addition of impurities, the mean and standard deviations of the three group respondents were (= 2.71, S.D = 1.01), (= 2.82, S.D = 1.03) and (= 2.98, S.D = 1.07), respectively. The weighted mean score was 1.81, which is interpreted at an extremely low level, because of poor community mobilization in conservation activities. There is no significant difference between and within the three means for F = 1.69 and P = 0.19 at the critical value P > 0.05 and F < 3. The numerical value indicated the absence of a fence at the water scheme. Additionally, it was demonstrated through the following field observation by the researcher: This suggests that a water scheme was subjected to various contamination activities and might malfunction when in contact with animals or young children.

Figure 5: The presence of fence as protection system of Water scheme

Source: Field Observation photo taken from dano-ejersa gibe kebele, on January 5, 2022

Respect to the degree the water schemes placed or constructed at proper position, the result obtained indicates that the mean value and standard deviation of Households, WUC and SC were ($\overline{X}$ = 2.55, S.D = 0.91), ($\overline{X}$ = 2.54, S.D = 0.89) and ($\overline{X}$= 2.54, S.D = 0.92) respectively.The weighted mean score was 2.63. The P and F values of the three types of respondents means were, (F = 2.54, P = 0. 006), respectively. This indicates that there is significance difference between and within the responses of the three group respondents at $P < 0.05$ and $F > 3$. This disparity in response could be validated by the response obtained from WSEs interview in which two of them showed that, the water schemes are built giving priorities for a place, where the water is available and home of users. This make task of selecting proper position for building water scheme difficult so that we could not say the all the water schemes were constructed in the exact engineering positions.

Figure 6: The presence of fence as protection system of Water scheme

Source: Field Observation photograph taken from Faji galila on, January 16, 2022

4.3.4 Pre-implementation training

According to the results of the project's pre-implementation capacity-building training for the members of the water committee, the mean value and standard deviation of households, WUC, and SC were (= 2.84, S.D = 0.86), (= 2.83, S.D = 0.95), and (= 2.79, S.D = 0.90), respectively. As all three group averages fall within the Likert Scale's range of values (2.61-3.40), the weighted mean score of 2.83 is evaluated as moderate. The means of three groups of respondents differ significantly from one group to another and within each group. At the crucial threshold, (F = 5.44, P = 0.01), P 0.05, and F > 3.The disagreement in the responses of the three groups meant the FGD indicated the water user committee (WUC) was selected democratically at the beginning of project implementation, but they had been managed water project depending on the technical and managerial guidance of the WWSE and WWRDO. Even if one or two trainings were given to them, the training is on the general aspect of water scheme projects and for a short time. Moreover, as most of the WUC had low educational backgrounds, they could not easily acquire the necessary technical skills, financial and overall management capacities through short training. This was one of the major challenges of rural water schemes' sustainability.

4.4 The level of project financing as a factor affecting sustainability of water supply project

Table 4: One Way ANOVAs Data on Financial Aspect of water scheme sustainability factors user

No	Variables	Respondent	N	Mean	S.D	F	Sig.
10	You're feeling on necessity of cost of salary of guard and maintenance being covered by the user.	Households.	1	2.75	0.79	1.05	0.35
		WUC	1	2.73	0.83		
		SC	8	2.89	0.81		
		Total	3	2.78	0.81		
11	The capability of users to meet the cost of operation, maintenance and guard payment water supply projects	Households.	1	3.70	0.88	2.64	0.07
		WUC	1	3.45	0.91		
		SC	8	3.65	0.88		
		Total	3	3.60	0.90		
12	Source of fund for water supply	Households.	1	3.08	0.82	0.65	0.53

	project was sufficient and did not need government subsidy to sustain the project.	WUC	1	3.13	0.81		
		SC	8	3.00	0.82		
		Total	3	3.08	0.82		
13	The extent of financial transparency of WUC for water users.	Households.	1	3.20	0.65	3.85	0.02
		WUC	1	3.28	0.98		
		SC	8	3.00	0.00		
		Total	3	3.18	0.72		
14	The provision of financial management training for CWU.	Households.	1	3.96	0.91		
		WUC	1	3.90	0.81	0.42	0.66
		SC	8	4.01	0.90		
		Total	3	3.95	0.87		
15	WUC mobilize the community to contribute resource in terms of material, money, labor	Households.	1	2.51	0.90	4.26	0.02
		WUC	1	3.44	0.94		
		SC	8	2.78	0.88		
		Total	3	2.94	0.91		

4.4.1 Income source for water service and maintenance of schemes.

With regard to the need of cost of maintenance being covered by the user, the response of the respondents indicates that the mean and standard deviation of households, WUC and EC were ($\overline{X}$ = 2.75, S.D = 0.79), ($\overline{X}$ = 2.73, S. D= 0.83) and ($\overline{X}$= 2.89, S. D= 0.81) respectively. The weighted mean score was 2.78 and all means of the three type of respondents fall in the interval (2.61—3.40) in Likert Scale that is interpreted at moderate level. The p value=0.35 > 0.05 and F value=1.05 < 3 imply that, there is no significance difference between and within the mean of the responses of the three group of respondents. So according to this figure, it is easy to understand that the respondents moderately agreed on the necessity of users' payment for maintenance.

The qualitative result from FGD showed that source of finance is needed for construction of water schemes, maintenance of the non-functional water schemes, purchasing chlorine for disinfection of water, cost of training and office logistic and payment for guard who protect the water scheme from damage. Before the project has been launched, the overall water schemes development cost was covered by NGOs such as cost of construction of water schemes, hand pump, spar part, cement and steel. But during post implementation

phase of rural water schemes, the WWREO and WUC take the task of managing the project and cost of maintenance of the water scheme, cost of training and office logistic and payment for guard would be covered either by mobilizing the community or collecting money from uses as water schemes maintenance and guard payment.

Regarding the capability of users to meet the cost of operation, maintenance and guard payment water supply schemes, the result obtained indicates that, as the mean value and standard deviation of households, WUC and SC were (= 3.70, S.D = 0.83), (= 3.45, S.D = 0.89) and (= 3.65, S.D = 0.88), respectively. The weighted mean score was 3.6, and all three respondents' means fell within the range of (3.41-4.20) on a Likert scale with five levels that showed high level..Between the means of the three groups of respondents, there is no statistically significant difference. at (F = 0.47, P = 0.63) at the critical value P > 0.05 and F < 3. The numerical figure indicated that most of the users had the financial capacity to pay for the requested service payment. One of the most challenging issues in the sustainability of rural water schemes is how to provide water service for very poor rural citizens who cannot pay the amount of payment set. In this connection, to understand the problem, the researcher conducted FGD with WHO, water supply engineers (WSE), and The participants of FGD reported that poor water users were supported by reducing their payments or giving other activities (labor work) like, fencing and cleaning areas around the scheme for exchange of the water payment.

Whether the source of funds from users was sufficient and so that government subsidy or NGO support were not required to sustain the project, the result indicated that the mean value and standard deviation of households, WUC and SC were (= 3.08, S.D = 0.82), (= 3.13, S.D = 0.81) and (= 3.00, S.D = 0.82), respectively. The weighted mean score was 3.07, and all three types of respondents' means fall within the range of the low level, five-level Likert Scale (1.81-2.61). There are no significant differences between and within the means of the three group responders at F and P values (0.65, 0.53), respectively. The quantitative data could be supported with a literature review such that, according to a World Bank report 2021, currently, in Ethiopia, even if the business climate has undergone significant changes with broad policy reforms, the price of foreign imported goods like maintenance spare parts has been alarmingly increased because of the

cumulative effect of the COVID-19 related economic downturn and with an intense civil conflict in and around Ethiopia's northern Tigray region, which is likely to result in increased economic instability in 2021 and 2022. Due to two remarkable reasons, that is the decline in the economy of the rural water users and the rise in the price of spare parts, chlorine price, and payment for local technical, it is impossible to cover all these expenses with the budget obtained from local users. Therefore, the WWREO is expected to run for income generation from local governmental and nongovernmental donors.

4.4.2 Financial management capacity of the water project

Regarding the extent of financial transparency of WUC for water users, the result indicated that, the mean value and standard deviation of households, WUC and SC were (= 3.20, S.D = 0.65) (= 3.28, S. D = 0.98) and (= 3.00, S.D = 0. 00) respectively. This indicated that the means of the three respondents are in the same category of the interval (2.61-3.40) of the five-level Likert Scale and the weighted mean value was 3.18, which corresponds to moderate level and the computed one-way ANOVA result (P = 0.02, F = 3.85), which indicated that statistically significant differences are observed between and within the three groups of respondents at $P > 0.05$ and $F < 3$. The quantitative analysis indicated that the WUC showed financial transparency to the users to a moderate extent. The quantitative result was proved with document analysis conducted in the WUC in which the researcher looked at the agendas in the minutes of meetings of the WUC with local users. Consequently, the income and expense summary (income statement revenue and expense accounts) were presented. They have a registered document and a minute. The contributed finance is deposited with Oromia International and the Commercial Bank of Ethiopia (CBE) in accordance with their budget. The financial performance of WUC is audited by a woreda auditor annually and reported to the end users to ensure accountability. Their drawback is that, there were no timely, meaningful, and reliable disclosures. Therefore, the WUC is expected to provide a comprehensive financial report or make water users aware of matters that are relevant to them quickly and efficiently.

Regarding the provision of financial management training for CWU, the result indicated that the mean value and standard deviation of households, WUC, and EC were (= 3.96, S.D = 0.91) (= 3.90, S.D = 0.81) and (= 4.01, S.D = 0.91) respectively. The weighted

mean score was 3.95 and all three types of respondents fall into the interval (2.61-3.40) in the five level Likert Scale that is interpreted at a moderate level. There is no significant difference between and within and between the means of the three groups of respondents at F and P values (0.42, 0.66). The quantitative finding indicated the training concerning financial affairs was given to a moderate extent. In the result of FGD showed that training was provided by NGOs on general aspects of management of the water scheme project and implementation of the project. But no formal training was provided by government bodies (WWREO) to enhance the financial management skills of WUC. Informal awareness creation has been given on the financial management of WWREO during supervision and their meeting time.

Regarding the subject of how much WUC mobilizes the community to provide resources in the form of materials, money, and labor, the data gathered reveal that the mean and standard deviation of households,WUC and SC were (=2.51, S. D =0.90), (=3.44, S. D=0.94), and (=2.78, S. D= 0.88), respectively. The weighted mean score was 2.91, which was interpreted at a moderate level. The P value = 0.02 < 0.05 and F values of 4.26 >3 indicate that there is no significant difference between and within the three mean groups, respectively. The result showed that the practice happened at a moderate level. In addition, the assessment made by the analysis of documents such as the financial report and income recite indicated that a great amount of money was obtained from water users from mobilization at any community meeting. In addition, the agreement reached in FGD indicated that WUC had mobilized the community and users and obtained money or cash for purchasing spare parts, for maintenance costs, and for water source guard wages. The water user also supported the water scheme project in kind by providing construction materials (stone, sand, and wood) and labor during maintenance of the water scheme and environmental conservation process.

Furthermore, qualitative investigation made through interviews and FDG on the financial activities indicated that the water scheme project needs a budget subsidy from the government or NGO to increase the number of potable water schemes, since the population's rising demand increases the water demand. This could be accomplished through the adoption of modern technology by using pumping machines to maximize the

pressure and volume of water needed for the community. Another essence of subsidy is a budget needed for continuous upgrading of the system and training of technical skills for maintenance and financial management.

4.5 Assessment on functionality and access of water scheme

4.5.1 Assessment on functionality of water scheme

Table 5: One Way ANOVAs statistical data on functionality of water scheme

No	Variables	Respondents	N	Mean	S.D	F	Sig.
A	**Level of functionality of water schemes**						
16	The level of functionality of supply systems.	Households.	138	2.55	0.91	1.00	1.00
		WUC	120	2.54	0.89		
		SC	81	2.54	0.92		
		Total	339	2.54	0.90		
17	Interrupted water schemes could get maintenance and quickly begin service.	Households.	138	2.61	0.96	0.30	0.74
		WUC	120	2.51	1.00		
		SC	81	2.54	0.96		
		Total	339	2.55	0.97		
18	The degree of technical capacity of local technicians to repairs/maintenance broken water schemes.	Households.	138	2.29	1.01	0.07	0.93
		WUC	120	2.25	0.94		
		SC	81	2.25	1.02		
		Total	339	2.27	0.98		
19	The ease of availability of spare parts for non-functional water schemes	Households.	138	2.13	0.84	.13	0.88
		WUC	120	2.18	0.76		
		SC	81	2.12	0.83		
		Total	339	2.14	0.81		
B	**Level of water accessibility**						
20	The amount of service coverage of water scheme.	Households.	138	2.28	0.59	0.7	0.46
		WUC	120	2.26	0.72		
		SC	81	2.37	0.62		
		Total	339	2.30	0.65		
21	The extent of distance from the household to the water source or point.	Households.	138	2.83	0.85	0.5	0.60
		WUC	120	2.77	0.86		
		SC	81	2.89	0.85		
		Total	339	2.82	0.85		

22	The duration of time used to fetch water.	Households.	138	4.08	0.60	0.0	0.96
		WUC	120	4.10	0.61		
		SC	81	4.09	0.60		
		Total	339	4.09	0.60		
23	The extent of adoption of technology for pulling out underground water.	Households.	138	2.22	0.93	0.0	1.01
		WUC	120	2.23	0.95		
		SC	81	2.20	0.94		
		Total	339	2.22	0.94		

Source: SPSS data analysis

4.5.2 The functionality of water scheme

With regards to the level of functionality of water supply systems, the result showed that the mean value and standard deviation of Households, WUC, and SC were, (X = 2.55, S.D = 0.91), (X = 2.54, S.D = 0.89) and (X= 2.54, S.D = 0.92) respectively, according to a five-level Likert scale with a modest level of interpretation, the weighted mean score was 2.54 and all group means fall within the range of 1.81 to 2.60.The means of the three group responses do not significantly differ from one another or from each other within groups, at [F = 1.00, P= 1.00] the critical value P > 0.05 and F < 3. From the respondent responses, one could understand that a large number of water supply systems were not functional..This result was confirmed with document analysis given in the table below.

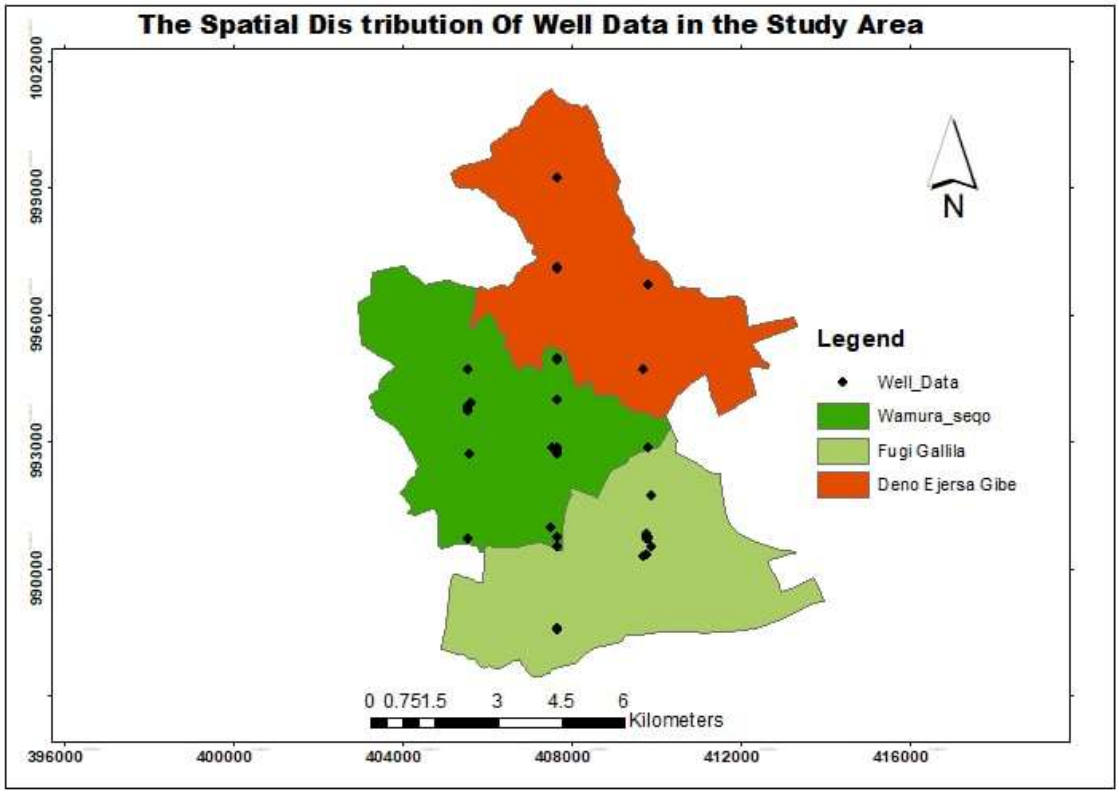
Table 6: The existing water schemes

No	Sample Kebeles	No water schemes	Functional	Non-Functional		From total no. of non-functional water scheme, the average time they remained without giving service unrepaired).
				Frequency	Percent	
1	Danoejersa gibe	8	5	3	37.5 %	4 years
2	Wamura-sako	16	10	6	37.5%	4.92 years
3	Fajigalila	23	15	8	34.78%	5.82 years
	Total(average)	47	30	17	36.17%	4.91 years

Sources :Dandi woreda water resource office

As it was displayed in the table, of the total water schemes about 17/47 (36.17%) schemes were non-functional. It was more than the country's average non-functionally of rural water supply schemes, which is 15.5% by the time 2014 (Ministry of Water, 2015).Unless non-functional water schemes could get rapid maintenance, no one could expect sustainability from the rural water supply scheme project. This could be done with the involvement of all segments of the community, in the form of full participation and control over the scheme's operation and maintenance.

Figure 7: water sources (scheme) distribution map



Source: Field data survey by GPS June, 2022

The distribution of water schemes at sample kebeles are not equally distributed for all villages and some of the are non-functional. The results obtained show that the interrupted water schemes were able to receive maintenance and rapidly resume service. The mean value and standard deviation of households, WUC, and SC were (X = 2.61, S.D = 0.96), (X = 2.51, S.D = 1.00), and (X = 2.54, S.D = 0.96) The weighted mean score was 2.55, and all three means are considered low values because they fell within the range of the five-level Likert Scale (1.81–2.60). There is no significant difference

between or within the three mean groups, as indicated by the P value of 0.74< 0.05 and F value of 0.30 0.3. Therefore, it is possible to say that the time taken for interrupted water schemes to get maintained and start service was long. This data was supported by the document analysis given in table 7, such that the average time the rural water schemes remained unrepaired in three sample kebeles was 4, 4.92 years, and 5.82 years, respectively. That, at an average time the schemes did not provide service, was 4.91 years. Thus, one can undoubtedly conclude that the duration of time water schemes remained unrepaired was a very long time. This could affect the sustainability of the rural water supply schemes to an even greater extent. In addition, the distribution of water schemes at the kebele level is not equal at all villages of kebeles. As a result, there is insufficient user/community involvement in the planning and site selection of the water points that are widely accepted by users and distributed evenly to meet demand.

4.5.3 Maintenance of water scheme

Regarding the degree of capacity of local technicians to fix broken water schemes, the result indicates that the mean value and standard deviation of households, WUC, and SC were (= 2.29, S.D = 1.01), (= 2.25, S.D = 0.94), and (= 2.25, S.D = 1.02), respectively. The weighted mean score was 2.27, and all the three group means fall in the interval (1.81-2.60), which shows low level capacity. T here is no significant difference between and within the means of three group respondents at [F = 0.07, P = 0.93], the critical value P > 0.05 and F < 3. The numerical result showed that the skill of the local technicians to repair broken water schemes was low. The findings obtained in the interview showed that most of the higher maintenance was done by the chief WWSE and the local technicians were traditional technicians who did not have sufficient skill in maintenance (not certificated with technical skill).

Concerning the ease of availability of spare parts for repair of non-functional water schemes, the result obtained indicates the mean value and standard deviation of households, WUC and SC were (= 2.13, S.D = 0.84), (= 2.18, S.D = 0.76) and (= 2.12, S.D = 0.83), respectively. The weighted mean score was 2.14, and all three types of participants' means fell within the interval (1.81-2.60) on the five-level Likert Scale,

which is interpreted at a low level. There is no significant difference between and within the means of the three group respondents at (F = 0.13, P = 0.88) the critical value P > 0.05 and F < 3. The numerical value indicates that the availability of spare parts is low. The majority of the interviewees reported that there were no enough building material shops in the rural area to purchase spare parts for the broken water schemes, so that WUC were forced to go a long distance to Addis Ababa, to purchase spare parts. Another issue mentioned here was unavailability dollar in national bank due to the country's economic depression one of the reasons for lack of adequate spare parts needed for maintenance of non-functional water schemes. Moreover, the findings obtained from FGD indicated the major causes of malfunction of water schemes were poor construction, monitoring and maintenance, technical faults, and lack of environmental conservation.

4.5.4 Water accessibility and Technology Adoption

Regarding the extent of accessibility of water services, the results showed that the mean value and standard deviation of households, WUC, and SC were (X = 2.28, S.D = 0.59), (X = 2.26, S.D = 0.72), and (X = 2.37, S.D = 0.62), respectively. On a five-level Likert scale with a modest level of interpretation, the weighted mean score was 2.30, which is within the range of (1.81–2.60. The P values of 0.77< 0.05 and 0.46 > 3 respectively, show that there is no significant difference between the mean groups. This numerical statistic showed that the amount of service coverage of the water scheme was low.

On the subject of the length of the distance from the household to the water source, the result indicated that the mean value and standard deviation of the three types of respondents were found to be (= 2.83, S.D = 0.85), (= 2.77, S.D = 0.86) and (= 2.89, S.D = 0.85), respectively. The weighted mean score was 2.82, which corresponds to a moderate level and falls in the interval (2.61–3.40) in the five-level Likert Scale. The computed one-way ANOVA showed that there was no significant difference at P = 0.60 and F = 0.51 at P > 0.05 and F < 3. The quantitative analysis revealed that the distance from the home to the water source was more or less far. The quantitative data was supported by document analysis made in Woreda's water resource department office

such that the finding indicates there is a variation in the distance between a user's home and water sources, with the average distance found to be 2 km. This value is below the national water service level standards set for the distance between the water source and the home of the user, which is a 1 kilometer radius (MoWE, 2015). From the analysis of both quantitative and document analysis, it is possible to come the conclusion that the length of the distance from the home to the water source is below the standard that affects the sustainability of the water project.

Regarding how long it took to collect water, the results show that the mean value and standard deviation for homes, WUC, and SC were (= 4.08, S.D = 0.90), (= 4.10, S.D = 1.06), and (= 4.09, S.D = 0.49), respectively. The weighted mean score was 4.09 and all the means of the three types of respondents fall into the interval (1.81-2.60) in the five-level Likert Scale that is interpreted at a low level. There is no significant difference between and within and between the means of the three groups of respondents at (F = 0.04, P = 0.96) the critical value P > 0.05 and F > 3. The results obtained from FGD indicated that the users took an average of 2 hours per day to fetch water. A large number of users go to a single water scheme to get water at a time, and this would result in a long queuing time and, most frequently, a type of quarrel, insult and sometimes combat among users. To solve these problems, the WUC attempted to establish the rules on the time schedule when the users in different locations could fetch water, but due to a large number of users getting water service from the single water schemes, the problem will be resolved soon. In addition, an observation was made in a small village that shows, how the problem was more challenging for a village with a larger population.

Figure 8: Queue of Jerikan waiting for water fetching

Source: Field Observation Photograph taken from Fajigalila kebele, January, 2022

Regarding the extent of adoption of technology for pulling out underground water, the result indicated that the mean value and standard deviation of the three types of respondents were found to be (= 2.22, S.D = 0.93), (= 2.23, S.D = 0.95) and (= 2.20, S.D = 0.94), respectively. The weighted mean score was 2.22, which corresponds to a low value as it falls in the interval (1.81–2.60) on the five-level Likert Scale. The computed one-way ANOVA showed that no significant difference at P = 1.01 and F = 0.03 was observed between the three groups at P > 0.05 and F<3. The quantitative analysis revealed that the extent of adoption of technology for pulling out underground water was low. The findings obtained from the majority of the interviewees confirmed that technology utilization was limited to a few water sources. The adoption of technology was for the purpose of maximizing the amount of water required by using solar pumps, electric pumps, and generator pumps to pull out a sufficient water yield. Moreover, the agreement reached in FGD indicated the absence of utilization of technology in purifying water through modern physical filtration methods and by using new chemicals to kill the harmful microbes in the water. Besides, the result obtained from document analysis indicated that out of 47 existing water sources, only three (two deep wells and one motorized spring) apply motor (technology) to pull out water.

4.6 Effects of socio-environmental factors on the sustainability of rural potable water scheme.

Table 7: One Way ANOVAs data analysis of socio-environmental factors

No	Variables	Respondents	N	Mean	S. D	F	Sig.
24	The provision of water service satisfies the needs of the target group.	Households.	138	2.75	0.79	1.05	0.35
		WUC	120	2.73	0.83		
		SC	81	2.89	0.81		
		Total	339	2.78	0.81		
25	The frequency of the users to be affected by water born disease.	Households.	138	3.70	0.88	2.64	0.07
		WUC	120	3.45	0.91		
		SC	81	3.65	0.88		
		Total	339	3.60	0.90		
26	Level of your satisfaction with physical quality of water	Households.	138	3.08	0.82	0.65	0.53
		WUC	120	3.13	0.81		
		SC	81	3.00	0.82		
		Total	339	3.08	0.82		
27	The degree that water user committee (WUC) fulfills the required knowledge and skill to manage the water scheme project.	Households.	138	2.47	1.05	5.26	0.01
		WUC	120	2.18	1.01		
		SC	81	2.65	1.05		
		Total	339	2.41	1.05		
28	The frequency of WUC to undergo meeting with user.	Households.	138	2.93	0.77	0.02	0.98
		WUC	120	2.93	0.77		
		SC	81	2.95	0.74		
		Total	339	2.94	0.76		
29	The level of activeness of WUC to perform their task	Households.	138	2.91	0.85	0.03	0.97
		WUC	120	2.93	0.86		
		SC	81	2.91	0.87		
		Total	339	2.92	0.86		
30	The urgency of WWRDO to respond to user Compliant.	Households.	138	2.93	0.77	0.02	0.98
		WUC	120	2.93	0.77		
		SC	81	2.95	0.74		
		Total	339	2.94	0.76		
31	To what extent WUC mobilize community to plant trees to maintain supply of portable water.	Households.	138	2.23	0.80	0.13	0.88
		WUC	120	2.19	0.84		
		SC	81	2.25	0.77		
		Total	339	2.22	0.81		

Source: SPSS data analysis

4.6.1 Social aspects of sustainable water supply

Regarding whether the target group's needs are met through the provision of water service, the outcome showed that, for households, WUC, and SC, the mean values and standard deviations were (X = 2.75, S.D = 0.79), (X = 2.73, S.D = 0.83), and (X = 2.89, S.D = 0.81), respectively. All three respondents' means fell between 2.61 and 3.40 on the five-level Likert Scale, and the weighted mean equates to a moderate level. The weighted mean score was 2.78 at (F = 1.05, P = 0.35), the critical value of P = 0.05, and F > 3. There is no statistically significant difference between the means of the three groups of respondents. Consequently, the numerical figure showed that the level of users' satisfaction with the amount of water service was moderate. This data was validated with the actual information obtained from the office of Woreda water resource department and showed that individual per capita per day was only 12 liters, which is below the Ethiopian national water access standard for each individual per capita per day per liter of 25 liters (MoWE,2015). From the quantitative and document analysis results, we can understand that the users were moderately satisfied with the amount of water service.

According to the results, the three types of respondents' means and standard deviations were found to be (= 3.70, S.D = 0.88), (= 3.45, S.D = 0.91), and (= 3.65, S.D = 0.88), respectively. The weighted mean score was 3.60, which corresponds to moderate value and falls in the interval (3.41-4.220) on the five-level Likert scale. The computed one-way ANOVA showed that no significant difference occurred at P = 0.07, F = 2.64, observed between the three groups at P > 0.05 and F<3. The quantitative analysis showed that the users were affected by water-borne diseases at a moderate level. The quantitative result was supported by the responses of the majority of interviewees, who stated that although the woreda water resource development officer used the chlorination method to remove disease-causing microbes, it was occasionally only used in and around Dandi woreda's town due to a lack of the chemical in the users' living areas. A user would be vulnerable to a water-borne illness in that situation.

Regarding the extent of your satisfaction with the physical quality of water (color, turgidity, smell), the results indicate that, the mean values and standard deviations of the

three groups of respondents were (= 3.08, S.D = 0.82), (= 3.13, S.D = 0.81), and (= 3.00, S.D = 0.82), respectively. The weighted mean score was 3.08 and all the means of the three-group participants fell into the interval (2.61—3.40) on the five-level Likert Scale that was interpreted at a moderate level.

The computed one-way ANOVA showed that no significant difference occurred at P = 0.53 and F = 0.65, observed between the three groups at P > 0.05 and F<3. The quantitative investigation indicated that the extent to which the physical quality of water was moderate. The results obtained from WSE interviewees indicated that in the aspect of physical quality during the rainy season and high temperatures, the color and taste of the water are changed because of poor environmental conservation, contaminated by natural factors and the disposal of solids and dust around the water schemes. In general, one can say that the physical quality of water was at a moderate level.

Concerning the degree that water user committees (WUC) fulfill the required knowledge and skills to manage the water scheme project, the result indicated that the mean value and standard deviations of households, WUC, and SC were (= 2.47, S.D = 1.05), (= 2.18, S.D = 1.01), and (= 2.65, S.D = 1.05), respectively. The weighted mean score was 2.41 and all the means of the three types of respondents did not fall into the interval (1.81-2.60) in five levels. There is a significant difference between and within three groups of respondents at (F = 5.26, P = 0.01), the critical value P > 0.05, and F<3. In general, the results from quantitative data indicated that water user committees (WUC) did not possess the required knowledge and skills to manage the water scheme project. The researcher used to triangulate qualitative data obtained through FGD with questioner. Accordingly, the participants claimed that some of the WUC were educated people so that they could easily perform the managerial roles, operation, and maintenance of water schemes through a single training. However, some members of WUC were illiterate, so they counter to manage the water scheme even if training had been given. They need continuous training, technical skills, and awareness to manage the project effectively.

Regarding the frequency of WUC meetings with users, the results showed that the mean value and standard deviation of the three groups of respondents—WUC and SC—were

(= 2.93, S.D. = 0.77), (= 2.93, S.D. = 0.77), and (= 2.95, S.D. = 0.74), respectively. The weighted mean score was 2.94 and all the means of the three groups fell into the interval (2.61-3.340) on the five-level Likert Scale that was interpreted to a moderate extent. There is no significant difference between and within and between the means of three groups of respondents at (F = 0.02, P = 0.98) the critical value P > 0.05 and F < 3. The quantitative investigation indicated that WUC conducted meeting reliability with user. The minutes of the meeting and the attendance of users indicated that the monthly meeting programs were held without interruption.

Concerning the extent of financial transparency of WUC for water users, the result indicated that the mean values and standard deviations of households, WUC and SC were (= 3.61, S.D = 0.91), (= 3.61, S.D = 0.96) and (= 3.69, S.D = 0.90) respectively. The weighted mean score was 3.63 and all three types of respondents do not fall in the interval (1.81.-2.6) in the five levels of the Likert Scale that are interpreted at a high level. The computed one-way ANOVA showed that a significant difference occurred at P = 0.78, F = 0.25, P > 0.05, and F<3. The numerical value demonstrates that the extent of the financial transparency of WUC for water users was at a high level. The document analysis made by the office of Woreda water resources department demonstrated that the practice of financial transparency of WUC was very good. They have been reporting the monthly income and expenditure to the users in their monthly meeting. Moreover, the financial performance of WUC has been audited by a woreda auditor annually, and the audit report will be presented at the annual meeting to the users.

4.6.2 Environmental aspects of sustainable water supply

Concerning the level of activeness of WUC to perform their task, the result obtained indicates that the mean value and standard deviation of the three groups were found to be (= 2.91, S.D = 0.85), (= 2.93, S.D = 0.86) and (= 2.91, S.D = 0.87), respectively. The weighted mean score was 2.92. The computed one-way ANOVA showed that there was no significant difference at P = 0.97, F = 0.03 at P > 0.05, and F<3. The numerical figure indicated that the WUC were moderately active in performing their task. The results obtained in FGD showed that the WUS has done facilitation and coordination of community participation in the conservation and management of water schemes as well

as the provision of raw materials (construction materials) and participated themselves and others in money, labor, and in-kind contributions for the maintenance of non-functional water schemes.

The results showed that the mean value and standard deviation of households, WUC, and SC were (X = 3.08, S.D = 0.77), (X = 2.93, S.D = 0.77), and (X = 2.95, S.D = 0.74), respectively. This result demonstrated the urgency of WUC to respond to user compliance. The weighted mean score was 2.94, and all three groups' scores were within the range of (2.61–3.40) on a five-level Likert scale that was evaluated as moderate. There is no significant variation among, within, and between the means of the three groups of respondents. (F = 0.02, P= 0.98) at the critical value P> 0.05 and F<3. The quantitative data indicated that WUC moderately responded to users' complaints. The result of document analysis of the feedback given by Woreda water resource department to WUC indicated that the major questions raised for immediate solution were: maintenance of non- functional schemes, lack of quality of water supply for the residents from the river and unprotected springs in the villages, hand-washing stations and dug wells were not able to fully satisfy the population's drinking water demands; etc. The feedback report indicated the majority of them remained on the shelf. This was one of the major issues with the long-term viability of rural water schemes.

Regards to what extent WUC mobilizes the community to plant trees to maintain a supply of portable water, the result indicates that the mean value and standard deviation of the three types of respondents were found to be (= 2.23, S.D = 0.80), (= 2.19, S.D = 0.84), and (= 2.25, S.D = 0.77), respectively. The weighted mean score was 2.22, and all three respondents fell within the interval (1.81.-2.60) on the five-level Likert Scale when interpreted at the low level. There is no significant difference between and within and between the means of the three groups of respondents at (F = 0.13, P = 0.88), the critical value P > 0.05 and F < 3. The quantitative figure indicated that WUC mobilizes the community to participate in the conservation process at a low level. The result acquired from FGD showed that this practice was done to a low extent because no capacity-building training was provided for water users on the usefulness of community conservation and its relationship with the sustainability of the water project.

In addition, the open question raised for the respondents on possible mitigation actions that will be taken to maintain the sustainability of water schemes, about 70% of the respondents answered with almost the same response. The respondents said that, to mitigate the sustainability of water schemes, *"all concerned bodies (government, non-government, and community) will have to play their role," especially in management and constructing additional water sources by using appropriate technology, capacitating the managerial and community mobilization skills of water user committees, as well as effective follow-up will be implemented by the water sector at all levels"*.

4.7 Discussion

The rural potable water scheme project generally consists of the pre-project implementation phase and post-project implementation phase. The pre-project implementation phase is the basic unit of a water scheme project that provides a general indication of how future phases will be sustained. In this connection, many questions were posed and both quantitative and qualitative investigations were explored. The level of access to potable water supply and the present high demand for potable water by the beneficiaries were good for project sustainability, but the source of the water supply being not very sufficient is a drawback because it will not allow for continuous service, especially at winter time when the amount of underground water is minimized. Besides, the quality of construction of the water scheme can be determined with proper site selection, engineering quality, and the quality of materials used for water scheme construction. All the quality indicators were investigated to be at a moderate or low level. These might cause immediate failures of the water scheme and force the need for frequent maintenance costs of the water scheme.

The most important issue in rural water scheme projects is to give the management responsibility to the end users because it eases protection of the water schemes, more continuous follow-up of water quantity and quality, and prioritizing the use of water to meet the needs of all stakeholders. In this connection, the practice that existed in Dandi woreda by electing WUC from the local community was good, but as most of them were not highly educated, the capacity building training given at the pre-project implementation phase was not sufficient and this could hamper the overall sustainability

of the project. In addition to the above mixed analysis of quantitative and qualitative investigation, additional information was obtained from the participants of interviews and FDG on the pre-implementation phase of rural water schemes' sustainability. As a result, it was discovered that a demand-responsive approach, proper training, and female membership in WUC were not encouraged.

Financial management is one of the most important aspects of water scheme projects that optimize and increase the efficient utilization of water (Pinto.J, 2017). So, the level of project financing, which comprises an income source for water service and maintenance of schemes and the financial management capacity of the water project, In the former case, the investigation indicated that most users have the capability to meet the cost of water service, operation, maintenance, and guard payment. In order to compensate for those who cannot afford it, fund mobilization was done and some amount of the cost has been covered by different stake holders. Concerning financial management, more or less certain gaps were observed in financial transparency and the provision of continuous financial training for WUC.

The functionality of water supply is the central part of a rural potable water scheme project that is related to the reliability, accessibility, adequacy, water fetching time in round trip, operation, and maintenance. In this regard, the finding indicated that 36.17% of water scheme projects were not functional. There was a scarcity of spare parts and a lack of certified skillful local technicians. This makes the time taken for maintenance high. All the problems related to the functionality of water schemes were so severe that they greatly affected the sustainability of the projects. The problem with the functionality directly affects the accessibility of water schemes. In the finding, it was obtained that the amount of service coverage of the water scheme, the length of the distance from home to the water source and the duration of time used to fetch water were found to be moderate, moderate and low, respectively. The adoption of technology for extracting underground water was limited. So great attention should be given to using technology to more efficiently pull water from underground and increase the amount of service coverage.

The last basic question was about social factors that measure either the satisfaction of society from the quality of potable water service or how effectively the end user in community managed the water project. Regarding the provision of water free from water-borne disease and physical contamination, the finding showed that sometimes water-borne disease occurred in the study area and there was no chemical treatment of water. Related to the project management, the WUC more or less conducted regular meetings with local people, and they performed the managerial tasks at a moderate level. But the task of Environmental conservation was limited. Therefore, the WUC are expected to scale up their managerial skills in order to keep the sustainability of the rural portable water scheme project.

CHAPTER FIVE

5. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of the Major Findings

5.1.1 Pre-implementation factors of the sustainability of rural potable water supply

Regarding the Goodness Water Scheme Project, the obtained weighted mean score of the three group respondents was 2.83 and there was no significant difference within and between the means of the three groups of respondents at [F = 2.37, P = 0.095]. So, the numerical analysis given above and the FGD result indicated that the project design is more or less good. As the demand is one of the criteria that measures the goodness of the project, the present of scarcity of portable water before implementation was investigated to be high by quantitative investigation made by the responses given by three group respondents at a weighted mean of =3.83. In addition, the quantitative study obtained from the three groups, respondents with a weighted mean of =2.82 and interviewees investigation indicated that the sources of water schemes were not sufficient to deliver portable water supply to the user all the time. The cause of this fact goes to the reality that the level of users' participation on the site selection of the water schemes was proved to be moderate by the quantitative investigation obtained with a weighted mean score =2.97 and a deep explanation given in the interview. Based on the above supporting facts, the researcher could summarize that the goodness of the water project was at a moderate level.

Pertaining to the overall construction of the researcher, he posed various questions. One of them was investigating the quality of materials used for water scheme construction. The result indicated the weighted mean score of the group respondents was 2.53 at (F = 2.25, P = 0.11), showing that, there was no significant difference within and between the means of three groups of respondents with the same support from document analysis. The finding indicated that, the quality of raw materials was low. With respect to the presence of protection systems (guard and fence etc.) at the water schemes, the quantitative result of the responses of three groups of respondents, with a weighted mean = 2.81, indicated the absence of a well protected fence at the water scheme.

In terms of the extent to which the water schemes were placed or constructed in the proper sites, the quantitative investigation with a weighted mean score of = 2.54 and interviewee responses revealed that all of the water schemes were built in the exact engineering positions. the above summative investigation of the quality of the water scheme, the overall construction quality standards of the water scheme were investigated by asking questions to three groups of respondents, and the obtained weighted mean = 2.13 showed that, the quality standards of the water scheme were low. As providing capacity building training for WUC is essential before launching and starting to implement water scheme projects, the qualitative investigation results indicated that sufficient and more frequent **c**apacity building training had not been given in financial management, procurement, operations, record keeping, and conflict resolution to enhance their management skills in the water facilities.

5.1.2 The extent Project Financing affect Sustainability of Rural Potable Water Supply

On the financial aspect of water scheme sustainability factors, various questions were posed to investigate the overall financial capacity. One of them was regarding the capability of users to meet the cost of operation, maintenance, and guard payment by water supply projects. In this connection, the response obtained by the three group respondents with a weighted mean = 3.71 indicated that there was no significant difference within and between the means of the three group respondents at ($F = 0.47$, $P = 0.63$). This finding is supported by the FGD agreement that showed most of the users had financial capacity to pay for the requested service payment. Even if the users had the financial capacity to pay for the requested service payment, the cost covered by poor users was covered either by government subsidy or through mobilization of the local community. Retarding assessment, the source of funds for the water supply project was sufficient and did not need government subsidy to sustain the project.

The quantitative data and literature findings all indicated that it was not covered with government subsidy. On the part of mobilizing the community for fund raising, the findings obtained both by quantitative data with a weighted mean of 2.94 and from FGD showed that this practice happened at a moderate level. Thus, the study investigation into

the necessity of covering the cost of guard salary and maintenance by users revealed that it was "covered by users" to a moderate extent. Lastly, on the issue of financial transparency and the provision of financial training for WUC, the results of quantitative findings with weighted mean of 3.18 and 3.95, respectively, and support given by qualitative investigation with document analysis and FGD, respectively, showed that financial transparency existed to a moderate extent and financial training had been provided to some extent.

5.1.3 The functionality and access of water scheme affecting the sustainability

Potable water supply

An investigation related to the functionality and access of water schemes was conducted in two categories; by an assessment of the functionality of the water scheme and by the identification of the level of water accessibility. The assessment of the functionality of the water scheme was investigated with various questions posed to the participants. Among them, the finding on the level of functionality of supply systems, the response obtained by the three groups of respondents with a weighted mean of =2.54 indicated that there was no significant difference within and between the three groups of respondents at [F = 1.00, P = 1.00]. This finding was supported by document analysis and both the findings indicated that even if it is above the percentage of average non-functionally of rural water set by the country, It was proved that most of the water supply schemes were non- functional.

Another indicator of the functionality of a water scheme was the time period given for maintenance of un-functional water schemes. The quantitative data and document analysis results showed that the time taken for maintenance was high. On the other hand, investigation related to the availability of spare parts for non-functional water schemes, numerical value with weighted mean = 2.14, and the finding in the interview showed that there is a high scarcity of spare parts in the local market. The last indicator regarding the degree of technical capacity of local technicians to repair or maintain broken water schemes was the quantitative examination. The weighted mean score was 2.27, and the finding obtained in the interview showed that the skill of the local technicians was low.

Regarding the identification of the level of water accessibility, various questions were posed to the participant. One of them was on the amount of service coverage of the water scheme. The quantitative investigation with a weighted mean score of 2.30 indicated that the amount of service coverage of the water scheme was low. The next was on the subject of the length of the distance from the household to the water source. The response obtained by the three group respondents with a weighted mean of =2.82 indicated there was no significant difference within and between the means of the three group respondents at P = 0.60 and F = 0.51 and the document analysis result indicated that the length of the distance was below the standard that affects the sustainability of the water project.

The other indicator on the identification of the level of water accessibility is related to the duration of time used to fetch water. On this aspect, the quantitative data weighted mean score was 4.09 and agreement reached in FGD showed that the time used to fetch water was high. The last indicator about the extent of adoption of technology for pulling out underground water, the qualitative finding obtained through interview investigation and agreement in FGD, indicated the practice was carried out to a low extent in using adequate technology like; shallow wells and deep wells and solar pumps.

5.1.4 Effects of socio-environmental factors on the sustainability of rural potable water scheme.

Socio Factors include two main categories, one is the on the satisfaction of society on water delivery system, another is about the overall work activities of WUC.

Regarding the assessment of social and environmental factors, many questions were posed to the participants of the study. The weighted mean of the responses obtained by the three groups of respondents was 2.78, indicating that there was no significant difference within and between the mean guide three groups of respondents at (F = 1.05, P = 0.35). This finding was supported by the information obtained in document analysis, and both results showed that the users were moderately satisfied with the amount of water service. The next is on, the frequency of the users being affected by waterborne diseases. The quantitative finding with a weighted mean =3.60 and interview investigation indicated that users were highly susceptible to waterborne diseases. Lastly,

regarding the extent of satisfaction with the physical quality of water, the quantitative finding with a weighted mean =3.08 and interview investigation showed that the physical quality of water was moderate.

Concerning the overall work activity of the WUC, related to the degree that the water user committee (WUC) fulfills the required knowledge and skills to manage the water scheme project, the qualitative investigation in the FGD showed that the WUC did not fulfill the required knowledge and skills. With respect to the frequency of WUC to undergo meetings with users, the quantitative finding with a weighted mean =2.94 and the exploration made with document analysis indicated that it was done to a moderate extent. Concerning the level of activeness of the WUC to perform their tasks, the quantitative finding with a weighted mean =2.92 and the results obtained in FGD showed that the WUC were more or less actively performing their major roles under the supervision of woreda water resource office. On the subject of the urgency of WUC to respond to users 'compliant, the quantitative findings and results obtained in document analysis showed that the work done in this respect was not satisfactory. Lastly, with regards to what extent WUC mobilized the community to plant trees to maintain supply of the project, the quantitative finding with a weighted mean =2.22 and the result obtained in FGD showed that the work done in this respect was low.

5.2. Conclusion

The conclusion summarized related to pre-implementation, financial factors, social factors, and problems related to the functionality and access of water schemes. The conclusion arrived on the pre-implementation factors indicated that, in general, the goodness of the pre-implementation project activities was found to be moderate and, in particular, the overall quality of the construction of water schemes was identified to be low. The failure of the rural portable water project in the study area resulted in various financial constraints, social challenges, and problems related to the functionality and access of the water scheme, as failure of a project at the pre-implementation stage is a serious thing that leads to unpredicted high risks and problems.

Related to the financial factor for the sustainability of the water project, covering the cost of operation covers through user service payment and mobilizing the community for fundraising and other administrative activities were carried out to a moderate extent. This result has an impact on the maximum effectiveness of the functionality and access of the water scheme and full satisfaction of water service delivery in terms of quality and quantity of water supply, leading to social-related issues.

Related to the functionality and access of water schemes, most of the water supply schemes were un-functional and the time needed for maintenance was high. In addition, the level of water accessibility (i.e., the amount of service coverage of the water scheme and the ease of getting water supply) was low. These were the backbone of the service delivery system of the project that needed immediate action. Lastly, related to social factors, the overall satisfaction of society with the supply and purity of water was found to be either moderate or low. With respect to managing the water project at a social community level, the overall work activities and capacities of WUC to control and manage the project were found to be at either a low or moderate level.

In general, the overall conclusion showed the rural water scheme project of Dandi woreda had suffered many challenges related to pre-implementation, financial factors, social factors, and problems related to the functionality and access of the water scheme. If these factors are not re-managed properly, they would influence the functionality and sustainability of rural water supply systems and even lead to the liquidation of the schemes.

5.3 Recommendation

Based on the findings of this research, the following recommendations are forwarded.

- The project implementers (government and nongovernmental organizations) should have strengthen the WUC and aware with a clear line of authority and responsibility. The WUC are expected to participate right from conception and design to the implementation of water supply.

- In order to keep the water supply system sustainable, there should be preventive and regular maintenance programs by local WUC institutions. It is, therefore, suggested that the Woreda's water resource office and local WUC should have to take a timely measure in maintaining the non-functional water schemes.
- It is also recommended that water User committees, project implementers, and water operators be trained adequately in financial management, procurement, operations, record keeping, and conflict resolution to enhance their skills in the management of the water facilities.
- Local maintenance technicians should take special operation and maintenance training supported by field practice that can enable them to perform major maintenance skills.
- Options and incentives to encourage more proactive maintenance of facilities by WUC should also be explored. To have timely repair of water facilities by the community itself, spare parts should be available in the woreda water resource office store.
- Effective project management strategies should be adopted to enhance accountability and transparency among community members on management issues. To achieve this, committee members need to develop a local constitution for each of the water project organizations to guide and direct management of their finances, election of committee members, and define a functional organization structure.
- In the management of water projects, an asset-based approach is required. Through the guidance of the government water officers, the community organizations need to adopt a policy of paying for the water supply services to cater for the operations and maintenance expenses.
- In relation to ensuring the environmental conservation of water supply schemes, the community should be given adequate awareness and training on different types of soil and water conservation techniques so that they will understand the linkage between the water supply and the conservation of the environment.
- In terms of using technology, shallow wells and deep wells need to be built at all kebeles considering the number of users, and solar pumps will be installed to

access adequate water service. Natural resources also need to be protected by implementing environmental conservation activities, such as water and soil conservation, and hygiene and sanitation need to be promoted in the area.

- The majority of water supply plans required extensive maintenance and required a lot of time. The government ought to have dispatched qualified, certified technicians at the kebele level to address this issue.

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7.APPENDICES

APPENDIX-I

DATA GATHERING TOOLS ENGLISH VERSION

PART I- QUESTIONNAIRE PRESENT FOR H.H, WUC AND SC

The main objective of this questionnaire is to collect information about the sustainability of rural potable water supply. The other objectives are to gather information about pre – implementation, post – implementation factors affecting the sustainability of rural potable water supply schemes and the level of functionality of the water schemes. Your information helps me to assess the sustainability of water supply schemes and to investigates the factors affecting the sustainability of rural water supply. So, please tell me the real information if possible.

Thank you for your cooperation!!

1.BACKGROUND INFORMATION THE RESPONDENT

1.1. Demography of Participants

1. Name of Kebele _____
2. Respondent sex a) male [ ] b) female [ ]
3. age _____ years. Religion _____
4. Marital status: a) Married [ ] , b) Single [ ] , c) Widowed [ ] , d) Divorced [ ]
5. Family size _____
6. The highest level of educational back ground?

a) No formal education [ ], b) Primary level [ ], c) Secondary level [ ],

No	STATEMENTS /ITEMS/	VL	L	M	H	VH
	Pre project factors					
01	The extent of scarcity of portable water before implementation of water scheme project					
02	The presence of sufficient water supply as source of water scheme.					
03	The goodness of the water scheme project design.					
04	The level of users participated on the Site Selection of the water schemes.					
05	The construction quality Standards of the water scheme.					
06	The quality of materials used for water schemes construction					
07	The presence of protection system (guard and fence etc) at the water schemes to from breakdowns or addition of impurities					
08	The degree the water schemes placed or constructed at proper position					
09	Project Pre-implementation capacity building training given to the water committee members.					

d) Diploma and above [ ]

7. work experience of the respondents

a) ≤ 5 years [ ], b) 6—10 years [ ], c) 11-15 year[ ], d) ≥16 years [ ],

1. The major pre –implementation factors affecting the sustainability of rural potable water supply schemes

	The functionality of water schemes					
10	You're feeling on necessity of cost of salary of guard and maintenance being covered by the user.					
11	The capability of users to meet the cost of operation, maintenance and guard payment water supply projects.					
12	Source of fund for water supply project was sufficient and did not need government subsidy to sustain the project					
13	The extent of financial transparency of WUC for water users.					
14	The provision of financial management training for CWU.					
15	WUC mobilize the community to contribute resource in terms of material, money, labor					

Assessment on functionality and access of water scheme

16	The level of functionality of supply systems.					
17	Interrupted water schemes could get maintenance and quickly begin service.					
18	The degree of technical capacity of local technicians to repairs/maintenance broken water schemes.					
19	The extent of adoption of technology for pulling out underground water.					
	Level of water accessibility					
20	The amount of service coverage of water scheme.					
21	The extent of distance from the household to the water source or point.					
22	The duration of time used to fetch water.					
23	The extent of adoption of technology for pulling out underground water.					

The Effect of Socio-Environmental Factors on the Sustainability of Rural Portable Water Scheme

	The Effect of Socio-Environmental Factors					
24	The provision of water service satisfies the needs of the target group.					
25	The frequency of the users to be affected by water born					
26	Level of your satisfaction with physical quality of water					
27	The degree that water user committee (WUC) fulfills the required knowledge and skill to manage the water scheme					
28	The frequency of WUC to undergo meeting with user.					
29	The level of activeness of WUC to perform their task					
33	The urgency of WWRDO to respond to user Compliant.					
31	To what extent WUC mobilize community to plant trees to maintain supply of portable water.					

32. What do you think the possible mitigation actions taken to keep the sustainability of water schemes in Dandi Woreda of Oromia Western zone?

PART II- NINTERVIEW GUIDE FOR KEY INFORMANT

I am Asfaw Kassa a student at Addis Ababa University in College of Development Study. I am currently undertaking my research project as a requirement for award of the degree of Masters of Science in Water Resource Management. The main objective of this Interview is to collect information about the sustainability of rural potable water supply. The other objectives are to gather information about pre-implementation, post-implementation factors affecting the sustainability of rural potable water supply schemes and the level of functionality of the water schemes. Your information helps me to assess the sustainability of water supply schemes and to investigates the factors affecting the sustainability of rural water supply project. So, please tell me the real information if possible.

Thank you for your cooperation!!

Woreda /kebele/ ----------, Name of respondent ---------- Sector---------- Sex--------Educational status ---------- Possession ----------

1. What are the major pre – implementation factors affecting the sustainability of rural potable water supply schemes?

   1.1 The extent of the participation of users at early phase of water scheme project development.

   a. Was the water scheme project designed to supply user pure water free from microbes causing water borne disease?
   b. Construction quality standards of the water schemes?
   c. The holding strength of ground base for construction of water schemes.
   d. The strength of the quality of construction of water schemes.

2. What is the level of functionality of the water schemes? The quality of maintained water schemes?

   e. The ease of availability of spare parts for non-functional water schemes
   f. The skill of local technician
   g. The extent of quality of various parts of the water schemes meeting construction standard

h. The capacity water schemes delivered water to users?

i. The amount a fund available to carry out operation and maintenance activities

j. Amount of money or in-kind resources received by users or a water committee from government or NGOs

3. What are the socio-economic factors affecting the sustainability of rural potable water supply schemes?

3.1 The accessibility of water supply provided for users?

3.2 The physical quality of water provided to users?

3.3 The extent that rural water supply being a cause of water born disease

3.4 The capacity of water scheme to deliver pure drinking water?

3.5 The extent that the water service is delivered based on the rule set.

3.6 Reasonability of the tariff for repairing water schemes and guard payment?

3.7 The financial capacity of the user to afford for this service?

3.8 What activities did WUC mobilize community perform to maintain supply of portable water.

3.9 The extent that WWRDO maintained the water rights of users.

3.10 Environmental conservation done by the user /community/ to securing the sustainability of existing water schemes

PART III- CHECK POINT GUIDE FOR FOCUS GROUP DISCUSSION (FGD**)**

Good morning / Good after noon everybody and Welcome to this session of our discussion. My name is Asfaw Kassa, I am an MSc candidate at Addis Ababa University and I am here with you for discussion. We are grateful for accepting to participate in this Focus Group Discussion (FGD). This study involves gathering information for the potable water supply sustainability and the perception of households towards sustainable potable water supply in your area. Specifically, it is our hope that the information gathered here will increase our knowledge on the affecting the sustainability of potable water supply project and our findings will not only benefit the community here but also other.

There for you should raise any of your feeling without any hesitation because your idea is very important for this study.

1. The degree that water user committee (WUC) fulfills the required knowledge and skill to manage the water.
2. The kinds of Community participation to sustain the project service
3. The extent that asset is repositioned.
4. The effectiveness of solved user's complaints by WUC and WWRD
5. The extent that rural water supply being a cause of water born disease.
6. The amount government provided subsidy for running the water scheme project
7. The amount a fund available to carry out operation and maintenance activities
8. The amount of water demand during the dry season
9. Absence of human activities (e.g., agriculture, industry, human settlements, mining, etc.) with potential to pollute the water source
10. Environmental conservation done by the user /community/ to securing the sustainability of existing water schemes

PART IV- GUIDING CHECKLIST FOR PERSONAL OBSERVATION

1. The types of water sources, performance or status, and potential risks to water quality.
2. The safeness of ground base for construction of water schemes.
3. The quality of materials (technology) used for water schemes construction
4. The type of rural potable water supply project (scheme)
5. The status (functionality and none functionality) of the rural potable water supply project (schemes)
6. The average distance of the rural potable water supply project (scheme) from the user community's village
7. The queuing up time to fetch water from the schemes
8. Environmental conservation done by the user /community/ to securing the sustainability of existing water schemes.

APPENDIX II

DATA GATHERING TOOLS AFAN-OROMO VERSION

KTAA- I.-GAAFILEE H.H,WUC FI SCF DHIYAATAN

Kaayyoon gaafilee kanaa odeeffannoo projectii dhiyeessii bishaan qulqulluu funaanudhaaf .Kaayyoon inni biroo odeefonnoo sadarkaa tajaajila kenninsa bishaan dhugaatii (hund pump), Rakkolee isaan muudatanii fi hubannoo/ Ilaalcha/ namoonni bishaan qulqulluu dhugaatii irrati qaban funaanuudhaaf. Odeeffannoon isin naaf kennitan qoranoon hojii irraa oolmaa fi sadarkaa kenninnisa tajaajila bishaan dhugaatii naannoo keessanitti argamu iyyaafannoof nagargaara, Ilaalch namootaa/ abbaa warraa/ fi rakkoolee bishaan dhugaatii baadiyyaa irratti geggeessuuf gargaarsa guddaa naaf kenna kanaafuu Odeeffannoo dhugaa irratti hundaa;uun akka naaf laattan kabajaanan isin gaafadha.

Deeggarsa naaf ggootaniif Galatoomaa!!

1. Odeeffannoo Haalduree

1.1 Odeeffannoo dhuunfaa

1.2 Maqaa Ganda jireenya _____Saala a) Dhiira [ ] b) Dhalaa [ ] 1.3 Ummurii/waggaan_____ Amantaa _____

1.4 Haala gaahilaa:a) kan fuudhe [ ],b) kan hinfuune [ ] , c) kadhima [ ] , d) kan hike [ ]

1.5 Bal'inamaatii _____

1.6 Sadarkaa qophii barnootaa olaanaa?

a) Hin baranne [ ],b) Sadarkaa 1^{ffaa} [ ],c) Sadarkaa 2ffaa[ ], d) Dippilomaa fi isaaoli [ ]

2. Gaafilee armaan gadii B G=baaye gadiaanaa, G= Gdiaanaa, Gg=Giddu-galeesa,OL= Ola-aanaa FI BO=baayee Ol-aanaa Kan. Haaluma Kanaan deebii keessan mallatto 'X' gochuun deebisa

Lk	GOSA GAAFILEE /ITEMS/	BG	G	Gg	O	BO
	Dhiibaalee ijaarsa duree					
01	water scheme project maddooleen bishaanii yeroo dheeraaf tajaajila akka kennu ijaarsaan dura ofeegganoon					

02	Argamin fi gahaa ta;uu madda bishaan qulqulluu haala kamiin ilaaltu					
03	Haall gaarummaa wixxinee perojectii bishaanii sadarkaa kamiin madaaltu/ilaa					
04	Sadarkaa hirmaanna fi lannoo saaytii madda bishaa irratti fayyadamtootiin madda bishaanii /uummanni qabu/					
05	Haalli qulqullina sadarkaa isaa eeggateen ijaarsa maddoota bishaanii					
06	Qulqullina meeshaalee ijaarsa maddoota bishaanii foolanii					
07	Haalli eegumsaa fi kununsimaddootabishaaniicabuu fi xuraaa\uu irraa ittisuuf gadhamu					
08	Maddoonni bishaan dhugaatii bakka barbaachisaa fi fudhatama qabutti ijaaramuu isaasa darkaa kamiin ilaaltu					
09	Ijaarsa maddoota bishaanii geggeessuun dura haal-duree godhamuu qabanii fi hirmaannaan uummataa maal akka ta\uu qabu irratti leenjii karee bishaaniif kennamu sadarkaa kamiin ilaaltu					
	Tajaajila kenninsa maddoota bishaan dhugaatii					
	Tooftaa Suphaa maddoota bishaan dhugaatii ilaalchisee					
10	Maddoonni bishaan dhugaatii yeroo miidhaaan irra gahe yeroo gabaabaa keessatti suphuun tajaajila akkkennu gochuun					
11	Ogeessota suphaa maddoota bishaanii cabanii fi miidhaan irra gahe suphaa geggeessan kansadarkaa gandaatti jiran gahumsi ogummaa isaan qaban					
12	Sadarkaa qulqullina suphaa maddoota bishaan dhugaatii baadiyyaa sadarkaa kamiin ilaaltu.					
13	Haalli meeshaalee suphaa maddoota bishaan dhugaatii baadiyyaa caban suphuuf tajaajilan akka salphaatti argamuu isaa					
	Sadarkaa dhangala'insa maddoota bishaanii guyyaa keessatti sa'aatii ini tajaajila kennu.					
	Argamaa fi ittifayyadama maddoota bishaanii (Reliability and Access to Water supply)					
14	Hanga haguugii tajaajila kenniinsa maddoota bishaanii					
15	Hanga dhiibbaa dhangala'insa maddoota bishaanii/ hanga oomishaa/					
16	Fageenya maddoonni bishaanii mana jiraanyaa fayyadamtootaa / uummataa irraa fagaatu					
17	Maddoota bishaanii irraa waraabbachuuf yeroon itti fudhatu					

18	Haala teekinooloojii ammayyaa bishaan lafa jalaa harkisuu danda'an fayyadamuu/ madaqsuu/ teekinooloojii					
	Dhiibbaa sooshoo-ikonomii fayyadamtootaa/ Socio-economic factors users/					
19	Sadarkaa kenniinsa tajaajilaa maddoota bishaanii fi itti quufinsa fayyadamtootaa.					
20	Sadarkaa itti quufinsa qulqullina bishaan maddoota bishaanii irraa argaman (turbidity, color, odor and taste)					
21	Hanga irra deddeebi'uun dhukuboota qulullina bishaaniin wal qabatuun qabamuun isaanii					
22	Haali fedhii guutinsa garee fayyadamtootaa dhiyeessii maddoota bishaanii irratti qaban.					
23	Hami namoota filannoo maddoota bishaanii biro fayyadamanii					
24	Kafaltii /baasii/ mindaa waardiyyaa maddoota bishaanii fi suphaadhaaf oolu fayyadamtootaan haguugamuu isaa irratti fedhiin qadan					
25	Cmii fi gaaffilee fayyadamtootaaf deebii quubsaa fi sirriita;e yeroodhaan kennuu/ komii furuu/					
26	Kafaltii /baasii/ mindaa waardiyyaa maddoota bishaanii fi suphaadhaaf oolu kafaluuf dandeettii qabeenya fayyadamtootaa.					
	Damdeettii ooggansa koree bishaanii) Effectiveness of WUC **on project management**					
27	Sadarkaa dandeetii fi beekumsa karee bishaan dhugaatii baadiyyaa (WUC) ooggansa maddootabishaaniii.					
28	Irra deddeebi'usa waltajii koreen bishaan dhugaatii uummata /fayyadamtoota waliin geggeessan					
29	Sadarkaa hojii isaaii seeraan bahuu koree bishaan dhugaaatii qulqulluu					
30	Arriiffannaa komii bishaan fayyadamtootaa deebii attatamaa waajira qabeenya bishaani aanaatiin kennamu.					
31	Sadarkaa koreen bishaanii uummata dadammaqsu hojiiee gumsaa fi kunuunsa qabeeny uumamaa/ biqiltuu dhaabsisuu/					

32. Rakkoole tajaajila kenninsa madoota bishaanii gandoota/ baadiyyaa furuuf hojii maaltuhojjatamuu qaba jettanii yaaddu.?

APPENDIX-III

THE STATUS OF EXISTING WATER SCHEMES

Kebele	Name of water point	Type of schemes	Year of installed	Current status	
				Function	Non-Function
Danoejersagibe	Salale sefer 1	Hand dug	1992	Functional	
	Salale sefer 2	hand dug	1995		Non-Functional
	Dano barodo	Deep well	1998	Functional	
	Mishegi	hand dug	1990		Non-Functional
	Fakare	hand dug	1990		Non-Functional
	Boche	hand dug	1998	Functional	
	Ejersa gibe	hand dug	1990	Functional	
	Laga Rasa	hand dug	2007	Functional	
Faji galia	Turo 1	Hand dug	1992		N0n -Functional
	Turo 2	Hand dug	1992	Functional	
	Turo 3	Hand dug	1997		Non-Functional
	Turo 4	Hand dug	1999	Functional	
	Turo 5	Hand dug	1992		Non -Functional
	Turo 6	Hand dug	1998		Non- Functional
	Turo 7	Hand dug	1999	Functional	
	Turo 8	Hand dug	2010	Functional	
	Ariye	shallow well	1998	Functional	
	Ratta Sintayoo 1	hand dug	2007	Functional	
	Ratta Sintayoo 2	Shallow	1991	Functional	
	Jallo	hand dug	1999		Non-Functional
	Gugsa	deep well	2009	Functional	
	Jallo Galila	springmotorized	2010		Non-Functional
	Kella fayya	Shallow well	2008	Functional	
	Galilaa	hand dug	2005	Functional	
	Garb tiki 1	hand dug	1999		N on-Functional

	Garb tiki 2	hand dug	2005	Functional	
	Bulga safar	hand dug	1995	Functional	
	Wajitu	hand dug	1991		Non-Functional
	Awash	hand dug	2004		Non -Functional
	Chafe Dake 1	Hand dug	2002	Functional	
	Chafe Dake 2	Hand dug	2011	Functional	
Wamura sako	Osole hund dug	Hand dug	1991		Non-Functional
	Chafe Sako	Hand dug	1998		Non-Functional
	Babali 1	Hand dug	1993	Functional	
	Meti 2	Hand dug	1998	Functional	
	Meti 1	Hand dug	1990		Non-Functional
	Meti 2	Hand dug	1996	Functional	
	Meti 3	Hand dug	2009	Functional	
	Wamura school 2	Hand dug	1990	Functional	
	Wamura School 1	Hand dug	1998		Non-Functional
	Salgan Liban	Hand dug	1998	Functional	
	Gare Aba korsa 1	Hand dug	1997	Functional	
	Gare Aba 2	Hand dug	2004	Functional	
	Gare Aba 3	Hand dug	1999	Functional	
	Boracho	Shallow well	1998		Non-Functional
	Dagoye 1	Shallow well	1998		Non-Functional
	Dagoye 2	Hand dug	1999	Functional	

APPENDIX- IV

LOCATION OF THE SCHEMES (LONGITUDE AND LATITUDE) COORDINATION

Cod	Name/Scheme/	GPS Reading			Kebele
		X	Y	Z	
1	Salale sefer hund dug 1	407658.472	999228.515	2245	DanoEjersa gibe
2	Salale sefer hand dug 2	4076550.576	999221.417	2256	
3	Dano barodo deepwell	407647.566	999220.311	2188	
4	Mishegi hand dug	407658.576	997098.715	2189	
5	Fakare hand dug	407658.526	997098.615	2159	
6	Boche hand dug	407659.516	997098.715	2170	
7	Ejersa gibe hand dug	407658.567	997094.225	2160	
8	Laga Rasa hand dug	407657.125	997066.213	2211	
9	Turo hand dug 1	407626.376	992831.211	2197	Wamura sako
10	Turo hand duag 2	407638.432	990506.308	2210	
11	Turo hand dug 3	407629.776	990731.309	2196	
12	Turo hand dug 4	407638.676	992716.407	2183	
13	Turo hand dug 5	405527.874	993837.311	2185	
14	Turo hand dug 6	405530.864	994706.302	2179	
15	Turo hand dug 7	405527.861	993825.309	2195	
16	Turo hand dug 8	405527.771	993706.325	2177	
17	Ariye shallow well	405537.872	993806.407	2167	
18	Ratta Sintayoo hand dug 1	405625.172	993914.213	2148	
19	Ratta Sintayoo Shallow 2	405622.119	993919.163	2147	
20	Jallo hand dug	405527.874	990706.609	2121	
21	Gugsa deep well	407658.479	994968.017	2123	
22	Jallo Galila deep well	407512.576	990968.583	2136	
23	Kella fayyas hallow well	407648.574	994938.415	2161	
24	Galilaa hand dug	407538.546	992837.411	2147	
25	Garb tiki hand dug 1	407658.575	992837.301	2147	

Cod	Name /Scheme/	X	Y	Z	
26	Garb tiki hand dug 2	409789.279	992837.322	2158	
27	Bulga safar hand dug	405581.274	992706.309	2169	
28	Wajitu hand dug	407658.264	992768.212	2182	
29	Awash hand dug	407658.176	993968.213	2182	
30	Chafe Dake hand dug 1	407658.475	994938.013	2168	
31	Chafe Dake hand dug 2	407658.574	994967.015	2186	
32	Osole hund dug	409789.279	990707.609	2191	Faji galila
33	Chafe Sako hund dug	409769.289	990807.619	2170	
34	Babali hund dug 1	407658.576	988575.907	2170	
35	Meti hund dug 2	407648.576	988565.807	2192	
36	Meti hund dug 1	407638.576	988545.901	2191	
37	Meti hund dug 2	409779.217	996706.701	2185	
38	Meti hund dug 3	409749.289	990306.602	2187	
39	Wamura school hund dug 2	409689.283	994706.608	2240	
40	Wamura School hund dug1st	409789.189	990716.547	2243	
41	Salgan Liban hund dug	4097879.269	990726.619	2210	
42	Gare Aba korsa hnd dug 1	409749.249	990731.611	2193	
43	Gare Aba korsa hund dug2	409759.279	990706.579	2200	
44	Gare Aba korsa hund dug 3	409879.317	990506.861	2208	
45	Boracho shallo well	409689.274	990276.633	2235	
46	Dagoye shallo well 1	409881.378	991706.507	2243	
47	Dagoye bhund dug 2	409789.258	990736.621	2224	

APPENDIX-V

PHOTOS TAKEN AT DATA COLLECTION AND FIELD VISIT

Well managed /secured/ and Functional water schemes

Source: photo taken from Fajigalila kebele , 2022

Non-Functional water schemes

From Wamura sako kebele

From Dano-ejersagibe kebele

Data collection from households in Faji galila kebele

At Wamura sako kebele, an interview was held for the water users' committee

The Woreda Water Resource Head was