JIMMA UNIVERSITY

JIMMA INSTITUTE OF TECHNOLOGY

SCHOOL OF CIVIL AND ENVIROMENTAL ENGINEERING

EVALUATION OF THE SUSTAINABILITY OF RURAL WATER SUPPLY SYSTEM THE CASE OF DABAT WOREDA, AMHARA REGION, ETHIOIPIA

BY

YAWKAL BIRKU ADAL

A THESIS SUBMITED TO THE SCHOOL OF GRADUATE STUDIES OF JIMMA UNIVERSITY IN PARTIALFULFILLMENT OF THE REQUIERMENT FOR THE DEGREE OF MASTERS OF SCIENCE IN HYDRAULIC ENGINEERING

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NOVEMBER2015

JIMMA, ETHIOPIA

Declaration

This research is my original work and has not been presented for a degree in any other universities and that all sources of materials used for this research have been duly acknowledged.

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Name of Candidate Signature Date

As Master research advisors, we hereby certify that we have read and evaluated this MSc research prepared under our guidance, by YAWKAL BIRKU ADAL entitled THE EVALUATION OF THE SUSTAINABILITY OF RURAL WATER SUPPLY SYSTEM: ACASE OF DABAT WOREDA, AMHARAREGION, ETHIOPIA

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Abstract

Ethiopia is situated at the area where the weather is complimented with relatively higher amount of rainfall. This has given the country with enormous water resource potential. Sustainability of water supplies is a key challenge, in terms of both water resources and service delivery. The United Nations International Children's Fund (UNICEF) estimates that one third of rural water supplies in sub-Saharan Africa are nonoperational at any given time. The objective of this study is to assess the factors affecting the sustainability of rural water supply system in Dabat woreda rural areas by evaluating and comparing functional and non-functional systems. The study was carried out in Dabat Woreda located in North Gondar, Amhara Region, Ethiopia. A total of 366 water supply schemes were constructed. Fromthese water points, 269 were functional and 97 were non-functional water supply points. In four kebeles from112 water supply schemes Seventy-six (thirty-eight functional and thirty-eight non-functional) among these systems were selected by simple random method. A household survey concerning the demand responsiveness of projects, water use practices, construction quality and their level of satisfaction was conducted at 380 households. The result shows that differences between the functional and non-functional system was the involvement of the local leaders. In the functional systems, 45% of the local leaders were involved in the initiation of site selection of the water points while 53% the local leaders involved in site selection for the nonfunctioning systems. According to the assessment of respondent's perception of the participation of women in water development process and water committee, more than 57% of the respondents in functional and 69% of respondents in non-functional systems are not members of the water committee. The field survey shows that 62% of functional WSPs were initially fenced. In nonfunctional systems, only 25% were fenced. Respondents confirmed that three-fourth of water points were never fenced and eventually became non-functional. In the functional system 54% of the respondents found construction quality of the system good, while 26% found them bad. For non-functional system, 31% of them well constructed while one fourth were considered poorly constructed. Because a larger percentage of respondents considered functional systems had good construction quality as compared to non-functional systems, poorly constructed scheme is more likely to become unsustainable.A general held belief that the community involvement during initiation and construction of the water supply system is most crucial factor in the success of a water supply system does not seem to be important factor in the study area. Instead, the organization of the community by having an effective local leader to interact with the contractor and Dabat personnel is important factor as well having the means to afford the payments for maintenance for a water supply system.The level of stakeholders' participation in the project planning and implementation should be increased to enhance the sustainability of the water supply points in the county.

Key words: Sustainability, Rural water supply, community participation, functionality

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Foremost the glory goes to the ALMIGHTY GOD; through him, all things are possible. In him, I put my trust for protection and guidance.

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List of abbreviations

ADB	African Development Bank
ADF	Africa Development Fund
CSA	Central Statistical Agency
DFID	Department for International Development
EHP	Environmental Health Project
EREP	Ethiopian Rural Education Project
EWRMP	Ethiopia Water Resource Management policy
FWSP	Functional water supply point
GOs	Governmental Organization
IMWI	International Water Management Institute
IRC	International Water and Sanitation Centre
NFWSP	Nonfunctional water supply points
NGOs	Non-Governmental Organization
OED	Operations Evaluation Department
RWS	Rural Water Staffs
RWSS	Rural water Supply and Sanitation
UNDP	United Nations Development Program
UNICEF	United Nations Children’s Fund
WaSH	Water Sanitation and Hygiene
WB	World Bank
WC	Water committee
WCED	Water, Engineering and Development Centre (UK)
WHO	World Health Organization
WPs	Water points
WSP	Water and Sanitation program
WUCs	Water user communities
WUGs	Water user groups

CHAPTER ONE

INTRODUCTION

1.1. Background

Ethiopia is geographically located at a region where the climate is complimented with comparatively higher amount of rainfall. This has given the country with immense water resource potential. Based on some preliminary studies conducted, it is estimated that the country has an annual surface runoff of close to 122 billion cubic meters of water excluding ground water (EWRMP, 2001). The country's groundwater potential has not yet adequately studied but professional estimates has put an approximate figure of 2.6 billion m^3 (ADF, 2005). In spite of this immense potential reality, sizable proportion of the country used to have faced uneven water distribution and inconsistency of its accessibility in terms of time and space (IMWI, 2007).

Sustainability of water supplies is a key challenge, in terms of both water resources and service delivery. The United Nations International Children's Fund (UNICEF) estimates that one third of rural water supplies in sub-Saharan Africa are nonoperational at any given time.

Realizing the critical importance of supplying potable water, national and regional governments, local and international NGOs invest millions of capital every year in developing countries to tackle the problem through implementation of water supply projects (Prokopy, 2005). However, constructing water supply systems alone would not eliminate all problems, especially in rural areas. Functionality, utilization by intended beneficiaries, and resilience of water projects are important characteristics to be considered and integrated in order to achieve maximum benefits (Harvey &Reed, 2007). Hence, integration between beneficiaries and project suppliers in decisions and contributions as well as management in all phases need to be addressed.

1.2. Statement of the Problem

Water is one of the most crucial and non-substitutable environmental resources. Adequate, quality, safe and affordable supply of drinking water is a basic need for human life. However many people across the planet do not have access to safe and adequate water supply services which affects their life in various ways (Yibeltal, 2011).

Lack of access to improved water causes higher infant mortality rates, low economic productivity, and low female enrollment in school. These consequences are more serious in the rural populations that have virtually no sanitation facilities, though only eight percent of the total population has access to sanitation (Dessalegn, 1999).

Construction of potable water projects in rural areas is the first step to increase community access and contribute to the health of its members. However, this alone would not achieve all the intended objectives. An African Development Fund (ADF) (2005) report shows that 33% of rural water services in Ethiopia are non-functional due to lack of funds for operation and maintenance, inadequate community mobilization and commitment, as well as lack of spare parts.

Construction quality in rural water supply schemes is in question in the study area. So many factors affect the construction quality at the study woreda. These are: most of the constitution materials are local which have no good standard; no integration between the owner of the schemes and the provider; the contractors for scheme development in rural areas are local who have no good experience and capacity.

Aspects of water supply systems that promote sustainability need improvement include better planning and follow-ups, better operation, maintenance, and management. As the level of investment in RWS by the international and national organizations increases, information that is more specific is needed on water supply systems. In addition, it is necessary to examine challenges that undermine long-term sustainability of rural water supply projects both at the planning and implementation phases. An assessment of the challenges of sustainable rural potable water use at both pre- and post-construction phases is critical for Ethiopia and particularly for the study area.

1.3. Objectives

1.3.1 General objective

The general objective of this study is to assess the factors affecting the sustainability of rural Water supply in Dabat woreda rural areas.

1.3.2 Specific objectives

1. To identify the cause of failures of rural water supply scheme in the study area
2. To assess the functionality and service level of existing water supply schemes in the study area;
3. To determine the level of community participation in the development of rural water supply system.

1.4. Research questions

- What are the main causes of failures of rural water supply schemes in the study area?
- How severe are problems with water service in the community?
- What type of participation did have during the project development of rural water supply system?
- How is the construction quality of the water supply schemes at Dabat woreda?

1.5. Organization of the Thesis

The first chapter of this paper describes the background of rural water supply, in which the general view of the core issues of the paper is discussed. A statement of the problem, general and specific objectives, research questions, and scope of the study follows it. The second chapter reviews literature pertinent to rural drinking water development, sustainability, and community management of schemes. Chapter three presents a description of the study area, data collection methods, research design and sampling procedures, sampling frame of the study, sample population and method of data analysis. In chapter four, the main findings and discussions are presented. Chapter 5 draws conclusions on the findings and makes recommendations.

1.5 Significance of the study

Since the research focuses on assessing the factors of sustainable water supply in Dabat woreda rural areas, it is expected to increase the knowledge and up to date information on rural water supply systems. It will also serve as a working document to policy makers in the water sector, the Non-Governmental Organizations (NGOs), the community and environmental advocates. The study will further serve as baseline data for any further investigation, as a useful material for academic purposes, and as an added literature to the existing knowledge.

1.6. Scope of the Study

The scope of the research was limited in space and time. The research was conducted to assess the sustainability of rural water supply in rural areas of Dabat woreda (it does not include Dabat town water supply system).

CHAPTER TWO

2. LITERATURE REVIEW

2.1. The Concept of sustainable rural water project

According to Sugden (2003), Sustainability "has become one of the most over used and abused words in the development vocabulary". In the most obvious sense, the term "sustainable" refers to something which can be kept going.

Hodgkin (1994) in a WASH Technical Report, The Sustainability of Donor-Assisted Rural Water Supply Projects defined sustainability as the ability of a development project to maintain or expand a flow of benefits at a specified level for a long period after project inputs have ceased.

2.2. Defining sustainability in Rural Water Supply System (RWSS)

There is a broad range of definitions of sustainability in RWSS used in different studies. The majority of these definitions are similar in nature but have slight differences in emphasis. There do also exist a number of definitions that are significantly different. How define, sustainability is important for selecting parameters, which are important for measuring and understanding the determinant factors that affect prospects of sustainability. As Hodgkin (1994) notes, there arises a problem for objective quantification of sustainability because the adjective "sustainable" has strong normative connotations. That is to say, that different group of people, users of water, donors, national governments, local private sector companies, research institutions, etc. have different perceptions of sustainability based on the relative value attached to its achievements. As Black (1998) pointed out, sustainability in water supply and sanitation sector was primarily associated with financial aspects of service delivery and the need to make projects self-sufficient, highlighting the need for users to contribute to cost sharing. However, the above definition is problematic when considering the ultimate goals of providing RWS services. Improvements in health and the later positive impact on the broader wellbeing of rural populations can be the perceived benefits of water projects for many national and international agencies. Therefore, the logical definition of sustainability from the perspective of these institutions may be one that includes sustained health impacts. Whereas, for many rural communities, the perceived benefit of a project may simply be continued access of water nearby; which is closer to the definition that simply describes sustainability as whether or not water continues to flow over time.

Most of the examples cited above include definitions of sustainability, which describe a benefit resulting from the implementation of a project or establishment of a service. The most common of these benefits include water delivery itself, health benefits through reduced exposure to pathogens and others such as time saved, convenience and contribution to livelihoods. Mukherjee et al (2003) describes sustainability based on the publication of WSP& IRC (2003) as the satisfactory functioning and effective use of services, and equity as everyone (men and women, rich and poor) having equal access to benefits from projects. Another publication by IRC (Schouten et al., 2003) includes, as part of its definition of sustainability, a statement that a system that reliably and sustainably meets the needs of 80% of the population while leaving the poorest 20% un-served cannot be counted a success. The incorporation of a measure of social equity in the definition of sustainability reflects, in part, a political or ideological position in terms of viewing access to basic services as a fundamental human right. Given this view it is fair to say that perhaps many of the definitions of sustainability may not yet have caught up with current thinking and that, at least for the community management model, definitions should be reconsidered and modified to account for this potential contradiction. Therefore, classifying a community-managed RWS system as sustainable should not necessarily preclude the community from having access to continuous, external back-up support of some kind.

2.3. Determinants of sustainability

A number of studies have identified various determinants of sustainability of rural water supply system. However, some of the most common determinant factors are: technical factors including design, performance and maintenance issues, community and social factors including willingness to support projects, institutional factors, including policy and external follow-up support, environmental factors, including the sustainability of the water source, financial factors, including the ability to cover recurrent costs, education to affect long-term behavioral changes.

2.3.1. Pre Project Factors

Before a project is going to be decided for implementation, there are some steps to be completed by the planners and project coordinators. The pre-implementation factors are related to project rules that are essential elements of project design. They are essential because they provide incentives for communities to express and act on their demand for the services provided. Some of the main elements of pre-implementation factors are described as follows.

2.3.1.1. Community and women participation

In its broadest sense, participation represents a fundamental link between project beneficiaries and project suppliers (Campbell et al., 1993). In the planning stage, therefore, participation of communities in all and women especially is very necessary (Aschalew, 2009). More attention should be putted on women because they take the central role in the collection, management and use of water, as well as general sanitation of the household (Fong et al, 2003). Furthermore, there is ample evidence to indicate that more active involvement of women can optimize the results and impacts of RWSS projects (Mukherjee et al., 2003; DFID, 1997). The World Development Report 1992 (World Bank, 1992) states that people's participation has three main advantages: it gives planners a more thorough understanding of local values, knowledge and experience, it wins support for project objectives and fosters community assistance in local implementation, and it helps resolve conflict over resource use. Gow et al. (1994) assure community participation also enhances accountability, equity, and sustainability of benefits. Hence, water supply projects should give the participation of women high priority since they are the ones who withstand the worst of lack of safe water supply. It is meaningless for water projects not to reduce the hardship, among others, of women and children.

2.3.1.2 Institutional Support

Another very important factor highlighted by literatures was the provision of follow up support to rural communities in the long term. This is increasingly recognized as a critical factor in sustainability, as evidenced by the importance it is accorded in many recent World Bank project proposals and in several recent publications by sector organizations such as the EHP (Lockwood, 2002) and the IRC (Schouten and Moriarty, 2003). In both of these documents, it is argued that the majority of rural communities cannot be expected to manage on their own indefinitely. In order to guarantee the sustainability of RWSS projects and the associated benefits, it is necessary to provide support and guidance that addresses a range of issues. As Lockwood pointed out, there are four main functions provided by such support mechanisms beyond technical support for the O&M of physical infrastructure. These are technical assistance, coordination and facilitation, monitoring and information collection and training.

2.3.1.3. Raising Awareness and Training to Community and Management Bodies

Raising awareness and providing training to water management bodies (water committee) could be important to equip users with the right knowledge in managing their scheme and responding to system failure. Moreover, by creating awareness and training the potential benefits of clean water could be promoted to the community. The community will then be willing to take responsibility for handling operation and maintenance issues, which will create a sustainable system. Therefore, education about the linkages between unsafe water, inadequate excreta disposal, and disease should be integrated to water supply schemes of rural communities (Gebre- Emmanuel Teka, 1977).

2.3.2. Post Project Factors

Post implementation factors are those factors that affect the functionality of RWSS after the system is developed. In this regard, we can identify two broad sets of issues, which can lead to problems for community-managed after projects will be implemented. The first set of issues are within the community including community dynamics, political or social conflict, lack of cohesion, lack of capacity (technical, managerial, etc.) and lack of financial resources. The second set are those constraints that are external to the community like lack of spare parts supply, lack of supportive policies and legislation, and lack of long-term support to help communities through major repairs. In some instances, there is a direct relationship between factors that are within the control of the community and those that are external. Some of the critical factors that affect RWSS identified by different literatures are presented below.

2.3.2.1 Availability of Spare Parts

The availability of spare parts is a critical factor to keep the system infrastructure working properly. An adequate supply of spare parts and maintenance tools is obviously of primary importance to long-term sustainability. Supply chains are now recognized as one of the key determinants of sustainability (Davis and Liyer, 2002), especially where the technology provided is imported, which has often been the case with large-scale hand pump programs in Africa, for example. The majority of recent World Bank proposal documents focus attention on the creation and support of spare part outlet chains, normally based on private sector providers, precisely to fill this perceived weakness. Linked to the issue of spare parts, is the question of sector standardization, which is part of the broader policy environment. In general, understanding and measuring sustainability is difficult. However, different researchers have tried to develop a conceptual framework to capture the inter linkage of different factors that affect sustainability of RWSS.

2.3.2.2. Types of Technology

In order for rural water supply to be, sustainable, appropriate technology must be used. Where the technology deployed is remote from the users' capacity to maintain, operate or pay for it, prospects of sustainability of services are equally remote. Therefore, it is experience with a number of projects that can ultimately lead to a better choice of technology (Harold et al.). According to the World Bank, Village Level Operation and Maintenance (VLOM) type pumps can be repaired and maintained easily by village level caretakers requiring minimal skills and few tools. Spare parts are easily available in markets and are cost effective. Skinner in Harold et al. (2003) indicated that technology type, operating and maintenance, capacity and acceptance of rural people and spare part accessibility issues are of importance for sustainability of the services given.

2.3.2.3. Users Satisfaction and Willingness to Sustain the System

Demand-responsiveness at the household level is a determinant of overall sustainability primarily due to its role in increasing consumer satisfaction and willingness to sustain the system. Consumers are more likely to be satisfied with results such as quantity of water, color and test of water, distance and waiting time to fetch water when they initiate the project, are involved in decision-making, and are informed about their responsibilities in terms of costs and O&M. It is predictable that under such circumstances, users express a higher sense of ownership, greater confidence in their ability to maintain the water system, a better understanding of how the tariff is used, and a willingness to pay for improvements. The central role that women pay in the collection, management and use of water, as well as with the general sanitation of the household is well documented (Fong et al, 2003). Furthermore, there is ample evidence to indicate that a more active involvement of women can optimize the results and impacts of RWSS projects (Mukherjee and van Wijk, 2003; DFID, 1998). Therefore, it is not surprising that the continued involvement of women, after project implementation has been completed, is identified as one important determinant of sustainability. Similarly, an adequate degree of social cohesion within a community is now considered as a fundamental factor in sustainability. The collective willingness to maintain a water supply system, is a reflection of social cohesion, and is dependent on the concept of community identity (Cater et al, 1999).

2.3.2.4. Cost Sharing and Cost Recovery

The issues of cost sharing and cost recovery are crucial in the process of enabling the community to manage their systems after completion. It must, however, be clear that does not imply total financial responsibility of the community. It does mean that some contribution from users is needed to establish commitment, which through time should increase to reach the intended level of making the developed systems sustainable (Evans, 1992: Sebsibe, 2002). The success of cost recovery efforts, as a key post-project determinant of sustainability, will be influenced by the extent to which individuals and committees are supported, re-trained, and guided in relation to tariff structures and broader financial management. If such (external) guidance is absent, then it is likely that the success of cost recovery efforts will slowly diminish over time (Misgina, 2006).

2.4. Conceptual/Theoretical framework

Sustainability is a complex and dynamic concept, which is made up many interrelated components. As can be seen from the literature section of this paper, sustainability of rural water supply schemes depend on community, technical, financial factors. Furthermore, each factor compromises of important elements that have to be considered to ensure sustainability of water supply schemes.

Regarding with technical factor, water supply project should consider village level operation and maintained schemes for ease of community management. Also adequately trained and skilled technicians those can undertake minor maintenance of schemes should be created within user communities. Besides, important tool kits that are required to undertake maintenance works should be availed. Furthermore, spare parts supply system should be established in a way that the communities can access and afford them if needed for maintenance. In addition, relevant professionals to avoid construction quality problem should supervise construction quality of schemes during well excavation /drilling and top works construction. In addition, practice of saving users contribution in local financial institutions should be there so that the maintenance of emergency breaks and costs of spare parts can be financed with little down time of schemes. Moreover, concerning community factors, there should be a demand for community for improved water supply schemes before development of the schemes. Community participation in general and women participation particular should be ensured starting from planning to financial management stage of the scheme development. Locally organized and recognized water committee should undertake overall management and governance of implemented schemes. Furthermore, staffing of water committee should be gender sensitive to include women as decision-making body for water supply schemes and governance. Therefore, this study employ the following conceptual /theoretical framework to assess problems to rural water supply schemes by examining the existence or absence of factors those contribute for water supply schemes functionality (See Fig 2.1) below.

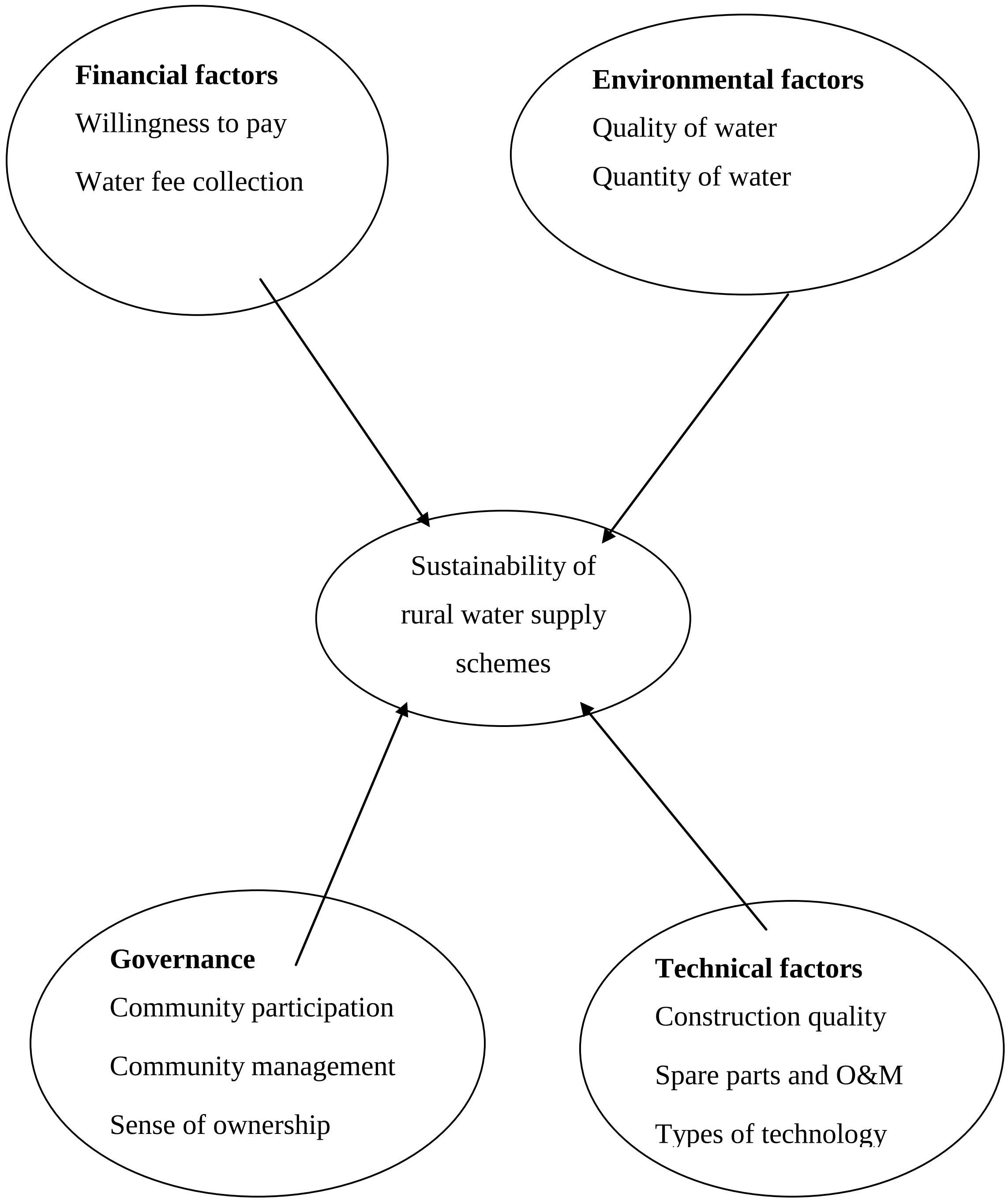

Figure 2.1 conceptual/theoretical framework (Source: Modified from Bezabih .G (2008)

CHAPTER THREE

3. MATERIALS AND METHODS

3.1. Description of the Study Area

Dabat Woreda is located at 814 km northwest of Addis Ababa, the capital of Ethiopia and 250km to the north of Bahir- Dar, the capital of Amhara region. It is situated at an altitude ranging from 1800 to 2700 m and has area coverage of 1,187.93 square kilometers. The area receives an average annual rainfall ranging from 1000 to 2000 mm and average daily temperature from 24 - 27oC. The study area is divided in 26 rural and 4 urban kebeles. In 2007, the population of Dabat Woreda was 164,798 (CSA, 2007). Dabat is one of the woreda in the north Gondar administrative zone in the Amhara region. The woreda is bordered by Debark woreda to the East,Tegede woreda to the West and Wogera woreda in the south. The research area has more than 366 rural water supply schemes, of which 297 are hand dug wells, 13 medium deep wells and 7 deep wells (with hand pumps) and the rest 49 water supply systems are developed springs.

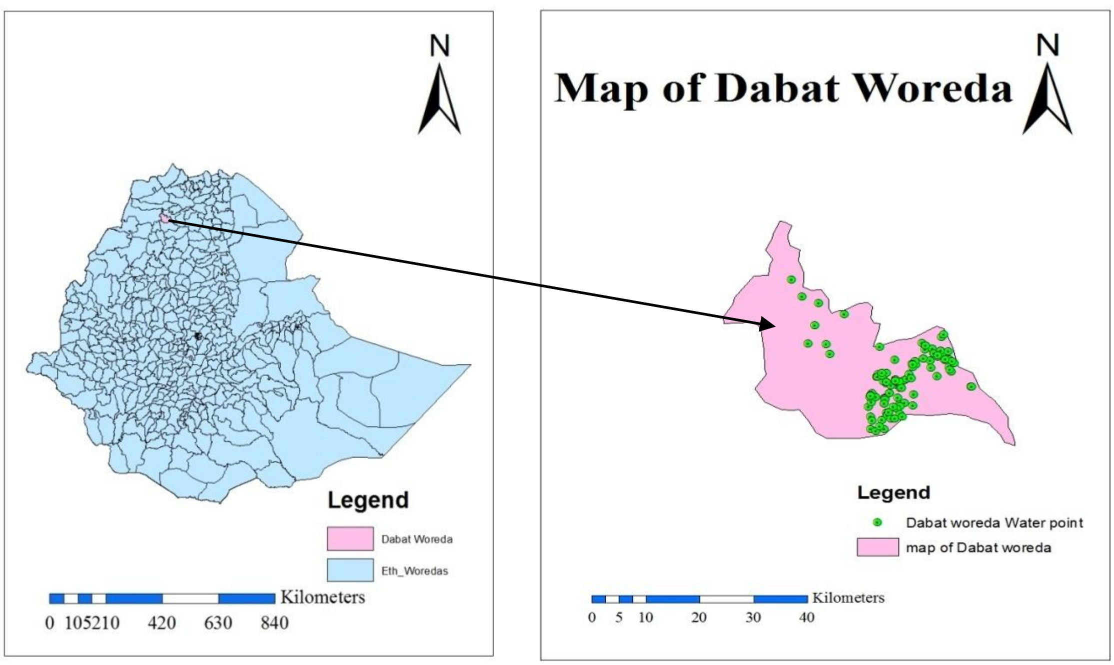

Figure 1: Map of Dabat woreda and distribution of water supply points in the study area (source delineation by using GIS shape file)

3.2 Research Design

This research used to collect, generate and analyze relevant data on the existing watersupply condition in the study area and on factors that impede the provision of safe and adequate water supply and its socioeconomic implication on the community using descriptive and exploratory methods.

Descriptive research – It sets out to describe and interpret the existing situation. Themethod employed in order to describe the state of affairs and the varying factors contributed to it. Because, it looks at individuals, groups, institutions, methods andmaterials in order to describe, compare, classify, analyze and interpret theentities and the events that constitute the various fields of inquiry.

3.3 Data type

Both qualitative and quantitative data were collected. These data were generated through Questionnaires, Focus Group Discussion, Key Informant Interview, and Personal observation data obtained from the Household survey.

3.4 Data Sources

All the necessary data required for the study were obtained from both primary andsecondary sources. The major sources of secondary data were from government and non-government publications, annual and inventory reports, previous studies, andbooks. Whereas the primary data were collected from sample households, Focus GroupDiscussion and Key Informant Interview, which were made with various stakeholders, community representatives. In addition, personal observation and informaldiscussion with users were also the other data sources.

3.5 Sampling Techniques and sample size

One of the central objectives of this study was to assess the factors that affect the sustainability of rural water supply systems in Dabat woreda rural areas; to this end to get therepresentative population and the necessary information accordingly; this study usedthe combination of random and purposive sampling techniques to select householdrespondents, Focus Group Discussants and Key Informants. Random sampling wasapplied to select the sample households to get representative informants whereaspurposive sampling was used to select the sample kebeles, 4 Focus Group

Discussantsand 10Key Informants (from 3woreda water office experts, 3 from zone water office and 4from local kebele administrator office).

To carry out the study, Seventy-six (thirty-eight functional and thirty-eight non-functional) among these systems were selected by simple random method. A household survey concerning the demand responsiveness of projects, water use practices, construction quality and their level of satisfaction was conducted at 380 households by sample size determination formula.The sampling was calculated using the formula:

$$SS = \frac{Z^2 \times (p) \times (1-p)}{C^2} = \frac{1.96*1.96*0.5*0.5}{0.0488*0.0488} = 403$$

$$\text{New SS} = \frac{SS}{1 + \frac{(SS - 1)}{Pop}} = \frac{403}{(1 + \frac{(403 - 1)}{6429})} = 380$$

Where= P= 50% of participation level of the community, a conservativeProportion that will yield maximum sample size.

- c= Confidence interval(c=0.0488), -Z = critical value at 95% confidence of certainty (=1.96)

In general, the study covered 380households from the total of 6429 households ofthe selected kebeleswere selected for this study. According to the information obtained from the woreda, water office Four kebeles were selected to participate in this study differ in various ways, including size, population, living standard, socio-economic status of households, nature of water usage, much amount of water supply schemes , high amount of nonfunctional water supply points generally based on their accessibility and feasibility factors . Therefore, the kebeles were purposively selected.

3.6 Data collection Techniques

Data on factors that may hinder the sustainable functioning of water supply schemeswere gathered through employing multiple methods including Questionnaire, Focus Group Discussion, Interview and personal observation were being vigorous instruments to directly observe the existing water supply problems in the study area. Prior to the actual collection of data, pre-testing of the materials was made to check its validity and clarity.

The pre-testing of the questionnaires actually helped in the administration andimplementation of the actual survey and in restructuring the questionnaire format andcontent.

DATA QUALITY

The Questionnaire was structured and standardized. Translation of questionnaire from English into Amharic and back to English was made by people who are able to do and checked by the principal investigator. Training guidelines was prepared on households' questionnaire, observation checklist, and focus group discussion. Training was conducted for supervisors and interviewers.Pre-test was conducted on 10 respondents.

Questionnaires:-Primary data related with the socioeconomic characteristics of therespondents. Demand responsiveness and sustainability factors of the service, type ofparticipation of beneficiaries and women, issue of cost sharing and recovery, communitytraining and awareness creation, level of consumer satisfaction for the service provided, physical condition of water supply points. In addition, willingness of beneficiaries tosustain the system, repair and maintenance for the water supply services, technical and institutional issues were collected through structured questionnaires.

Focus Group Discussion (FGD): - This method was used to enrich the primary data, which were collected from sample households. Concerned personals from differentgroups were recruited. This in turn has helped to understand how people discuss about water issues as a group rather than as individuals.

3.7 Data Analysis

To analyze the data collected a combination of quantitative and qualitative analysismethods were employed. Quantitative data, which was generated from household survey, were analyzed using simple descriptive statistical tools like frequency and percentages and they were operated with Micro Soft Excel. The qualitative data collected using KeyInformants Interview and personal observation was analyzed through description,narrating and interpreting.

3.8 Data Presentation

The data analyzed has been presented using tables, graphs and photos.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Characteristics of Respondents

During the data collection process, the majority of respondents were Water User Groups (WUGs) in the community. The respondents were categorized according to their age, marital status, household size, educational background. Both questionnaire and semi structured interview were carried out during study to the respondents. Among the respondents, about 54% were male and 46 % were female. To avoid the biasness in the result, almost equal numbers of male and female respondents were drawn but during the actual data collection, percentage of male respondents in terms of gender was greater than female respondents. The age of the respondents ranged from 18 to 70. The majority of respondents were in the age bracket of 20-60. These age groups were targeted because people in this age group were actively taking part in community activities for the pre-construction, construction and post-construction phases. Respondents were asked about their marital status and the result showed that more than 88% of the respondents were married. The household sizes of the respondents were taken into consideration and results showed that 39% and 48% of households have household size below 5 and 5-10 respectively. Due to lack of awareness in the family planning, the number of family members was large. Respondents mentioned that the need for large household size is due to need of labor for farming activities. Most of the people in the study area were illiterate, and only few had attained primary level education.

Table 1: Respondents Demographic Characteristics

Characteristics	Category	No of respondents		Percentage	
		FWSPs	NFWSPs	FWSPs	NFWSPs
	Under 19	6	2	3	1
	20-40	90	102	47	54
	41-60	86	72	46	38
	Above 60	8	14	4	7
Age	Total	190	190	100	100
	Male	103	115	54	61
	Female	87	75	46	39
Sex	Total	190	190	100	100
	Married	174	161	92	85
	Separated	12	18	6	9
	Unmarried	4	11	2	6
	Widow	0	0	0	0
Marital status	Total	190	190	100	100
	1-4	74	68	39	36
	5-10	92	102	48	54
	above 10	24	20	13	10
Family Size	Total	190	190	100	100
Education	Not educated	112	121	59	64

	Adult education	50	56	26	29
	Grade 1 to Grade 12	28	13	15	7
	Total	190	190	100	100

4.2. Existing problems to sustainability of rural water supply Schemes

4.2.1. Physical Condition, Construction Quality, availability of spare parts and Type of Technology of Water Supply Schemes in the Study Area

4.2.1.1. Physical Condition of Water Supply Points

The physical condition of water supply points is an indicator for sustainability. Appropriate fencing with the right kind of fencing material (wood or metal wires) could prevent animals and humans from freely entering water supply points.

Table 2: Distribution of respondents to whether their nearer potable water point has been fenced and whether animals enter to WPs

Measurement	Is WSP fenced?				Do animals enter to WSP?			
	FWSPs		NFWSPs		FWSPs		NFWSPs	
	Yes	No	Yes	No	Yes	No	Yes	No
No.	118	72	48	142	34	156	114	76
Percentage	62	38	25	75	18	82	60	40

The field survey shows that 62% of functional WSPs were initially fenced. In nonfunctional systems, only 25% were fenced. Respondents confirmed that 75% of water points were never fenced (Table 2) and eventually became non-functional. At these water points, the probability of animals entering the area is very high causing contamination of the service. Accordingly, 60% of the respondents said that animals enter the water points

(Table 2). Discussions with elder water users has revealed that when irresponsible visitors pass, in the study area water point for example, they will take the service key and leave the water point vulnerable to damage. As a result, sustainability could be affected despite the presence of water supply guards. Sustainability of water supply points is higher in those water points that are fenced properly with adequate door and key. Hence, considerable attention shouldbe given by project owners to consider fencing of scheme. This should be the main project rule applied and accepted by the community in order for them to take responsibility for the service.

Figure 2 :Fencing status of NFWSPs in the study area (source: in the field observation, July 2015)

4.2.1.2 Construction quality of water schemes

According to literature, appropriate technology is fundamental in order to make the Water supply system sustainable. In the study area, different organizations participate in the construction of rural water supply systems, and they have their own approach to implement the water supply scheme. These approaches lead difference in sustainability of the water supply system implemented by different organizations. The result shows that out of the total water points (212) constructed by (WaSH) only 53 (25%) are non-functional, 3 (10%) are non-functional from 30 water points constructed by UNICEF, from 84 water points implemented by Dabat Woreda Water Desk office 12(14%) water supply points are nonfunctional. Therefore, out of these organizations UNICEF has shown to be superior in sustainability of the water supply systems. UNICEF and Dabat Woreda water Desk office involve the community in the process of implementing the water supply system, but in case of UNICEF, the cost of the water project is fully covered by the implementer.

Construction quality plays a great role in water supply schemes functionality or sustainability. There was a similar style of construction used throughout the study area most of the water supply points were poorly constructed due to shortage of time, poor supervision and budget release and availability. This was evidenced by the discussion with water committee members.

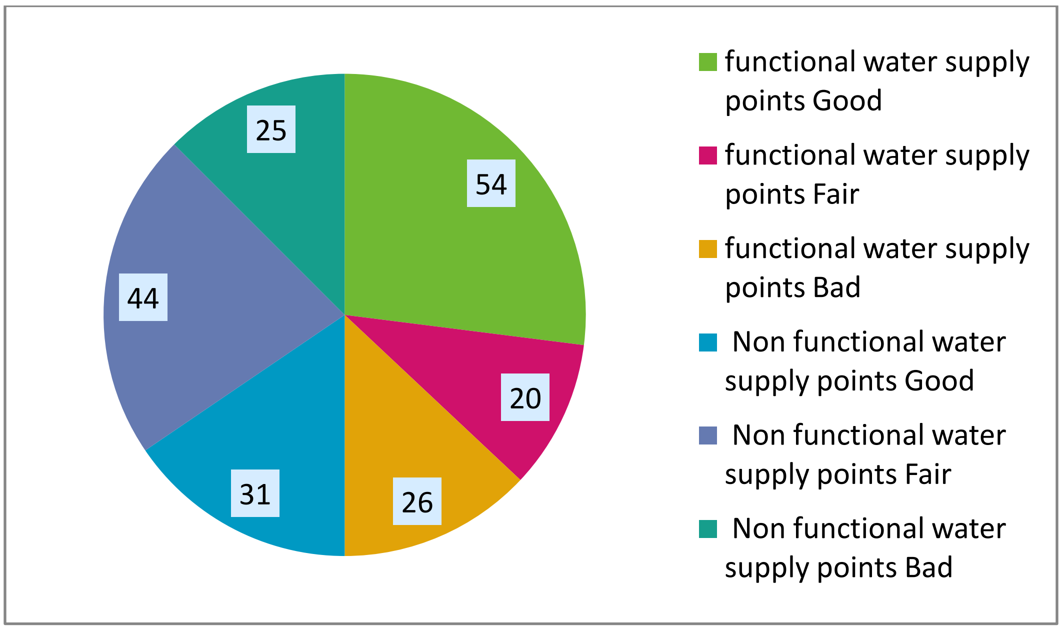

Figure 3: Opinion of respondents on the construction quality of water schemes

In the functional system 54% of the respondents found construction quality of the system good, while 26% found them bad (figure 5).For non-functional system, 31% of them well constructed while 25% were considered bad, or poorly constructed. Because a larger percentage of respondents considered functional systems had good construction quality as compared to non-functional systems, a poorly constructed scheme is more likely to become unsustainable.

Example of poor construction quality can be seen in figure 6. The picture to the right shows the foundation of scheme was cracked and the stones removed due to improper construction material ratio so that beneficiaries were not using this scheme any more. The left hand picture shows that non-functional point that was built inrainy season. As result, construction in rainy season have not recommended in water scheme construction.

During observation made on some of developed water points, there construction qualities were poor. For example, the drainage ditches were not constructed according to the right standard which should be in relation to the characteristics of the area observed.

Figure 4: The construction quality of removal of spare parts and cracking of non-functional water supply points in the study area (source: field observation, July 2015)

It may be a dangerous for people when a facility breaks down and cannot be repaired because of a fault in the design and construction. There was a question "how do you evaluate the construction quality of existing water supply schemes?" for the household respondents in the study woreda. They answered Varity of answers according to their understanding. The evaluation criteria were "good", "fair" and "bad" of the water supply schemes construction quality. The survey result revealed that, 69% of the household respondents responded that the construction quality is "fair" and 31% of the household respondents said the construction quality is good. No one said the construction quality is not good in functional water supply points, 62% of the respondents said the construction quality is fair 17% good and 21% is bad. But this is not the reality from physical observation in the selected kebeles.

Their views were due to less awareness and lack of understanding upon the design and quality of construction within the user communities. Moreover, the illiteracy of the household respondents in the survey area made them accepting a given constructed schemes without observing the construction quality.

From experience, it is not uncommon for the failure of water supply schemes because of construction quality problems. Common construction quality problems that result in scheme functionality are:

- Improper site selection due to poor and lack of feasibility study
- Partial penetration of an aquifer
- Poor casing arrangement
- Poor gravel packing and poor estimating of well yield.

Such kind of well completion problems eventually results in well dry up and as a result the schemes will be abandoned (Harney & Reed 2004).

4. 2.1.3.Availability ofSpare Parts

Concerning the availability of spare parts at community level in rural water supply schemes whenever needed, almost all reported that there is not easily available and accessible.

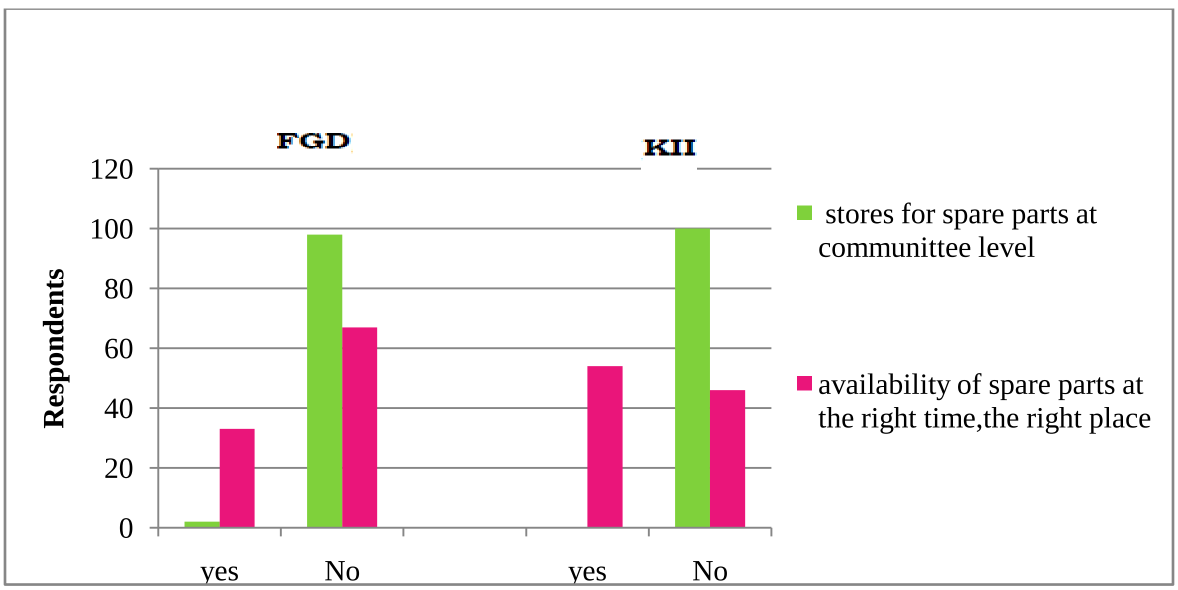

Figure 5: Availability of spare parts in the study area (source: on survey; July 2015)

According to key informant interview made with zonal water head and experts, and woreda water office head and experts, there were no stores for spare parts at community level and at woreda level except at regional level. At regional level, as governmental structures donors supply spare parts and government budget allocation also adjusted at the level. At the woreda, level there is no stores for spare parts provision. This is because; at the higher (regional) level, office did not give attention for operation and maintenance, which are the basic for sustainability of rural water supply schemes. The shortage of budget and not getting position by the higher-level organization are the bottlenecks of spare parts availability and provision for operation and maintenance. These in turn resulted in the less ownership of With regard to spare parts and toolkits availability and affordability, the key informant interview shows that there were not readily available and affordable. However, they get from private owners, government and there is a store at some of the zones at neighboring zones. In somehow availability and affordability in the study area is very difficult which had negative impact on sustainability of rural water supply schemes at the study area. Finally, according to focus group discussions made with water committee emphasized that there were great problem in provision or availability and affordability of the spare parts at the right time, at the right place, and as soon as the schemes get mal functioning. If there is unavailability and affordability, their life stops or they are going to use rivers for different activities, which might result in water related diseases. This in turn resulted in non – productivity of the household in the study area. This finding is related with the suggestion of Musonda (2004) who stated that appropriate tools for carrying out repairs should be made available to achieve sustainability. Furthermore, lack of spare parts has been a major constraint in the sustainability of water supplies. In some cases, it has led to a complete abandonment of schemes.

4.2.1.4. Technology selection

Technology selection is one of the very important elements in the sustainability of rural water supply schemes. There are so many types of technologies practicing in different areas in the world in different purposes and for different activities .With regard to rural water supply schemes, in the study area, there were almost similar technologies selected by different organizations including governmental, Non- governmental, community based organizations, and communities depending on different factors such as financial (economic), environmental (geological) and etc. In the study area, according to key informants interview made with woreda, zonal, regional water, mine and energy departments emphasized that shallow wells fitted with hand pumps are the most practical technology in the rural area, this is because, the area is not feasible for hand dug wells and financial viability is the great problem to select others technology except hand pumps. In some cases spring developments with network distribution when there is a fund from different non-organizations. This technology needs much money for construction and distribution, which need much investment. The last chance is selecting boreholes with distribution or extension, which need huge investment more than the others do. These technologies can be done for areas, which are not feasible for hand-dug wells; shallow wells and spring development since it need much investment, which cannot be easy for governmental organization. These are some of the ideas from the key informant interview (KII) indifferent level of water offices. However, these technologies may or may not easily be operate and manageable by the user communities in the study area. If technologies are not easily operated within the user communities, the schemes could not be functional for longer time. This is because; their acceptance has great effect on the sustainability of rural water supply schemes.

4.3. Training to Water Committees and household in the study area

Mobilizing and administering appropriate training to water committees and households that focus on operation and maintenance and personal education is important to improve sustainability of water supply systems. Training on O&M informs people of what expectations they should have for their water system and how to identify and address minor problems in the system before they become major. It also educates community members that the responsibility for maintaining the system rest with them, not with project owners or the government. Training provides knowledge about how to operate and maintain the system and increase the awareness of the communities about willingness to sustain the system.

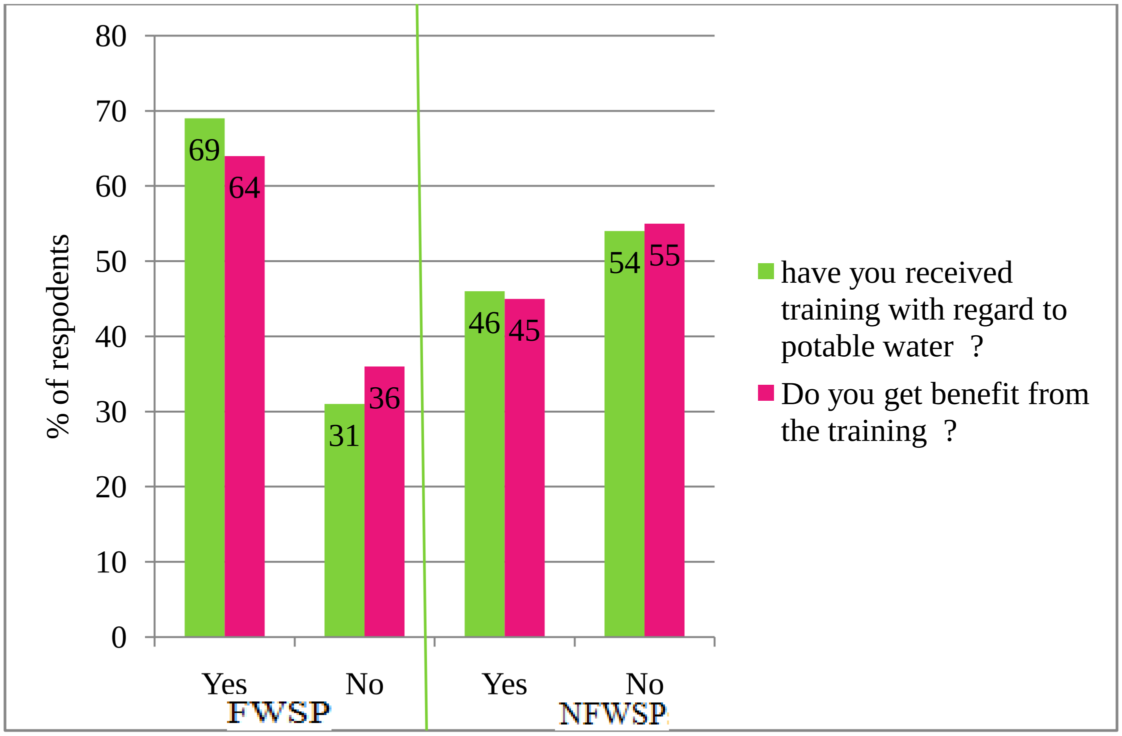

Figure 6training giving to water committee and household

Nearly 69% and 64% of the households in FWSPs participated in training educations and have received benefits from training respectively and the rest (31%) do not received training. However, more than half (54% and 55%) of the household in NFWSPs do not receive training and do not get benefit. All respondents who have attended the education session have indicated that they have in one way or another benefited from the providing training. For many projects the creation and existence of a water committee is a prerequisite for receiving project assistance and developing a water supply point. Accordingly, all supply points have a water committee with five members: three males and two females. Although the establishment of a water committee is a prerequisite, the members are not selected based on their willingness, especially with regard to females who were selected for formality.

The purpose of a water committee is to control and oversee the system's operation. This may include conducting preventive maintenance, collecting tariffs or payments for repairs, keeping records of financial transactions, manuals and blueprints, and sanctioning people for non-payment. Communities that do not have water committees often rely on traditional leaders to manage the water system. This study found the traditional system of management often was ineffective. In many cases, leaders purposefully sited the system on their property and excluded some residents from using the service. Trained water committee staff turnover is the main problem observed in most of the water supply points under study. Due to the traditional thinking of the community, female members of the water committee are not effective decision-makers. Hence, it is necessary to capacitate females in order to harness their decision-making ability.Strengthening their interest to solve water related problems would also be beneficial to the community.

4.4. Level of Satisfaction of Beneficiaries and their Willingness to sustain

4.4.1. Beneficiaries Satisfaction

When beneficiaries show active participation in the development of their WSP, it is an important indicator for community project acceptance. Moreover, the level of Consumer satisfaction as an indicator of sustainability of water supply schemes is also reflected by the continuous support and participation of the community in water supply related issues. About 61% of the respondents average (test, color and amount) are satisfied by the improved water sources for the nonfunctional scheme (Table 3), usually because of failure of the water point within a short period after construction. For the functional systems, the water point (Table 3) satisfies more than 75% of the community.

Table 3: Respondents satisfaction of water supply characteristics

Satisfaction level	Test		Color		Amount of water	
	FWSP (%)	NFWSP (%)	FWSP (%)	NFWSP (%)	FWSP (%)	NFWSP (%)
Good	76	69	77	73	75	41
Somewhat	24	28	23	25	25	31
Poor	0	3	0	2	0	28
Total	100	100	100	100	100	100

The result shows that almost 69%-77% of the respondents said that they were satisfied with the test; color and amount of water in both systems but only 41% are satisfied with amount of water in non-functional WSPs (Table 3). Similarly, about 26% of the respondents stated that they were somewhat satisfied with the test, color and amount provided in functional and nonfunctional systems (Table 3). Respondents from functional water supply points explained that there is no water supply system with poor test, color and quantity of water. Respondents were not satisfied with the water service provided in non-functional water systems as evidenced by the percentage of 'Poor' responses (Table 3). Those dissatisfied beneficiaries explained that water points located beside rivers were affected by floods and resulted in polluted, non-functional schemes. This was the case for a protected spring in Darakebele. Another problem in some water points, such as, both animals and people were using the service causing the color and test of the water to be affected. Furthermore, seasonal variation of the quantity in water supply points under study, especially in Tenseye and Benker kebele, causes consumer dissatisfaction.

4.4.2. Willingness of community to sustain the schemes

Willingness of the community is an indicator of sustainability of water supply points as it provides evidence of community support. It is general fact that when people value something, they try to keep the service from damage. Willingness is important to measure the degree to which community members feel responsible for maintaining their water system.

Table 4: Water uses of respondents in the study area

Water use	FWSPs		NFWSPs	
	No.	%	No.	%
Drinking and food preparation	11	6	4	2
Bathing	13	7	51	27
Clothes washing	17	9	13	7
Animal drinking	6	3	0	0

Garden vegetation	8	4	8	4
All uses	135	71	114	60
Total	190	100	190	100

In this particular study, about 71% of (FWSP) respondents fetch water for all uses. However, only 60% of the NFWSP respondents fetch water for all uses. 6%, 7%, 9%, 3% and 4% of the FWSP respondents use water for drinking and food preparation, for bathing, for cloth washing, for animal drink and vegetation respectively (Table 4). On the other hand, 27%, 7% and 4% of the NFWSP respondents use water for bathing, for cloth washing and garden vegetation respectively. This indicates that the water supply is important for day-to-day activities. Hence, people would expect the community to finance future maintenance, repair, and system replacement and express willingness to pay for improvements.

Discussions with the users as well as with water committee members found that there were beneficiaries using water from other sources (unprotected, rivers, springs, and rainwater) in order to reduce the burden and damage of improved water supply points. Accordingly, beneficiaries' perception of alternative water use and its importance in sustainability were assessed. It was found that most of the respondents use alternative water sources continuously.

4.5. Capacity of the Woreda Water Staffs andInstitutional Support

The institutional organization at village level to support the water points is village water user committees (WUCs). Some of the purposes of the water committees are managing the water service, operating, maintenance, and giving education during meeting. The remaining village water user committees are now disappeared because (I) the water committee members were not selected by the communities, (II) and even if the communities the members have no experience on how to manage, facilitate the community, operating and maintenance of the water supply systems selected these water committee members. Dabat Woreda water resource office is responsible to provide all the required support to the rural community for the development of clean water supplies. The office is the contact point for all national and international organizations that assist in water supply projects. A group discussion was held with the woreda water resource office staff and the education and qualification of the group is given in (Table 5).

Table 5: Dabat Woreda water staff based on their education and qualification

field of study	Responsibility	Education	
		Diploma	degree
General mechanics	Pump Attendant	1	
Chemistry	Water quality expert		1
Rural water supply and sanitation	Rural supply water Expert	2	
Management	Planning and documentation expert		1
Management	Office Head		1
Water Resource Engineering	Water engineer		1
Hydro-Geologist	geologist		1

With the above staff members, the woreda water office was providing water development facilities and support to the community. Only five BSc degree professional staffs and three Diploma experts are there in the study area. Discussion with Woreda water office identified that the staffs are not enough to provide the necessary water development service.

The experts or technicians of the woreda water offices are small in number relative to the number of water supply systems existed in the study area. With these small number of technicians and experts it is difficult to support the communities, especially the communities whose water supply systems are not Functional. There are six technicians for the total water supply systems in the woreda, the woreda consists about 366 water supply schemes. This indicates one technician corresponds to more than 60 water supply systems. Therefore, communities should manage their scheme through their representative (WUCs). For every village water user committees there is one committee technician, who took training for five days about operation and maintenance. If the breakage is beyond the capacity of the water committee technician, they move to the woreda water office in order to get support from the woreda technicians, but most of the time they did not find the technician because they are busy. The community together with the water committee members tried to repair the water point so many times, but within a short period, the water point breaks again. Here the technicians know about to repair, but they need to paid. On the other hand, some of the water committee members select the site of the water supply system near to their houses, which is swampy area, depending on their position in the village administration.

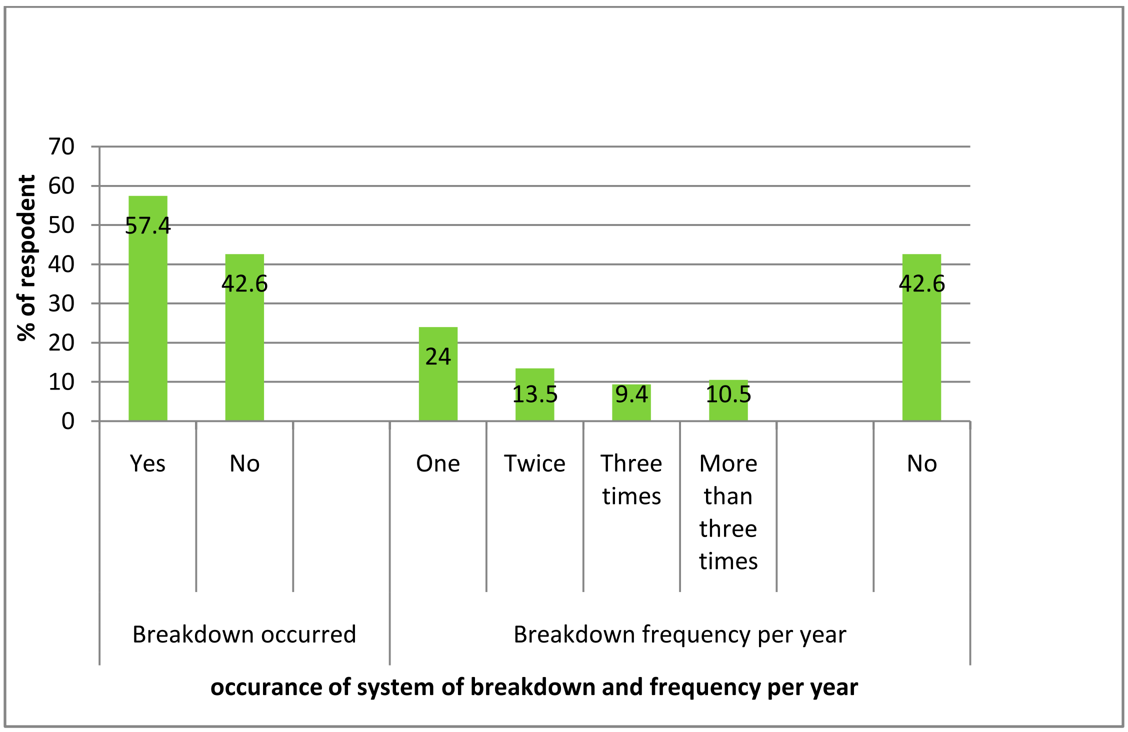

Figure 7 Respondents perception of occurrence of system breakdown and frequency peryear

The field survey indicates that 57.4% of the respondents said that a system break occurred in their water supply system (specifically in the case of Dara and Tenseye protected springs). The rest of the respondents (42.6%) explained that there was no major system break. On the other hand, 24%, 13.5%, 9.4% and 10.5% of the respondents confirmed that there was system failure once a year, twice a year; three times a year and more than three times a year, respectively (figure 8).

As seen from the results, unless beneficiaries report system failures, the woreda will not know the status of the scheme. This indicates weak monitoring and supervision activity in the study area.

4.6. Community Contributions and participation in Water Supply systems

One factor for the sustainability of rural water supply systems is community contribution in cash, material, ideas and labor for water supply development and operation and maintenance. Communities are expected to cover the operation and maintenance cost as well as guards' monthly salary and needs capacity building in money collecting, management and operation and maintenance. Rural communities have lack of awareness about the collected monthly water fee, if there are contributions of money per month for the purpose of operation, maintenance and guards' salary for the functional water supply systems. The non-functional water supply systems have no contribution of money per month; of course, there was some contribution of water fee for some of the nonfunctional water supplies when it was functional. Currently 23 water supply systems have a saving account for operation and maintenance in Amhara Credit and Saving Institute (ACSI). The rest has no savings, and they are paying only for the guard per month.

Table 6: Percentage of respondents based on type of contribution

Mode of contribution	FWSP		NFWSP	
	No.	percent	No.	percent
Money	34	18	63	33
labor	45	23	34	18
local materials	17	9	23	12
Ideas	8	4	2	1

All (cash, labor and local materials)	84	44	55	29
Not participated	2	1	13	7
total	190	100	190	100

Communities' contribution to construction of their water point scheme has different forms. These are in cash, in idea and supporting locally available materials. In functional water schemes majority of the community (44%) contribute in cash, labor and local materials, this increases the ownership of the community. However, in case of nonfunctional water point majority of the community participate by supporting materials like food and local materials like stone, and other necessary for construction , which is shown as others in (Table 6). Only 29% of the communities in nonfunctional water points participate in cash, material and labor, as a result the ownership of the community decreases and they do not take care for the water scheme. Cash and labor contribution during construction is another distinct factor that affects functionality in the study area.

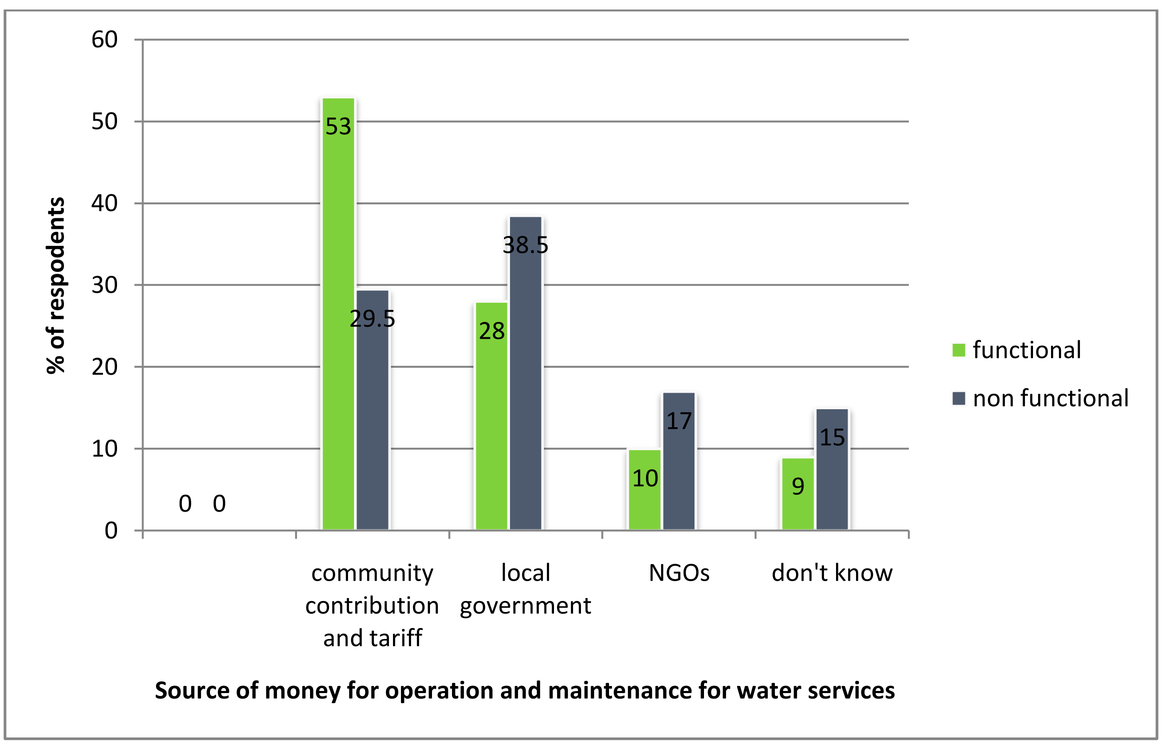

Figure 8 Respondents on source of money for operation and maintenance of waterservices

About 53% functional water supply points and 29.5% non-functional water supply points of the respondents said that operation and maintenance costs should come from community contribution and tariff. a significant percentage of the community from nonfunctional water supply points 38.5% of the respondents revealed that woreda level water management (government) should finance operation and maintenance costs while 17% said project owners should (figure 9).This indicates beneficiaries lost ownership of the asset and do not want to contribute money for operation and maintenance especially in nonfunctional water supply points. This is one reason why water supply points become unsustainable.

For the water points where the community contributes money per month, the average is 2 birr per month and if that village has for example 150 community members in average who contribute monthly water fee, then the total amount of birr collected per year is 3600 ETH birr. When subtract the monthly salary of the guard nearly150 birr per month, they have left 1800 ETH birr per year. The current cost of most frequent damaged accessories (O-ring, Uccle, Bush bring and Bobbin) is 415 birr and damaged four times per year in average the cost become 1660 birr. In addition to this operator per diem and additional spare parts damage, increase the cost of operation and maintenance beyond the capacity of water user committee saved money. They need support from the concerned organizations. But most of the water points in the study area have no contribution of monthly water fee as well as labor, as a result when the water scheme fails they ignore the system.

4.7. Demand Responsiveness of the Water Projects in the study area

4.7.1. Project Initiation and Baseline Survey

The current method for organizing water projects in the study area was done mostly in the regional office of water resources. Community leaders (who are agents simply to pass the community messages to the office) will request the woreda level water resource development office to implement a WSP. An expert from the office will visit and install a system regardless of its feasibility, accessibility of water, or community preference.

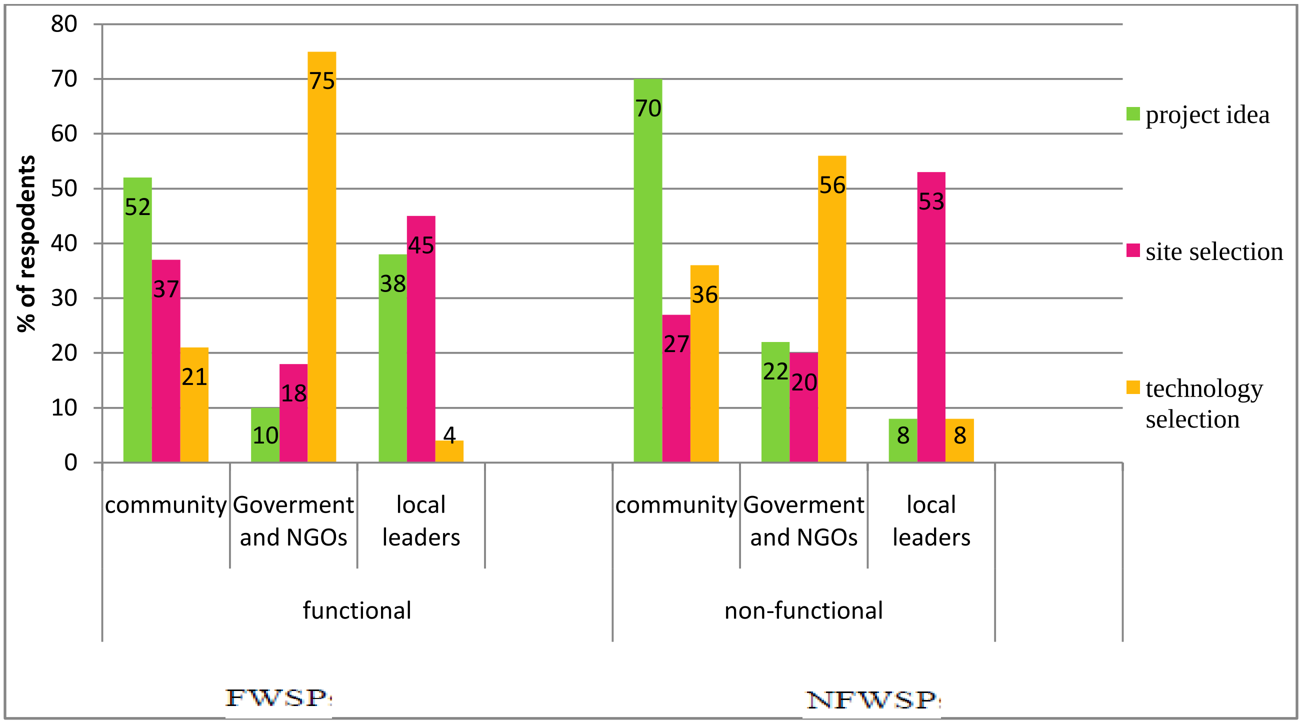

Figure 9: Community share project initiation, site selection and technology type

There is a high demand for improved water supply systems by the community in both systems. The survey results show that 52% and 70% of the respondents initiated the idea of improved water development in FWSP and NFWSP, respectively. This is an important precondition for the project owners to create responsibility of the community for taking the project as their asset. Site selection was made by local leaders in 45% of FWSPs and 53% of NFWSPs. 75% and 56% of type of technology selection were made by the project owners in FWSPs and NFWSPs, respectively (Figure 2). This indicates that the community had a relatively small part in selecting the site based on their suitable area (especially in NFWSPs) and the type of technology installed. Full participation of the local leaders during project initiation is important in order to consider the demand of beneficiaries rather than implementing supply side approach. The local leaders involve in decision making in site selection and type of technology, the greater the potential for sustainability. On the other hand, doing a base line survey by the project owners through active local leader participation is an important step to identify the primary problems of the community. When a project implemented that does not fit the needs and is not apriority of the community, it will not be accepted by the local leaders and making it sustainable.

4.7.2. Female participation

Since responsible persons for fetching water from the source are mostly women, their participation in all steps of water supply system is paramount. The result of data analysis in (figure 3) tells that participation of women in non-functional schemes is low. Participation of women can be considered as the factor functionality of water supply scheme in the study area. As women are the most knowledgeable group concerning water use and sources, it is appropriate including them in every step is important including as a member of water user committee.

Evidence and experience obtained from field observation and discussion with women water commute members revealed that women and children (especially girls) are responsible to fetch water from distant and unsafe water points.

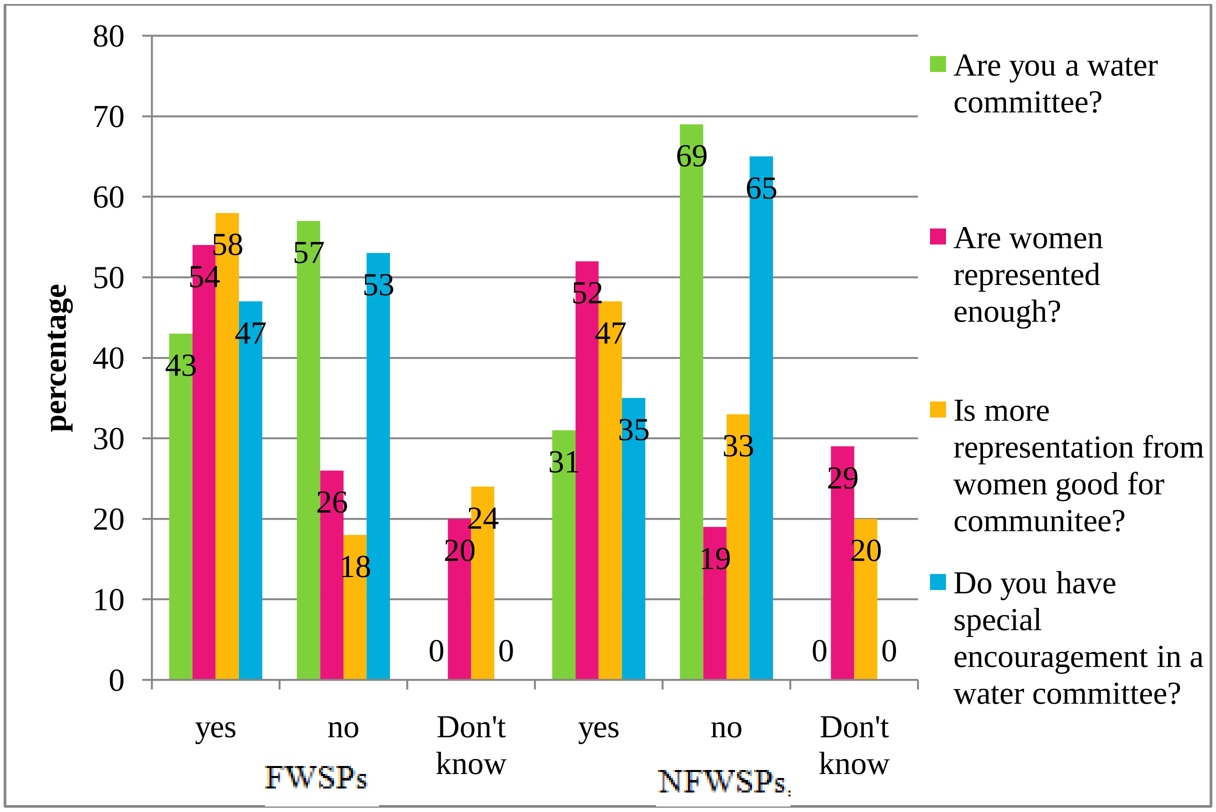

Figure 10: participation of women in WC and perception of respondents

According to the assessment of respondent's perception of the participation of women in water development process and water committee, more than 57% of the respondents in functional and 69% of respondents in non-functional systems are not members of the water committee. Of FWS users, 26% believe that the current level of women's representation (2 women of 5 members) was not enough while 19% NFWSP users hold the same view. Conversely, 18% and 33% of the respondents in FWSPs and NFWSPs, respectively, stated that more representation of women is not good for community. No special encouragement for women to be water committee members was the response for 53% and 65% for both functional and non-functional systems. For those who responded 'Don't know', 24% believe that more representation (3 women out of 5 members rather than 2) of women would be beneficial to the improvement and sustainable water supply (Figure 3). There were respondents who replied 'Don't know' on the importance of women's participation for the improvement of the water supply points. The level of participation of women in WCs is very low despite the fact that all beneficiaries believe that the implementing organization has made every effort to facilitate more participation of women and the existing effort is satisfactory.

4.8. The Environmental Sustainability of the Water Supply Systems

Different areas have different water levels and according to representative head of the Woreda water office, the water level varies from 2.5 to 60 m. The water level is lowest at the end of dry season and highest at the end of rainy season. In some cases, the water level reaches the soil surface. Wells that are usually dug to such a depth that within 24 hours the water table rises to 2m above the bottom of the well. This means when the well is dug during the rainy season that the well becomes dry during the dry phase. It is recommended that the wells be dug during the dry season. Despite that, many wells are constructed during the rainy phase. The reasons is that the implementers release the budget at the end of the dry phase, shortage of technicians, less participation of the community because the community is busy from May to July with plowing the field. Other factors are that the management bodies (user committee members) did not control the contractor resulting in poor worker strips and construction at a time convenient to him/her in the rainy phase, which in addition is cheaper because the well depth is less.

4.8.1 Households' Attitude towards Water Quality

Households' perceptions about water quality indicate that knowledge about quality is somewhat limited. About 38% of the participants mention that clean water is water free from harmful pathogens and chemical toxicity, whereas 41% of the respondents report that 'clarity to the eyes' is the sole indicator of safety. Twelve percent and 8%, respectively, explain that 'test and odor' and 'being piped' are indicators of water quality. Accordingly, 59% of the respondents believe that the water from their source is 'safe' or 'highly safe' for them for all household purposes. Respondents who believe that the water from their source is not safe mention that the cause is floodwaters entering into the tank (31%), which suggests that environmental mitigation such as flood protection, drainage canals and catchments rehabilitation are underlying concerns of the households. About 8% believe that the cause of poor quality is livestock contamination, indicating that well-built fencing and full-time caretaking are required. About 16% report that there have been one or two incidences of waterborne diseases during the last year within their individual household. A significant number of respondents believe that the incidence of illness has significantly decreased after the construction of the water sources.

Table 7: Chemical and bacteriological quality of water from sample water Sources

Water sources		**PH**	**conductivity, µs/cm**	**Nitrate, mg/l**	**Nitrite, mg/l**	**Fluoride, mg/l**	**Total coliforms, colonies/100ml**
WHO guidelines value		6.5-8.5	<4000	50(as No3)	3(as No2)	1.5	0
tenseye	nebrye	6.61	316	0.21	0.008	0.2	0
tenseye	tachnebrye	6.88	298	0.2	0.075	0.21	0
tenseye	tenseye	6.69	248	0.23	0.006	0.25	0
tenseye	Tachlule	7.15	341	0.25	0.001	0.23	0
chila	shola	6.83	342	0.21	0.006	0.1	0

chila	askober	6.76	219	0.43	0.005	0.2	0
chila	shinbrawuha	7.05	311	0.27	0.007	0.22	0
chila	giz	7.17	324	0.2	0.003	0.3	0
Dara	belesbadma	7.21	327	0.2	0.012	0.2	0
Dara	bata	6.94	317	0.2	0.01	0.2	0
Dara	afafit	7.12	320	0.21	0.098	0.15	8
Dara	areke	7.08	247	0.24	0.001	0.2	0
Benker	kebit	6.80	197	0.2	0.003	0.2	0
Benker	kebit qutir2	7.25	213	0.2	0.001	0.3	6
Benker	ahiyagedel	6.70	264	0.23	0.009	0.25	5
Benker	mateb got	7.1	323	0.2	0.006	0.2	0
min		6.61	197	0.2	0.001	0.1	0
max		7.21	342	0.43	0.098	0.3	8

To compare the safety perceptions of the households towards water from their sources to its scientific quality, and to examine the technical quality of water from the sources, a laboratory testing was carried out on selected drinking water quality parameters in North Gondar zone water resource office laboratory. The results depict that important elements for chemical quality of water from the sample sources are under the World Health Organization (WHO) guideline values. However, the bacteriological results show that three water source samples have5,6,8 total coli form colonies per 100 milliliters (see Table 7) exceeding the WHO standards, which do not allow any fecal or total colonies in drinking water. The results indicate that rural communities in the study area have good knowledge, judgment and water quality perceptions of improved water supply sources.

In all the sampled water points, were within the WHO guidelines for drinking water quality (WHO, 2004) only the three water points that existed total coliforms.Fluoride was also found to be below the WHO health based limit (that is, 1.5 mg/l).The WHO guidelines for drinking-water quality (WHO, 2004) recommends that for all waters intended for drinking no total and/or fecal coliform bacteria should be detected in any 100 ml water sample. The result indicated that bacteriological water quality is a concern in this study area. It must be clear that the provision of water services must result in health improvements to users as an ultimate goal.

4.8.2 Amount of Water Collected

The amount of water collected per day depends upon different factors of water points i.e. availability of water, groundwater level, population, number of household and household size in the community. It was found that most households of the communities were allowed to fetch about (40-60 liters) of water from the water points. The figure 4.10 provides the figure of water users in the communities. The number of households determined the amount of water collected per day in the communities. If the numbers of households was large, each household was allowed to take only two Jar of water and on the other hand, if the household member was small, then each household was allowed to take more than 40-60 liters of water.

The other problems associated with water collection were depth of the well and groundwater availability especially in hand dug wells. It was observed that, though the water points were functional, due to low groundwater level, the discharge of water was very low. Sometimes people had to wait in long queue for water in those communities where water points were constructed in rocky terrain, for example in Darakebele two water points constructed by World Bank.

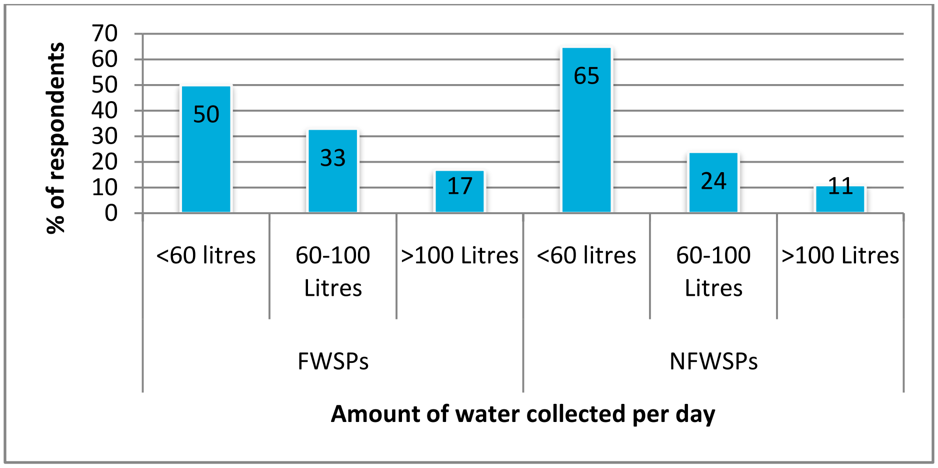

Figure 11 Amount of water per day in both functional and non-functional WSPs

In case of some of nonfunctional water supply points communities, there was abundance of water, thus each household from those communities 65% of the respondents collect water less than 60 liters, 24% 60-100 liters were collected water.In some of communities, there was less limitation of water.

According to the standard for a well that can store a certain amount of water in a night, its yield should correspond with the amount specified to fully supply sixty to seventy households (from 300 to 350 users). This is based on an average use of 20 liters of water per person per day which is believed to be enough for rural people. The results of the water quantity measurement show that compared to the Amhara Region Water Resources Office standard some of the schemes did not provide sufficient amount of water for the community. In the study area many water schemes were constructed with the discharge of 0.032 l/sec. With this amount of discharge did not provide sufficient amount of water 0.032l/sec could be satisfied for only 138 users for 20liters per person.

According to Harvey & Reed (2004) recommend the following procedure to be followed as a guideline to Selecting an appropriate hand pump for an area:

(a)A thorough assessment of the groundwater conditions should be made. This should include:

• Depth of operation Measurement of groundwater levels and seasonal variations, so that the maximum lift required of the pump is estimated. The maximum lift should be measured from at least 2 meters below the lowest recorded water level to ground level.

• Level of usage (number of users/liters to be pumped) the number of users and corresponding flow rate required should be estimated and the yield of the borehole should be measured. Depending on the number of users the required flow rate can be estimated using the formula: Required flow rate (liters/min) = (1.1 PgW /60H)

Where P = population to be served ,g = population growth rate if taken into account W = water usage per capita per day (ℓ/c/day),H = Pumping period (hours) the required flow rate is the flow rate the chosen hand pump should be able to lift and the yield of the borehole must be sufficient to support this flow rate.

CHAPTER FIVE

5. CONCULUSION AND RECOMMENDATION

5.1. Conclusion

This study response the main reasons why water supply systems have become nonfunctional within a short time after installation in the study area. Field survey, personal interviews, focused group discussion and field observations were done to collect the relevant information about seventy six water supply schemes in the study area. The majority of water supply systems installed were still functional after installation in the study area, and only a relatively small amount (26.5%) became nonfunctional.

Beneficiaries are willing and happy to sustain their systems as far as the service is provided for drinking, bathing, watering their animals, clothes washing and garden irrigation because the communities (about 78% of the respondents) understand the system belong to them. They were also happy to refund the system in order to rehabilitate as much as possible. In addition, communities depend on rivers, lake, and unprotected natural springs for other water needs than drinking and food making to reduce pressure and frequent failures, which is resulted from concern and satisfaction.

The results agree with most of the literature (e.g. Gelar, 2008) that without community involvement the water supply system fail after installation. In Dabat woreda, some water supply systems installed without community support is still functioning. However, community participation by itself is not sufficient systems installed with community support became non-functional.

The other important factor identified from analysis is the involvement of women in the decision making process and in the village water user committee. In this study, the participation of women was greater in the functional water points than in the nonfunctional schemes. In some functional schemes, there were two women members of a water committee. When women are more involved in the day-to-day operation of water points, these systems will be more sustainable.

The institutional support of the water supply systems after construction was weak. The woreda technicians or experts are small in number (i.e. 6) and have no capacity to cover all the water supply systems in the woreda. One way of improving the situation is increasing the number of experts or providing training for the community members in order to operate and maintain their system. The latter is widely accepted strategy in developing countries as increasing the number of experts is expensive.

The establishment of a water committee has a significant effect on sustainability of water supply schemes as a committee is important for producing plans for new water supply systems and maintenance of old ones. In addition, committees in both functional and nonfunctional were responsible for collecting tariffs, keeping financial records, encouraging the community to take part in the existing and new water development projects, demonstrating the benefit of sanitation, sanctioning people for non-payment, promoting additional drinking water developments, and maintaining existing water supply systems.

For rural water projects, the creation of a water committee elected by beneficiaries is a prerequisite to receive project assistance. The study found that almost all water supply points established their water committees having five members with a three men and two women composition. However, women members were elected just for the sake of fulfilling the criteria of the system. However, there were two women members in the water committee in major water supply points. This is attributed to the cultural attitude of the area, which discourages women to sit and discuss problems with their male counterparts in water committees and others. Women's participation as members of water committees was low in the study area.

Poor training approaches and inconsistencies in training are likely the result of the shortage of skilled labor at Dabat Woreda water resource development office. Furthermore, there is a lack of labor to conduct in advance an integrated baseline survey at the water supply project proposed site. Moreover, no effective monitoring and supervision during and after the project was completed despite their support to the community for making repairs.

The other result of this study is that both household and water committee training before and after the project plays an important role in ensuring sustainability. Training provides knowledge of the operation of the water system, the means to repair parts, various health benefits to protecting the water source and preventing major problems. The training approach for water committees is inconsistent since some committees have received trainings multiple times while others have not received a single training. 31% and 54% of trainer have no received training in functional and non-functional water supply systems respectively.

5.2. Recommendations

A total of 366 water supply points (297 hand-dug wells and 49 developed springs) were constructed. Of these water points, 269 were functional and 97 were non-functional. This indicates that a decent effort is being made to improve water supply access in the rural communities.

When the role of project initiation and selection of service level options, technology and siting are placed in the hands of well-informed local leaders rather than project owners or water committees, there is often a high level of sustainability of water supply points. Projects should take steps to ensure that community representatives truly stand for all members of the community, including women and other traditionally excluded groups. Beneficiaries should be viewed as consumers with demands so that their needs are directly addressed in the design. Special attention should be paid to assuring that women leaders are part of the process and that their particular needs are included.

Construction quality, appropriate fencing, system area conservation practices and periodic monitoring, and effective supervision of rural potable water projects enhance sustainability of schemes. In the study area, there was a gap on these infrastructures mention above. Hence, the woreda water office in collaboration with the project owners should develop a standard rule for appropriate fencing, construction quality, monitoring and supervision activities.

Investing in household and water committee training strengthen the sustainability of water supply systems. Projects should include training as part of their project design and training should be related to the project objectives. Communities that receive household-level training in operation and maintenance and hygiene education are more satisfied with their systems, more willing to pay the costs of maintenance, keep the system in better physical condition and take better overall care of their systems.

It is recommended that appropriate cost sharing and recovery could improve sustainability of water supply systems. However, water payment of the users in the study area was weak. More awareness creation efforts should be done related to the importance of tariff payment, it was paid for their service use, and even they are willing to increase the water tariff further. Hence, users should be encouraged to set a reasonable tariff that enables them to recover sufficient reserve fund for replacement and rehabilitation of schemes. Regulations or subsidies should be in place that cannot pay.

The level of stakeholders' participation in the project planning and implementation should be increased to enhance the sustainability of the water projects in the county.

The water projects should be managed by highly competent personnel to increase its efficiency and sustainability.

Implementation of integrated watershed management activities to conserve and enhance the groundwater resource and creation of awareness in the community on the nature of the groundwater resource and the importance of source conservation, enhancement and protection.

Promotion of the private sector to open a spare parts shop in Dabat town to solve problems related to cost and scarcity of spare parts.

There has to be detail feasibility study of the groundwater in the areas where water points are planned to be constructed.

The implementation agencies should focus on sustainability of the water points by making spare parts available for maintenance with involvement of private sectors.

REFERENCES

ADF (African Development Fund) (2005) Rural Water Supply and Sanitation Admassu, Mengesha, Abera Kumie, Misganaw Fantahun (2002)Sustainability of Drinking Water Supply Projects in Rural of North Gondar, Ethiopia, *EthiopianHealth Dev*. 2003; (3):221-229.

Aschalew, D. (2009):Determinants Of Household ParticipationIn Water SourceManagement: Achefer, Amhara Region, Ethiopia

Bezabih, G. (2008): Assessment of problems to sustainability of rural water supply schemes: The case of menge woreda, Benishangul Gumuz regional state, MA thesis, CDS, AAU.

Black M. (1998): Learning what works: twenty-year retrospective view on international water and sanitation cooperation UNDP-World Bank, 1998

Campbell, T with E Munoz and M. Morgan (1993):“Participation, choice andaccountability in local government”: LAC and the U.S. Dissemination note.

Carter, R. C., Tyrrel, S. F. and Howsam, P. (1999): Impact and sustainability ofcommunity water supply and sanitation program in developing countries.

CSA (Central Statistical Agency) (2008) Summary and Statistical Report of the 2007 Population and Housing Census: Population Size by Age and Sex

Davis, J. & Liyer, P. (2002) Taking Sustainable Rural Water Supply Servicesto Scale: A Discussion Paper, Bank of Netherlands Water Partnership Energy and Water Department, World Bank, Washington DC.

Dessalegn, R. (1999):Water Resources Development in Ethiopia; Issue ofSustainability and Participation,for Social Studies. Addis Ababa, Ethiopia

EWRMP, 2001. “Ethiopian Water Resource Management Policy”, the Federal Democratic Republic of Ethiopia Ministry of Water Resources 2001.

Fong M., Wakeman W. &Bhushan, A. (2003):“Toolkit on Gender in Water andSanitation”WorldBank, 2003:http://www.worldbank.org/gender/resources/checklist.htm)

Gebre-Amanual, T. (1997): Water Supply-Ethiopia; an Introduction to Environmental Health Practice, AAU Press, Addis Ababa, 1977

Gebrehiwot, M. (2006) An Assessment of Challenges of Sustainable Rural Water Supply: The Case of Ofla Woreda in Tigray Region. MSc Thesis, Regional and Local Development Study (RLDS). A.A.U. Ethiopia.

GelarStayaBudhi (2008) Escalating People’s Participation in Rural Development through GO -NGO collaboration. Vol.26. No 1 July 2008: 58-70

Gleick, P. (2006) The World’s Water 2006-2007.The Biennial Report on FreshwaterResources. Island Press, Washington, D.C.h*ealth Dev*. 2003; (3):221-229.

Gow, D. and J. Franken Hoff (1994). ‘‘Local Governments and participation’’ paperpresented at workshop on participatory development, 17-20 may 1994.

Harold, Alex & Wendy, (2003): Assessing Sustainability in Rural Water Supply: theRole of Follow-Up Support to Communities”: by Harold Lockwood, Alex

Harvey P.A. & Reed P. 2004. Rural Water Supplyin Africa: Building Blocks for Hand pumpSustainability, WEDC, Loughborough University, UK

Harvey, A. & Reed, A. (2007) Community-Managed Water Supplies in Africa: Sustainable or Dispensable? Community Development Journal Vol. 42 No 3 July 2007 pp. 365–378.

Hodgkin J. & WASH Project Staff (1994):The Sustainability of Rural Water Supply Projects, WASH Technical Report No. 94, April 1994

IRC (2005): From system to service: scaling up community management Report of theconference,12 - 13 December 2001, The Hague, The Netherlands, Report,Unpublished document, IRC International Water and Sanitation Centre, Delft,The Netherlands

IWMI, 2007. Water resource and irrigation development in Ethiopia, IWMI Availableat:http://www.iwmi.cgiar.org/publications/Working_Papers/working WP123.p f [Accessed 11 August 2011].

Lockwood, H. (2002): Institutional Support Mechanisms for Community managedRural Water Supply & Sanitation Systems in Latin America: EnvironmentalHealth Project, U.S. Agency for International Development Washington, DC

Lyer, P., Davis, J., Yavuz, E. & Evans, B. (2002) Rural Water Supply, Sanitation and Hygiene: A Review of 25 Years of World Bank Lending(1978–2003): Water Supply & Sanitation Working Notes, World Bank.

Management: Achefer, Amhara Region, Ethiopia

Mengesha, A. Abera, K. &Mesganaw, F. (2003) Sustainability of DrinkingWater Supply Projects in Rural of North Gondar, Ethiopia, *Ethiopian J.*

Misgina (2006): An Assessment of Challenges of Sustainable Rural Water Supply:The Case of Ofla Woreda in TigrayRegion. Addis Ababa, Ethiopia.

MOWR (2007): Ethiopian Water Sector Strategy. The Federal Democratic Republic of Ethiopia Ministry of Water Resources 2001Projects, WASH Technical Report No. 94, April 1994

MOWR (2007): Ethiopian Water Sector Strategy. The Federal Democratic Republic of Ethiopia Ministry of Water Resources 2001.

Mukherjee N. &van Wijk C. ends (2003): Sustainability Planning and Monitoring inCommunity Water Supply and Sanitation", Water and SanitationProgram/IRC2003

Musonda, K (2004): Issues regarding sustainability of rural water supply in Zambia, master's dissertation, university of South Africa, departments of social works, South Africa.

Prokopy, S. (2005): The Relationship between Participation and Project Outcomes Projects in India: Evidence from Rural Water Supply, World Development 33, No. 11, pp. 1801–1819

Sara, J. & Katz, T. (1997): Making Rural Water Supply Sustainable: Report on the Impact of Project Rules, by Jennifer Sara & Travis Katz, UNDP World Bank Water and Sanitation Program, 1997

Schouten T. and Moriarty P. (2003):From System to Service - draft The Hague, The Netherlands, IRC International Water and Sanitation Centre and ITDG, August2003

Sebsibe, A. (2002): Guidelines on sustainable Community management andfinancing of rural water Supply and sanitation. COWDO, Addis Ababa, 2002

Sugden S. (2003): Indicators for the Water Sector:examples from Malawi, WaterAid Fieldwork Report, March 2003Third Rural Water Supply and Sanitation Project,Paraguay 1992; SAR Report No.10684

WHO & UNICEF (2000): Global Water Supply and Sanitation Assessment 2000 Report World Health Organization and United Nations Children's Fund, 2000

Yibeltal, B. (2011):The value of improved water supply in Eastern Gojjam. Addis Ababa, Ethiopia.

APPENDICES

QUESTIONNAIRE FOR BENEFICIARIES

The main objective of this questionnaire is to collect information about thereasons for failures of rural water supply points after construction. The other objectives are to gather information about the technical factors, environmental factors, financial factors, socio-economic factors and like. Your information helps me to find the causes for the non-functionality of rural water supply points. So, please tell me the real information if possible.

Thank you for your time and cooperation!

Household ID NO ____

Name of Respondent ______________________________________

Name of Village ____

Name of Water Source _____________________________________

Socio-economic characteristics of Households

Name of the water point	Information of giver			HH's size	HH’s Head	Marital status	Education
	Name	Gender	Age		1.Male 2.Female	married Unmarried Divorced Widowed	illiterate Grade 1-8. grade 9-12 Above grade 12 Read and write
		1.male 2.female					

II. Identification of Demand responsiveness and non-functionality factors of theServices.

1. How many years have you lived in this area?
2. Whose idea was it to build the project?

a. The community b. Local leaders

c. NGOs d. Governmental offices e. other

3. What were your major sources of water before the project?
4. Whose idea was it to choose the site selection of the project?

a. The community b. Local leaders

c. NGOsd. Governmental offices e. other

5. Whose idea was it to choose the type/ technology of the project?

a. The community b. Local leaders

c. NGOs d. Governmental offices e. other

6. How severe are problems with water service in your community?

a. low b. fair c. strong d. very strong e. No problem

7. If there were problems other than water problem, what are they?

8. What was the source of the project funding?

III. Identification of type of Participation of beneficiaries

9 Have you participated in the development processes of the water project?

a. Yes b. No

10 What type of participation did you have during the project development?

a. Cash b. Labor contribution c. contribution of local materials d. Idea e. Others

Women's participation

11. What type of participation did you have in the overall project development?

a. planning and management b. implementation

c. utilization d. all of the above e. None

.12. Are you member of the water committee?

a. Yes b. No c. no committee

13. How many women you think should be members of total water committee? Circle the number of women.

a. 0 b. 1 c. 2 d. 3 e. 4 f. 5 g. 6 h. above 6

14. Do you think representation of more women in the water committee is good for the Society? Why? Alternatively, why not?

15. What do you think are the reasons that prevent you and other women from participating in the water committee?

16. Have you been given special encouragement to participate in the water committee? Explain. a. Yes b. No

17. Do you usually pay a fee for your water service?

a. Yes b. No

18. If yes, how much did you pay?

19. How do you think funds should be obtained for water system repaired?

a. Tariff and additional contribution by users

b. local government c. NGOs d. Other

20. Do you pay water fees on time? a. Yes b. No

21. If your answer for Q20 is No, what are your reasons? Explain.

22. Do you think that the collected fee is properly managed?

a. Yes b. No c. don’t know

23. Are there any educational sessions given in your communities regarding use of drinking water?

a. Yes b. No c. don’t know

24. How many sessions did you attend?

25. If your answer for Q24 is No; what prevented you from participating?

26. Do you get benefit from the education given?

a. Yes b. No c. don’t know

27. If your answer for Q26 is yes; what are the benefits to you?

28. For what purpose do you fetch water? Circe all that you use water

a. HH drinking and food preparation b. Bathing and washing clothes

C. Animal drinking d. irrigation of crops e. Other

29. In addition to the project water source. Do you use other sources?

a. Yes b. No

30. List the other water sources, if your answer is yes

31. How satisfied are you with number of hours available?

a. excellent b. very good c. good d. somehow e. poor

32. What is your perception of color of water?

a. excellent b. very good c. good d. fair e. poor

33. What is your perception of taste?

a. excellent b. very good c. good d. fair e. poor

34. Have you satisfied with the quantity available?

a. Very much b. It depends on season c. No

35. What is your overall satisfaction with the service?

a. excellent b. very good c. good d. Fair e . Bad

36. How you long stand in line a long time?

37. How important are new water points for you and your society?

a. very high b. high c. somewhat d. not important e. I do not know

38. What types of contaminations are you worried about?

39. How is your water source protected?

40. How do you evaluate the quality of the construction of the project water source?

a. excellent b. very good c. good d. Fair e. Bad

41. Is the system being repaired? How often? By whom?

42. Currently are there any defects in catchments or wells?

a. Yes b. No

43. Have you satisfied with the system?

a. Yes b. No

44. What is your perception on tariff level?

a. Expensive b. Fair c. Inexpensive d. I do not know

45. Do you have problems in paying tariff (ability to pay)?

a. Yes b. No c. Sometimes

46. Where could replacement of funds come from?

47. Does community had financial capacity to sustain the service.

a. Yes b. No c. don't know

48. Who is the owner of the scheme?

a. the community b. local government

c. don’t know d. NGOs e. others

49. Do you think that the available water supply is sufficient for the community?

a. yes b. No

50. If your answer for Q49 is No; what are the reasons?

51. Currently does the water system need repair?

a. Yes b. No

52. How frequently are repair needed?

53. How many times in a year does your water source need repair?

a. once in a year b. twice a year

c. Three times a year d. more than three times a year. No need

APPENDIX B

Issues (points) discussed with woreda water experts about the rural Water supply assessment and their technical support.

1. How do you prepare water projects?

2. Do you make a baseline survey before the project and what situations do you examine?

3. Did the communities participate in the project?

4. Did communities participate in choosing place of construction for the hand dug wells and spring developments?

5. Did women participate in the processes involved?

6. Did your organization give chance to the community in choosing the type of technology of the water points constructed?

7. How do you know the yield of the well or the spring that your organization constructing is enough for the community consumption?

8. Had your organization helped the community in organizing water committee in the community?

9. Did your organization helped the community in institutionalizing the hand dug wells and spring developments?

10. Did you make contractor supervision?

11. Do you think that your staff technicians are enough for the woreda water supply systems and capable enough?

12. What problems do you see in the processes of implementing rural water supply systems?

13. At what season does the water point digging? If it is, hand dug well

APPENDIX- C

Points of discussion with Water Committee Members and women about women participation, training and water service management.

1. Who chose you as a water committee member or simply as a trainee?

2. When did you get the training?

3. For how much days was the training given? Moreover, who gave the training?

4. Do you think that you know all the parts of the water supply scheme that need frequent maintenance?

5. Do you think that the training was adequate so that you can maintain the scheme by yourself without assistance at any time? If not why?

6. If you and your friend(s) trained with you maintained a failure(s) in the scheme's system, how many times the system was maintained and made it function?

7. Has the scheme maintained up to now by those other than you and your friends, trained with, because you were unable to maintain the system?

8. Who covered the maintenance cost?

9. If you and your friend(S) trained with you tried and failed to maintain the scheme, how many times the failure happened

10. Are there maintenance spare parts available around?

11. Is there an institutional support from the concerned bodies like the woreda water supply offices?

12. How you manage the water point?

13. How the contribution of water fee per month collected? If they contribute

14. Do you have rules and regulation for your committee to govern the community and to manage the water point?

15. How many members are members of the water committee? How many of them are women?

16. What are the major problems faced during management of rural water supply services?

APPENDIX D

SUPPLEMENTARY TABLES

Characteristics	Category	No of respondents		Percentage	
		FWSPs	NFWSPs	FWSPs	NFWSPs
	Under 19	6	2	3	1
	20-40	90	102	47	54
	41-60	86	72	46	38
	Above 60	8	14	4	7
Age	Total	190	190	100	100
	Male	103	115	54	61
	Female	87	75	46	39
Sex	Total	190	190	100	100
	Married	174	161	92	85
	Separated	12	18	6	9
	Unmarried	4	11	2	6
	Widow	0	0	0	0
Marital status	Total	190	190	100	100
	1-4	74	68	39	36
	5-10	92	102	48	54
Size	above 10	24	20	13	10

	Total	190	190	100	100
	Not educated	112	121	59	64
	Adult education	50	56	26	29
	Grade 1 to Grade 12	28	13	15	7
Education	Total	190	190	100	100

Table1: Respondents demographic characteristics

Measurement	Is WSP fenced?				Do animals enter to WSP?			
	FWSPs		NFWSPs		FWSPs		NFWSPs	
	Yes	No	Yes	No	Yes	No	Yes	No
No.	118	72	48	142	34	156	114	76
Percentage	62	38	25	75	18	82	60	40

Table 2: Distributions of respondents to whether their nearer potable water point has been fenced and whether animals enter to WPs.

Satisfaction level	Test		Color		Amount of water	
	FWSP (%)	NFWSP (%)	FWSP (%)	NFWSP (%)	FWSP (%)	NFWSP (%)
Good	76	69	77	73	75	41
Somewhat	24	28	23	25	25	31
Poor	0	3	0	2	0	28
Total	100	100	100	100	100	100

Table 3: Respondents satisfaction of water supply characteristics

Water use	FWSPs		NFWSPs	
	No.	%	No.	%
Drinking and food preparation	11	6	4	2
Bathing	13	7	51	27
Clothes washing	17	9	13	7
Animal drinking	6	3	0	0
Garden vegetation	8	4	8	4
All uses	135	71	114	60
Total	190	100	190	100

Table4: water use of Respondents in the study area

field of study	Responsibility	Education	
		Diploma	BSc
General mechanics	Pump Attendant	1	
Chemistry	Water quality expert		1
Rural water supply and sanitation	Rural supply water Expert	2	
Management	Planning and documentation expert		1
Management	Office Head		1
Water Resource and Environmental Engineering	Water engineer		1

Hydro-Geologist	geologist		1

Table 5: Dabat Woreda water staff based on their education and qualification

Mode of contribution	FWSP		NFWSP	
	No.	percent	No.	percent
Money	34	18	63	33
labor	45	23	34	18
local materials	17	9	23	12
Ideas	8	4	2	1
All (cash, labor and local materials)	84	44	55	29
Not participated	2	1	13	7
total	190	100	190	100

Table 6: percentage of respondents based on type of contribution

Water sources		**PH**	**conductivity, µs/cm**	**Nitrate, mg/l**	**Nitrite, mg/l**	**Fluoride, mg/l**	**Total coliforms, colonies/100ml**
WHO guidelines value		6.5-8.5	<4000	50(as No3)	3(as No2)	1.5	0
tenseye	nebrye	6.61	316	0.21	0.008	0.2	0
tenseye	tachnebrye	6.88	298	0.2	0.075	0.21	0
tenseye	tenseye	6.69	248	0.23	0.006	0.25	0
tenseye	Tachlule	7.15	341	0.25	0.001	0.23	0
chila	shola	6.83	342	0.21	0.006	0.1	0

chila	askober	6.76	219	0.43	0.005	0.2	0
chila	shinbrawuha	7.05	311	0.27	0.007	0.22	0
chila	giz	7.17	324	0.2	0.003	0.3	0
Dara	belesbadma	7.21	327	0.2	0.012	0.2	0
Dara	bata	6.94	317	0.2	0.01	0.2	0
Dara	afafit	7.12	320	0.21	0.098	0.15	8
Dara	areke	7.08	247	0.24	0.001	0.2	0
Benker	kebit	5.68	197	0.2	0.003	0.2	0
Benker	kebit qutir2	5.51	213	0.2	0.001	0.3	6
Benker	ahiyagedel	6.34	264	0.23	0.009	0.25	5
Benker	mateb got	7.1	323	0.2	0.006	0.2	0
min		5.51	197	0.2	0.001	0.1	0
max		7.21	342	0.43	0.098	0.3	8

Table 7: Chemical and bacteriological quality of water from sample water Sources