FACTORS AFFECTING THE SUSTAINABILITY OF RURAL WATER SUPPLY SYSTEMS: THE CASE OF MECHA WOREDA, AMHARA REGION, ETHIOPIA

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ABSTRACT

Many Ethiopian rural communities suffer from lack of safe drinking water. One of the reasons is that one third to one half of all drinking water systems fail shortly after construction. The goal of this study was find the reasons that these systems are not working. The MechaWoreda, in Amhara Region, Ethiopia was chosen. These types of wells are used: shallow dug wells, spring and deep wells. A survey was carried out with 160 household in 16 water supply systems constructed by different organizations. The results confirm literature findings about the importance of community involvement in the construction of well points. In Mecha Woreda only one of the 21 systems installed without community support was still functioning while only 12 of the 142 systems installed with community failed. One of the reasons of abandonment of dug wells despite full participation initially during planning and construction was the presence of (unprotected) springs in walking distance from water points because people generally preferred the taste of spring water above that of well water. Moreover, spring water was free, quantity unlimited and required usually less waiting time than for the constructed water point.

The other important factor identified from analysis of the survey was the greater involvement of women in the decision making process of the functioning wells than initially for the abandoned wells. The institutional support of the water supply systems after construction was very weak mainly due to understaffing of the woreda office. Meaningful training of community members to make them responsible for operation, repair and maintenance of the water point will alleviate some of the understaffing problems in their system. Consideration of the above mentioned factors may help in decreasing the failure rate of newly installed water supply systems.

BIOGRAPHICAL SKETCH

Habtamu Addis Beyene was born on September 27, 1983 in Debre Markos, Ethiopia. He received his diploma from Gondar College of teachers' education in 2003 and Bachelor degree from Bahir Dar University in 2007 in mathematics.

He has been teaching Mathematics at high school since 2003. In 2010 he joined the Master of Professional studies offered by Cornell University in Integrated Watershed Management and Water Supply.

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LIST OF ABBREVIATIONS

ADF	Africa Development Fund
BWR	Basic Water Requirement
CSA	Central Statistical Agency
ETH	Ethiopia
HEWs	Health Extension workers
HHs	Households
MDGs	Millennium Development Goals
NGOs	Non-Governmental Organization
O&M	Operation and Maintenance
ORDA	Organization for Rehabilitation and Development in Amhara
SPSS	Statistical Package for Social Sciences
UNICEF	United Nations Children's Fund
UWCs	User Water Committees
WHO	World Health Organization

CHAPTER ONE

1 INTRODUCTION

According to a report of USAID (2009) more than one billion people do not have access to safe drinking water and over 2.5 billion people have inadequate sanitation. In Africa around 300 million people do not have access of safe drinking water and 313 million have no access to sanitation. That means Africa has the lowest total water supply coverage of the other continents in the world (ADF, 2005). Water is life and especially potable water is essential for life and health. So, access to drinking water, improves overall socio-economic and environmental existence (Gebrehiwot, 2006).

In developing countries national and regional governments, local and international NGOs and other concerned organizations invest large sums every year for the implementation of rural water supply projects (Gebrehiwot, 2006). However, construction of water projects does not help if they fail after a short time. In order to make the investment in water supplies more effective, failure rates of these systems should be reduced. According to Gebrehiwot (2006), this can be accomplished by better integration of people who receive the water and water project suppliers in decisions concerning planning construction and management of water supply systems.

ADF 2005 report shows that about 33% of rural water supply projects in Ethiopia are non-functional due to lack of funds for operation and maintenance, inadequate community mobilization and commitment, less community participation in decision making as well as lack of spare parts. As Harvey and Reed (2007) report showed that community issues like perceived lack of ownership, lack of education on water supply and sanitation, poor management system and limited demand are related to low sustainability rates of water supply systems (Harvey and Reed, 2007). This is a summary of rural water supply sustainability challenges by Well (1998).

> "Insufficient water facilities, poor physical structures, low reliability of the service and facility designs, distance and time needed to collect water and low awareness about their uses are some of the factors that affect the continued functioning of the rural water supply systems. In addition to these inappropriate technologies use is also one of the factors. The sustainability of rural water supply systems is correlated with institutional, social, technical, environmental and financial dimensions" (WELL, 1998).

Enhancing the capacity of the community in planning, implementation, development and maintenance of rural water supply systems are the first step towards the sustainability development of rural water supply schemes. To examine the impact of the water supply system socio economically, the full impact should be taken under consideration (UNICEF, 1999).

Involvement of the communities is crucial for the sustainability of rural water supply systems. Females are responsible for fetching water by carrying a clay pot water container or jar long distances. The rural part of Ethiopian topography has rugged terrain and the water points are far especially during the dry phase of the monsoon from the individual households as a result females move up and down by carrying water (Admassu et.al, 2002). About three hours are being lost per day per household fetching water by rural households who have no access to safe drinking water sources around their houses (UNICEF, 1999). Sometimes women prefer fetching water from unprotected spring, river and other sources of it is closely in order to decrease the time spent to fetch water and from these sources they get water free from payment without worrying about the quality of water and its consequences (Admassu et.al, 2002).

If there is less time spent for fetching water, girls can have a chance to attend in the school and get time to study in the house (UNICEF, 1999). In Africa almost 40 billion hours are lost every year for fetching water from distant sources. And reports indicate that in this continent an additional benefit of the community is that many costs of the project are minimized or eliminated (UNICEF, 1999). As the community provides volunteer or low-cost labor during construction or contributes locally available materials, the sense of ownership increases and this involvement in the planning stage of the project may provide the local knowledge necessary to avoid using a water source that would be inappropriate for cultural reasons (UNICEF, 1999). If the operation and maintenance program of a water project is designed by the community, the project will function much better than when the program is designed by outsiders and the consequence will reduce the repair cost (UNICEF, 1999; USAID, 2009).

Gleick (2006) mentioned that the human body's basic water requirements (BWR) depend on climate, workload and environmental factors. The amount of water needed for other purposes, including cooking or hygiene, is more variable and depends on cultural habits, socio-economic factors and types of water supply. On the other hand if women fetch water from distant sources they lose one third of their nutritional intake which is about 600 calories because they walk a long distances to fetch water. So, improved water sources near to the households decreases the amount of calorie that burn and increase the nutritional status of most women and children (UNICEF, 1999).

1.1 SUSTAINABILITY OF WATER SUPPLY SYSTEMS

Sustainability[1] of rural water supply system depends on factors controlled by the project like; training, technology, cost of the project and construction quality and

[1] “Sustainability” in this context best defined as the functionality of the water point over long period of time.

factors that are not controlled by the project for example, communities' poverty level, access to technical assistances and spare parts (Mbithi and Rasmuson, 1977). The sustainability of rural water supply systems is a function of two broad factors. These are: (1) Project rules and (2) External factors. The project rules are project rules related to communities demand responsiveness such as community participation and cost sharing arrangements and other project rule including technology type, sub project costs and training (Gizachew, 2005).

Sustainability rate of rural water supply systems increases as a result of communities' owning and managing their schemes, existence of management organization at the village level, protection of the water point, communities cost recovery for operation and maintenance, technology type and availability of their spare parts and recognition of women.

Building a partnership with the communities that should lead towards improving the people's problem solving capacities improves the expectation that the sustainability to be achieved. Communities' better participation in hand dug wells is much better than in developed spring because of the difference in approach used by stakeholders for community mobilization and communities thinking about developed spring. "However, it is impossible to rule out whether, the weakness came from the stakeholders' participatory approach related to wells or not, which is as important as the other water points (Admassu et al., 2002)."

Willingness-to-pay in cash, materials, labor, and idea can be taken as a useful indicator of the demand for improved and sustained water services (Bhandari and Grant, 2007; Mbata, 2006; Whittington et.al, 1992). According to Mbata (2006), if willingness to pay for specific services increases in the community, then it is possible to conclude that the awareness of the community about ownership also increase for that service. Similarly, if households are willing to contribute cash and labor useful for the management of water sources, then the service that they obtain from a source is valued; and, it is a means of promoting its sustainability.

There are different factors affecting the sustainability of rural water supply systems. Some of the factors that affect the functionality of rural water supply systems, especially in developing countries like Ethiopia are: lack of involvement of the community in selection of site and technology, implementation, operation and maintenance of the water source, lack of finances at the community level for operation and maintenance of water sources, use of complicated technology without proper capacity-building at community level and deep water table and poor quality of water.

1.2 OBJECTIVES OF THE RESEARCH

The general objective of this research is to assess and identify the causes for failing of water supply systems by determining the social and physical characteristics of functional and non-functional rural water systems. This research paper also identifies both the degree and type of community involvement, (especially that of women), and the institutional support during the design, construction and maintenance phases of functional and non-functional systems. Investigate the empirical relationship among financial, environmental, technical and social factors that affect the functionality of rural water supply systems. This study is carried out in Mecha Woreda[2] water supply systems, which are implemented by different organizations like UNICEF, Red Cross,

[2] "Woreda" is a division of Administration that administers a population up to 400 thousand.

Organization for Rehabilitation and Development in Amhara (ORDA), woreda government office and Zone Water Desk. These organizations follow different strategies to implement the water supply systems. In studying both successful and failed systems this study helps us to understand reasons for failure and aid us in the development of strategy for increased sustainability of newly constructed water supply schemes in the future.

CHAPTER TWO

2 LITERATURE REVIEW

Research has shown that rural water supplies in sub-Saharan Africa, particularly those relying on hand pumps, often demonstrate low levels of sustainability. The key causes for this include inappropriate policy or legislation; insufficient institutional support; unsustainable financing mechanisms; ineffective management systems; and lack of technical backstopping. The problem will only be solved by adopting a holistic approach to planning and implementation rather than focusing on one issue (Niyi et.al, 2007).

The determinant factors for the sustainability of rural water supply systems are categorized in to two main categories. These are pre implementation factors and post implementation factors. Community participation, technology selection, site selection, demand responsiveness, construction quality, population and training are some of the pre-implementation factors. And post-implementation factors are technical support, community satisfaction, institutional and financial management, training and willingness to sustain the water project (Gebrehiwot, 2006).

One of the pre implementation factors for rural water supply systems is demand responsive approach. In this context 'demand' is defined as the quantity and quality of water, where community members will choose to consume at a given price (Gizachew, 2005). In a demand responsive approach, beneficiaries should feel the need for safe drinking water supply, in order to identify safe drinking water supply projects. Water projects are more or less demand responsive to the degree that beneficiaries make choices and carry out resources in support of their choices (Gebrehiwot, 2006). If there is willingness in the community to provide valued resources in the exchange for services then these community members valued the service. As a result demand for supply of water will facilitate the management of the water supply system and it enhances the rate of sustainability of the water supply system (Gizachew, 2005).

In the last three decades, literature in the water supply sector has shown that sustainability of rural water supply structures has become positively associated with small-scale initiatives, which maintain public participation (Davis and Liyer, 2002). Involving the users in the planning, implementation, operation, protection and maintenance of water supply systems meaningfully is the key to sustainability. Community members' contributions might take the form of money, labor, material, equipment, or participation in project-related decision-making and meetings (Davis and Liyer, 2002).

Over the past three decades, experience has shown that water and sanitation activities are most effective and sustainable when they adopt a participatory approach that acts in response to genuine demand, builds capacity for operation and maintenance and sharing of costs, involve community members directly in all key decisions, develop a sense of communal ownership of the project, and uses appropriate technology that can be maintained at the village level. Also important are educational and participatory efforts to change behavioral practices (USAID, 2009).

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

Gleick (2006) stated that the international acceptable standards for water requirements for basic needs, commonly referred to as basic water requirement (BWR). BWR is defined as water requirement in terms of quantity and quality for the four basic needs of drinking water, human hygiene, sanitation service and modest household needs. This standard is defined by WHO guide line as 20 liters per capita per day (Admassu et. al, 2002).

When springs are used for multiple purposes such as domestic use, livestock watering, irrigation and tanker supply, care should be taken to prevent contamination of water used for human consumption (Muthusi et.al. 2007). Relative to hand dug wells natural or developed springs is easily contaminated by different contaminant agents.

The effective operation and maintenance (O & M) of rural water supply systems is crucial element for the sustainability of the water project. The community management of rural water supply systems on operation and maintenance (O & M) is not successful, if financing resources are not available and frequent supports are not provided (Binder, 2008). Budgeting sufficient funding for rural water supply systems is an important issue for sustainability and proper maintenance but not only one.

Binder (2008) states that “increasing the budget allocation for rural water supply systems is very important, but that is not the only thing to meet the challenges of achieving the Millennium Development Goals (MDGs).” Enhancing the capacity of the operators’ related to the choice of appropriate institutional management is also mandatory to achieve the Millennium Development Goals (MDGs).

CHAPTER THREE

3 MATERIALS AND METHODS

3.1 DESCRIPTION OF STUDY AREA

Mecha Woreda is located at 500 km northwest of Addis Ababa, the capital of Ethiopia and 35km to the west of Bahir Dar, the capital of Amhara region. It is situated at an altitude ranging from 1800 to 2500 m and has area coverage of 156 thousand hectares (ha). The area receives an average annual rain fall ranging from 1000 to 2000 mm and average daily temperature from 24 - 27^{o}C. The Woreda is divided in 39 rural and 4 urban kebeles. In 2007 the population of Mecha was 336,697 in rural areas and 27,637 in urban areas, a total of 364,334, of which 181,228 were females (CSA, 2007).

Mecha is one of the woredas in the west Gojjam administrative zone in the Amhara region. The woreda is bordered by Yilmana Densa woreda to the East, South Achefer woreda to the West, Bahir Dar Zuria woreda to the North and Sekela woreda to the South. The two agro climatic zones in the woreda are high lands or ‘Dega’ that covers 80% of the area and the remaining 20% is consists of moderate (temperate) or ‘Woyina Dega’. About 92% of the woreda’s economy is dependent on Agriculture. The main products are maize, teff, millet and ‘dagussa’. The most dominant is a nitisol that covers 92% of the area, and the remaining soils vertisols and vertic nitisols. Seventy five percent of the study area is gently sloping, 13% is moderately sloping and 8% mountainous while, 4% consists of valley soils.

The research area has more than 265 rural water supply schemes, of which 200 are shallow wells, 50 medium deep wells and 2 deep wells (with hand pumps). Two springs are equipped with an electric pump and the rest (11) are developed springs without electric pump. Eighty percent of the urban population and 35% of the rural population have access to tap water.

3.2 RESEARCH METHODS

3.2.1 DATA COLLECTION METHODS

The functionality of rural water supplies was assessed by questionnaires, focus groups and field observations. The questionnaire was used to evaluate the degree and type of participation, and to evaluate the institutional support during design, construction and maintenance phases. The questionnaire included questions about community contribution (capital, labor and material), female participation, technical factors (design of construction), financial factors, environmental factors (the sustainability of the water source), health factors and the like (Appendix A). Information was verified using cross check questions. In addition to the questionnaire focus groups discussion were arranged to obtain relevant information about the water supply systems. Questionnaires were also completed with woreda experts (Appendix B) concerning water supply assessment and their technical support and with community water committees (Appendix C) about women participation, training and water service management.

To understand the realities of the water supply system field visits were conducted. Informal discussion with elders and users were conducted to get direct information about that water point. The field observation helped the researcher to identify the standard of the construction, the condition of the contributing watershed, the type of the water point and to determine the degree of protection. Waiting time to fetch water and the distance between the water point and the household house was not as well.

3.2.2 SAMPLING FRAMEWORK

In Ethiopia, rural water supply systems are constructed by local and regional governmental offices, non-governmental organizations and other concerned organizations. In the Mecha Woreda these organizations are Organization for Rehabilitation and Development in Amhara (ORDA), UNICEF, Red Cross, Woreda water Office, West Gojjam Administrative Zone Water Desk, Koga Watershed and Irrigation Project (it is a government project being constructed by a Chinese private Contractor) and Water, Sanitation and Hygiene project (Table 1 in Appendix D). The installed systems are either hand dug wells or developed springs with piped or public taps. In this project 8 functioning and 8 non-functioning systems were randomly selected. Ten households were selected from the villages in each water points.

3.2.3 METHOD OF DATA ANALYSIS

Descriptive statistics based on percentages was used to analyze findings. Qualitative data collected from households, technical staff members and water committees using structured questionnaire, interviews and discussions was organized and entered in to Statistical Package for Social Sciences (SPSS) version 16 or obtaining descriptive statistics. In the village each respondent was coded with numbers so that the situation in each village for the different questions in the questionnaire could be analyzed. Questions in the questionnaires were identified by a variable name and within variables there were values and value labels for identification of responses from the respondents. After coding the information from the questionnaires, template for entering data in the computer program was created. The coded data was then entered in the SPSS version 16 computer programs where frequencies, multiple responses, mean, standard deviations and cross tabulations was computed during the analysis.

CHAPTER FOUR

4 RESULTS AND DISCUSSION

4.1 HOUSEHOLD SOCIOECONOMIC CHARACTERISTICS

From the household socio-economic characteristics Table 1 summarizes about respondents' age and family size[3]. The minimum age is 18 for functional, 20 for non-functional systems and the maximum is 72 for both, with almost the same average and the same standard deviations. In case of the family size the minimum family size is 1 member and the maximum is 9 members and both type systems have almost the same mean and distribution. The mean is slightly greater than the family size of 4.7 persons in Ethiopia (CSA, 2007).

Table 1: Age and family size of respondents

	N	Functional water point				Non Functional water point			
		Min	Max	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.
Age	80	18	72	39.7	12	20	70	40	11
Family size	80	1	9	4.9	2	1	9	5	2

Table 2 summarizes the proportion of respondents who are female and who are male for both functional and nonfunctional systems. About 35% respondents are females and the remaining 65% are males for the functional water scheme and 36% are females and 64% are males for nonfunctional water schemes. Out of the total 160

[3] "Family size" includes the members of household and laborers who live together with the household.

respondents or household heads 140 (87.5%) are married, only 1 (0.6%) unmarried, 9 (5.6%) of them are divorced and the remaining 10 (6.2%) are widowed (See Table 3).

Table 2: Gender of the respondents

GENDER	Functional schemes			Non-functional schemes		
	Freq.	%	Valid %	Freq.	%	Valid %
Female	28	17.5	35.0	29	18.1	36.2
Male	52	32.5	65.0	51	31.9	63.8
Total	80	50.0	100.0	80	50.0	100.0

Table 3: Marital status of the respondents

MARITAL STATUS	Functional schemes			Non-functional schemes		
	Freq.	%	Valid %	Freq.	%	Valid %
Married	70	43.8	87.5	70	43.8	87.5
Unmarried	0	0.0	0.0	1	0.6	1.2
Divorced	4	2.5	5.0	5	3.1	6.2
Widowed	6	3.8	7.5	4	2.5	5.0
Total	80	50.0	100.0	80	50.0	100.0

The survey results indicate that about 64% of the respondents were not educated meaning that they did not attend formal education. Of this group only 9% of the households could read and write, by attending either religious or adolescence education program. The remaining 27% have formal education, of which only 1 (0.6%) attended school after grade twelve. Thus in general the educational status of the surveyed households is very low; (See Table 2 in Appendix D).

4.2 HOUSEHOLD WATER USE PRACTICES

4.2.1 CONSUMPTION PATTERNS

According to the result shown in Figure 1 more than 90% of the respondents consume below the standard of WHO 20 liter per day in both functional and nonfunctional water schemes. But relatively more users in the study area consume greater than 10 liter showing that the developed sources in the study area fulfilled the minimum requirement defined by Gleick et.al (2006). However, per capita consumption rates from either functional or nonfunctional systems were relatively similar. More than 81% of the respondents from the functional and greater than 76% from the nonfunctional systems consumed water between 5 and 20 liters per person per day. Fifteen percent of the respondents from nonfunctional and 11% from functional consumed between 16 and 20L per person per day. Less than 5% consumed greater than 25 L while only two households claimed to use less than 5L per person per day from functional schemes.

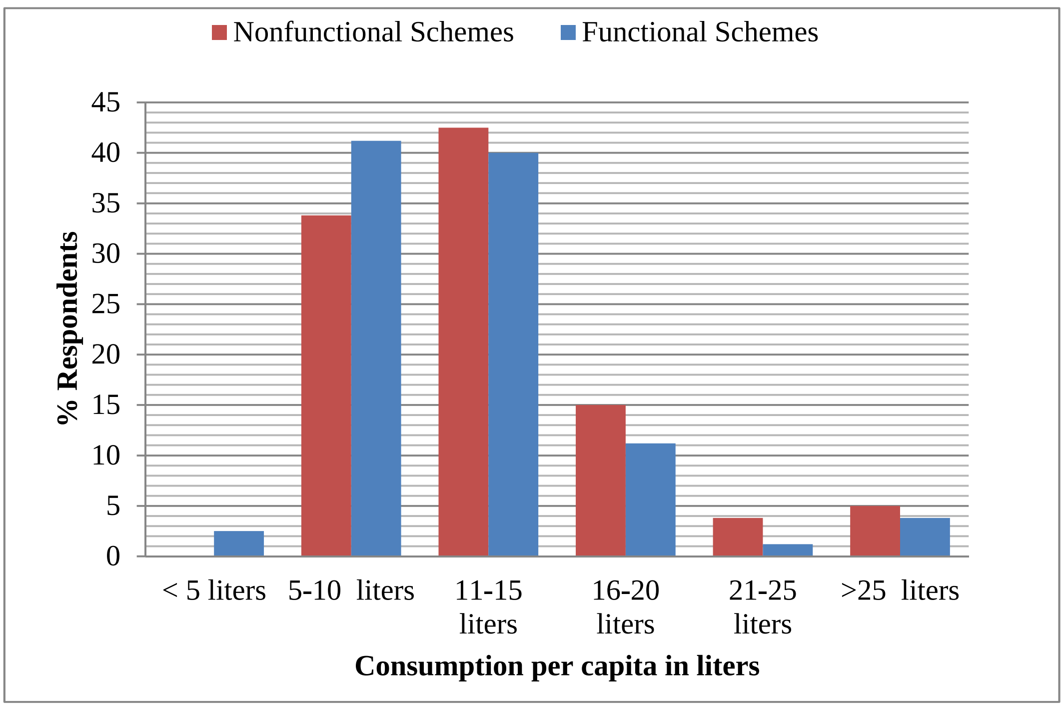

Figure 1: Amount of water consumption per capita per day

Thus, for most of water source found in different villages in the study area, the communities are likely using these improved water sources for the purpose of drinking and as well cooking. In Table 3 in Appendix D, it is shown that 56% and 40% of respondents were using water for drinking and cooking from functional and non-functional schemes respectively. For other type of uses such as washing cloths and hygienic practices, communities depend on unprotected sources to fulfill beyond their minimum demand which is drinking.

Further analysis of consumption considered per capita water consumption and the size of a household. Households with two to four family members averaged just over 15L per person per day while households with more than four members averaged less than 15L per person per day (Table 4 in Appendix D). Figure 2 and Table 5 in Appendix D show that the correlation between family size and their water consumption is negative and it is significant. As the family size increases, the amount of water consumption per person decreases for both functional and non-functional schemes.

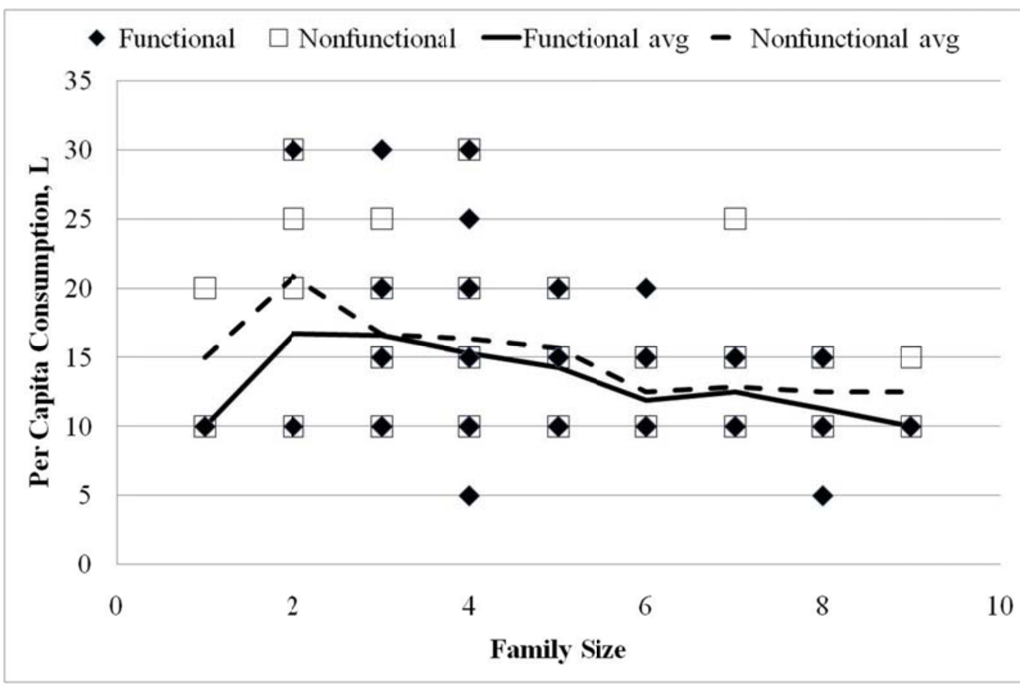

Figure 2: Water consumption per capita versus family size

The analysis (Table 6 in Appendix C) for correlation between the educational status of the household and their water consumption per day is insignificantly correlated as positive for functional scheme and negative for non-functional schemes. This indicates that the educational status does not have an impact on amount of water consumption.

4.2.2 SATISFACTION LEVEL OF RESPONDENTS

About 88% of the respondents are not satisfied by the improved water sources[4] for the nonfunctional scheme (Table 4), usually because of failure of the water point within a short period of time after construction. For the functional systems more than 70% of the community is satisfied by the water point (Table 4).

Table 4: Communities satisfaction by the water supply system

	Functional scheme			Nonfunctional scheme		
	Freq.	%	Valid %	Freq.	%	Valid %
Not satisfactory	11	7	13.75	65	40.625	81.25
Fair	7	4	8.75	6	3.75	7.5
Good	12	7	15	6	3.75	7.5
Very good	19	12	23.75	3	1.875	3.75
Excellent	31	19	38.75	0	0	0
Total	80	50	100	80	50	100

Fifty six percent of the community in the nonfunctional water scheme use unprotected spring and about 51% of the community in the functional water scheme use traditional hand dug well-constructed at the back yard of the household (Figure 3). In rural areas of Ethiopia the community believes that the quality of water is better than for traditional developed hand dug well. The communities who have access to unprotected spring will use this water rather than the developed water scheme. However, communities that use traditional hand dug well will move to the developed water

[4] 'Improved water sources' include developed hand dug wells, developed spring and piped water points.

scheme, because the quality of water for traditional hand dug well is bad. This indicates existence of a spring is one of the factors that affect negatively the functionality of the water supply system. Aschalew (2009) showed the same in Achefer Woreda that availability of alternative sources affected willingness to pay cash for maintenance and operation.

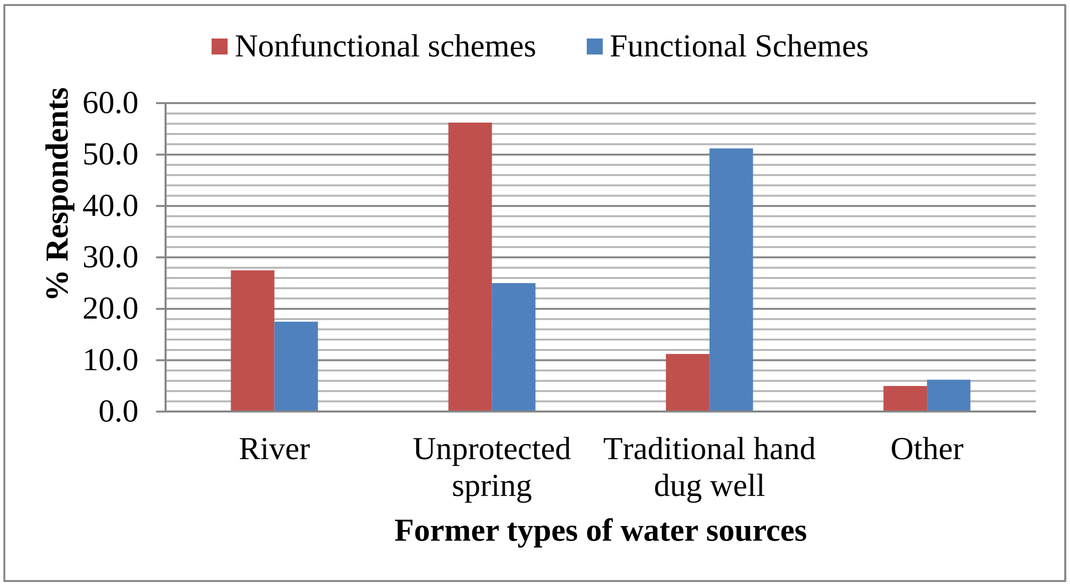

Figure 3: Type of water source used before the developed scheme

In the villages where the developed water supply system is not functioning or the water fetched from developed sources is not enough for functional water schemes, users tried to have their own traditional hand dug wells or use springs and rivers. In an effort to reduce consumption pressure at some water points, water user committees in some functional water points imposed rules and regulations on households that limit the amount of water they can fetch during a day independent of their household size. Because of these rules, households with a large family are forced to collect water from other alternatives non–protected sources.

People paid from 300 up to 500 Birr (ETB) and above to have a traditional hand dug well depending on the water level of the area for the digging of one traditional hand dug well. In some villages water is found at shallow depth and in other areas it is deep increasing the cost to have hand dug well. There are people who have no money to have the traditional hand dug well; as a result they fetch water from other hand dug wells by paying 10 to 30 cents per clay pot. So, when it is calculated the amount of money that such people spent varies from 12 birr to 36 birr per month, if they fetch water 4 times per day on average. This is equal to the wage for one to two days.

However, there are people who allowed other community members, who have no support or their monthly income is small to fetch water for free from their own traditional hand dug well. Even the owner does not make these people to wait for the paying customers waiting the others.

Fetching water is generally the responsibility of women and children. Men are only responsible when children and women are not healthy or if they are out of the village. Women collect water by traveling long distances up to 1.5 km, on average 4 times per day using a 20 liter jerry can or traditional clay pot (with capacity of 17 to 24 liters).

The average waiting time for fetching water at the water source is 21.9 minutes, standard deviation 20.2 minutes and the waiting time varies from 1 to 120 minutes (Table 8 in Appendix D). Waiting time to fetch water from developed spring and hand dug well in average are 19 minutes for developed spring and 22 minutes for hand dug wells. For the non-functional water points the communities get water from unprotected spring, river and traditional hand dug wells. So, in order to get ‘clear’ water from the spring they fetch slowly and little amount at a time, as a result they take time (more than 20 minutes) to fill the jar or traditional clay pot.

4.3 COMMUNITIES ATTITUDE TOWARDS WATER QUALITY

The result of respondent survey shows that about 67%, communities use traditional clay pot (Figure 4) and the rest 33% use a 20 liter or 10 liter jerry can for the purpose of collecting water in both schemes (Table 5). Aschalew (2009) report stated that traditional clay pot is easily contaminated by water pathogens relative to jerry cans, because of the width of the mouth of the clay pot. In the research area it was common to use this clay pot, but currently with the help of health extension workers (HEWs)[5] they used jerry cans instead of clay pots. In some water points the guards prepared part of plastics in order to flow the water from the tap to the jerry can without wastage.

Figure 4: (a) A women pulled up water from traditional hand dug well (b) A girl waiting her mother carrying clay pot with water filled to the 'Rim'.

[5] Health Extension Workers (HEWs)provide basic curative and preventive health services in every rural community of Ethiopia through the health extension program administered by Ministry of Health.

Table 5: Type of container used to collect water from the source

CONTAINER FOR WATER COLLECTION	Functional schemes			Non-functional schemes		
	Freq.	%	Valid %	Freq.	%	Valid %
Clay pot	54	33.8	67.5	53	33.1	66.2
Jerry can	26	16.2	32.5	27	16.9	33.8
Total	80	50.0	100.0	80	50.0	100.0

In some water points HEWs gave training for the community members about the disease caused by water pollution consequently the household members made practice to decrease the disease caused by water contamination, by keeping the quality of water. One of the indicators for the change of attitude of the community towards water quality is that in two villages the community members fetch water from unprotected water sources instead of improved source, because the improved sources was constructed on a swampy area, as a result the quality of water is poor and not accepted by the community (it was functional but because of this not functional, Figure 5). According to the respondents the smell of the water is bad and the color of the water is turbid when they see. More results of households' perception of water quality at their schemes are in Table 9 of Appendix D.

Figure 5: Swampy area near to the hand dug well (a) and a non-functional hand dug well on a swampy area (b).

But, the attitude toward water quality still needs improvement. No treatment is for example usually made for traditional hand dug wells owned by private users at Kuyu locality in Rime Kebele. The rope installed in the well to pull up a bucket laid down on a dirty area in time of no fetching and people inserted the rope with the bucket during fetching water that contaminates the water in the well. It was only observed at one hand dug well in which the owner of the traditional hand dug well add “Water Guard” twice per month and sometimes once per month. One bottle of “Water Guard” contains 30ml and uses this amount for one month and sometimes for two months. The practice by some of the community is drinking the water by boiling and by most of the community is drinking without any treatment.

4.4 SUSTAINABILITY

4.4.1 COMMUNITY PARTICIPATION AT THE INITIAL STAGE OF THE WATER PROJECT

In rural water supply projects, a key issue of sustainability is community ownership and management. Meaning that, the communities take the final decision on important aspects of the planning and implementation of water supply schemes in sustainable rural water supply systems. Currently involvement of community in different phases of the project is widely accepted by NGOs, governments and other stakeholders. Communities’ participation in which the community takes the responsibility of managing the water supply systems by themselves is one of the indicators for sustainable community management in rural water supply schemes.

In almost all water points the communities mentioned that they contributed money for operation and maintenance before the installation of the project and the contributed money was kept by the water committee treasurer together with WC accountant or a person selected by the community members. For example, the strategy used by Organization for Rehabilitation and Development in Amhara (ORDA) is that before constructing the water point, staff members of the implementers first made discussion with the community, whether communities contribute cash, labor and kind during construction and money for operation and maintenance after construction or not.

Communities' contribution to construction of their water point scheme has different forms. These are in cash, in kind, in idea and supporting locally available materials. In functional water schemes majority of the community (47.5%) contribute in cash, labor and local materials, this increases the ownership of the community. But, in case of nonfunctional water point majority of the community participate by supporting materials like food and local beer for laborers which is shown as others in Table 6. Only 21.2% of the communities in nonfunctional water points participate in cash and labor, as a result the ownership of the community decreases and they don't take care for the water scheme. Cash and labor contribution during construction is another distinct factor that affects functionality in the study area.

Table 6: Type of contribution of the sample respondents

CONTRIBUTION OF COMMUNITY	**Functional schemes**			**Non-functional schemes**		
	Freq.	**%**	**Valid %**	**Freq.**	**%**	**Valid %**
Cash	2	1.2	2.5	5	3.1	6.2
Labor	4	2.5	5.0	12	7.5	15.0
Local Materials	2	1.2	2.5	0	0.0	0.0
Other (food, local beer)	0	0.0	0.0	49	30.6	61.2
All (cash, labor and local materials)	38	23.8	47.5	0	0.0	0.0
None	34	21.2	42.5	14	8.8	17.5
Total	80	50.0	100.0	80	50.0	100.0

Contribution of cash for operation and maintenance before construction was not a factor in the study area, as communities contribute money for the operation and maintenance in all water points except three. In all the non-functional water points in the study area, there was no contribution of cash during operation; as a result they used only the cash that was contribute initially for maintenance and when the amount of money saved was finished maintenance was stopped. The reason for no monthly cash contribution during operation is likely due to the choice of the communities for their prior alternative sources which are mainly unprotected sources mentioned in the previous section. Their reason to this choice might be proximity, quantity and quality of water that the unprotected spring is providing, and so that they obtain water free from payment.

However, in some functional water schemes it was observed that communities developed means of income by selling grasses that grow around the water point. They protected this grass from grazing by fencing first their water point and then fencing the area that was used for grass production around the water point. The money collected from grass was used for operation and maintenance and also for guard’s monthly salary. Paying monthly water fee has positively associated with ownership; as a result communities manage and control their developed water supply scheme properly (Table 10 in Appendix D).

4.4.2 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 Table 7 tells that participation of women for no-functional schemes is generally low. The result shows that about 38% and 74% females are not generally participating in the water supply project in the functional and non-functional water schemes respectively. Participation of women can be considered as the third factor for 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.

Table 7: Modes of female participation

	Functional schemes			Non-functional schemes		
	Freq.	%	Valid %	Freq.	%	Valid %
Other (treasurer, accountant)	2	1.2	7.7	4	2.5	12.9
Planning and Management before construction	3	1.9	11.5	1	0.6	3.2
Implementation	9	5.6	34.6	2	1.2	6.5
Give training how to use water	2	1.2	7.7	1	0.6	3.2
No participation	10	6.2	38.5	23	14.4	74.2
Total	26	16.2	100	31	19.4	100

Seven water points from functional and two from non-functional water points have village water committees, of which eight water committees have 7 members each and one from functional water point have five members. The result showed that only one committee has 3 female members, three committees have 2 female members' two committees have 1 female and two committees have no female members from functional schemes. The two water committees in the non-functional water points have one female member each (Table 11 and 12 in Appendix C).

4.4.3 COMMUNITY PARTICIPATION IN THE SITE SELECTION

Community participation is crucial for the sustainability of rural water supply systems. The participation should be started from the initial phase of the project. Selections of site and technology type are the main participation at the initial phase of the project. Table 13 in Appendix D also shows the results of the community's participation in the initial phases of the water project. If inappropriate location of the source is selected the water supply system becomes nonfunctional within a short period of time.

Environmentally the water level of the source, especially for that of hand dug wells become dry. According to the result of survey respondents the location of the water point was selected by about 80% of the community in the functional water system and only 55% in the non-functional (Figure 6). In the currently non-functional water supply systems government staff had a relatively large role in the selection (21%) while this was much smaller (7.5%) for the functional system.

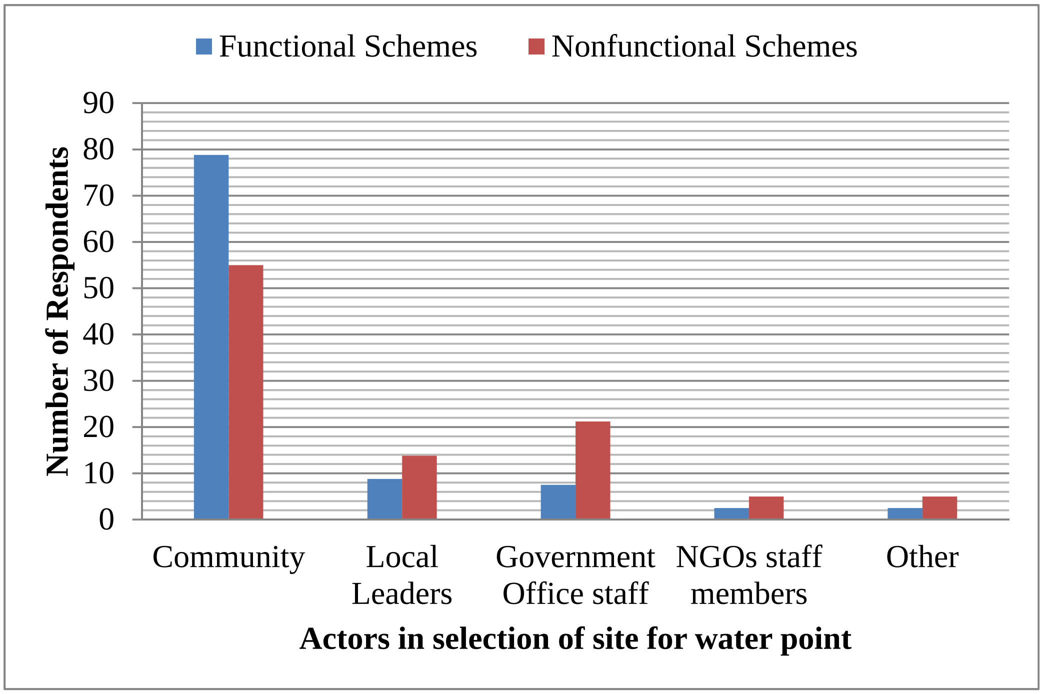

Figure 6: Selection of location of water points by various actors in water point development.

This indicates the participation of the community in the selection of the site of the functional water supply system is higher than the nonfunctional. In further discussions it became clear that in some of the community with the non-functional water supply systems the technicians did not ask the opinion of local leaders and the community while communities prefer sites near their houses technicians preferred sites near the main road; that is easily accessible to the construction company but at the same time is easily accessible to passengers, children and livestock on the road that damage the water supply system and contaminate the water.

One example of poor site selection is non-functional ‘Gerchech’ site that has a developed spring near to a small river. The households must cross the river to get water from the spring (Figure 7). One person alone could not fetch water, because they have to cross the river after getting the water in their container. So, every household need support when they carry clay pot full of water, and some people mentioned that many clay pots were broken down because of trying to move up alone by carrying clay pots. During rainy season they constructed bridge from wood and need to wait until the runoff or flood decreases. At this time the spring would be flooded and consequently the spring was contaminated.

Figure 7: ‘Gerchech’ developed spring which is near to Small River. Now it is not functional.

Another good example of a non-functional water point near a road towards a big market is “Timt”. Passengers fetch water and drink when they move to the market and when they return. Passengers in order to get access to the water had broken down the fence around the water point. The waiting time at this water point increases during market day, because most people are thirsty when they back to home from market.

Figure 8: ‘Timt’ unprotected spring digging by the community members traditionally and used as a drinking water source for human being and cattle.

The community members from this water supply system decreases the frequency of fetching water because of the waiting time during market day and travel to additional alternative sources like spring. This decrease of the frequency of fetching water decreases the ownership of the users on the water point and consequently they do not take care on that water point and finally the water point become non-functional. Children in this water supply system play using the hand pump and one time children killed an eagle and dropped it into the well (See Figure 9). After that the community members did not use this water, even after the bird was pulled up. Communities believed that such type of bad materials are not removed by using different treatments; they simply ignore fetching water from this source.

Figure 9: (a) A child play by the hand of a hand pump. (b) Children washing their legs by fetching water from the hand dug well. (Photo by researcher)

4.4.4 TRAINING OF THE COMMUNITY MEMBERS AND VILLAGE WATER COMMITTEE MEMBERS

Household and village water committee members training play a great role in ensuring the sustainability of the project. Even if the community members have high demand for water they may lack the ability to operate and maintain the system by their own. Training provides knowledge about how to operate and maintain the system and also increase the awareness of the communities about willingness to sustain the system.

The result in Table 8 show that about 29% of the respondents in the functional water point took training concerning about the water scheme, but nobody took training in the nonfunctional water scheme. Although this indicates training has a positive impact on the sustainability of the water supply system, the training system needs improvement in both water schemes in order to sustain the water supply system.

After discussing with the water committee members, it became clear that most of the communities did not receive training for the community members and also did not repair the water system when it is not functional. They simply took the training for the sake of getting per diem. On the other hand there are some village water user committee members who take the responsibility and give education by arranging meetings with other users. These people also repair the water point at the village level when the water point breakage is simple.

Table 8: Communities receiving training

	Functional scheme			**Nonfunctional scheme**		
	Freq.	**%**	**Valid %**	**Freq.**	**%**	**Valid %**
Yes	23	14	29	5	3	6
No	53	33	66	78	46	91
I don't know	4	3	5	2	1	3
Total	80	50	100	80	50	100

The main problem here is that the institutional support of the woreda water development office staff members and technicians is less. Due to small number of technicians at the woreda office, they did not arrange training at the village level for the communities (especially for WCs) and the woreda water development office have shortage of budget to give training for village WCs.

If the community has lack of education or awareness about the water point, they do not take care on the water supply system. The reply of some respondent tell us that as a result of lack of education, there are some community members who steal the wood from the fence of the water point at night for the purpose of fuel. This allows the livestock and children to enter to the water point, to disable the water point and also for water contamination. These water committees have no rules and regulations to punish such type of people. In some villages they have rules and regulations to govern the community members, to limit the amount of water fetching, type of punishment (punishment of money and if they have no money by labor work) when somebody made mistake, how to contribute monthly water fee and the like.

4.4.5 INSTITUTIONAL SUPPORT AFTER THE CONSTRUCTION OF THE WATER POINT

The institutional organization at village level to support the water points is village water user committees (WUCs). In the research area there are nine (seven from functional and two from non-functional) village water user committees, of which five of the water committees are functioning. Some of the purposes of the water committees are collecting monthly water fee, managing the water service, operating and maintenance and giving education during meeting. The remaining village water user committees are now disappeared because (1) the water committee members were not selected by the communities, (2) and even if these water committee members were selected by the communities the members have no experience on how to manage, facilitate the community, operating and maintenance of the water supply systems.

The experts or technicians of the woreda water offices are small in number relative to the number of water supply systems existed in the woreda and area coverage. 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 five technicians for the total water supply systems in the woreda, the woreda consists about 265 water supply schemes. This indicates one technician corresponds to more than 50 water supply systems. Therefore, communities should manage their scheme through their representative (WUCs). For every village water user committees there is one 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.

In Kuyu village the former village water committee members who were selected by the communities are changed by the new water committee. This committee consists of members who are kebele[6] administrators, and the head of the committee is the chairman of the kebele. The water supply system at this village is not functional, because of breakage of the pipe, collecting chamber and damage of the spring box. The community together with the water committee members tried to repair the water point so many times, but within a short period of time 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. And also in one site there was a personal conflict between one community member and head of the water committee, the head prevents the women fetching water from the source. This tells us that the water committee members have a great power in the community on the controlling and management system of the water supply scheme.

4.4.6 COMMUNITY'S ATTITUDE TOWARDS COST RECOVERY FOR OPERATION AND MAINTENANCE

One factor for the sustainability of rural water supply systems is community contribution in cash or labor for operation and maintenance per month or per year. Communities are expected to cover the operation and maintenance cost as well as guards' monthly salary and needs capacity building in money collecting, management

[6] 'Kebele' in this context is defined as sub division of woreda administration that is equivalent to the peasant association.

and operation and maintenance. Table 10 in Appendix D shows the monthly contribution of water users. 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 non-functional water supplies when it was functional. Currently there are six villages that 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.

About 61% of the sample respondents mentioned that the source of fund for the water project is government, 30% of them mentioned the source is NGOs (Table 9). Even if the source of fund is NGOs they said that the source is government, because they have no awareness about NGOs and frustration on government staff members. In addition, the majority of the respondents did not know about the collected monthly water fee. However, there are users who ask the water committee members about the report of the collected money.

Table 9: Source of operation and maintenance fund

SOURCE OF OPERATION AND MAINTENANCE FUND	Functional schemes			Non-functional schemes		
	Freq.	%	Valid %	Freq.	%	Valid %
I don't know	62	38.8	77.5	34	21.2	42.5
Community's contribution	10	6.2	12.5	0	0.0	0.0
Local	0	0.0	0.0	3	1.9	3.8
NGOs	1	0.6	1.2	7	4.4	8.8
Other(government)	7	4.4	8.8	36	22.5	45.0
Total	80	50.0	100.0	80	50.0	100.1

For the water points where the community contributes money per month, the average is 1 birr per month and if that village has for example 200 community members in average who contribute monthly water fee, then the total amount of birr collected per year is 2400 ETH birr. When we subtract the monthly salary of the guard nearly100 birr per month, they have left 1200 ETH birr per year. The current cost of most frequent damaged accessories (O-ring, Uccle, Bush bring and Bobbin) is 350 birr and damaged three times per year in average the cost become 1050 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.

The reasons why the communities in most nonfunctional schemes and in some functional schemes did not contribute money for operation and maintenance are (1) they believe that fetching water is free from payment, it is a gift from government or non-governmental organization (2) because of lack of awareness (3) they considered that collecting monthly water fee is only the duty and responsibility of water fee collector who is a member of village water committee (4) no auditing and distrust of the fee collector (5) the quality of the water from the developed source (6) water collected per household is not sufficient.

Even if, there was contamination of water from traditional hand dug wells the community uses these water and no suffering by water borne diseases because the community buildup an immunity to this water. But, if someone from outside this village, especially from urban area drinks this water, he/she suffer a lot by *Giardia* and other water borne diseases. Some households construct their toilet at the upper side of others' traditional hand dug wells; as a result the household members who use this water become sick.

4.4.7 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 3 to 60 m. The water level is lowest at the end of dry season and highest at the end of rainy monsoon 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 monsoon phase. It's recommended that the wells are dug during the dry season. Despite that many wells are constructed during the rainy monsoon 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 April to July with plowing the field. Other factors are that the management bodies (user committee members) did not control the contractor resulting in poor workman strips and construction at a time convenient to him in the rainy phase, which in addition is cheaper because the well depth is less.

4.4.8 COMMUNITIES' PARTICIPATION ON THE SELECTION OF TECHNOLOGY TYPE AND THEIR APPROPRIATENESS

According to literature, appropriate technology is fundamental in order to make the water supply system sustainable. The selection of type of technology should consider the availability of spare parts and the socio economic situation of the community. Communities should participate in the selection of the technology, in order to operate and maintain the technology at the village level by the communities themselves.

An example was the wrong choice of technology led to failure is the Kuyu-Rim water supply system. The source is a spring and a piping system is used to serve another village community. The pipe did not fit with the water pump. The pressure of water pumped is much greater than the size of the pipe, as a result the pipe breaks.

In technology selection the result shows that majority of the respondents about 85% mentioned that the technology was selected by the government office staff members. The remaining 5%, 3.8%, and 6.2% mentioned that the technology was selected by the community, local leaders and NGO staff members respectively for functional scheme. Table 15 in Appendix D shows the respondents' participation in the selection of the technology used in their water scheme. There is no that much difference among the functional and nonfunctional schemes, but more governmental staff members participate in the selection of technology for nonfunctional than functional. This indicates that the community participation in the process of selecting the technology is very less relative to the government office staff members. The consequence of such type of technology selection is breakage of the spare parts and difficult for operation and maintenance at village level.

In the study site 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 (110) constructed by Organization for Rehabilitation and Development in

Amhara (ORDA) only 4 (3.7%) are non-functional, 8 (25%) are non-functional from 32 water points constructed by UNICEF, from 21 water points implemented by West Gojjam administrative Zone Water Desk only one is still functional. So, out of these organizations ORDA has shown to be superior in sustainability of the water supply systems. UNICEF and ORDA 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.

CHAPTER FIVE

5 CONCULUSION AND RECOMMENDATION

Construction of water supply systems would definitely increase the people with access to safe drinking water. However, this number could be greater if systems did not fail after construction. The underlying causes for the degree of functionality are examined in the Mecha woreda, in Amhara Region, Ethiopia. A survey was carried out with 160 households in 16 water supply systems.

The results agree with most of the literature (e.g. Gelar, 2008) that without community involvement the water supply system fail after installation. Mecha woreda only one of the 21 systems installed without community support is still functioning. However, community participation by itself is not sufficient since 14 of the 142 systems installed with community support became non-functional.

One of the major factors even after full participation in abandonment of drinking water systems is the presence of (unprotected) springs in walking distance from water points. People generally preferred the taste of spring water above that of well water. Moreover, spring water was free, quantity unlimited and required usually less waiting time than the constructed water point.

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. We pose that 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 very weak. The woreda technicians or experts are small in number 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 analysis of the data in this study area showed that communities or committees in the functional water points had more training than in the nonfunctional scheme. However, the overall training was very low. We might have missed the informal training that took place, but more training is needed to increase the capacity of these village water committee members to operate and maintain the water supply system.

One further factor identified in the study area was contribution of cash and labor during and after construction. In areas where the contribution of cash and labor were high, the sustainability was better. One of the approach or strategy accepted by some organizations is that around thirty percent of the project cost should be covered by the community that is for operation and maintenance (for example ORDA). These funds are saved for operation and maintenance. This was largely unknown by the community by making these operational and maintenance funds better known will increase the ownership of the water supply system by the community.

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APPENDIX A

QUESTIONNAIRE FOR BENEFICIARIES

The main objective of this questionnaire is to collect information about the non-functionality of rural water supply points. The other objectives are to gather information about the technical factors, environmental factors, financial factors, health factors, socio- economic factors and the 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 cooperation!!

I. **Socio-economic characteristics of Households**

Name of the water point	Information giver			HH size	HH's Head	Marital status	Education
	Name	Gender	Age				
		1.male 2.female			1.Male 2.Female	1.married 2.unmarried 3.Divorced 4.Widowed	1. illiterate 2. grade 1-8 3. grade 9-12 4.Above grade 12 5.Read and write

II. Identification of Demand responsiveness and non-functionality factors of the services.

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. NGOs d. 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 and Women

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 (from Q 11 – 18 for women only)

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. What is the average Distance from your home to your previous source of water? Use local measurements.

13. Does the present project source of water help you reduce the amount of time required to fetch water? If so, how much time?

14. Are you member of the water committee?
a. Yes b. No c. no committee

15. 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

16. Do you think representation of more women in the water committee is good for the society? Why? or why not?

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

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

19. How strongly do you feel about users paying water fees?
a. 0 b. 1 c. 2 d. 3 e. 4 f. 5

20. Do you usually pay a fee for your water service?
a. Yes b. No

21. If yes, how much did you pay?

22. 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

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

24. If your answer for Q23 is No, what are your reasons? Explain.

25. Do you think that the collected fee is properly managed?
a. Yes b. No c. don't know

26. Are there any educational sessions given in your communities regarding use of drinking water?
a. Yes b. No c. don't know

27. How many sessions did you attend?

28. If your answer for Q26 is No; what prevented you from participating?

20. Do you get benefit from the education given?
a. Yes b. No c. don't know

30. If your answer for Q29 is yes; what are the benefits to you?

31. What type of container do you use to fetch water?
32. 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
33. What is your daily water use? (In litters)
34. In addition to the project water source. Do you use other sources?
a. Yes b. No
35. List the other water sources, if your answer is yes.
36. How satisfied are you with number of hours available?
a. excellent b. very good c. good d. somehow e. poor
37. What is your perception of color of water?
a. excellent b. very good c. good d. fair e. poor
38. What is your perception of taste?
a. excellent b. very good c. good d. fair e. poor
39. Have you satisfied with the quantity available?
a. Very much b. It depends on season c. No
40. What is your overall satisfaction with the service?
a. excellent b. very good c. good d. Fair e . bad
41. How you long stand in line a long time?
42. How important are new water points for you and your society?
a. very high b. high c. somewhat d. not important e. I don't know
43. What types of contaminations are you worried about?
44. How is your water source protected?
45. 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
46. Is the system being repaired? How often? by whom?
47. Currently are there any defects in catchments or wells?
a. Yes b. No
48. Have you satisfied with the system?
a. Yes b. No

49. What is your perception on tariff level?
a. Expensive b. Fair c. Inexpensive d. I don't know
50. Do you have problems in paying tariff (ability to pay)?
a. Yes b. No c. Sometimes
51. Where could replacement of funds come from?
52. Does community had financial capacity to sustain the service?
a. Yes b. No c. don't know
53. Who is the owner of the scheme?
a. the community b. local gov't
c. don't know d. NGOs e. others
54. Do you think that the available water supply is sufficient for the community?
a. yes b. No
55. If your answer for Q54 is No; what are the reasons?
56. Currently does the water system need repair?

a. Yes b. No

57. How frequently are repair needed?

58. 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 yeare. no need

59. Is there anything else you would like to say about your project water source?

Thank you

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. Does the water committee helpful or the community and also the sustainability of the water point?
10. Have your organization followed demand driven approach?
11. Did your organization helped the community in institutionalizing the hand dug wells and spring developments?
12. Did you make contractor supervision?
13. Do you think that your staff technicians are enough for the woreda water supply systems and also capable enough?
14. Do you give support for the community members after construction of the project?
15. What problems do you see in the processes of implementing rural water supply systems?
16. At what season does the water point digging? If it is hand du

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? And by whom the training was given?
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 enough 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. What do you recommend for sustainable use of the water supply scheme?
12. Is there an institutional support from the concerned bodies like the woreda water supply offices?
13. How you manage the water point?
14. How the contribution of water fee per month collected? If they contribute.
15. Do you have rules and regulation for your committee to govern the community and to manage the water point?
16. How many members are members of the water committee? How many of them are women?
17. What are the reasons that make more women not participating in the water committee?
18. Do you have special criteria for tariff setting? If so, explain it.
19. Do you have community bank account? If so, who manage the account?
20. What are the major problems faced during management of rural water supply services?
21. What do you think about the water service for the non-payer community members?
22. Do you give training for the community members about water use and willingness to pay

APPENDIX D

SUPPLEMENTARY TABLES

Table 1: List of the sample water points, type, functionality status, year of implementation, contractor and protection

No.	Village	Type of water scheme	Depth (m)	Status of the water point	Year of construction	Contractor	No of users	Protection
1	Bursa	Hand Dug Well	28	Functional	2007	UNICEF	335	Fenced
2	Cheboch	Hand Dug Well	40	Functional	2007	UNICEF	445	Fenced
3	Arbit	Hand Dug well	10	Functional	2008	ORDA	900	Fenced
4	Salayish	Hand Dug Well	46	Functional	2007	UNICEF	285	Fenced
5	Alshaya	Hand Dug well	10	Functional	2008	ORDA	450	Not fenced
6	Kurkurit	Hand Dug Well		Functional	2010	Koga Project	730	Fenced
7	Bikolo Ageligilot	Hand Dug well	13	Functional	2008	ORDA	150	Fenced
8	Anchiro	Hand Dug well	7	Functional	2008	ORDA	372	Fenced
9	Evali	Hand Dug well	5	Non Functional	2008	ORDA	294	Not fenced
10	Tebielo 2	Hand Dug well	5	Non Functional	2000	Zone	134	Not fenced
11	Ketafisha	Hand Dug well	6	Non Functional	2000	Zone	400	Not fenced
12	Fendika	Hand Dug well	6	Non Functional	2008	ORDA	288	Not fenced
13	Kotkotima	Hand Dug Well	61	Non Functional	2007	UNICEF	450	Not fenced
14	Timt	Hand Dug well	7	Non Functional	2001	Zone	450	Not fenced
15	Kuyu	Developed Spring		Non Functional	2000	Zone	1100	Partiall y fenced
16	Gerchech	Developed Spring		Non Functional	1990	Red cross		Not fenced

Table 2: Household education status

EDUCATIONAL STATUS	Functional schemes			Non-functional schemes		
	Freq.	%	Valid %	Freq.	%	Valid %
Illiterate	52	32.5	65.0	51	31.9	63.8
Read and Write	3	1.9	3.8	11	6.9	13.8
Primary	22	13.8	27.5	14	8.8	17.5
Secondary	2	1.2	2.5	4	2.5	5.0
Above secondary	1	0.6	1.2	0	0.0	0.0
Total	80	50.0	100.0	80	50.0	100.0

Table 3: Purpose of water used at household level

PURPOSE FOR WATER	Functional schemes			Non-functional schemes		
	Freq.	%	Valid %	Freq.	%	Valid %
Drinking and cooking	45	28.1	56.2	32	20.0	40.0
Bathing and washing cloths	21	13.1	26.2	25	15.6	31.2
cattle watering	5	3.1	6.2	4	2.5	5.0
Irrigation	2	1.2	2.5	2	1.2	2.5
Other	7	4.4	8.8	17	10.6	21.2
Total	80	50.0	100.0	80	50.0	100.0

Table 4: Family size of respondents * Amount of water used per capita Cross tabulation

Functional water point		Amount of water used per capita						
		<5 lit	5-10 lit	11-15 lit	16-20 lit	21-25 lit	>25 lit	Total
Family size of respondents	1	0	1	0	0	0	0	1
	2	0	2	0	0	0	1	3
	3	0	3	5	4	0	1	13
	4	1	5	8	3	1	1	19
	5	0	3	9	1	0	0	13
	6	0	11	4	1	0	0	16
	7	0	4	4	0	0	0	8
	8	1	1	2	0	0	0	4
	9	0	3	0	0	0	0	3
Total		2	33	32	9	1	3	80
Non Functional water point								
Family size of respondents	1	0	1	0	1	0	0	2
	2	0	2	0	1	1	2	6
	3	0	2	3	3	1	0	9
	4	0	4	10	3	0	2	19
	5	0	2	9	4	0	0	15
	6	0	6	6	0	0	0	12
	7	0	5	1	0	1	0	7
	8	0	4	4	0	0	0	8
	9	0	1	1	0	0	0	2
Total		0	27	34	12	3	4	80

Table 5: Correlations between family size and amount of water used per capita

	Functional water point			Non Functional water point			
		Family size of respondents	Amount of water used per capita			Family size of responde	Amount of water used per
Family size of respondents	Pearson Correlation	1	-.344**	Family size of respondents	Pearson Correlation	1	-.380**
	Sig. (2-tailed)		0.002		Sig. (2-tailed)		0.001
	N	80	80		N	80	80
Amount of water used per capita	Pearson Correlation	-.344**	1	water used per capita	Pearson Correlation	-.380**	1
	Sig. (2-tailed)	0.002			Sig. (2-tailed)	0.001	
	N	80	80		N	80	80

**. Correlation is significant at the 0.01 level (2-tailed). **. Correlation is significant at the 0.01 level (2-taile

Table 6: Correlations of educational status of respondents and amount of water used per capita

Functional water point				Non Functional water point			
		Educational status of	Amount of water used per			Educational status	Amount of water
Educational status of respondents	Pearson Correlation	1	0.187	Educational status of	Pearson Correlation	1	-0.191
	Sig. (2-tailed)		0.097		Sig. (2-tailed)		0.09
	N	80	80		N	80	80
Amount of water used per capita	Pearson Correlation	0.187	1	water used per capita	Pearson Correlation	-0.191	1
	Sig. (2-tailed)	0.097			Sig. (2-tailed)	0.09	
	N	80	80		N	80	80

Table 7: Type of water sources before the developed water source

FORMER WATER SOURCE	Functional schemes			Non-functional schemes		
	Freq.	%	Valid %	Freq.	%	Valid %
River	14	8.8	17.5	22	13.8	27.5
Unprotected spring	20	12.5	25.0	45	28.1	56.2
Traditional hand dug well	41	25.6	51.2	9	5.6	11.2
Other	5	3.1	6.2	4	2.5	5.0
Total	80	50.0	100.0	80	50.0	100.0

Table 8: Amount of time waiting to fetch water

	N	Functional water point				Non Functional water point			
		Min	Max	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.
Waiting time to fetch water	80	3	80	21.63	16.909	1	120	22	23.209

Table 9: Households thinking about the quality of water

Thinking about water quality	Functional water point		Non Functional water point	
	Freq.	Valid %	Freq.	Valid %
Bad	1	1.2	14	17.5
Good	3	3.8	12	15
Very good	38	47.5	29	36.2
Excellent	38	47.5	25	31.2
Total	80	100	80	100

Table 10: Amount of money paid for water per month

	Functional schemes		Non Functional schemes	
	Frequency	Percent	Frequency	Percent
0	30	37.5	73	91.2
0.5	20	25	3	3.8
1	10	12.5	1	1.2
3	20	25	0	0
9	0	0	1	1.2
12	0	0	1	1.2
15	0	0	1	1.2
Total	80	100	80	100

Table 11: Number of water committee members

Number of water committee members	Functional schemes		Non-functional schemes	
	Freq.	Valid %	Freq.	Valid %
0	1	12.5	6	75
5	1	12.5	0	0
7	6	75	2	25
Total	8	100	8	100

Table 12: Number of females in the water committee

Number of females in the water committee	Functional schemes		Non-functional schemes	
	Freq.	Valid %	Freq.	Valid %
0	2	25	6	75
1	2	25	1	12.5
2	3	37.5	1	12.5
3	1	12.5	0	0
Total	8	100	8	100

Table 13: Participants who create the idea of water supply service

SOURCE OF IDEA FOR WATER SERVICE	Functional schemes			Non-functional schemes		
	Freq.	%	Valid %	Freq.	%	Valid %
Community	51	31.9	63.8	44	27.5	55.0
Local Leaders	5	3.1	6.2	8	5.0	10.0
Government Office	19	11.9	23.8	24	15.0	30.0
NGOs	2	1.2	2.5	0	0.0	0.0
Other	3	1.9	3.8	4	2.5	5.0
Total	80	50.0	100.0	80	50.0	100.0

Table 14: Source of fund for water supply system

Source of fund for water project	Functional water point		Nonfunctional water point	
	Freq.	Valid %	Freq.	Valid %
Community	1	1.2	0	0
Government	36	45	62	77.5
NGOs	39	48.8	10	12.5
Other	3	3.8	8	10
I don't know	1	1.2	0	0
Total	80	100	80	100

Table 15: Participants in the selection of technology type of the water supply system

SELECTOR OF TECHNOLOGY	Functional schemes			Non-functional schemes		
	Freq.	%	Valid %	Freq.	%	Valid %
Community	4	2.5	5.0	9	5.6	11.2
Local Leaders	3	1.9	3.8	0	0.0	0.0
Government offices	68	42.5	85.0	60	37.5	75.0
NGOs Staff	5	3.1	6.2	9	5.6	11.2
Other	0	0.0	0.0	2	1.2	2.5
Total	80	50.0	100.0	80	50.0	100.0