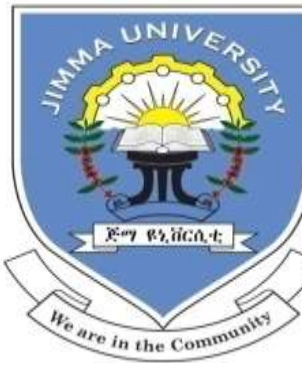

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Factors affecting the sustainability of rural water supply system: A Case study on Basona Worana Woreda, Amhara Region, Ethiopia

A thesis submitted to the School of Graduate Studies of Jimma University in Partial fulfillment of the requirements for the Degree of Masters of Science in Hydraulic Engineering

By

Endeewket Metaferia Amaru

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Adviser **Tamene Adugna (Dr.Ing)**

Co-Adviser **Andualem Shigute (MSc)**

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Abstract

Many water supply schemes have failed to deliver the intended benefits and many water facilities are not operating well. In Ethiopia 33% of the rural water supply schemes are non-functional due to lack of funds for operation and maintenance, inadequate community mobilization and commitment, as well as lack of spare parts (ADF, 2005). The report from Amhara Region Water Resources Development Bureau also shows that 25% of schemes in rural areas of the region are not functional (Tigst, 2014). Despite the reports, less is known about the reasons or factors that contributed to problem. Therefore, the objective of this study was to identify factors that affect the sustainability of rural water supply system in Basona worena Woreda, Amhara Region, Ethiopia.

According to the Woreda Administration Office the Woreda has five clusters. All rural Kebeles of the Woreda are characterized by similar cultural settings and socio-economy conditions except the Woreda Kebeles clusters. Out of 30 Kebeles of the Woreda 30% or 9 Kebeles were selected as a sample. According to the above clusters the sampled Kebeles was selected from one up to three Kebeles randomly. From each sampled Kebeles, two villages were selected by simple random sampling techniques and also the water supply systems samples were selected one for each district village. 15 % of the total numbers of households have been selected as a sample size of the total Households.

The data was collected from primary and secondary data source. After sorting out the effective data, the numerical portion of the data was analyzed using SPSS software ,Excel software, charts and tables, whereas the word portion was digested from all the FGD check list notes and questions from the questionnaires.

The study results show that there were socioeconomic factors, institutional factors, environmental factors, technical factors, financial factors and lack of community participations were found to be the problems for sustainability of rural water supply on the study area. The communities have actively participated during constriction but in the management of water point is weak. Active participation of the community in all aspects before, during and after project implementation is a strong indication of sustainability of water supply systems.

Acknowledgement

First of all I would like to thank the almighty God without his assistance every things is impossible. With great pleasure, I express my gratitude to my Advisor Dr.ing Tamen Adugna for his guidance, to prepare this thesis. I thank him for his concern and kindness.

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Acronyms

ACSI	Amhara Credential and Saving Institutions
ADF	Africa Development Fund
BWFEDO	Basona Worana woreda finance and economics development office
DFID	Department for international development
EHP	Environmental Health Perspectives
FGD	Focus Group Discussion
FWSS	Functional water supply system
GIS	Geographical information systems
GPS	Global positioning System
IRC	International rescue committee
M&E	Monitoring and Evaluation
MDG	Millennium development goal
NFWSS	Non-Functional water supply system
NGOs	Non-Governmental Organization
O&M	Operation and Maintenance
RWS	Rural water supply
RWSS	Rural water supply schemes
SPSS	Statistical Package for Social Science
UAP	Universal Access Program
UK	Kingdom
WASH	Water Sanitation and Hygiene
WCED	World Commission and Environment Development
WFEDO	Woreda Finance and Economics Development Office
WHO	World Health Organization
WRDO	Water Resource Development Office
WWRDO	Woreda water resource development office

CHAPTER ONE

1. Introduction

1.1 Background of the study

The importance of water to sustain life cannot be overstated. Drinking water supply for urban and rural households, irrigation for crops, and water for livestock, wildlife, recreational, navigations, electric generations and industrial purposes are uses that touch us.

Providing sustainable potable water supply systems for rural areas in resource-limited nations remains at the forefront of national and international agendas (Jones et al. 2012). WHO and UNICEF reports that in 2008, approximately 884 million people around the globe lacked access to improved water sources, while 2.6 billion people lacked adequate sanitation services. Unfortunately, these figures mask the extent to which these problems affect rural communities: 84 percent of people lacking potable drinking water in rural areas (Jones et al. 2012). In Africa also around 300 million people do not have access to safe drinking water (Habtamu ,2012).

Similar to many African countries, Ethiopia faces water shortages, poor sanitation, and lack of access to clean water sources. Hence, the Government has given priority to expand the coverage of potable water supply, in rural as well as urban areas. For this reason, large amounts of fund from national and regional governments as well as local and international NGOs have been flowing to rural areas of the country to reduce the inaccessibility of rural community to potable water (Zemenu, 2012). Due to this, a number of potable water supply projects have been constructed in many villages of the country.

Construction of potable water projects would definitely increase access to potable water and contribute to health of citizen; However, this alone could not bring the intended objectives. Increasing the rural water supply coverage is directly related to the functionality and non-functionality of the water supply schemes. In Amhara region half of

the Bore Holes and Hand dug wells are not functional which implies that much work should be done to increase the capacities of each community on operation and maintenance (Selamawit, 2007).

Sustainability could be defined in different forms. Brikké and Bredero (2003) has summarized as a water supply service is sustainable if:

- It is functioning and being used;
- It is able to deliver an appropriate level of service in terms of quality, quantity, convenience, continuity and health to all,
- The management of the service involves the community implying that the community has full involvement in its operation, maintenance, rehabilitation, replacement and
- Administrative costs are covered by the community through user fees or other financing mechanisms;
- It adopts a perspective that addresses gender issues;
- It can be operated and maintained at local level with limited external support; and
- It accounts for environmental issues and negative spillover.

Adhering to the above mentioned issues of sustainability, this study was designed to identify factors affecting the sustainability of rural water supply schemes in Basona Worana Woreda in North Shewa Zone of Amhara Regional State.

1.2 Statement of the problem

In Ethiopia, both governmental and non-governmental development agents have been involved in order to enhance the coverage of clean water supply in different parts of the country. Many water supply schemes have failed to deliver the intended benefits and many water facilities are not operating well. There is very limited data available on water service sustainability, it has been estimated that in most developing countries, 30–60 percent of rural water supply schemes are not functioning at any given time (Brikké and Bredero, 2003). The Africa Development Fund (2005) reported that 33% of the 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. In addition the report shows that by the end of 2015, about 26,300 hand-dug well and 18,900 protected springs will be developed in a country. But if the current trends are allowed to continue, a minimum of 15,820 rural water facilities will be completely non-functional(ADF, 2005). During 2013 WASH inventory in Amhara region 25% of rural water supply schemes are nonfunctional(Tigst ,2014).

Despite the reports, less is known about the reason or factors that contributed to problem. With full understanding that the factors could be divers and complex problems, the objective of this study is to identify what factors are contributing to the well-kwon failure of rural water supply schemes; and to explore the extent of community participation in water supply system planning, implementation and management and its contribution to system sustainability in Basona worena Woreda Amhara Region.

1.3 Significance of the Study

This research will contribute to the better understanding of problems and factors related to sustainable water supply system. It intends to provide stakeholders with possible indicators of sustainable water supply scheme and associated factors that need to be given due emphasis in the future. It will also contribute towards awareness creation among sector and partner institutions about the importance of community participation, institutional requirements in the management of rural water supply schemes. It will also contribute towards future planning, implementation, and management of rural water supply schemes. And it will contribute systematic study to address the problems of rural water supply systems on the study area.

1.4 Objectives

1.4.1 General Objectives

The major objective of the study is to identify factors that affect the sustainability of rural water supply system in Basona Worana Woreda.

1.4.2 Specific Objectives

1. to identify the factors that determines the sustainability of rural water supply system in Basona Worana Woreda;
2. To explore the extent of community participation on water supply in the study area.
3. To identify community contribution on rural water supply systems sustainability in the study area.

1.4.3 Research Question

1. What factors contribute to the sustainability of rural water supply scheme in Basona Worana Woreda?
2. To what extent communities participate on water supply systems in the study area?
3. Is there any contribution the community on rural water supply systems sustainability in the study area?

CHAPTER TWO

2. Literature Review

2.1. The Concept of Sustainability

The word sustainability is derived from the Latin word of sustinere, which means to hold-up (tenere, to hold and sus, up) (Oxford Advanced Learner's Dictionary - 8th Edition).The concepts of sustainability first came from the environmental influence and attempts to protect natural resources and ecological systems from over-extraction, shocks or stresses. However, it has also been extended to integrate other dimensions like economic, social and institutional. In every recent development endeavor, the issue of sustainability is given serious consideration. As a result, sustainable development has been given several definitions by different institutions and researchers. World Commission and Environment Development have the most commonly mentioned definition of sustainable development that reads as: "Sustainable development is development that meets the needs of the present generations without compromising the ability of future generations to meet their own needs" (WCED, 1987). And International Institute for Sustainable Development, USA; describes as "To be sustainable, development must improve economic efficiency, protect and restore ecological systems and enhance the well-being of all peoples." And also UK Government "A better Quality of Life" (1999) defines as, "Sustainable development is a very simple idea. It is about ensuring a better quality of life for everyone, now and for generations to come" (Wonduante, 2013).

The concept of sustainability in relation to rural water supply has five different but interrelated dimensions (see Fig 2.1).

1. Technical sustainability refers to the reliable and correct functioning of the technology and for water supplies, the delivery of enough water of an acceptable quality.
2. Financial sustainability refers to systems can only function if financial resources meet at least the costs of operation, maintenance, and common repairs

3. Institutional sustainability refers to the formal and informal rules and structures governing the management of water supply schemes.
4. Social sustainability implies users will only sustain services that satisfy their expectations, this means services which they can easily access, that are in accordance with their socio-cultural preferences and practices and services that they consider worth the cost they incur.
5. Environmental sustainability including the availability and quality (across time and space) of the water resource itself, linked to characteristics that affect the supply and its sustainability.

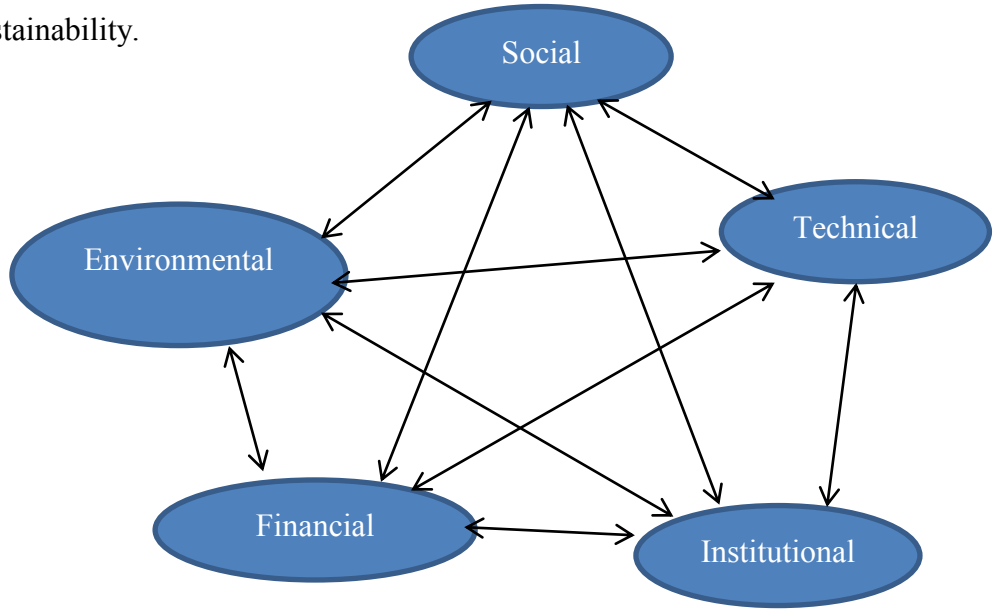

Figure 2.1 Key aspects of sustainability of water supply system services (Gine & Perez-Foguet, 2008)

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 also exist a number of definitions that are significantly different. How we define sustainability is important for selecting parameters, which are then important for measuring and understanding the determinant factors that affect prospects of sustainability. As (Black M., 1998, Hodgkin J., 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 (Zemenu ,2012). Different organizations may choose to use sustainability from different angle, like technical performances, empowerments, social equity or the environment.

Sustainability of rural water supply schemes refers to whether or not the schemes continue to function over time. It also refers to the provision of safe, adequate, water supply facilities at reasonable costs on long-term basis. It is evaluated on different dimensions such as, the extent to which the new scheme continues to supply at the same rate the quantity needs as planned at the beginning and the environmental aspect of the supply continues to be improved (Carter et,al, 1999, Mengesha et, al. 2002).

According to Amhara Water resource Regional state a rural water supply service is Sustainable: If the water sources are not over exploited but naturally replenished, facilities are maintained in a condition which ensure a reliable and adequate water supply, The benefits of water supply continue to be realized by all users indefinitely, The service delivery process demonstrates a cost- effective use of resources that can be replicated (Asrat, 2012).

2.3. Determinants of sustainability rural water supply system

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, and health factors, including the need to continue the provision of hygiene, education to affect long-term behavior changes (Zemenu,2012).

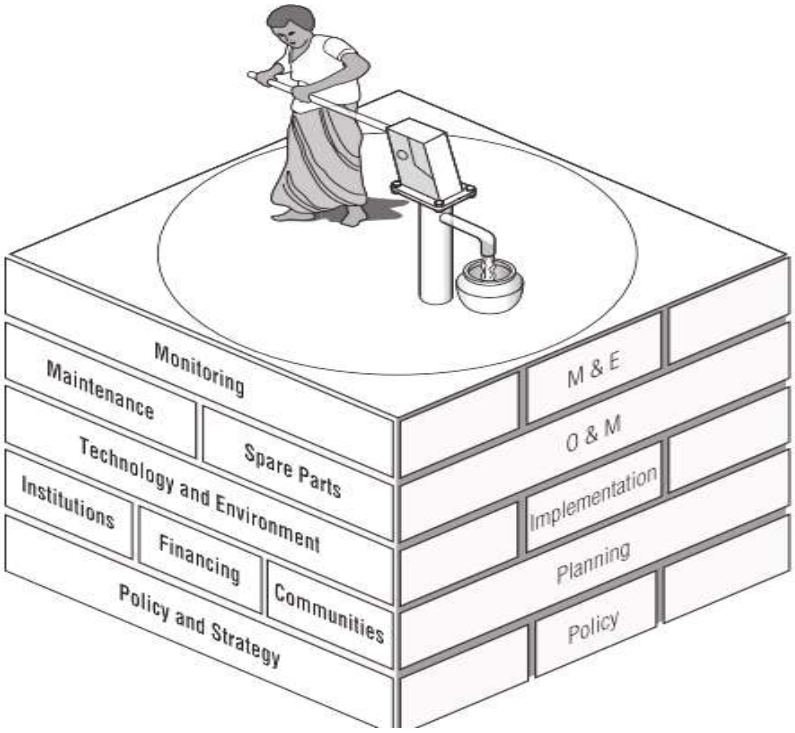

Figure 2.2 Sustainability Building Blocks [Peter Harvey and Bob Reed, 2004]

2.3.1. Technology Selection and Technical Issues

Appropriate technology selections, construction quality of the schemes, technical skills needed to operate and maintain the system, availability, accessibility and affordability to spare parts and toolkits are important technical and/or technological factors that contribute or undermine water supply program in the rural areas. If a community is to manage a water supply system, the technology used needs to be the type that community caretakers can maintain with little outside assistances. The technology must suit the locally available skills or that can be acquired by community members. Technology is considered suitable if it is socially acceptable, economically viable, technically effective and environmentally sound. According (Musonda K., 2004) communities should have a say and participate in technology option. However, study in Mierab Abaya, Ethiopia has shown that water committees have never been participated in technology selection activities (Israel et al,2008).

According to Amhara Regional State Water Bureau; - Despite increased emphasis on social and community aspects of water supply, technology does still matter. Technology options which are low-cost, easy to understand and easy to maintain & repair are likely to be more sustainable than those that require specialist, skills or equipment. The choice of technology and its environment is the main determinant factor for sustainability of rural water supply schemes(Asrat, 2012)

In addition to selection of appropriate technology, careful engineering design and quality water projects construction are important in RWS program particularly in poor communities. Regarding this group (Carter et,al, 1999) shows it may be disastrous for poor people when a facility breaks down and cannot be repaired because of a fault inherent in the design or construction.

2.3.2 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. And also Desalegn argued that lack of comprehensive legislation as one reason for the slow pace of progress in water supply services in rural areas of Ethiopia (Desalgn,1999). 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 H. (2002) pointed out, there are four main functions provided by such support mechanisms above and beyond technical support for the O&M of physical infrastructure. These are technical assistance, coordination and facilitation, monitoring and information collection and training (Zemenu, 2012)

2.3.3 Financial factors

Charging money for the provision of water has always been a controversial issue. The operation, maintenance, and management of a water supply costs money. Weather it is managed by agency or community, the money for the running of a supply system must come from somewhere. The cost can include from the regular replacement of a worn out buckets and major pipes to recovery of the initial investment /capital cost. If dependence on outside support is to be reduced to a minimum, the users must contribute financially to the management of their own water supply system. Although access to water is the right of an individual and it should be free provisions of safe and adequate water supply will costs money. Besides, such issues as who should cover, who is going to set the tariff and how it is to be collected and administered and what type of strategy is relevant to sustain a water supply system financially are still debatable issues. In fact, countries may follow a wide range of policies to address the issues such as from 'free water' delivery to "full cost recovery." Whatever types of policies are followed, here, it should be noted that the issue of financial sustainability is still unresolved, and is a hotly debated one in the rural water supply scenes (Zelalem, 2005).

2.3.4 Availability of Spare Part

According to (Musonda 2004), lack of spare parts has been a major constraint in the sustainability of water supplies and has been a recurring problem. In some cases it has led to the complete abandonment of the water supply system. If sustainability is to be achieved, it should be ensured that, after appropriate technology is chosen, spare parts for that type of technology are made readily available (Musonda 2004)

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 (Zemenu ,2012)

2.3.5 Environmental Factors

It is obvious that the benefits of a water supply project can be sustained only if the water resources are sustained. Each watershed has inherent physical limits to water resource development. Planning should be based on the water yield of a particular watershed and its absorptive capacity to neutralize wastes. Unfortunately, rapidly growing populations are exceeding the local sources of supply in many locations throughout the world. Water sources that are found at some distance (or at great depths) from the users are becoming prohibitively expensive to develop. Water sources should also be developed so they do not exceed their regenerative capacity; otherwise a basic tenet of sustainability, providing for succeeding generations, is violated.(Meron ,2012)

As an example the guidance used for Community managed project programs in Amhara region limits advice on environmental issues associated with water point construction to: 'Although the effect of the construction of hand dug wells and spring developments on the environment is very minimal, some aspects should be considered during siting. Before a site is recommended for the construction, the following should be taken in to account: as much as possible Quality and quantity of the water source: though the quality of different water sources differ each other, it can be possible to mitigate the quality problem. The selection of water sources should also considers in meeting the long-term community needs. Protect the water source: in order to ensure the required quality and quantity of water supply, the water source should be protected against contamination and resource degradation (Dinku, 2010).

2.3.6 Community and women participation

The importance of community participation in rural water supply is often emphasized. Community participation might include the following:

- Prioritization and vocalization of community need;
- Selection of appropriate facilities, technology and locations;
- Financial contribution to capital costs;

- Provision of labor and local material for construction system and facilities;
- Management of operation and maintenance after handing over of schemes;
- Setting and collection of water tariffs; and
- Physical maintenance and repair activities.

Generally, community participation should start as early as possible from problem identification to scheme handover (Asrat, 2012).

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 all communities, especially women, is very necessary (Aschalew, 2009).

The World Development Report 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 (World Bank, 1992). According to Zelalem community participation also enhances accountability and equity and sustainability of benefits. Hence, water supply projects should give the participation of women high priority since they are the ones who bear the brunt of lack of safe water supply. It is meaningless for water projects not to reduce the hardship, among others, of women and children (Zemenu ,2012).

2.3.7 Social aspects

The sustainability of a rural water system depends on the willingness of users to provide the necessary time, money and labor to keep the system functioning. This willingness may be affected by socio-economic factors such as income level, ethnic homogeneity, or the willingness of villagers to work together. More commonly, however, the willingness will depend on consumer satisfaction with the service, usually compared to the previous water source in a community. When communities perceive a significant improvement in water services, they are usually more willing to pay for O&M. Willingness-to-pay is also

affected by community perceptions of ownership or sense of entitlement to free services from the government. In brief, all these are the social aspects of sustainability (Musonda , 2004).

CHAPTER THREE

3. Material and Methods

3.1. Description of the study area

Basona Worena is found at 9°50'N 39^{0}20'E in North Shewa zone of the Amhara Regional State, Ethiopia. The capital town of Basona Worena is Debrebirhan, which is located at 135 km northeast of Addis Ababa. The total Area coverage is 118,563 hectare. The total population is estimated to be 132,553 people .From the total population 67,865 are male and 64,688 are females lived in the study area. Among the total population, 98.8% lived in the rural area and 1.2 % lived in the urban. Basona Worena Woreda has thirty one Kebeles among which a thirty Kebeles are found in rural area (BWFEDO, 2014).

The Most parts of the Woreda has plain topography which accounts 70 % and followed by 23% slightly undulating (rising and falling) and 7 % of the other topographical feature is mountainous and the types of soils which have existed in the Woreda are black soil, dark brown soil, and red soil which accounted for 2.6%, 78.4%, and 19% respectively .

Climatic condition of the area is degas, woyinadega, kola, and wurchi to interpret with percent 50%, 46%, 2%, and 2% respectively . The altitude of the area above sea level is between 1500-3500 Meters with average annual temperature of 12 º c and a sunny month of the Woreda starts on October and lasts on May (BWFEDO, 2014).

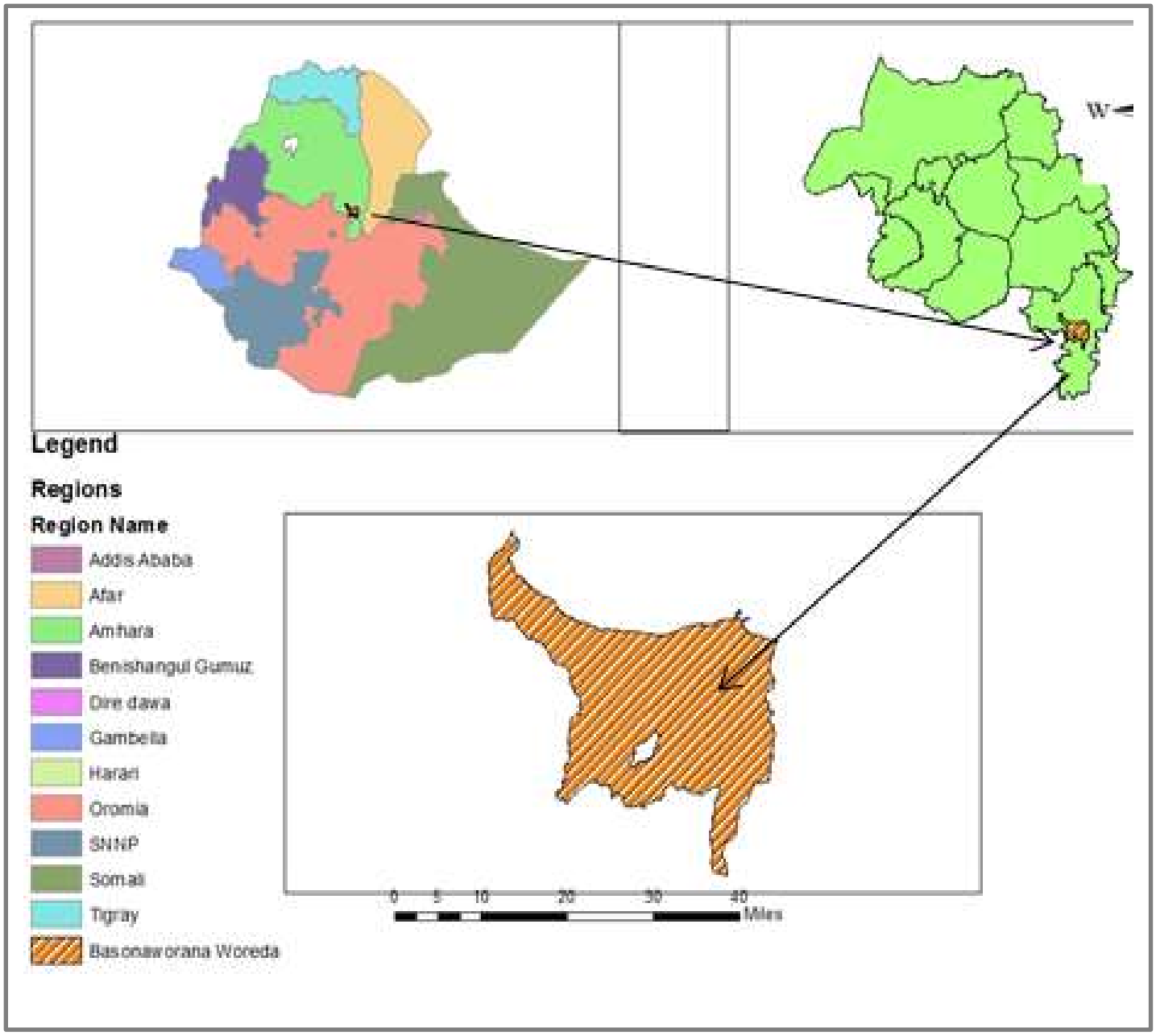

Figure 3.1 Basona Worana Woreda

3.2 Sample population

Rural water supply system beneficiaries were the main primary data sources in this study. All rural Kebeles of the Woreda are characterized by similar cultural settings and socio-economy conditions except the Woreda Kebeles clusters. Out of 30 rural Kebeles of the Woreda 9 Kebeles, i.e 30% of the total Kebeles were selected as a sample using probably stratified sampling method. According to the above clusters from Gudobert zuriya cluster out of 9 Kebeles select Three Kebeles, from Goshebado and debele cluster out of 7 and 6 Kebeles 2 Kebeles was selected for both clusters, but other two clusters are consists 4 Kebeles, for each clusters will be selected one Kebeles randomly. The sample size of the Household was approximately 15 % of the total number of households by using simple random sampling technics. The Focus group were formed from each sampling rural water supply schemes, each Focus group discussion (FGD) water committees were composed five-seven individuals (women and men) and 18 water supply schemes were used and one Focus group discussion was selected from Woreda water resource office experts the group consists 6 individuals.

3.3 Selection of the Study Area

The research area Basona Worana Woreda was selected purposely because: the existences of non-functional water supply schemes increase from time to time. Lack of any systematic study to adders the problems of rural water supply systems on the study area**.** To increase the sustainability of rural water supply schemes this research mainly focused on the objective of this study is, to identifying factors affecting the sustainability of the Woreda rural water supply systems and finally recommends the way forward

3.4. Study Period

The study period set for this research was six months and the six months divided into different time frames to execute the research.

3.5 Sample Size and Sampling Procedure

A three stage sampling procedure will be followed.

1. **To select sample Kebeles :-** According to the Woreda Administration Office, the Woreda has five clusters, namely, Gudobert zuriya, Deble zuriya, muticherkos zuriya, Zendegur zuriya and Chinbre zuriya. The clusters Consists of 9, 6, 4, 4 and 7 Kebeles respectively. Out of 30 Kebeles of the Woreda 30% or 9 Kebeles were selected as a sample. According to the above clusters from Gudobert zuriya cluster out of 9 Kebeles select Three Kebeles, from Goshebado and Debele cluster out of 7 and 6 Kebeles 2 Kebeles was selected for both clusters, But other two clusters are consists 4 Kebeles, for each clusters one Kebele was selected randomly.

2. **To select the district villages and the water supply schemes**

To select the district villages and the water supply systems from each sample Kebeles, two villages were selected and one also the water supply scheme was selected as a sample for each district village by using Probability Simple random sampling method.

3. To select the sample size of the Household is approximately 15 % of the total numbers of households have been selected as a sample size of the total Households by using probably stratified sampling method. This total sample stands proportionately to the 18 sample villages according to their number of households by using the formula.

$$ni = \frac{NiS}{N}$$

Where, ni= number of samples for each village

Ni= number of households in the village

S= Total number sample $= \frac{\text{the sum of number of households in the villages} \times 15}{100}$

N= ∑Ni i.e. number of households in the villages $\sum_{i=1}^{18} N\,i = (N1 + N2 + N3 + \cdots N18)$

Table 3.1 Sampled Kebele, village, water supply systems and sample size of the Households.

No	Kebeles	Villages	Name of water supply schemes	Types of water supply	Household beneficiary			sample of households		
					F	M	T	F	M	T
1	Dibut	Lay Wesebri	Tekile aregay minch	Spring	7	27	33	1	4	5
4	Sariya	Lay Salaysh	Mesk Tig	Spring	20	33	53	3	5	8
2	Dibut	Tach Wesebri	Wesebri	Spring	13	27	40	2	4	6
5	Bakelo	Ametsegna	Kinbo Ager	Hand dug well	13	33	47	2	5	7
3	Sariya	Beryu	Beryu	Hand dug well	13	20	33	2	3	5
6	Bakelo	Senga Beret	Atakochakuchign	Spring	13	33	47	2	5	7
7	Chiraro Debir	Tach Menos	Menos Meda	shallow well	13	27	40	2	4	6
8	Chiraro Debir	Koreb Cotit	Korebtit	Hand dug well	20	33	53	3	5	8
9	Debele	Debele	Atela Gur	Hand dug well	13	53	67	2	8	10
10	Debele	Debele Ansas	Ansas	Hand dug well	20	67	87	3	10	13
16	Baso Dengora	Koso	Quarf	Spring	20	20	40	3	3	6
11	Birbirsa	Koshem	Cheko	Hand dug well	33	47	80	5	7	12
12	Birbirsa	Dubisa	Fefa	Hand dug well	13	20	33	2	3	5
13	Angolela	Totocho	Atero	Spring	20	47	67	3	7	10
14	Angolela	Asede	Asede	Hand dug well	7	20	27	1	3	4
15	Baso Dengora	Andit tid	Kundi	Spring	13	13	27	2	2	4
17	Chinbre	Meteratr	Beles	Spring	13	40	53	2	6	8
18	Chinbre	Mechanekiya	Tikur Chika	Spring	20	33	53	3	5	8
Total					287	593	880	43	89	132

3.6 Study Variables

In this research both independent and dependent variables were assessed. Technical aspects, financial aspects, community aspects, environmental aspects and institutional aspects were independent variables but sustainable rural water supply was taken as dependent variable. The dependent variable changes with respect to the conditions.

3 .7 Data Collection Process

Both quantitative and qualitative data were collected from primary and secondary data sources. Before starting the actual formal survey, a reconnaissance survey was conducted and some background information was collected about the study area. The field observation helps to understand and synthesize the general picture of the study area and provision of rural water supply.

3.7.1 Primary data

Primary data collection includes the following data collection methods such as key informant interview, focus group discussion (FGD), house hold survey, and direct field observation,

The data was collected from primary data; status of rural water supply scheme, determinants of rural water systems, community participation in planning, implementation and management, appropriate solution for sustainability determinant, water supply point location by using GPS and Photographs of relevant sites

3.7.2 Secondary Data

Secondary data, for factors affecting the sustainability of rural water supply schemes such as ; Community contribution during project implementation, statistics on existing water and sanitation facilities, inventory data of the study area, demographic data of the study area, reports of the Water committee and Water supply point location.

3.8 Data processing and analysis

Data collected and organized was both in terms of numbers and words. After sorting out the effective data, the numerical portion of the data was analyzed using SPSS software ,Excel software, charts and tables, whereas the word portion digested from all the FGD check list notes and questions from the questionnaires.

3.9 Ethical considerations

In this research the ethical considerations was not that much a problem. Because, challenges of sustainability of rural water supply systems are the concerns of every one. This leads to the concept of participation in solving this hindering problem than the concept being offensive.

3.11 Data quality assurance

In order to assure quality of data taken, much precision was taken in arranging final checklist stating the desired points to be short and precise. Test runs were taken on the checklist to eliminate weak questions. Adequate trainings were given to data collectors and partial involvement of the data collecting process was also insured the quality of data gathered.

3.12 Plan for dissemination of findings

This research mainly concentrated on rural water supply systems that are constructed implemented by the Basona Worana Woreda. The methods of dissemination is by means of supplying hard copies for the Woreda water resource office. And finally so as to make it helpful for other following researchers it will be published on reputable journal.

CHAPTER FOUR

4. Results and Discussion

4.1 General

This chapter presents the factors affecting the sustainability of rural water supply systems in the study area, the community participation in the rural water supply systems and their contributions on rural water supply systems sustainability.

4.1.1 Over all Woreda water supply systems distribution

According to the Woreda water resource development office 2013/14 report the Woreda has a total of 317 water supply systems (60 hands dug wells, 5 shallow well, 1 deep well and 251 natural protected spring). Out of these water points, 238 were functional and 79 (25%) were non-functional. These were constructed in the years of 2003/2004-2013/2014. The number of rural water supply schemes constructed increased over the study period as well as the number of non-functional water supply schemes.

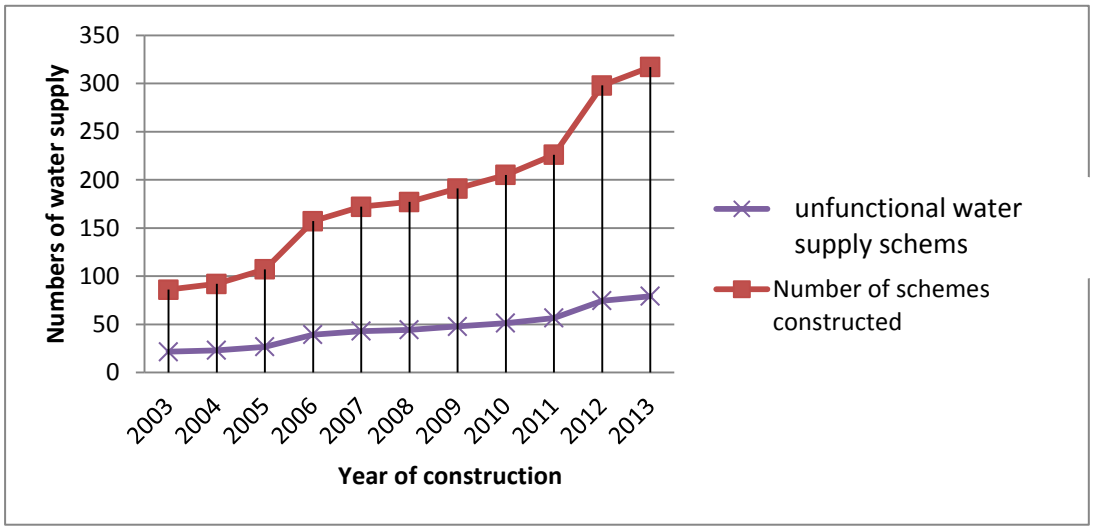

Figure 4.1 Distribution of water supply schemes constructed within 2003-2013

4.1.2 Physical Status of Schemes by type

Functionality is one of the main key indicators to describe the physical status of a scheme as it expresses best the general condition based on the working condition of each

component of the scheme. Eight HDWs, nine protected spring and one shallow well were sampled.

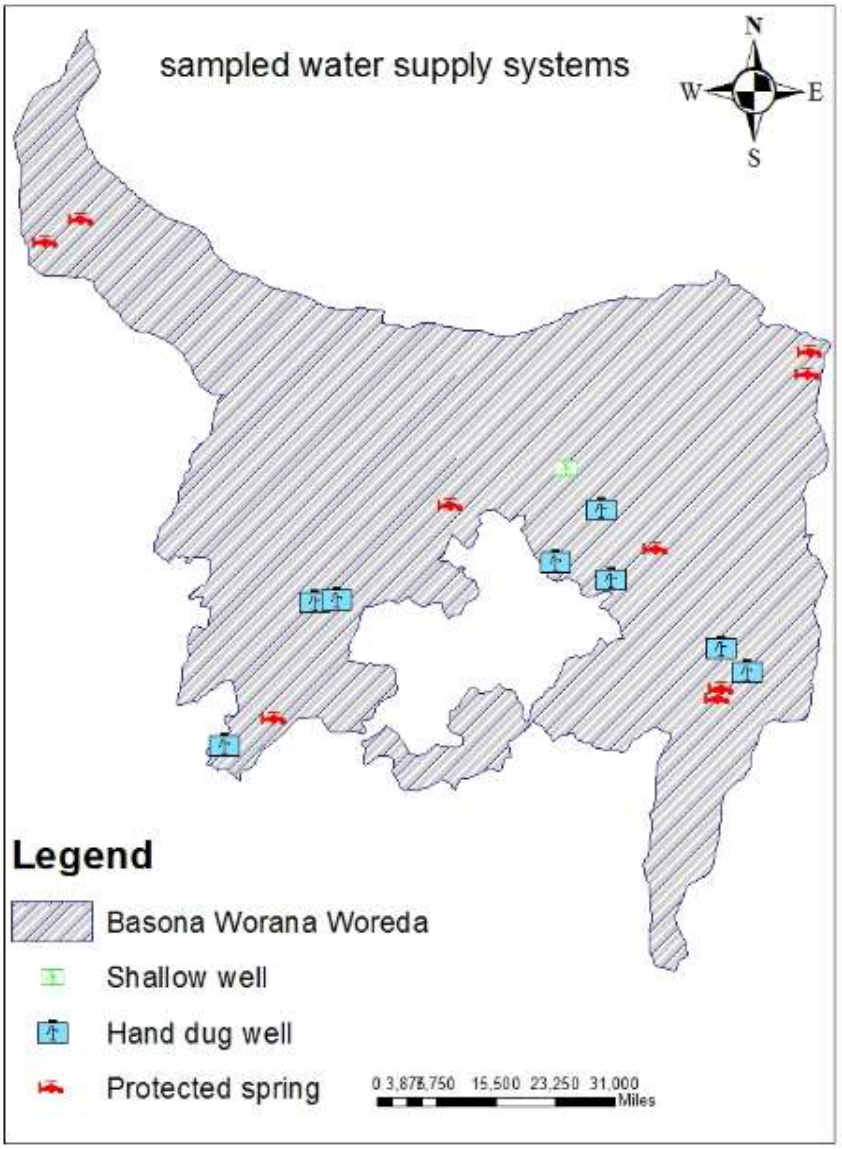

Figure 4. 2 sampled water supply systems

The status of the schemes has been designated based on their current working conditions, the type and extent of failure/damage & the possibility of reinstatement repair and maintenance requirement for future utilization.

The following terms were used to designate the status of the schemes.

1. **Functional water supply systems:** are schemes, which are in good working condition, and all their components are functional.
2. **Non-functional water supply systems**: are schemes which are currently not functioning due to failure of one or more part/parts of their system/system components that could be maintained and made functional. Schemes included in this group are;
   I. Springs eye changes the course of flow. Water is not tapped and hence required the reconstruction of the intake or collection chamber etc.
   II. Schemes where hand pumps or others components are not functional.
   III. Abandoned Schemes, which have been abandoned and cannot be reinstated, like dried up springs, wells, etc.

In order to provide clear and broader picture, based on the above designation, out of the total rural water supply schemes in the sample Woreda, detailed description of the physical status, are discussed in the following table.

Table 4.1 physical states of sampled water supply systems

Types of water supply systems	**No of Functional water supply systems**	**No of non-functional water supply systems**	total
Hand dug well	4	4	8
Spring	4	5	9
Shallow well	1	0	1
Total	9	9	18

4.2 Socio-economic factors

4.2.1 Sex Composition and the age of the householders

The socio-economic and demographic background information about sample populations is very important to know their characteristics. The size of sample households for this study is 132, covered by 18 developed water supply systems in the nine sample Kebeles. From sample Kebeles respondents were selected in such a way that 15 % of the total water beneficiary households. From these sample population 89 (67.4%) are male and 43(32.6%) female respondents. From the findings majority of the household respondents were male while minorities were female. The findings indicate that majority of the households were headed by males who were involved in the water projects in the locality. With regard to age composition, from 15-30 years ,19(14.4%) ,31-45 years,34(25.8%) , 46-60 years 36 (27.3%) and above 65 year 43(32.6%) .Out of the total respondents, the dominant one is that of male above sixty and this will increase the reliability of the data collected since these member of the society are old aged and has got ample experience on the issue of water schemes from the past.

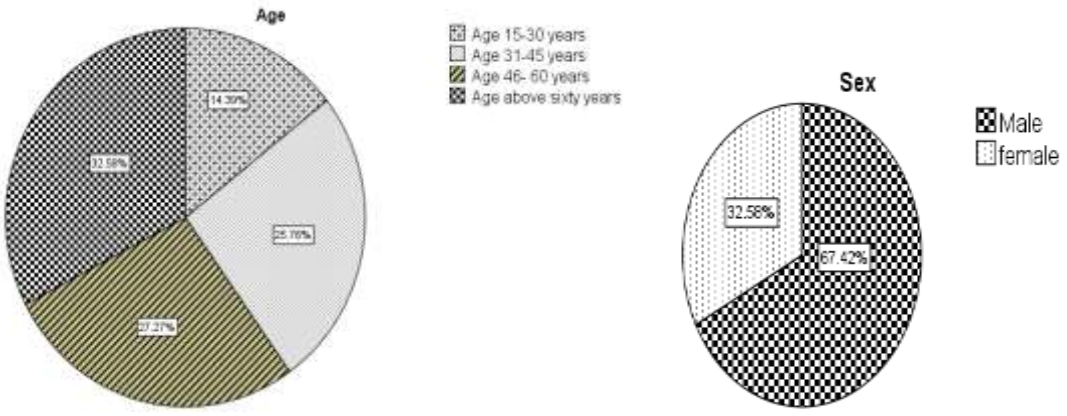

Figure 4. 3 Distributions of Respondents by Sex and Age

4.2.2 Marital Status and Family Size

Marital status has to do with family size and family heads which, in turn, has an impact on water consumption and participation in projects targeted to water supply. The organization of collected data (Table 4.2) reveals that 104(78.8%) respondents were married, whereas 6 (4.5%), 3(2.3%), 19 (14.4%) of the respondents is divorced, widowed and single respectively. Family size of households has to do with initial investment of water supply projects, water consumption and payment for its. With regard to the household family size, those respondents with family size less than 5 comprise about 46(34.8%), family size between 6- 8 constituted 59(44.7%), are 25(18.9%) of the respondents their family size between 9 -11 and only 2 (1.5%) of household respondents indicate that their family size above 11. In principle, despite the differences in socio-economic status and other related factors, households having large family size consume large volume of water. Thus, the flat payment principle applied in rural areas need to be revised. FGD made with water committees also revealed that almost all rural water supply institutions had not rejected the flat payment principle and they did not started to charge their beneficiaries based on water consumption/progressive payment.

Table 4.2 Distributions of Respondents by Marital Status and Family Size

Marital Status and Family Size		Frequency	Percent	Cumulative Percent
Current marital status	Single	19	14.4	14.4
	Divorced	6	4.5	18.9
	Married	104	78.8	97.7
	Widowed	3	2.3	100
Total		132	100	
Household family size	Below 5	46	34.8	34.8
	between 6-8	59	44.7	79.5
	between 9-11	25	18.9	98.5
	Above 11	2	1.5	100
	Total	132	100	

4.2.3 Occupational profiles of Households and its income range

Sample households were also asked about their main sources of income and the survey result of the households are presented in Table 4.3, almost 89 (67.42%) of the respondents report that farming is the main sources of income, whereas 35 (26.52%) and 8 (6.06%) of the respondents report that in addition to forming, commercial trade and daily labor were additional sources of income respectively. Nine respondents constituting 6.8% of the total respondents are in the income category of above 17001 Birr per year. 16 (12.1%) are within the income range of 14001-17,500 birr per year, while 15(11%) fall in the income range of 10501-14000 birr per year. Those respondents with income range of 7001-10500 birr per year constitute 11(8.3%) of the total. Respondents with income range of 3501-7000 birr per year represent 39(29.5%) of the sample population. The other Respondents' income range less than 3500birr per year 42 (31.8%) out of the total respondents. Therefore the majority of the households was poor and could barely afford the basic household needs due to lack of finances.

Table 4.3 Respondent income range vs. Household Income source

Respondent income range(birr/year)	Household Income source			Total	Percentage %
	farming	farming and commercial	farming and Daily labor		
< 3,500	33	5	4	42	31.8
3,501-7,000	32	5	2	39	29.5
7,001-10,500	5	4	2	11	8.3
10,501-14,000	9	6	0	15	11.4
14,001-17,500	7	9	0	16	12.1
>17,001	3	6	0	9	6.8

4.2.4 Educational Level of the Respondents

Education is an instrument for socio-economic development of a nation. It is a basic parameter for any development activity particularly water supply programs. This is because literate citizen can be better participants and involve in projects targeted to water supply and management. Knowledge and technology transfer are also easier in a community that constitutes educated people. Educated individuals demand for better services and toward improvement of their living condition. As it is shown on Table 4.4 out of the total households 53(40%) were found to be unable to read and write (illiterate) and those who can only read and write were 34(26%), and 21(16%) of the respondents were having 1-4 grade and some primary school (5-8) grade 20(15%), and only 4(3%) of the respondents have secondary school level of education (9-12). Therefore it can be noted that majority of the household respondents had not attained the basic education and thus would not provide valid and consistent information about sustainability of water supply systems.

Table 4.4 Distribution of Respondents by educational level

Educational level	Water supply schemes functionality		Total	Percentage%
	Functional	Nonfunctional		
Unable to read and write	23	30	53	40
Can only read and write	15	19	34	26
1-4 grade	11	10	21	16
some primary (5-8) grade	8	12	20	15
high school (9- 12)	1	3	4	3
Total	58	74	132	100

4.3 Institutional Support

4.3.1 Institutional Support and Coordination among Stakeholders

Starting from the establishment of regional states, any development, operation and maintenance activities of water supply schemes in their respective territory are decentralized to regional states. Again Regional States also decentralized some of their duties to Woreda level. Water Resources Bureau along with its zonal offices and Woreda water resource is the one who is responsible for the development of the water sector in Amhara Regional State. There were different stakeholders involved in rural water supply development in Basona Worana Woreda. These were government institutions at bureau, zone, and Woreda levels, different NGOs and community members. In order to make effective contribution, these organizations have to coordinate their efforts of water supply development.

4.3.2 Government Institutions

The water supply development activities in the region are expected to be coordinated by Amhara Water Bureau. This study attempted to gather information from different stakeholders: regional, zonal, and Woreda level water institutions. There are identified duties and responsibilities at these three stages i.e. bureau, zone, and Woreda levels. Amhara Water Resource Bureau plays the regulatory role. The zone and the Woreda water offices are the implementers. NGO and any interested body to develop water supply have to make an agreement with Water Resource Bureau and sign the tripartite agreement with Water Resource Bureau, Finance & Economic Development Bureau, and the implementer (NGO) itself.

In the implementation phases, there should be horizontal relations with the water offices for the activities and with finance and economic development offices for reporting and monitoring. According to the procedures by the regional government, NGOs are licensed by Amhara Finance and Economic Development Bureau. The developments of water supply schemes were given to the regional level, zonal and Woreda level. The motorized deep well schemes and motorized spring with distribution systems are under the mandate of the regional water bureau while spring

development without motorized and hand dug wells are the mandate of zone and Woreda Water Offices. The maintenance activities are divided in to two major stages namely minor and major maintenances. Minor maintenances can be performed by the community itself and the Woreda water office. These activities include fast moving spare parts exchange and maintenances that do not need machineries. The major maintenances are those which need machineries and major spare parts exchange. These activities are the works to be done by zone personnel or both zone and Woreda together. Because there is no any maintenance machinery allocated at Woreda level (Dinku, 2010).

4.3.3 Woreda Water Office

Basona WoranaWoreda Water Office man power requirement was 29, and while this study was conducted the office have only 14 staff which accounts 48.3% of what is required. The office was under staffed and works to discharge its responsibilities with less than 50% staff members.

Table 4.5 Basona Worana Woreda water staff based on their education and qualification

No	Field of Study	Responsibility	Education level	
			Diploma	BSc
1	Water resource and irrigation engineering	Water engineer		1
2	Rural water supply and	Rural supply water Sanitation ,pump attendant , pipe installer and Water quality Expert	5	
3	General Mechanics	Mechanics	1	
4	Geology	Geology		1
5	Geography	Planning and documentation expert		1
6	Natural resource	Office head		1
7	Land resource management	Energy expert		2
8	Electrician	Electrician	1	
9	Computer science	Secretary and Administrator	1	
Total			8	6

With the above staff members, the Woreda water office was providing water development facilities and support to the community. Only 6 BSc degree professional staffs and 8 Diploma experts are there in the Woreda. During the discussion made with the water office of the Woreda the staffs are not enough to provide the necessary water development service. According to the discussion result, held with in the water office, the staff can maintain all hand pumps and spring without any help from the zone. The staff can operate all types of the scheme technology and maintain all minor maintenances and some major maintenance that do not need machine support. The Woreda staff members registered high performance compared to other Woreda in the zone; and this was confirmed by the zone water office and Amhara regional state Water Energy Bureau. However, the field survey indicates that lack of support and supervision from Woreda water offices was the main causes for the failure of water supply systems. 78(59.1%) of the respondents said that lack of support and supervision from Woreda water offices is the failed water ,but 54(40.9%) respondents Woreda water offices lack of support and supervision was not the main causes failed of water supply systems(Table 4.6). This indicates weak monitoring and supervision activity in the Woreda. To conclude, in the study area there is lack of support and supervision from Woreda water development office. This is the main causes of rural water supply schemes.

Table 4.6 lack of support and supervision from Woreda water offices is the main causes for the failed of water supply systems

lack of support and supervision from Woreda water offices was the causes for failed of water supply systems		Water supply schemes functionality	Total
		Functional	Nonfunctional	
Yes		24	54	78
		41.40%	73.00%	59.10%
No		34	20	54
		58.60%	27.00%	40.90%
Total		58	74	132
		100.00%	100.00%	100.00%

Figure 4.4 functional water supply with full participant of water committee, community and institute supporter

Figure 4.5 Angolena kebele totacho atero water supply systems unsustainability caused by lack of institutional facility

4.3.4 Community Institutions

There are two types of community level water management institutions. These are water committee for single scheme management and Kebele water resource development Committee for many schemes management. Water committee five to seven members consists. The community institutions were not adequately supported by technical institutions from government and NGOs. According to the discussion result with Woreda water office the trainings were given to the committees depending on the budget availability to train the community. There was no regular program to capacitate the committees to manage their water supply. There was no water administration manual supplied to water committees except orientation type training at the beginning of their election to start their duty.

The Kebeles water resource development committee completely not functional. But for a single rural water supply system water committee functionality 45(60.8%) of nonfunctional water supply systems respondents said that the water committees are non-functional. but 29(39.2%) and 58(100%) of non- functional and functional water supply systems was water committees are functional respectively (table 4.7).

Table 4.7 Water committee is functionality with Water supply schemes functionality

Water committee is functionality	Water supply schemes functionality		Total
	Functional	Nonfunctional	
Yes	58 100.00%	29 39.20%	87 65.90%
No	0 0.00%	45 60.80%	45 34.10%
Total	58 100.00%	74 100.00%	132 100.00%

Figure 4.6 Un-functional water supply Bakelo kebele caused by water committee functionality and lack of institutional support.

4.4. Technical factors

The technical issues relating to the design, construction quality of schemes, technical skills needed for operation, maintenance, appropriate technology selection, and spare part availability of rural water supply system are the most determinant of technical sustainability of water supply systems.

Poor construction quality leads to the failure of the water system before the end of its designed life span. Similarly, design flows including hand dug well or spring developments and insufficient discharge (low yield) may cause a system to fail from the outset. In the study area 75 (56.8%) respondents said a Poor design and low construction qualities are the main cause of unsustainability rural water supply systems but 57(43.2%) respondents Poor design and low construction qualities are not the main cause of un sustainable water supply systems. 52 (39.4%) of the respondents mentioned that insufficient water at the source is the main cause of unsustainability rural water supply systems , 114(86.4%) respondents referred to the lack of qualified local technicians is the main cause of non-functionality water supply schemes. The above result indicates Poor design and low construction qualities, insufficient water at the source and the lack of qualified local technicians are the cause of unsustainability rural water supply systems.

Table 4.8 technical problems the main causes of unsustainable rural water supply

The following technical variables affected your water supply schemes sustainability?	Respondent answers	Water supply schemes functionality		Total
		Functional	Non-functional	
lack of qualified local technician	Yes	52 89.70%	62 83.80%	114 86.40%
	No	6 10.30%	12 16.20%	18 13.60%
Total		58	74	132
Poor design and construction quality	Yes	6 10.30%	69 93.20%	75 56.80%
	No	52 89.70%	5 6.80%	57 43.20%
Total		58	74	132
insufficient water sources	Yes	33 56.90%	19 25.70%	52 39.40%
	No	25 43.10%	55 74.30%	80 60.60%
Total		58	74	132

Figure 4.7 Saria kebele lack of qualified local technician and spare part

Figure 4.8 Poor design and low quality construction material affect the unsustainable rural water supply

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. Community participation in the process of selecting the technology is less the consequence of such type of technology selection is breakage of the spare parts and difficult for operation and maintenance at village level.

In technology selection the result shows that majority of the respondents about 37(63.8%) mentioned that the technology was selected by the community. The remaining 11 (19.0%), 4(6.9%), and 6(10.3%) mentioned that the technology was selected by the government office staff members, NGO staff members and both community and governmental offices respectively for functional scheme. But result shows for non-functional schemes type of technology selection the respondents about 29(39.2%) mentioned that the technology was selected by the community. The remaining 23 (31.1%), 18(24.3%), and 4(5.4%) mentioned that the technology was selected by the government office staff members, NGO staff members and both community and governmental offices respectively. (Figure 4.9) shows the respondents' participation in the selection of the technology used in their water scheme. There is difference among the functional and nonfunctional schemes, the community more participate in the selection of technology for functional than nonfunctional. This indicates that the community participation in the selection of technology increased the sustainability of rural water supply systems.

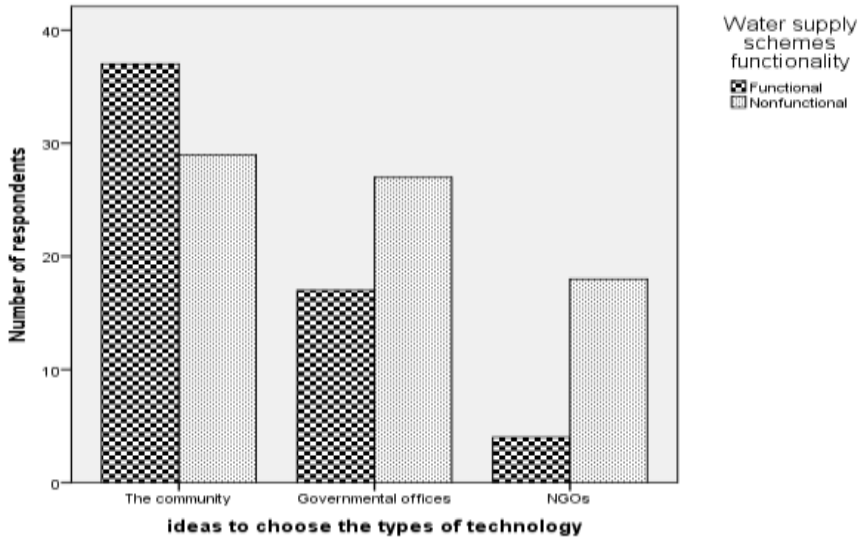

Figure 4.9 Idea to choose the types of technology

4.4.1 Spare parts

The WWRDO is engaged in the provision of free spare parts in case of scheme failure for water committees. The water committee also depends on spare parts provision from the NGO. The main reason for this is that, in the majority of cases, hand pump spare parts are

not found as single units but rather as part of a set, hence they are very expensive. Spare parts for pumps are very expensive and mostly they are to be found in Addis Ababa. Water committees indicated that spare parts available in the market are expensive, except those that are found in ordinary building material shops.

4.5 Financial Element

The financial element is one of the most important and critical points of achieving sustainable water schemes. People have different views and attitudes towards paying water services as every one of us believes that he/she have a right to get water. May be a view of us also believe that it is right to pay to our water services in order to keep it sustainable for the next generation. This part discussed on the overall financial contribution and management of water schemes in rural water supply schemes.

4.5.1 Operation and maintenance (O &M) fees

In almost every functional water point, money is collected every month or year for operation and maintenance of the scheme. Beneficiaries pay from 1 up to 3 birr and above per household per month (Birr/HH/M) as a service fee. In the functional water supply schemes 54(93.1%) of the users pay this money and there seems to be no problem in tariff payment of the beneficiaries, even some of them suggested to increase this fee and justified as it is very low and affordable to them. The money is saved in Amhara Credential and Saving Institutions (ACSI). This money is used for maintenance of the scheme in terms of breakdowns, guarding, fencing and other necessary issues for the scheme. But 45(60.8%) respondents of non-functional water points users did not pay water tariffs and also 81.1% non-functional water schemes beneficiary respondents Lack of finance for operation and maintenance is the causes of un sustainable rural water supply systems.

In functional water supply systems user's full responsibility in terms of maintenance and operation has worked well; this is also one reason of scheme functionality. If a minor failure happens, it is easier to fix, since they have saved money.Respondents were happy with Water committee's money collection and saving process and they admitted that everything was transparent since money is in the hands of a third party (ACSI). Water committees have their own account in ACSI.

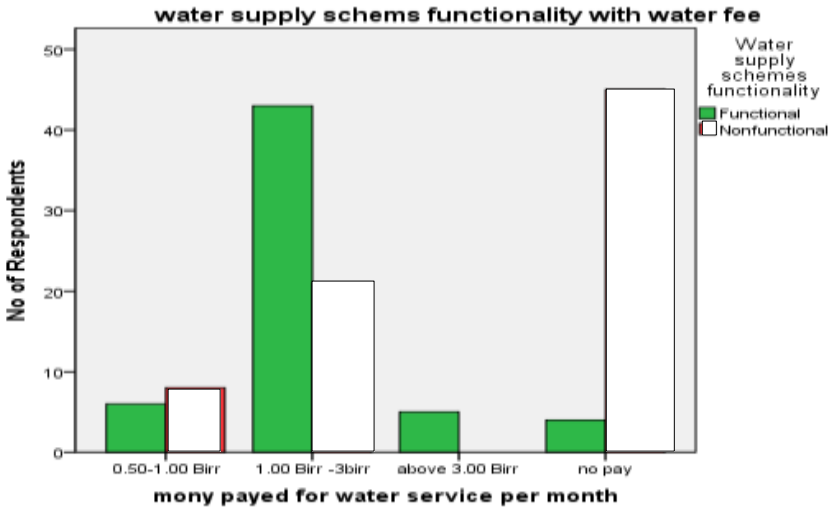

Figure 4.10 Number of Respondent and amount of financial savings for O & M per month

As shown the above graph, roughly majority of functional schemes save for O & M an amount of money about 1-3 Birr per month. Comparing this to the yearly increasing cost of spare parts will not help.

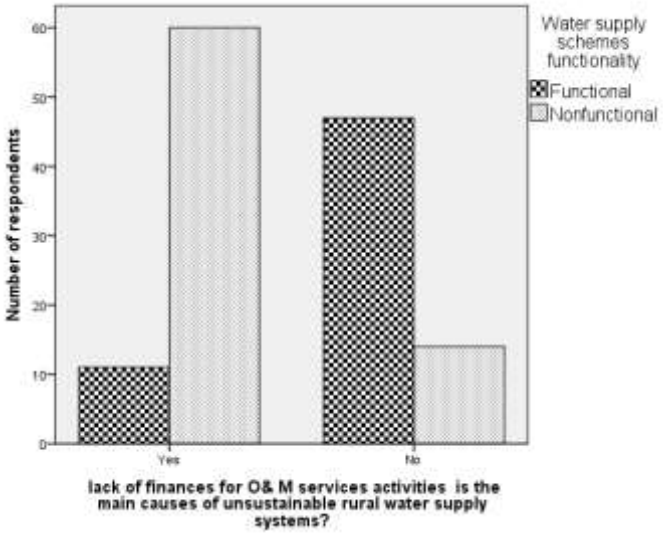

Figure 4.11 lack of finance and cause of sustainability

4. 5.2 Sustainability and Cost recovery

Cost recovery is a tool for the long-term scheme sustainability. Still the mentality of beneficiaries of getting new scheme after major scheme failure happens is very strong

and if this ideology is not crossed out there will not be full sustainability in the rural water service system. One way to tackle this problem could be encouraging people to save some separate fee as a cost recovery.

There were no signs of any kind of cost recovery encouragements, either from the community or administration. Adopting this policy of cost recovery could be a good way of sustaining schemes as well as the scheme existence in the long run.

Getting additional water points in water shortage period is what people mostly suggest when asked "From whom are you expecting this additional water point," simply they will say "From donor NGOs or from government." Therefore if this strategy of cost recovery would be encouraged, it would decrease beneficiary's dependence on donors only to rehabilitate schemes or implement newer ones.

4.6 Environmental problem

Environmental issues include possibility of landslides from gravity schemes; drainage problems; pollution of aquifers due to poor quality wellhead construction and ponded wastewater around water points are contributing factors. The wastewater from washing slab stands flows on the surface of the source due to lack of drain. The quality of the potable water supply depends on the water source used which could be natural and the way the scheme source managed after construction. The selection activities of the source mostly performed before the water supply project implementation during design period. The water source should be protected from pollution. Source protection activities are ongoing activities from project inauguration up to the end of service period of the scheme.

Figure 4.12 rural water supply systems protection

The common practices to protect rural water supply 15 (25.9%) and 29(39.2%)of the respondents from functional and non-functional water supply systems only fencing is the common practices to protect water supply systems respectively. And 43 (74.1%) of the respondents from functional and water supply systems Paid guard and fencing and continuous protection and control by the users are the common practices to protect water supply systems. 45 (60.8%) of the respondents from non-functional water supply systems there is no common practices to protect water supply systems.

Table 4.9 Water supply source protection from pollution response

The common practices of protection you made to sustain the rural water supply	Water supply schemes functionality		Total
	Functional	Non-functional	
Fencing	15	29	44
	25.90%	39.20%	33.30%
No protection	0	45	45
	0.00%	60.80%	34.10%
Paid guard and fencing and Continuous protection and control by the User	43	0	43
	74.10%	0.00%	32.60%
Total	58	74	132
	100.00%	100.00%	100.00%

Season of water supply construction is also the cause of unsustainable water supply .The water level is lowest at the end of dry season and highest at the end of rainy monsoon season. 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. And also the well dug by the community they are not performance to dig the rock so that the well depth is less.

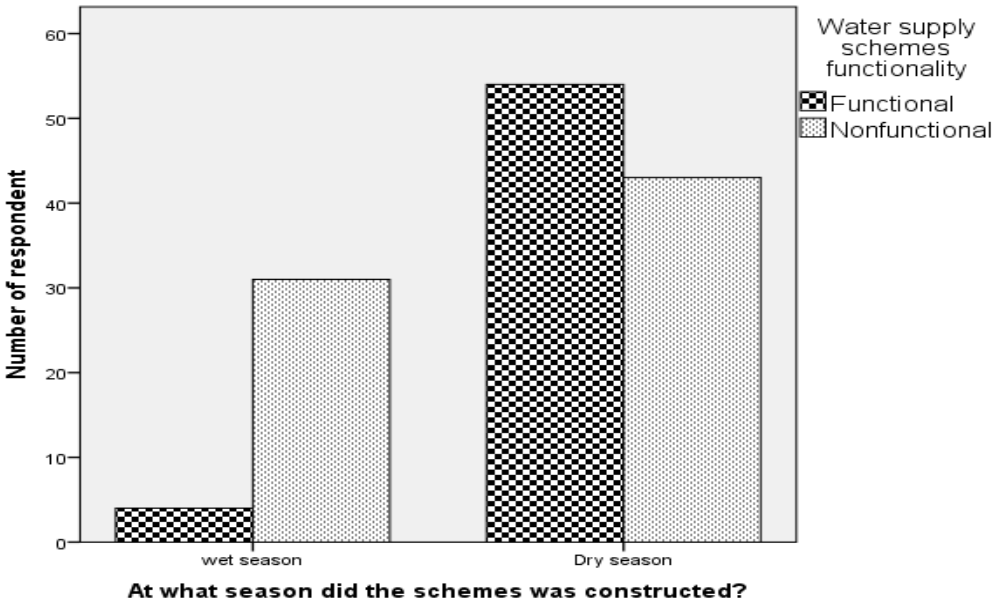

Figure 4.13 Schemes construction season and its functionality

4.7 Community participation in rural water supply systems and its contribution on sustainability

Active participation of the community in all aspects before, during and after project implementation is a strong indication of sustainability of water supply systems. From the study it has been found that the communities have shown active participation during the project initiation stages. The survey results show that 53 (91.4%) and 45(60.8%) of the respondents said that the idea to improved water supply project rise by the community and FWSP and NFWSP, respectively. But the project idea was instated by the government and NGOs the non-functionality was occurred (figure 4.14).

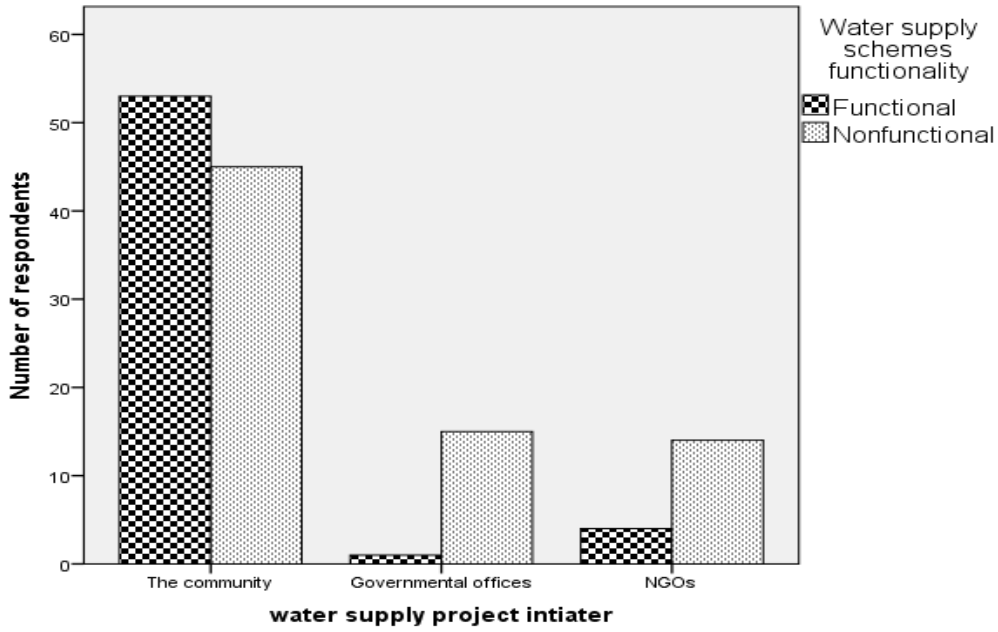

Figure 4.14 Water supply project initiator

51.7% and 71.6 % the project site selection were made by the project owners in FWSPs and NFWSPs, respectively and also 28(48.3%) and 21(28.4 %) of the project site selection were selected by the community FWSPs and NFWSPs, respectively (Figure 4.15).

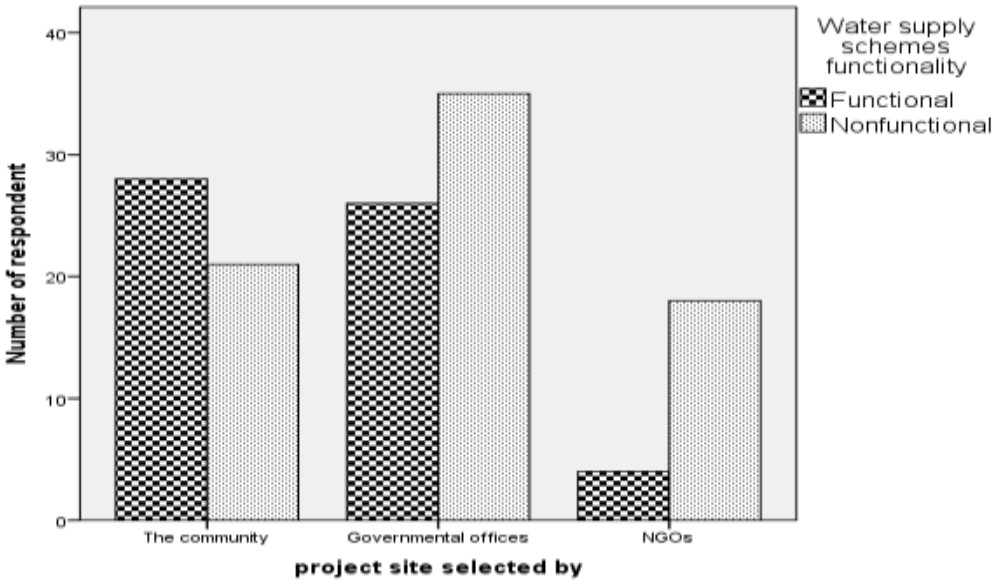

Figure 4.15Water supply project site selectors

This indicates that the community had a relatively small part in selecting the service site based on their suitable area (especially in NFWSPs) and the type of technology installed. Full participation of the community during project initiation is important in order to consider the demands of the beneficiaries rather than implementing supply side approach. More community involve in decision making in site selection and type of technology, the greater the potential for sustainability

There is high community participation during the project development process. They know that their participation has a big role in the success of the project in both systems as well as what the source of the project budget. More than 89% of the respondents have participated in the development endeavor in one way or another (Figure 4.16and 4.17).

Table 4.10 Community participation in water project implementation

At what stage of the development process did you participate	Water supply schemes functionality		Total
	Functional	Nonfunctional	
Only in Planning	1 1.70%	0 0.00%	1 0.80%
Only in Construction	21 36.20%	54 73.00%	75 56.80%
At Planning and Construction stage	10 17.20%	1 1.40%	11 8.30%
At a construction and After construction in the management part	15 25.90%	5 6.80%	20 15.20%
participate In all phases(Planning, Construction and After construction in the management part)	11 19.00%	2 2.70%	13 9.80%
not participate at all stage	0 0.00%	12 16.20%	12 9.10%
Total	58 100.00%	74 100.00%	132 100.00%

Beneficiaries of functional water supply systems contributed 6.9% Labor and local materials, 40% Labor , Money and local materials and 14% Labor , Money , local materials and information provision in site selection are contribute by the beneficiary during water project development (Table 4.11). On the other hand 6.8 % only with Labor, 37.8% with Labor and local materials, 35.1% with Labor, Money and local materials and 4.1% with Labor, Money, local materials and information provision in site selection of the respondents contributed in non-functional water supply systems. Hence, level of participation of the community is a firm basis for the sustainability of the schemes developed.

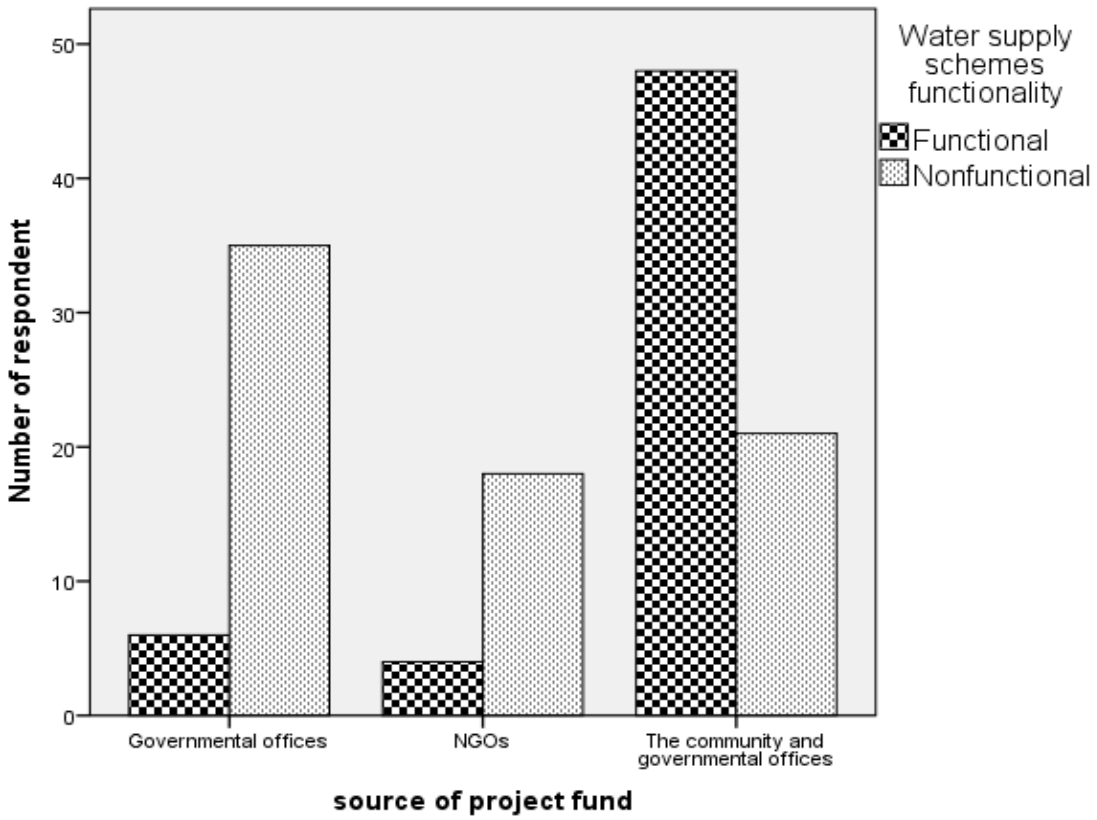

Figure 4.16 Sources of project fund

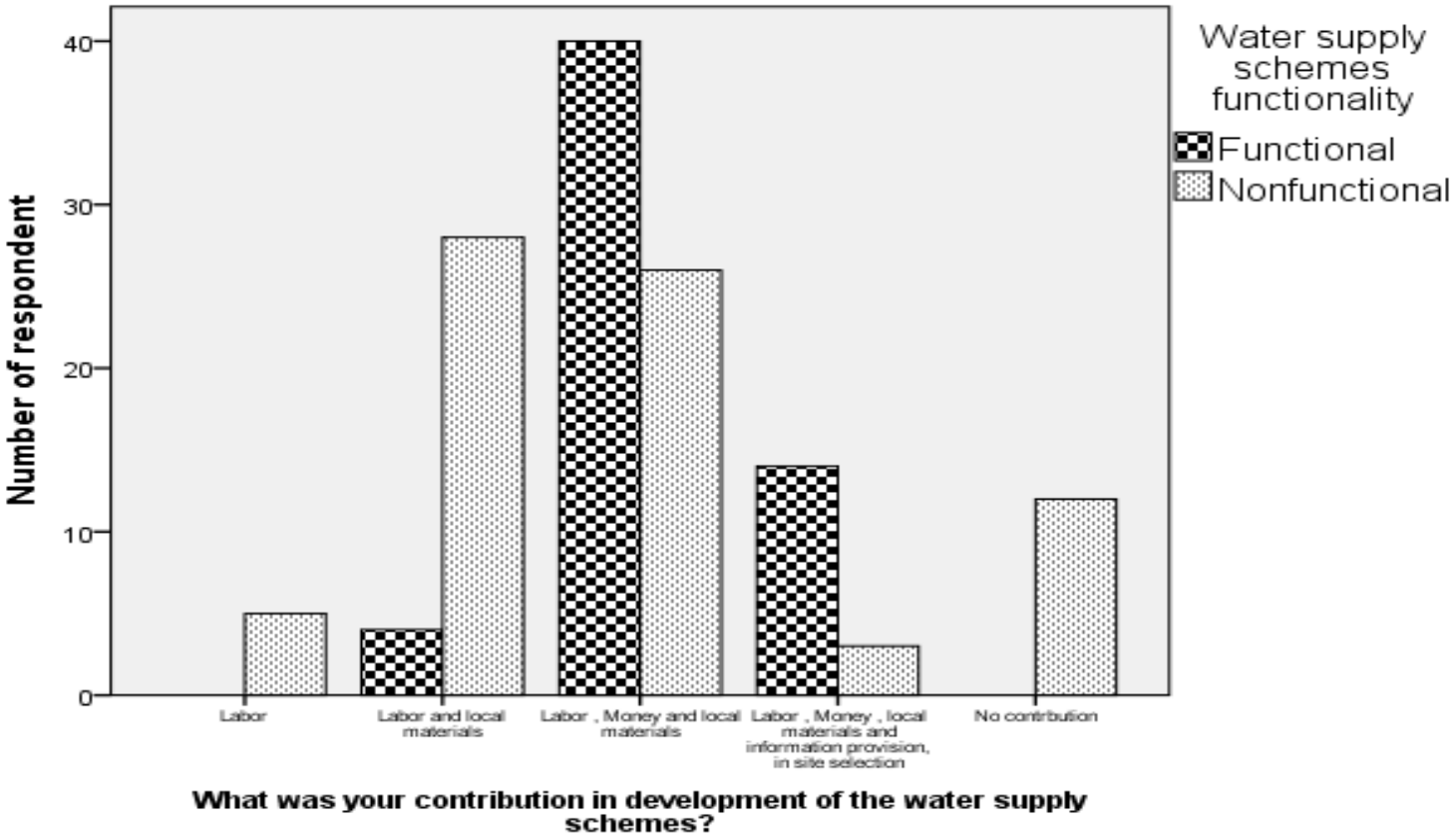

Figure 4.17 Community contribution on water supply systems project

Table 4.11 community contribution for water supply

community contribution for water supply	Water supply schemes functionality		Total
	Functional	Nonfunctional	
Labor	0 0.00%	5 6.80%	5 3.80%
Labor and local materials	4 6.90%	28 37.80%	32 24.20%
Labor , Money and local materials	40 69.00%	26 35.10%	66 50.00%
Labor , Money , local materials and information provision in site selection	14 24.10%	3 4.10%	17 12.90%
No contribution	0 0.00%	12 16.20%	12 9.10%
Total	58 100.00%	74 100.00%	132 100.00%

4.7.1 Participation in Rural Water Supply Schemes Management

Managing rural community water supply means operating and maintaining the system and supply of water as planned. Therefore, water supply schemes will be more sustainable if they are managed by users themselves than by external agencies because communities are closer to the schemes than external agencies. If the communities are not capable of managing the schemes there is need to strength their capacities and willingness to take ownership and responsibility of managing their water supply systems by taking adequate training on technical, financial and overall management of the systems as well as accessed to external supports. Rural water supply schemes were managed by the communities through elected water management committees, whose members were mainly of which about two or more women. The water management committees include one chair person, one secretary, one cashier, two local technicians and two other members.

As focused group discussion with water committee in the selecting village participants of FGD confirmed that "water committee was established during the water supply development process and mobilize users to contribute labor and local material during constriction. Further it held of their water committee in carrying out their duties responsibilities and proper manage the schemes through collecting of users fee, carrying out operation and maintenances,, fixing time of fetching ,coordinating the user to fencing the schemes , keeping its satiations and report to the WRDO if there is any problem beyond their capacities of the user.

Water committee did not work as hard as managing rural water supply properly, because of lack of power to enforce rule of the committees and had no normal authority to act with to implement this rule, lack of adequate training and follow up from the office, absences of working manuals are identified as major problems that consternate the water committees for managing their schemes properly. In addition to this they indicate that most of the local residents have actively participated during constriction but in the management of water point is weak.

4.7.2 Senses of Ownership to Water Supply Schemes

The involvement of local communities in the whole process rural water supply and management of the schemes is one of the channels to build the beneficiary sense of ownership, which is crucial for sustainable utilization of the projects. During households survey to assessed the sense of ownership of the community in functional water supply systems 22(37.9%) of the households believe that developed water points belongs to the community, 6(10.3%) reported that it belong to water committees, while 30(51.7%) respondents indicated that the existing water supply schemes belongs to the collaborations of all; the government, local NGO, water committees and communities. On other hand during households survey the sense of ownership of the community in non-functional water supply systems 8(10.8%) of the households believe that developed water points belongs to the community, 23(31.1%) reported that it belong to Woreda water offices, 20(27.0%) reported that it belong to water committees, 8(10.8%) of the households

believe that developed water points belongs to the only local NGO, while 15(20.3%) respondents indicated that the existing water supply schemes belongs to the collaborations of all; the government, local NGO, water committees and communities (Fig 4.18). The survey result indicates lack of the community sense of ownership is one of the cause of unsustainable rural water supply.

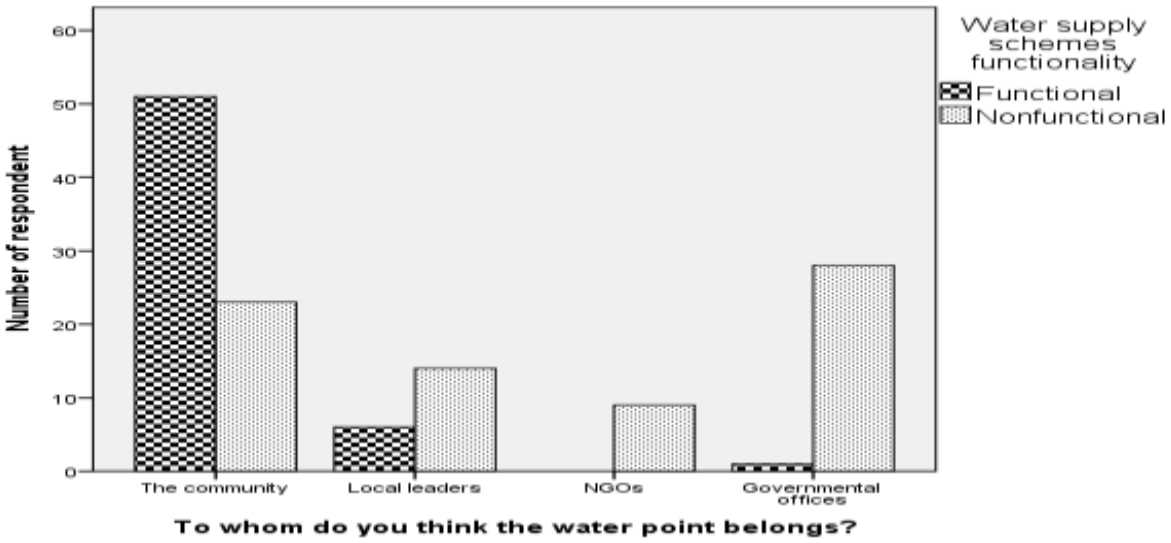

Figure 4.18 Distribution of Respondents on the Senses of ownership of the schemes

4.7.3 Training the Community

Educating the beneficiaries on how to keep the sanitation of the source area, water fetching materials, water storing materials, and the use of protecting the source is very helpful to make use of the potable water source abandoning the none potable water source as well as to keep the sustainability of the supply system. Though many members of the community understand the need of potable water supply and demand for, there are some members of the community who need education on the use of water supply, sanitation, source management, and the side effect of none-potable water source. Survey result shows 84(63.6%) of the total respondents did not get any education on potable water utilization and sanitation. Only 48(36.4 %) responded that they were educated on water resources management, operation, maintenances and water

utilization (table 4.12). This shows low level of provision of education activities which is the very sensitive subject to understand the need of potable water supply and hygiene and to keep the scheme sustainable.

Table 4.12 water supply systems beneficiaries taken training on water resources management operation, maintenances and water utilization education response

No	Educated on water resources management operation, maintenances and water utilization	Frequency	Percent
1	Water utilization education status	48	36.4
2	Not educated	84	63.6
	Total	132	100

Provision of community trainings on water supply systems is one important factor for rural water supply systems sustainability. These trainings should be given not only for water management bodies (water committee members) but also for all beneficiaries. This study revealed that the majority of the beneficiaries did not get any kind of training opportunities. This lack of training of the whole community affect not only utilization and management of the water supply but also the control of managing body and responsibility share for sustainability of the supply.

4.7.4 Women Participation in Rural Water Supply

According to the list of committee members from the water office the women participation in water committee is about 40 percent in aggregate of all schemes of the Woreda. The present participation of women as water committee members is fair but not adequate. According to the discussion results with the Woreda water office staff members and the water committee members, there is no straight forward opposition on women participation. However, there are socially agreed up on norms that a married women could not stay away from her home in discharging her responsibilities

given to her. This forwardly unknown principle retards female heads from taking responsibility. The respondents of this study synonymously replied that the women are not adequately represented in the management of rural water supply. From eighteen sampled schemes have 102 water committee members out of which 37 were female. This proportion is 36 percent of the total committee members (table 4.13).

Lacks of education to take responsibilities and absence from the meeting at the time of election of water committee are factors they produced for under representation of women in the committee. On the other hand respondents unequivocally responded that the participation in the water committee is advantageous for the community. This is so because the women are the most affected category of the community, they pay due attention to the water and its sources. They are also good managers to take care of the money from the water sales which in turn keep the scheme sustainable. Therefore, at all levels discussion results and the respondents confirm that women are not adequately represented. Again they all confirm that the women's' responsibility could be advantage for the scheme sustainability because of their attachment with the day to day water supply of the households.

Table 4.13. Female participation on water supply systems

No of water committee			No of water committee attained on FGD		
Male	Female	total	Male	Female	total
65	37	102	59	20	79
64%	36%	100	75%	25%	100

CHAPTER FIVE

5. Conclusion and recommendation

5.1 Conclusion

This study elicited the reasons why water supply systems have become unsustainable after installation in Basona Worana Woreda. Field survey, personal interviews, focused group discussion and field observations were done to collect the relevant information about eighteen water supply systems in the Woreda. The majority of water supply systems installed were still functional in Basona Worana Woreda, and 25% of rural water supply systems became nonfunctional. The rural water supply systems have been unsustainable to serve the planned population because of many reasons.

The study results show that in the study area there were socioeconomic factors, institutional factors, community participation, environmental factors, technical factors, and financial factors of water supply sustainability problems.

Socio-economic factors;-The findings indicate that majority of the households were headed by males who were involved in the water projects in the locality. And the majority of the households was poor and could barely afford the basic household needs due to lack of finances. The society had not attained the basic education and thus would not provide valid and consistent information about sustainability of water supply systems. households having large family size consume large volume of water. Rural water supply institutions had not rejected the flat payment principle and they did not started to charge their beneficiaries based on water consumption/progressive payment.

Institutional factors;-The Woreda water office was under staffed and works to discharge its responsibilities with less than 50% staff members. The community institutions were not adequately supported by technical institutions from government and NGOs. There was no regular program to capacitate the committees to manage their water supply systems. There was no water administration manual supplied to water committees except orientation type training at the beginning of their election to start their duty. Kebeles water resource

development Committee completely nonfunctional. A single rural water supply system water committee functionality also affect rural water sustainability. Identified in this study are the operation and maintenance sub-process core activity was not budgeted at zone level as well as at Woreda level.

The technical factors identified are the lack of beneficiary communities training to build their capacity to manage and maintain the water supply schemes. Poor design and low construction qualities, insufficient water at the source and lack of qualified local technicians are the cause of unsustainability rural water supply systems. The community more participate in the selection of technology for functional than nonfunctional. This indicates that the community participation in the selection of technology increased the sustainability of rural water supply systems. Most of the water committees indicated that spare parts available in the market are expensive.

The Financial factors identified mostly Lack of finance for operation and maintenance happened in nonfunctional water supply systems. The water fee comparing to the yearly increasing cost of spare parts will not help. No signs of any kind of cost recovery encouragements, either from the community or administration. Tariff setting procedures, ownership perception of the community to take full responsibility, limitation of the amount of tariff collection are the main financial problems. The other financial problem identified is the budget allocation problem at government level for the water supply operation and maintenance facilities.

The environmental factors identified are: poor source protection, inappropriate placement of the scheme site, sanitation problem and Season of water supply scheme construction. **Community participation;-** The survey results show that when the communities actively participate in planning, implementation and after project implementation the sustainability of rural water supply systems are increased. The contribution in labor and local materials takes the largest percentage, but weak community participation during the planning stage and after project implemented, low level of women involvement and weak sense of ownership are problems that worsen on the sustainability issue of rural water supply

systems. This study also revealed that the majority of the beneficiaries did not get any kind of training opportunities. This lack of training of the whole community affect not only utilization and management of the water supply but also the control of managing body and responsibility share for sustainability of the supply.

5.2 Recommendation

The future interventions need to pay due attention to community, socioeconomic, environmental, technical, institutional, and financial factors that adversely affect the rural water supply sustainability. Based on the findings, the followings are recommended:

The households having large family size consume large volume of water. Rural water supply institutions had not rejected the flat payment principle and they did not started to charge their beneficiaries based on water consumption/progressive payment. The flat payment principle applied in rural areas need to be revised.

In order to strengthen the managerial and technical capacity at Woreda level attention should be given to capacity building in terms of manpower, logistics and budget.

In order to keep a water supply system sustainable, both governmental and non-governmental organizations should give greater emphasis on institutional support to solve problems that are beyond the capacity of the community such as retraining and resources allocation (material resources, financial and human resources) after the construction of water schemes.

This support should encourage long-term management strategies built on clear relationships between institutions and communities to utilize and manage the water supply Schemes sustainable basis.

Poor construction quality and inappropriate site selection is threat for sustainable rural water supply in the study area; hence, improving construction quality should be seriously explored by water supplying agencies. In these sense selections appropriate designs, appropriate technology, quality of building and construction material employing competent

contractors, assigning qualified supervisors helps to minimize the problems.

The existing schemes should be protected by fencing and keeping the hygiene of the surrounding environment.

The tariff of water supply service should be decided by the community alone based on the explanations from the Woreda water office workers on what costs should be included in the tariff setting. The community member should clearly know why he/she pay water service fee and know that the scheme is his own property. In addition, the community has to take the responsibility of running the water supply system financially, technically and in every management aspects.

The water supply facilities process team should be well budgeted to serve the needy community. Thus, the top government attention given for new scheme constructions should also be equally given to water supply facilities team and budget the team well to keep the schemes already existing in service.

The cost recovery strategy would be encouraged, it would decrease beneficiary's dependence on donors only to rehabilitate schemes or implement newer ones.

The researcher recommends strengthening community participation and capacity building of the community to manage water supply schemes properly. Water supply schemes will be more sustainable if they are managed by users themselves because communities are closer to the schemes than external agencies and to take ownership and responsibility of managing the water supply schemes. Therefore, Woreda Office Water Resources Development should create conducive environment and capacity building for rural water supply management local institution (water committee) through legalizing the water committees, clearly defining their roles and responsibilities and providing them with adequate and practical training on financial ,technical and the offices should be also develop working manual, provide incentives for water committee member like as refresher training, experiences sharing.

Further problems related to the lack of training for the community members and the committee members should have to be improved and given adequate consideration. The training should be programmed in such a way that the member of communities, the water committee members and the technicians are constantly trained on their specific needs.

Water supplying agencies should ensure that women are actively involved in all phase of the project management.

The water resources offices (at all levels) and the implementing agencies should allow the community to participate in a coordinated manner at every phases (at the initial stage of project idea generation, technology selection, and site selection, implementation, managements, operation and maintenances) of the water supply project implementation and create awareness to every member of the community that the water supply scheme is their own property. In doing this every member of the community could understand that the responsibility of management of the constructed scheme belongs to them.

References

ADF (2005). Rural water supply and sanitation program appraisal report: Ethiopia. Infrastructure department, North, East and South, ONIN. ADF.

Aschalew, D. (2009). Determinant of Household Participation in Water Sources Management Acheffer Woreda, Amhara Region, Ethiopia. Cornel Unviversity , Proffessional studies .

Asrat, K.,(2012). Rural water supply Sustainability,training manual.Amhara Regional State Water Resourec Development Biro.volume I page 1-17.

Black M., (1998). Learning What Work Went Year Restrospective on International Water and Sanitation Cooperation. UNDP-World Bank Water and Sanitation Program 1818 H Street NW Washington, DC 20433

Brikké, F. and Bredero, M., (2003). Linking technology choice with operation and maintenance in the context of community water supply and sanitation, Reference Document for Planners and Project Staff, WHO and IRC International Water and Sanitation Centre (IRC), Geneva.

BWFED office (2014). Basona Worana Woreda Finance and Economics Development office 2014 annual journal.

Campbell, T with E Munoz and M. Morgan (1993). Participation, choice and accountability in local government: LAC and the U.S. Dissemination note. LACTED the World Bank.

Carter C, Tyrrell S., How Sam P (1999). Impact and Sustainability of Community Water Supply and Sanitation Programs in Developing Countries. Journal of the Chartered Institution of Water and Environment.

Desalegn, R., (1999). Water Resource Development in Ethiopia: Issues of Sustainability and Participation. Dessalegn Rahmato, Addis Ababa, June 1999: Forum

for Social Studies.

Dinku, G., (2012). Assessment of sustainability on rural water supply schemes: the case of Adami tullu jiddo kombolcha Woreda.

Gine, R., & Perez-Foguet, A. (2008). Sustainability assessment of national rural water supply program in Tanzania.

Habtamu, A., (2012). Factors Affecting the suitability of rural water supply systems: Case Study Of MechaWoreda, Amara Region, Ethiopia. . Addis Ababa University, Proffessional studies.

Hodgkin J., (1994). The sustainability of rural water supply project. WASH Technical Report No. 94, April 1994. USAID, Washington DC.

Israel, D., & H, A. (2008). The sustainability of water supply schemes a case study in Alaba Special woreda Hawassa

Jones, S. Anya, A. Stacey, N. and Weir, L (2012). A Life-cycle Approach to Improve the Sustainability of Rural Water Systems in Resource-Limited Countries.

Lockwood, H., (2002). Institutional Support Mechanisms for Community-managed Rural Water Supply and Sanitation Systems in Latin America, Strategic Report 6, Environmental Health Project (EHP).

Meron, G., (2012). Assessment of the community managed projects approach in developing rural water supply schemes: a case of pawe and mandura woredas, north eastern part of benishangul gumuz regional state, Ethiopia.

Mengesha, A., Abera, K. & Mesganaw, F. (2002). Sustainability of Drinking Water Supply Projects in Rural of North Gondar Ethiopia. Ethiopian J. Health Dev, vol.2.

Musonda, K., (2004). Issues Regarding Sustainability of Rural Water Supply in Zambia. Masters Thesis Unviersity of South Aferica, Department of Social Works

.Unvirsity of South Africa, Social Work. South Africa.

Oxford Advanced Learner's Dictionary 8th edition CD-ROM.

Peter H. and Bob R. (2004). Rural Water Supply in Africa, United Kingdom.

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

Selamawit. A, (2007). Evaluation of Technical Sustainability of Rural Water Supply Projects in the Amhara Regional State Case Study in South Wollo, 2007, Addis Ababa.

Tigst , M. (2014). Factors Affecting the suitability of rural water supply systems, in menz mama Wereda Amara Region, Ethiopia.

Wonduante (2013): Assessing the challenges of sustainable water supply in Gondar Town, Ethiopia.

World Bank (1992). Village Infrastructure Project for Java. Staff Appraisal Report. Country Department III East Asia and Pacific Region the World Bank.

World Commission on Environment and Development (WCED). (1987). “Our common future: The Brundtland report.” Oxford University Press, Oxford, UK.

Yitayh. L., (2011). Assessments of problems to sustainable of rural water supply and management systems in Machakel Woreda, Amhara Region Ethiopia.

Zelalem .G, (2005). Determinants of Sustainable Rural Water Supply System in Ethiopia: The Case of Two Rural Water Supply Systems: Amuyee Serra and Habru Seftu Schemes.

Zemenu,A., (2012). Assessment of challenges of sustainable water resource supply: Quarit Woreda, Amhara Region Ethiopia.

Annex.

Annex 1. General information on water supply systems sample

No	Kebeles	village	Name of water supply schemes	types of water supply systems	Household beneficiary			beneficiary with actual			GPS location			Discharge m/s	stats water supply schemes	Cattle trough	Washing basin	public fountain	reservoir capacity leter	water flow
					M	F	T	M	F	T	x-coordinate	Y-coordinate	z-coordinate							
1	Dibut	Lay Wesebri	Tekile aregay minch	Spring	7	27	33	65	50	115	574355	1064613	3137	0.05	functional				4	Gravity
4	Sariya	Lay Salaysh	Mesk Tig	Spring	20	33	53	126	126	252	556785	1076370	2543	0.04	Non-functional	1	1		4	Gravity
2	Dibut	Tach Wesebri	Wesebri	Spring	13	27	40	64	49	113	574129	1063945	3094	0.02	functional				4	Gravity
5	Bakelo	Ametsegna	Kinbo Ager	HDW	13	33	47	83	92	175	567170	1071622	2857	0	Non-functional					Afrediv pump
3	Sariya	Beryu	Beryu	HDW	13	20	33	82	66	148	563580	1072744	2851	0.56	functional					Afrediv pump
6	Bakelo	Senga Beret	Atakochakuchign	Spring	13	33	47	69	55	180	570071	1073574	2876	0.1	Non-functional					Gravity
7	Chiraro Debir	Tach Menos	Menos Meda	Shalwell	13	27	40	154	119	273	564318	1078778	2748	0.08	functional					Afrediv pump
8	Chiraro Debir	Koreb Cotit	Korebtit	HDW	20	33	53	170	152	322	566566	1076052	2823	0.09	Non-functional					Afrediv pump
9	Debele	Debele	Atela Gur	HDW	13	53	67	148	133	281	576069	1065659	3091	1	functional					Afrediv pump
10	Debele	Debele	Ansas	HDW	20	67	87	199	176	375	574343	1067190	3138	0.1	Non-functional					Afrediv pump
16	Baso Dengora	Koso	Quarf	Spring	20	20	40	54	77	131	580144	1086272	3181	0.02	functional		1	1	4	Gravity
11	Birbirsa	Koshem	cheko	HDW	33	47	80	146	169	315	547876	1070152	2764	0.07	Non-functional					Afrediv
12	Birbirsa	Dubisa	Fefa	HDW	13	20	33	43	41	84	549386	1070275	2764	0.04	functional					Afrediv
13	Angolela	Totocho	Atero	Spring	20	47	67	189	168	357	545291	1062694	2774	0.03	Non-functional	1	1	1	4	Gravity
14	Angolela	Asede	Asede	HDW	7	20	27	47	41	88	542059	1060926	2739	0.35	functional					Afrediv
15	Baso Dengora	Andit tid	Kundi	Spring	13	13	27	41	46	87	579976	1084819	3226	0.01	Non-functional	1	1	1	4	Gravity
17	Chinbre	Meteratr	Beles	Spring	13	40	53	163	118	281	530382	1093346	2153	0.07	functional	1	1		4	Gravity
18	Chinbre	Mechanekiya	Tikur Chika	Spring	20	33	53	90	95	185	532753	1094767	2653	0.09	Non-functional				4	Gravity
	Total				**284**	**593**	**880**	**1933**	**1773**	**3762**						**4**	**5**	**3**		

Annex 2 Number of water committee attained on FGD

Kebeles	village	Name of water supply schemes	types of water supply systmes	No of water committee			No of water committee attained on FGD		
				Male	Female	total	Male	Female	total
Dibut	Lay Wesebri	Tekile aregay minch	Spring	5	2	7	5	1	6
Sariya	Lay Salaysh	Mesk Tig	Spring	3	2	5	2	1	3
Dibut	Tach Wesebri	Wesebri	Spring	5	2	7	3	2	5
Bakelo	Ametsegna	Kinbo Ager	HDW	3	2	5	4	1	5
Sariya	Beryu	Beryu	HDW	3	2	5	3	1	4
Bakelo	Senga Beret	Atakochakuchign	Spring	3	2	5	3	1	4
Chiraro Debir	Tach Menos	Menos Meda	Shalwell	4	3	7	4	1	5
Chiraro Debir	Koreb Cotit	Korebtit	HDW	4	3	7	2	2	4
Debele	Debele	Atela Gur	HDW	5	2	7	4	1	5
Debele	Debele	Ansas	HDW	3	2	5	4	1	5
Baso Dengora	Koso	Quarf	Spring	3	2	5	3	1	4
Birbirsa	Koshem	cheko	HDW	3	2	5	3	1	4
Birbirsa	Dubisa	Fefa	HDW	3	2	5	3	1	4
Angolela	Totocho	Atero	Spring	4	1	5	3	0	3
Angolela	Asede	Asede	HDW	4	1	5	3	1	4
Baso Dengora	Andit tid	Kundi	Spring	3	2	5	4	1	5
Chinbre	Meteratr	Beles	Spring	4	3	7	3	2	5
Chinbre	Mechanekiya	Tikur Chika	Spring	3	2	5	3	1	4
		Total		65	37	102	59	20	79

Annex 3. Household Survey Questionnaire (Questionnaires For community or Households)

The main objective of this questionnaire is to to identify factors affecting the sustainability of rural water supply systems in Basona Worana Woreda.The other objectives are to gather information about the socio-economic, institutional and technological factors that determines the sustainability of rural water supply system in Basona Worana Woreda; To explore the extent of community participation in water supply system planning, implementation and management and its contribution to system sustainability in the study area. Your information helps me to find the factors that affect the sustainability of rural water supply systems. The study is conducted only for academic purpose and be sure that the information you provide will only be used for this research. Your full support and willingness to respond to questions is very important for the success of the study. Therefore you are kindly requested to answer all questions and give reliable and complete information on the issues.

Background Information

Woreda: Basona Woran Kebeles: _____Sub-location: _____
Types of water supply Systems _____.Name of the Water supply Systems: _____Year of Establis _____constructed by_____.

1. Date _____
2. Age range of the respondent A. 15-30 B. 31-45 C.46- 60 D. above sixty
3. Sex A. Male B. Female
4. Current marital status A. Single B. Divorced C. Married D. Widowed
5. Household family size A. Below, 5 B.6-8 C. 9-11 D. Above 11
6. Educational level? A. Unable to read and write B. Can only read and write C. 1-4 grade D. some primary (5-8) grade E. high school (9- 12) F. above high school
7. Respondent religion A. Orthodox B. Protestant C. Muslim D. Other

8. What is your i Income source ? A. farming B commercial /Trade C. Government employee D. Daily labor E. A&B F. A&D
9. Respondent income range A. < 3,500 birr B. 3,501-7,000 birr C. 7,001-10,500 birr D. 10,501-14,000 E. 14,001-17,500 birr F. >17,001
10. How many years have you lived in this area? A. bellow one year B. 1 – 5 year C. 5- 10 year D. above 10 year
11. The water committee is functional? A Yes B. No C. Could not have water committee
12. Who came up with the idea of developing improved water supply? A. The community B. Governmental offices C. NGOs D. if other specify_____.
13. Whose idea was it to choose the site selection of the project? A. The community B. Governmental offices C. NGOs D. if other specify_____.
14. Whose idea was it to choose the type/ technology of the project? A. The community B. Governmental offices C. NGOs D. if other specify_____.
15. What was the source of the project funding? A. The community B. Governmental offices C. NGOs D. A& B E. A&C F. all of the above G. if other specify_____.
16. How far is/are the water source from the house? A. bellow 0.6 km B. Between 0.6 and 1.5 Km C. above 1.5 km
17. Are the existing water supply schemes functional throughout the year? A. Functional B. Nonfunctional C. Partial functional
18. Who under takes the operation and maintenance activities when the schemes get failures? A. local technicians' B. Woreda water resource office C. both D. No one repaired Count In your water supply scheme
19. In your water supply scheme insufficient water source is the main causes of unsustainable rural water supply systems? A. Yes B. No
20. In your water supply scheme lack of provisions spare parts is the main causes of unsustainable rural water supply systems? A. Yes B. No
21. In your water supply scheme lack of community participation in the water point management is the main of unsustainable rural water supply systems? A. Yes

B. No

22. In your water supply scheme lack of qualified local technician is the main causes of unsustainable rural water supply systems? A. Yes B. No
23. In your water supply scheme poor construction is the main causes of unsustainable rural water supply systems?A.Yes B. No
24. In your water supply scheme lack of support and supervision from the water offices is the main causes of unsustainable rural water supply systems? A. Yes B. No
25. In your water supply scheme lack of finances for O& M services activities is the main causes of unsustainable rural water supply systems? A. Yes B. No
26. In your water supply scheme environmental problem is the main causes of unsustainable rural water supply systems? A. Yes B. No
27. At what season did the schemes construct? A. wet season B. Dry season C. If other, please specify _____
28. Did the Woreda Water Resource office provide support to water supply system in your community? A. Yes B. No
29. How do you see the adequacy of water sources? A. Adequate B. Inadequate C. Do not know
30. Did you face water quality problems while using existing water supply schemes? A. turbidity Problems B. Color and Odor problems C. Sanitation problems D. A&B E.A&C F. No G. Other specify
31. At what stage of the development process did you participate? A. Planning B. Construction C. After construction in the management aspect D. A&B E. B&C F. Participate In all phases G. not participate at all stage
32. What was your contribution in development of the water supply schemes? A. Labor B. Money contribution C. local materials (stone, sand, wood) D. information provision, in site selection E.A&C F. A,B&C G. B&D H. all of the above
33. Do you think that women are given fair opportunity to participate in all the processes of rural water supply and management activities? A. Yes B .No
34. What were the reason females not given fair opportunity to participate in rural water supply systems processes? A. They not willing to participate in such

projects B. most of them they do not time due to household responsibilities C. Lacks of education to take responsibilities and absence from meeting D. If other, please specify

35. If your response to question number "31"is not participate at all stage what did you think can be the reason for not participating? A. I haven't asked B. Lack of awareness C. everyt hing is done by government and local NGO D. other
36. To whom do you think the water point belongs? A. The community B. Local leaders C. NGOs D. Governmental offices
37. Did you get any kind of training related with water resources management including operation, maintenances, diversification and sanitation? A. Yes B. No
38. Who is responsible for management of the any water supply pointes scheme? A. communities B. Woreda water offices C. water committees' D. only local NGO E. collaborations of all F. If other, please specify___
39. Do you have good awareness on water resources management? A. Yes B. No
40. How many times Water point open per day? A. Once B. Twice C. Open all the day
41. Can water supplies be kept working in the long term under the present management system? A. Yes B. No
42. What are the common practices of protection you made to sustain the rural water supply? A. Paid guard and fencing B. Fencing C. Continuous protection and control by the User D. No protection E. A&C F. B&C
43. How Mach water consume Per capita (liters) ? A. Greater than 20 Liter B. Less than 20 Liter
44. What is your filling about your water consumption ? A. It si enough to me B. It si Not enough bcause of water scarcity It is not enough because the source far from home.
45. Do you pay any fee for using the water A. Yes B. No
46. If your answer to question No "47" is yes how much do you pay for water per

month? A bellow 0.25 birr B. between 0.25-0.50 birr C. Between 0.50-1.00 Birr D. Between 1.00 Birr -3birr E above 3.00 Birr

47. How do you perceive the existing water fees? A. expensive B. Fair C. Cheap
48. Is there is additional payment for operation and maintenances? A. yes B. no
49. If you answer for question number "47" the answer is no why? Because, A. water is considered as a gift of nature and should be provided for free B. No any coordinators in the water tariff collection C. because of our water supply schemes has nonfunctional so our sources is traditional point D. lack of awareness about the purposes of water fee
50. If you answer to question number "47" the answer is yes when do you pay water fee? A. every time when water fetches B. at the end of month C. once or two times every year
51. What type of penalty you have suffered, if you fail to pay the fee? A. protect from water fetching B. To pay twice of the normal tariff by coercion C. By using negotiate return to pay D. no Measurement at all
52. What are your recommendations to sustain rural water supply systems

Annex 4.Checklist for Focus group Discussion (FGD) with Water Committees

The general Objective of this Focus group discussion is to identify factors affecting the sustainability of rural water supply systems in Basona Worana Woreda, Amhara region Ethiopia.

1) Woreda:Basona Worana Kebeles: _____Village: _____Types of water supply Systems _____Name of the Water supply Systems: _____constructed by_____. Beneficiary_____male____female___total_____.
   1. Who initiated the project?
   2. When did the project construct and handed over to the committee?
   3. How and when the water committee came into being?
   4. How many times can a committee be elected?
   5. How and by whom was the scheme established?
   6. What were your involvement and contribution?
   7. What is the composition of water committee in terms of gender?
   8. What are the reasons that make more women not participating in the water committee?
   9. Do you have a legal registration certificate? If so … (if no why not?)
   10. To whom are you accountable? (Kebele/Woreda Admin. /WWRDO)
   11. Do you report to them? When? About what?
   12. What action can be taken by the WWRDO or community following the report?
   13. Is there financial and material and equipment auditing?
   14. What incentive mechanisms are there for water committee? (benefits in being a water committee member?) (Increased social acceptance, Money)
   15. How do you collect and manage user fees from the community?
   16. Do you have revenue collection and expenditure receipts?
   17. How is the technical capacity of water committee to manage the scheme?
   18. Have you taken trainings? What kinds of trainings? (financial, maintenance, managerial?) By whom are they given?

19. Are users aware of their rights and responsibilities in water service delivery? (Attend meetings organized by water committee, Participate in the discussion, Contribute in cash or labor for the scheme as requested by water committee, and Feel sense of ownership of the scheme)
20. Is there any support before and after construction from the concerned bodies like the Woreda water supply offices?
21. Are there maintenance spare parts available around?
22. What are the main sources of income for operation and maintenance costs?
23. Who design the water tariff rate?
24. Did the users pay the fee regularly? A. Yes B. No
25. If your answer question No"25" is No what do you think can be the reasons and what measures have been taken to alleviate the problems
26. Do you have a system to support people who cannot pay for the service?
27. Do you save money? (Y/N) For what purposes do save? (Maintenance, rehabilitation)
28. The price of spare parts around is affordable?
29. What can you say about the general water supply and demand in the village?

    • Insufficient for domestic activities?

    • People also use unsafe alternative sources?

    • Competitive uses for agriculture and domestic activities?

30. How often the scheme breaks down
31. At what season the scheme frequently breakdown
32. What do you think are the main reasons for the breakdown of the scheme? A. Source problems B. Design problem C. Water quality problem D. Incapability of committee
33. What kind of support is provided by the bureau to committee members? A. technical support B. training C. no support D. if other mention
34. What do you think the main reasons for the failures water supply schemes?

35. What are the major problems that have been seen on the existing water schemes?
36. How is the level of community participation in rural water supply development program (starting from site selection to construction up to in the management of the existing water supply schemes) in general and women participation in particular in the water supply project management?
37. What solution do you recommend in order to alleviate the problems associated with the problem of sustainability of water schemes?

Thank you for your cooperation and participation!!!

Annex 5. Check list for field observation

No	General information	Description
1	Woreda:Basona Worana	
2	Kebele	
3	Village:	
4	Types of water supply Systems	
5	Name of the Water supply Systems:	
6	constructed by	
7	Beneficiary(total)	
8	Male	
9	Female	
10	X coordinate	
11	Y coordinate	
12	z coordinate	
13	Discharge m/s	
14	Cattle trough	
15	Washing basin	
16	Reservoir capacity	
17	water flow	
18	public fountain	
	Community aspects	
1	Demand Responsiveness Project initiative	
2	community participation in construction of WSPs	
3	Responsibility and ownership feelings	
4	Organized and elected community group to be responsible for operation and maintenance (representative of the community social structure, including men and women)	

5	Managerial and technical capacity of the community group, and availability of tools	
6	Willingness to sustain system	
	Environmental aspects	
1	Quantity and quality of water resource, including the need for water treatment, water resource management and seasonal variations	
2	Water source protection	
	Institutional aspects	
1	Legal framework and national strategy	
2	Training availability and capacity	
3	Follow-up support, including monitoring	
4	Availability of technical assistance to the communities	
	Technical aspects	
1	Present and future water consumption	
2	Technical standards and complexity of O&M procedures, with a preference for technologies that can be operated and maintained at community level	
3	Cost and availability /accessibility of spare parts/	
	Financial aspects B2	
1	Ability and willingness to pay	
2	Tariff structure (covering O&M and replacement costs),	
3	Cost-recovery procedures	
4	financial management capacity	

Annex 6. FGD check list for Woreda water resource development office (WWRDO)

1. How do you explain the functionality of the schemes developed in the Woreda?
   - How long do they perform after construction?
   - How soon are they maintained?
   - Which schemes fail more repeatedly and why?
   - Which schemes perform for a longer period of time without failure? Why?
   - Is it serving beyond its design population?
   - For what purposes are they used? (domestic, irrigation, cattle watering)
2. How do you see the schemes' capacity/ability to meet the water demand of user communities?
   - High population pressure on the schemes beyond the designed population?
   - How is scheme location in relation to user communities? (near, average, far)
3. Is there a regular monitoring system for the water quality of schemes?
4. Are there any complaints by the user community on the quality of the water delivered?
   - What kinds of complaints are they? (taste, odour, colour)
5. What are the roles and responsibilities of the office?
6. What criteria are there for water committee selection?
7. How is your involvement in water committee selection?
8. Is there a legal structure between your office and water committee?
   - Do you have signed agreements? How frequently do they report to you?
   - About what do they report to you? If no:
   - How do you communicate?
   - To whom are the water committees accountable?
   - How do you perceive the roles and responsibilities of water committee?
9. What major barriers are there affecting the performance of water committee? In what ways do they affect them?
10. In what ways do you support water committee?
    - Capacity building? How many trainings have you given to them? In what aspects?
    - Budget allocation? For what purposes? (O&M?)

- Human resource allocation? Technicians for major scheme failure maintenance?
- Spare parts provision?

11. How do you perceive the legal status of water committee and their accountability in case of mismanagement of the scheme resources? What is the office's role in correcting water committee mismanagement?
12. What are the qualities of best performing water committee in the Woreda? Who are they?
13. What are the causes of worst performing water committee in the Woreda? Who are they?
14. What opportunities are there to make water committees perform effectively and efficiently?
15. Do you do regular follow-up and supervision of the schemes and water committees?
    - How frequently?
    - What aspects do you see while you supervise and follow up?
16. What factors most affect the sustainability of water supply schemes in the Woreda?
    - Spare parts: availability, price, local providers?
    - Water quality problems?
    - Poor stakeholder communication?
    - Water committee inefficiency?
    - Low community awareness on hygiene and sanitation?
    - Low community participation?
17. Do you participate in feasibility studies (potential assessment; community, site and technology selection) and implementation phases of scheme development? If yes, how? If no, why not?

Thank you for your collaboration and patience.

Annex 7 photo taken during research period


Photo taken Researcher during field observation


Photo taken during Researcher interviewed the beneficiary


Photo taken during water committee focus group desiccation