ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES
COLLEGE OF SOCIAL SCIENCE

ASSESSING POTABLE WATER SUPPLY AND DISTRIBUTION PROBLEMS OF REBU GEBEYA TOWN, AMHARA REGION (ETHIOPIA)


A THESIS SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES OF ADDIS ABABA UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS IN GEOGRAPHY AND ENVIRONMENTAL STUDIES

By

Yehuala Minwuye

Addis Ababa, Ethiopia

May,2015

ADDIS ABABA UNIVERSITY

SCHOOL OF GRADUATE STUDIES

COLLEGE OF SOCIAL SCIENCES

ASSESSING POTABLE WATER SUPPLY AND DISTRIBUTION PROBLEMS OF REBU GEBEYA TOWN, AMHARA REGION (ETHIOPIA)

By

Yehuala Minwuye

Approved by Board of Examiners:	**Signature**
1. Mohammed Assen (Ph.D.) Advisor	_____
2. _____ Examiner	_____
3. _____ Chairperson of the department	_____

May, 2015

Addis Ababa, Ethiopia

ACKNOWLEDGEMENT

First and foremost, I would like to express my deepest thanks to almighty God who helped me in all aspects of my life.

Next to God, I am very much indebted to my advisor Dr. Mohammed Assen for his valuable advisory support, comments and suggestion to conduct this research.

My gratitude also goes to my uncle, Ato Abateneh Linger, without his support none of this would have been possible and even I would not be have attained this programme.

Finally, yet, importantly, it is a great pleasure for me to acknowledge the assistances provided to me and the contributions made by different individuals during the preparation of this research. Thus, my special thanks go to my undergraduate instructors, instructor Desalegn Yayeh and Emishaw Girma and Debre Markos University librarians for their everyday support, encouragements and cooperation respectively. Besides, I would like to say heartily thanks to all my friends, especially Ato Lakachew Ayenew and other colleagues for their cooperation, material and moral support.

Table of contents

Contents **page**

List of tables

Table **page**

List of figures

Figures **page**

Acronyms

CSA	Central Statistics Agency
FGD	Focus Group Discussion
MDGs	Millennium Development Goals
MoH	Ministry of Health
MoWR	Ministry of water Resources
NGOs	Non-governmental Organizations
RTWSO	Rebu Gebeya Town Water Service Office
UN	United Nations
UNDP	United Nation Development program
UN-HABITAT	United Nation Human Settlement Program
UNICEF	United Nations International Children Emergency Fund
UNESCO	United Nation Education Scientific and Cultural Organization
USAID	United States Agency for International Development/Ethiopia
WB	World Bank
WHO	World Health Organization
UAP	Universal Access Program
WSP	Water and Sanitation Program

Abstract

Water is a vital element for the survival of the human race. Nevertheless, severe problems with its provision are as old as mankind. The gap between water need and supply has widened steadily in Ethiopia's urban centers despite continuous efforts by the government in providing potable water supply to the rapidly growing urban population. Similarly the study area, Rebu Gebeya town was in the forefront of potable water supply and distribution problems. Thus, the primary objective of this research is to assess water supply and distribution of Rebu Gebeya town focusing on assessing the existing water supply, distribution progress and level of people participation and investigating the major challenges of water supply and distribution and to see the effects of water supply shortages in the study area. In order to achieve these objectives the researcher applied descriptive survey research method. The researcher applied both probability and non-probability sampling technique to obtain the samples of households and others. Both primary and secondary sources of data were collected for study. These were analyzed via qualitative and/or quantitative methods, as appropriate, of data analysis methods. The study indicated that the town has very low water supply coverage and there was no additional water supply service for the Town dwellers after 2009 and various factors such as population growth and urbanization, lack of technological capacity, insufficient financial resource, insufficient water resources, weak sector coordination and topography of the area were interacting factors to the very low water supply coverage. The town dwellers faced water related health problems caused by both water-washed diseases and risks arising from waterborne infections, and community participation in the water supply and distribution schemes was inadequate. Safe and adequate quantity of drinking water is an essential input for life. However, the efforts made by the state government and other organizations have not been enough in covering all habitations of Rebu Gebeya town. The current level of potable water supply and distribution coverage and accessibility in Rebu Gebeya town is very low in any standards. Thus, to overcome the problems of existing water supply and distribution, there should be an urgent need for planned action to manage urban water resources and construction of additional water sources and simultaneously improving the current coverage of private pipe water distribution and also public fountains in favor of the lower income groups.

CHAPTER ONE

1. INTRODUCTION

1.1. Background of the study

Water supply is among the most essential natural requisites for sustenance of living things. As Hall (1995) states without water, life on earth could be impossible. No living thing-plant, animal or human live without this precious liquid.

Throughout history, water has been people's slave and their masters. Great civilizations have risen when water supplies were plentiful. They have fallen when these supplies failed. People have killed one another for a muddy water hole. Sometimes the rains have fallen too heavily and too suddenly. Then rivers have overflowed their banks, drowning large numbers of people and causing enormous destruction of property (World Book encyclopedia, vol. 21.2001).

Water is a basic requirement for the healthy functioning of the entire world's ecosystem (UNDP, 2004 cited Yitayh, 2011). According to World Book encyclopedia (vol. 21.2001) water helps to keep the earth's climate from getting too hot and too cold. Water is important for human beings at home and in our modern industries to manufacture different industrial products. Besides we also use water to irrigate dry farmlands and to produce electricity.

According to Puttaswamaiah (2005) potable water, in adequate quantity and safe quality, is a basic requirement for life and a determinant of standard of living. Poor or no access to safe water supply can result in many diseases including diarrhea, floursis, cholera, trachoma, etc. These ailments potentially constrain human resource development and productivity, especially of the poor.

Thus, clean potable water is an absolute prerequisite for healthy living. The importance of water in human welfare cannot be over-emphasized in the saying “water is life”. The normal functioning of the human body depends entirely upon an adequate quantity and quality of water. But if the water is from contaminated sources, it causes numerous water-associated diseases (Tesfaye and Zeyede, 2004).

Water was, it is, and it will remain a vital element for the survival of the human race. It is within as well as around us in seemingly abundant resource amounts. Nevertheless, severe problems with its provision are as old as mankind (Dalhuisen *et. al*; 1999). The problem of potable water scarcity is more acute in cities and towns of the developing world, where most of the challenges of water supply, sanitation and environmental sustainability are still unanswered (Bassi and Kumar, 2012).

Eight-hundred eighty-four million people in the world do not have access to improved sources for drinking water. While access in rural areas is usually significantly lower than in urban areas, the increase in the use of improved drinking water sources is barely keeping up with the urban population growth (WHO and UNICEF, 2010).

Therefore, the scarcity of potable water places a severe constraint on food production, economic development and protection of natural ecosystem. And as it is mentioned in World Book encyclopedia (vol.21.2001) shortages of fresh water have troubled people throughout history and today, they trouble people more than ever because the demand for water is growing rapidly.

The actual water supply coverage in towns of developing countries in general and African towns in particular is very low while compared to the demand (WHO, 2000). This is also true for Ethiopia. Access to safe potable water in the year 2000 for urban areas was 72 per cent, and if Addis Ababa is excluded the figure becomes much worse, 38 percent (CSA, 2008).

1.2 Statement of the problem

Water is at the origin of life on earth; no organism can live without it. Although water is essential to human life in its many dimensions, universal access is far from being guaranteed and, amidst those communities which benefit from this access, water is also far from being distributed equitably. The World Health Organization believes that more than a billion people are deprived of basic access to water (WHO, 2000). The United Nations Organization (1997) estimates that about 2.3 billion people suffer from diseases connected to water; in other words to both its shortage and poor quality.

According to WHO-UNICEF (2008) providing potable water security is a serious challenge of the twenty-first century world considering that more than 2.5 billion people live without access to improved sanitation and about 0.9 billion survive without access to improved water supply. As WHO (2006) only 16 percent of people in sub-Saharan Africa had access to drinking water through a household connection which can be an indoor tap or a tap in the yard.

Water supply has an important role in both social and economic development. Improved public health, better living standards and economic developments are intimately related to the availability and accessibility of adequate water supply with good quality (Hofkes 1998, cited Yitayh, 2011).

Access to safe, sufficient and affordable water is one of the basic indispensable human rights as well as a prerequisite for improving the overall life of a society. The provision of sufficient potable water for peoples within reasonable distances from reliable and acceptable sources is essential for people's wellbeing and sustainable economic progress (Yimer, 1992). Thus, improving water supply and distribution programs is crucial to spurring growth and sustaining economic development and incorporating water improvements into economic developments is necessary to end the severe problems caused by water supply shortage and to improve public health and advance the economic stability of urban areas.

Problems with water supply stem from various sources. One of the major challenges driving water stress in developing nations is rapid urbanization (Post, 2002). The world's water requirement for all purposes is increasing at an alarming rate in urban areas of both developed and developing countries. The main reasons are the rise in urban population growth in practically all countries of the world, industrial growth and expansion (adequate water is an essential raw material for an industrial enterprise) and increase in overall per capita consumption of water.

About 3.6 billion people in world use a piped water connection. But the quality of water supplied, especially to urban areas of developing regions, is questionable (WHO-UNICEF, 2008). Thus, Poor quality of supplied water can have adverse health impacts on the population.

In sub-Saharan Africa the proportion of people with access to potable water supply and adequate sanitation is very low (Yitayh 2011). The World Bank Group (2005) stated that though Ethiopia

is often referred to as the “water tower” of Africa, only a quarter of the country’s population has improved access to water sources.

Access to safe potable water in Ethiopia in the year 2000 for urban areas was 72 percent, and if Addis Ababa is excluded the figure becomes much worse, 38 percent, that is more than 60% of people in urban Ethiopia do not have access to clean drinking water, indicating that the level of coverage and services for water supply for domestic uses must be addressed (CSA, 2008).

According to CSA (2004) lack of safe water is the major cause of water-borne diseases and deaths in most developing countries, including Ethiopia. Unavailability of safe, adequate, and affordable water seriously affects social, economic and health conditions of society. More specifically children and women, who are directly involved in water collecting and managing activities at household levels are more vulnerable to problems (Yitayh, 2011).

As Getachew (2002) stated, water supply and sanitation situation in Ethiopia is very poor, as most of the population does not have access to safe and adequate water supply and sanitation facilities. As a result three-fourth of the health problems in Ethiopia is due to communicable diseases attributable to unsafe or inadequate water supply and improper waste management particularly excreta.

Water is the most important of all public services. It is the most essential necessity of life after oxygen. Anything that disturbs the provision and supply of water therefore tends to disturb the very survival of humanity. Water supply plays a significant role in the social, economic and political life of people. Water supply shortages increase conflicts and public health problems, reduce food production and endanger the environment. However, the gap between water need and supply has widened steadily in Ethiopia’s urban centers despite continuous efforts by the government in providing potable water supply to the rapidly growing urban population. Similarly the study area, Rebu Gebeya town, is in the forefront of potable water supply and distribution problem.

Therefore, water supply and distribution has been the major concern of Geographers in research area because the task of solving water supply problems can hardly be separated from solving

social and economic problems in a given society as it affects and affected by various socio-economic and geographic characteristics.

1.3 Research Objectives

The general objective of this research is to assess water supply and distribution of Rebu Gebeya town. The specific objectives include the followings:

1. To assess the existing water supply, distribution progress and level of people participation.

2. To study the major challenges of water supply and distribution in Rebu Gebeya town.

1.4 Research questions of the study

The following are the guiding research questions of the study

1. What are the major challenges of water supply and distribution in Rebu Gebeya Town?

2. What is the level and progress of urban water supply and distribution in the study area?

3. What looks like (seems) the participation of the town's population in the water supply scheme?

4. What are the effects of water supply shortages in the study area?

1.5 Significance of the study

The study is believed to be important, since it expects to assess the main problems of water supply and distribution in the study area and the task of solving water supply problems can hardly be separated from solving social and economic problems in a given society. This study gives an insight (a clue) or serves as a reference for those working in the planning and design of water supply to manage the existing schemes in efficient and effective ways and also it serve as a stepping stone for other researchers who will be interested in the area.

1.6 Delimitation of the study

In order to conduct an in depth investigation of the nature, cause and effects of water supply and distribution problems and to get rid of these problems by providing recommendations to planner, the study is restricted in Sinan Woreda Rebu Gebeya town.

The main reasons for selecting Rebu Gebeya town as a study area are due to the researcher's personal acquaintance with the area as his workplace of Rebu Gebeya higher, secondary and preparatory school, he is fully aware of the problems of potable water faced the people of the town since long. Water supply problem is critical & burning issue requiring urgent attention in the town but probable causes, challenges and impacts of potable water supply problem in the town were not yet assessed to address the problems of water supply and distribution in the study area. It is with this views that the researcher wants to study the problems of water supply and distribution in the town.

1.7 limitation of the study

The followings can be considered as the limitations of the study in conducting this research. Regarding to documents and secondary data, there were no adequate documents in Rebu Gebeya town municipality, which were relevant to this study. Reference books for the study and study area were rarely available and this influenced the study to some extent to review the literature. Besides, reluctance of the targeted group in the cooperation with the researcher to provide reliable and proper information and shortage of time and finance were also the major challenges to accomplish this thesis on time. However, the researcher tried to overcome these obstacles with the great efforts.

1.8 Organization of the thesis

This thesis consists of five chapters. The first chapter is the one section that deals with background of the study, statement of the problem, objectives and research questions, significance and delimitation of the study. The second chapter of the study explored review of related literatures. The geographical profiles of the study area and research methodology adopted for the study including sources of data, decisions regarding sample procedures and sample size,

and statistical tools used in data analysis would present in chapter three. Then, chapter four contains the data analysis and discussions. Finally, the paper is summarized with conclusions and some recommendations in chapter five to overcome the main problems of water supply and distribution in Rebu Gebeya town.

1.9 Definition of operational terms

Access to water supply: According to UN-HABITAT (2003) it is an adequate amount of water which is needed to satisfy the metabolic, hygienic and domestic requirements usually about 20 liters of safe water per person per day and its source may be a public fountain or a stand pipe not more than 200 meters away from households.

Fresh water: According to Hall (1995) it is the water having a salt concentration below 0.01 percent. As a result of purification by evaporation, all forms of precipitation are fresh water, as are rivers, ground water and other bodies of water that have a through flow of water from precipitation.

Insira: It is a clay pot (container) that is used to fetch water.

***Kebele*:** It is the smallest administrative unit.

Polluted water: is water that contains one or more impurities making the water unsuitable for a desired use.

Potable water: water that is safe to drink (drinkable water).

Purified water: is water that has had pollutants removed or rendered harmless.

Safe water-water supply service with adequate quantity and acceptable quality (Hall, 1995).

Salt water: According to Hall (1995) is water typical of oceans and seas that contain at least 3 percent salt (30 parts salt per 1000 parts water).

Sefer: It is the sub-division of one Kebele in the town.

Springs: are occurrences of groundwater naturally issuing at points where the water table reaches the surface, or where the top confining layer over the water – bearing strata is broken.

Traditional water sources: refers any water source used by the urban people for domestic purposes that is not properly constructed by qualified people to protect from any possible contamination.

Water supply: supplying of clean water for human use.

Water supply agencies: refers all institutions (Government, NGO, donors, private sectors and others) which are involved in the provision of water to the community through funding and implementation.

Water supply schemes: infrastructures (hardware) built to deliver water supply services.

Water supply service: delivering water services for domestic purposes.

Water quality: is the degree to which water is pure enough to fulfill the requirements of various uses.

Water quantity: is the amount of water available to meet desired demands.

Woreda: District level of administrative unit.

CHAPTER TWO

2. REVIEW OF RELATED LITRATURE

This chapter deals with the theoretical overview of potable water supply and distribution. It assesses the sources of water supply, urban water supply accessibility, major challenges of drinking water supply and distribution, urban potable water supply problems in developing countries in general and in Ethiopia in particular, benefits of access to safe, reliable, adequate and affordable potable water supply and impacts of inaccessibility of urban water supply and distribution facilities. In addition to these it assesses the Ethiopian government's water supply and sanitation policy, institutional arrangement and responsibilities at different levels.

2.1 Urban water supply

It refers to access to a variety of water sources mainly surface, underground, rainwater that are used for various household purposes, like drinking, food preparation, hygiene related purposes, washing cloths and body, as well as for livestock drinking, etc (Forrest and Wright, 1977 cited in Yitayh, 2011).

Safe drinking water is the birthright of all humankind as much as birthright as clean air (Rao, 2002) while access to clean water can be considered as one of the basic needs and rights of a human being. The health of people and dignified life is based on access to clean water (Korkeakoski, 2006).

2.1.1 Sources of water supply

According to Sijbemsa (1989), and Tesfaye and Zeyede (2004) water sources fall in to three categories. These are:

Surface water; It originates from rain water. Surface water is found non-uniformly distributed over the earth's surface. As the rain reaches the surface of the earth, it becomes surface water or runoff. Surface water includes rivers, streams, lakes, ponds, tanks, manmade reservoirs and sea water. The quantity and quality of surface water depend upon the conditions of the surface or catchment area over which it flows. It is the main source of water supply in many areas. Surface

water is prone to contamination from animal and human sources. As such it is not safe for human consumption unless subjected to sanitary protection and purification before use.

Rain water; It refers to rain is that collected from surfaces (by roof or ground catchment) and stored in a container, ponds, tank or cistern until used. This water is the purest water in nature yet it tends to become impure as it passes through the atmosphere. It picks up suspended impurities from the atmosphere such as dust, soot and microorganisms and gases such as carbon dioxide, nitrogen and ammonia. In regions where rainfall is abundant and frequent, rainwater can be a good source of water supply for individual families and for small communities. The storage of rainwater is particularly important in areas with a long dry season.

Ground water; It may be defined as that portion of the total precipitation which has percolated downward into the porous space in the soil and rock where it remains, or from which it finds its way out to the surface. It is water used by humans comes mainly from land such as wells, springs, etc. It tends to be of higher microbiological quality having undergone natural soil filtration. However, it is relatively difficult to extract. Compared to other water sources more technology and energy is needed to bring water from within the earth up to the surface.

According to UN-habitat (2006) water service provision options are stand pipes, yard and house connection.

Stand pipes/public tap; It is a public water point from which people can collect water. Many low-income households that are unable to afford a household connection are relying on public water points.

Household connection; It is a water service pipe connected with house plumbing to one or more taps (e.g.in the kitchen and bathroom or a tap placed in the yard or plot outside the house).

Domestic resellers; It is when households with a private connection are selling water to their neighbors.

Intermediate service provider; this include private providers or community based organizations delivering water in un-served area.

2.1.2 Urban water supply accessibility

To understand the best location, defining accessibility is probably the most complex and important of all tasks facing those concerned with the provision of any social service. According to Adeyemo and Afolabi (2005), accessibility is the balance between the demand for and the supply of consumer services over a geographic space and narrowing or bridging the gap between geographic spaces is the all significance of transport. Accessibility can be seen within the context of the ease with the people can obtain the services of a facility and function. Accessibility increases with decreasing constraints both physical and social.

According to UN-HABITAT (2003) access to safe water is the share of the population with reasonable access to an adequate amount of safe water. In urban areas the water source may be a public fountain or a stand pipe not more than 200 meters away from households and the adequate amount of water which is needed to satisfy metabolic, hygienic and domestic requirements usually about 20 liters of safe water per person per day. This minimum quantity however vary depending on whether it's an urban or rural location and whether warm or hot climate.

According to UNICEF (2006) population using improved sources of drinking water are those with any of the following types of water supply; piped water (into dwelling yard or plot), public tap or stand pipe, tube well or borehole, protected well, protected spring, and rain water collection where as unimproved sources are unprotected dug well and spring, surface water (stream, canal, pond, dam, lake, river ,irrigation channel),vendor provided water(cart with small tank or dam, tanker truck), tanker truck provided water.

2.1.3 Water supply accessibility indicators

With regard to water accessibility WHO (2004) stated basic indicators of measuring water accessibility. These indicators show four paramount levels of water accessibility that include optimal access (water supply through taps continuously), intermediate access (water supplied through multiple taps continuously within less than 100m distance travel and within 5 minutes), basic access (between 100m and 1000m distance and 5-30 minutes time) and no access (more than 1000m distance travel and more than 30 minutes time). These are indicators of the level of

water availability which is a measure of the quantity available for use. Basically, they reflect the extent to which accessibility challenges time, distance and affordability etc.

2.1.3.1 Time and distance travel to fetch water

Time and distance traveled to fetch water are the key indicators of water accessibility. As WHO (2004) standards if households travel more than 200 meters far away from house in urban areas, there is no access. In relation to time, if the time is within 5 minutes, 5-30 minutes and more than 30 minutes, there is intermediate access, basic access and no access respectively.

2.1.3.2 Affordability

The affordability of water has a significant influence on the use of water and selection of water sources. Households with the lowest levels of access to safe water supply frequently pay more for their water than households connected to a piped water system. The high cost of water may force households to use small quantities of water and alternative of poorer quality that represent a greater risk too (Public Health Protection, 2000). Private access to tap water is the cheapest for the consumer. Dependence on a shared standpipe increases prices four times. Private water delivery through tanker service or sachet or bottled water is the most expensive and tanker delivery costs many times the tap water price. Therefore, the consumers paying the most for water are the ones with the lowest income (Alaci and Alehegn, 2009).

2.2 Urban water supply in developing countries

According to world book encyclopedia (vol.21.2001) we live in a world of water. Water is the most widely occurring substance in the world. It covers more than 70 percent of the earth's surface. If this water were evenly distributed, it would cover the entire earth to a depth of 3.2 kilo meters or 2 miles (McKinney *et al,* 2007). But most of the earth's water about 97 percent is in the oceans and it is too salty that cannot be used for human consumption (Hall, 1995). Only about 3 percent of the world's water is fresh and most of it is not easily available to people.

Of course, the total quantity of fresh water on the earth could satisfy all the needs of human population if it was evenly distributed and accessible (Melkamu 2008, cited in Yitayh, 2011).

Yet, it is difficult in many locations to obtain desired amounts of water of suitable purity especially in developing countries.

Thus, access to safe water supply has been one of the top priorities in developing countries over the past three to four decades and billions of dollars have been invested to achieve the goal of 'universal service'. And yet, the general consensus at the 2002 United Nations conference on sustainable development was that the current reality and the situation expected in the near future are far from that goal (The Economist 2002, cited in Guiyani *et al*, 2005). Despite international and local efforts towards improving water supply conditions, changes are not satisfactory in many African countries.

According to WHO-UNICEF (2008) cited in Bassi and Kumar, (2012) revealed that providing water security is a serious challenge of the twenty-first century world considering that more than 2.5 billion people live without access to improved sanitation and about 0.9 billion survive without access to improved water supply. According to WHO (2006) only 16 percent of people in sub-Saharan Africa had access to drinking water through a household connection which can be an indoor tap or a tap in the yard. Thus, water access and services in the developing world need to be improved dramatically and urgently, especially if we are to make gains in the fight against poverty, hunger and disease.

According to World Book encyclopedia (vol.21, 2001) our demand for water is constantly increasing. Every year there are more people in the world. Factories turn out more and more products, and need more and more water. This is true especially in urban areas of developing countries since as the human population increases rapidly, it demand more and more water than is readily available and water shortages occur when supply does not meet demands.

Since 1990, 926 million urban dwellers (till 2006) gained access to improved drinking water sources but at the same time, around 137 million urban people are still without access to improved drinking water sources. Although most of this increase in access took place in urban areas of the developing region, the public service delivery systems in these countries are struggling to keep pace with rapidly growing urban populations (UN, 2008).

Problems with water supply stem from various sources. One of the major challenges driving water stress in developing nations is rapid urbanization (Post, 2002). Approximately half of the world's 7 billion people live in urban areas. Predictions of the world's future urban population classified Asian and African countries as high urban concentration areas (Jiang *et.al,* 2008). The increasing number of people living in urban areas is associated with increasing water demand and difficulties for many people to access adequate supply of clean water and sanitation (Post, 2002). Increased population led to an increased pressure on the limited amount of fresh water, which constitute only about 0.4% of water available in the world. Secondly, concentration of people in locations which overtime were further and further removed from water sources resulted in a need for networks transporting water from sources to users. Thirdly, industrialization and increased population have tremendously increased the pollution of water, urging for cleaning and costly water treatment facilities (Dalhuisen *et al,* 1999).

Africa has the lowest water supply and sanitation coverage of any region in the world. More than 30% of Africans residing in urban areas currently lack access to adequate water services and facilities. In the year 2000, World Health Organization (WHO) estimated that Africa contains 28% of the world's population without water access to improved water supplies, and 13% of the world's population without access to improved sanitation. Only 62% of the people in African countries have access to improved water supplies, and only 60% have access to improved sanitation (WHO 2000, cited in Wonder, 2007).

The problem of water supply in urban areas of developing countries is a major concern. UN (1995) cited in Khan and Siddique (2000) revealed that urban population of developing countries increased from 50% in 1970 to 66% in 1994 and predicted to be 80% by 2020. The rate at which urban population of developing countries grows is higher as compared to developed countries. Brockchoff (2000) in Kharti and Vairavamoorthy (2007) estimated a 2.3% average growth rate in less developed countries while it will be 1% in developed countries in the years from 2000 to 2030. However, the common shortfall in official statistics of urban population is excluding slum populations. This brings about mismatch between demand estimations and projections in water supply designs of urban areas with the actual demand. One hundred thirty four million people in urban Africa have gained access to an improved drinking water source since 1990. However, since the same year the total urban population without access to an improved drinking water

source increased by 28 million people to 57 million people in 2006. Of the 366 million people in urban Africa only 47% has a piped connection on premises, down from 56% in 1990 (UNICEF/WHO, 2008).

2.2.1 Urban Water supply and challenges in Ethiopia

The World Bank Group (2005) stated that though Ethiopia is often referred to as the "water tower" of Africa, only a quarter of the country's population has improved access to water sources.

A number of factors are indicated for marginal urban water supply and distribution in different literatures. Those which focus on the problem in developing countries point out the common factors like population growth and urbanization, economic development, distribution inefficiency of the water supply system, inconsistency of the system, climatic changes (temperature and rainfall variability), topography of the area, water loss in the system, capacity of nations and towns to manage the water system which could be technological and institutional, inadequate finance and declining of global water resource to improved water supply. Thus, Ethiopia like other sub-Saharan countries faces a number of challenges in improving water supply coverage.

2.2.1.1 Urban population growth and urbanization

Urbanization and/or rise in living standard as a factor for water supply shortage increases urban population and water consumption. As stated by Yimer (1992) the problem of adequate potable water supply for urban communities is intimately related to the growth of urban centers, mainly in respect to rapid population growth and people's changing sense of urbanism which implies having water using appliances/fixtures, frequency of bathing, using water for house/floor washing, etc. Thus, the higher the living standard, the more water is required.

Access to safe potable water in Ethiopia in the year 2000 for urban areas was 72 per cent, and if Addis Ababa is excluded the figure becomes much worse, 38 percent, that is more than 60% of people in urban Ethiopia do not have access to clean drinking water (CSA, 2008). Ethiopia has adopted the international millennium declaration. And also the water supply and sanitation UAP was ratified by the Ethiopian parliament in 2005 and is the current guiding planning framework

for WASH. The MDG target is to attain 70% of national potable water access in 2015 and the MDG target of urban water supply coverage is to achieve 96% by 2015. UAP national targets are much more ambitious than those set under MDG. It is to attain 98% of rural potable water access within 1.5km (15 liters/capita/day) and 100% of urban potable water access within 0.5km (20 liters/capita/day) by the end of 2012. However, this target remains far more ambitious and achievements are still way behind the plans. Rapid rate of urbanization and limited capacity of the public water sector to provide sustainable water supply is at the core of the problem.

The increasing urban population and rising living standards are direct sources of a variety of social and economic problems along with environmental concerns. While the rapid urbanization has fueled developments of new residential communities, making real estate a lucrative business, the construction of these new communities did not come with a careful and foreseeable plan to ensure access to safe drinking water for this growing urban agglomeration.

As Bassi and Kumar (2012) urban areas are increasingly facing water crisis due to mounting water demand and inadequate measures to meet the demand. This particular situation is arising because of increase in urban population, inefficient management of water supply systems, inefficient use of water and multiple institutional arrangements.

2.2.1.2 Insufficient financial resource

With regard to this, Montegomery *et al* (2007) pointed out that in many developing countries lack of financial resources and low prioritization of water and sanitation constrain both the maintenance and expansion of water and sanitation services. Despite sharply increasing demands for urban water supply services has been constrained by insufficient investment (even the use of available funds tends to be inefficient and remains largely underutilized) and human resources, lack of capacity to mobilize resources from user community, local government and private sectors (Francis, 2004 cited Yitayh, 2011).

2.2.1.3 Lack of institutional capacity or weak policy environment

Leaders of most developing countries lack strong organizational framework, and good governances that result in weak policy environment for water supply and sanitation sector.

Underinvestment, undefined ownership, poor participation, weak regulations, and conflict priorities are the outcomes of weak policies (Francis, 2004 cited in Yitayh, 2011).

Institutional issues of urban water supply are raised by WSP (2009) in such a way that the poor performance of water supply and sanitation services is often due to an inappropriate institutional framework, lack of regulatory mechanisms, an absence of appropriate attitudes and skills, and a lack of explicit directives and incentives to serve the poor.

2.2.1.4 Lack of technological capacity

According to Sijbemsa (1989) innovative technologies are essential to overcome barriers to water supply and distribution problems. Technological capacity includes the development and application of new technologies, the technical skills needed to efficiently construct, operate and manage a technical solution, the translation of information regarding to promote informed decision-making when implementing a technical solution, the availability and accessibility of spare parts. Thus, most systems and facilities of water supply are poorly constructed, designed and utilize technologies that are not appropriate (MoFEED and UNDP, 2005 cited in Yitayh, 2011).

2.2.1.5 Inconsistency of water supply system

Inconsistency of water supply is another factor that causes water supply shortage. In most of the developing countries, the water supply system is not continuous but intermittent. According to Vairavamoorthy and Mansoor (2006) in Kharti and Vairamoorthy (2007) intermittent supply leads to many problems including severe supply pressure losses, great inequalities in the distribution of water and contamination.

2.2.1.6 Climatic changes

Temperature increase can also cause water supply shortage by causing water demand increase. As Yimer (1992) indicated the amount of water used for drinking and bathing increases with an increase in temperature that in turn increases water consumption per head and this may be over and above that is required for normal physiological process. In this respect, Hofkes (1986) in

Yimer (1992) stated that the daily water demand in a community area will vary during the year due to seasonal patterns of climate, work situation and other factors.

2.2.1.7 Topography of the area

Topography and/or relief also affect the transmission or conveyance of water and the pressure maintained in pipe lines which determines the efficiency of the distribution system.

2.2.1.8 Water loss in the system

Extensive difference between the water amount produced and consumed, that is water loss, also contributes for water supply shortage. As Arlosoroff (1999) in Kharti and Vairamoorthy (2007) stated many studies revealed that water losses in cities of developing countries are at levels of between 40-60% of water supplied. According to Universal Access Program document of Ministry of Water Resources (2006) a study of water production and usage conducted in 87 towns of Ethiopia, shows that the amount of water production per person per day reaches 20.7 liters. Data gathered during Master Plan study by Ministry of Water Resources indicates that 30.1% is wasted due to various reasons and only 48% of the total amount that can be produced is actually produced and distributed.

2.2.1.9 Weak involvement of private sector

International experience with private sector participation in urban water supply suggests that it is likely to come up if countries are politically stable; governments are powerful; economic condition does not have great bearing on this; and contracts ensure that disadvantaged groups are served through providing appropriate incentives and explicit subsidies if necessary (Perard, 2006; World Bank, 1998 cited in Bassi and Kumar, 2012).

The weak involvement of private sector in the process of water supply has resulted in lack of accountability, lack of community ownership, poor sustainability and weak management of supply systems. The involvement of the private sector can ease large burden of expanding the services by government (Francis, 2004 cited Yitayh, 2011).

2.2.1.10 Lack of community Participation

The definition of participation (Cohen *et al*, 1977 cited in Yitayh, 2011) all of them include, in some measure, the notion of contributing, influencing, sharing, or redistributing power of control, resources, benefits, knowledge, and skill to be gained through beneficiaries involvement in decision making.

As Bassi (2012) stated community participation could result in the project yielding greater social benefits and reducing the social costs. In addition to the positive externalities associated with community empowerment, community participation in planning could result in maximum benefits of water and sanitation provision going to the poorest urban households and communities; reduced expenditure on guarding pipeline networks; reduced expenditure on detecting leaks, and leakage and theft prevention; and reduced transaction cost of metering and pricing water volumetrically.

According to Tesfaye and Zeyede (2004) lack of community involvement is one of the factors which contribute to the problems related to water supply in Ethiopia. The water supply project in most cases will not be sustainable if done without the involvement and will of the community. Therefore, taking the conditions of the locality in to account, the community should participate from the planning to implementation phases particularly in small-scale water development projects. Active involvement is highly needed during the construction activity and the community in this phase may involve in collecting local construction materials (i.e., sand, gravel, stone, etc. if available) and in the construction activities (i.e., in excavation work, mixing of mortar, fencing etc.)

Thus, active involvement of the community is very essential in water source development activities, in order to have sustainable projects and feeling of ownership.

2.3 Benefits of access to water supply and distribution

The importance of water as the most fundamental constituent of life needs no explanation. It was, it is, and it will remain a vital element for the survival of the human race. It is understood that our body is made up of about 70 percent water and that it controls virtually every aspect of

our health. The importance of water is not only attached to the drinking but also to cooking, bathing, washing and other activities. Thus, water is the most important of all public services. It is the most essential necessity of life after oxygen. Anything that disturbs the provision and supply of water therefore tends to disturb the very survival of humanity (Wonder, 2007).

Today, more than ever, water is both slave and master to people. We use water in our homes for cleaning, cooking, bathing, and carrying away wastes. We use water to irrigate dry farm lands so we can grow more food. Our factories use more water than any other material. We use the water in rushing rivers and thundering water falls to produce electricity (Word Book encyclopedia, vol.21, 2001).

Access to safe, sufficient and affordable water is one of the basic indispensable human right as well as a prerequisite for improving the overall life of a society. The provision of sufficient potable water for peoples within reasonable distances from a reliable and acceptable source is essential for people's wellbeing and sustainable economic progress (Hofkes, 1986 cited in Yitayh, 2011). It has been widely argued that safe, adequate, and accessible supplies of water together with proper sanitations are surely basic needs and essential components of primary health care.

The lack of suitable supplies of water lies at the root of many of the difficulties experienced by developing countries. Besides fulfilling basic life requirements, water availability is a cornerstone of satisfactory sanitation, public health, agricultural production, industry, recreation, environmental maintenance, and urban development.

Thus, there are a number of potential benefits to improved access to water supply, in addition to the reduction of disease. That is the reasons why many communities give for placing a high priority on improved water supply usually relate to benefits beyond health. These benefits are of particular importance to women. A closer, clean source of water can produce immediate and far-reaching improvements on women's lives (UNICEF, 1999).

2.3.1 Water supply, Health and Disease

Water is a basic necessity for life, that is why the saying “water is life” is found in many cultures around the world. Unfortunately, not all water helps human to survive. Water from contaminated sources causes numerous diseases and untimely deaths. The fact that a human needs water and cannot live without it forces him to use it even for drinking purposes, from any source, whether pure or contaminated, As a result, many people suffer or die from waterborne diseases. In the developed world, water-associated disease are rare, due essentially to the presence of efficient water supply and waste water disposal systems. However, in the developing world, the majority of people are without a safe water supply and adequate sanitation.

2.3.2 Water supply and development

Water has been vital to the development and survival of civilization. The first great civilizations arose in the valleys of great rivers-in the Nile valley of Egypt, the Tigris-Euphrates valley of Mesopotamia and the Huang Ho valley of China. All these civilizations built large irrigation systems, made the land productive and prospered. Civilizations crumbled when water supplies failed or poorly managed. Many historians believe the Sumerian civilization of ancient Mesopotamia fell because of poor irrigation practice (Word Book encyclopedia, vol.21, 2001).

Water is quite literally a source of life and prosperity and a cause of death and devastation. Aside from the air we breathe, freshwater is our most precious resource, something upon which all life depends. Throughout history humans have tended to take fresh-water for granted, generally assigning little value to it beyond their immediate needs. That is probably because it seemed to be in abundant supply (Caso, 2010). Water has always played, and continues to play, a central role in human societies. It is an input, to a greater or lesser extent, to almost all production (in agriculture, industry, energy, transport, by healthy people in healthy ecosystems. For poor countries it is a key to improving food security and reducing poverty. It is also a force for destruction catastrophically through drought, flood, landslides and epidemic, as well as progressively through erosion, inundation, desertification, pollution and disease (Mwendera *et al*, 2003).

Access to essential resources and services has come to be recognized as positively related to development such that inaccessibility or lack of access is cited as lack of development or symptoms of underdevelopment (Ayeni, 1987 and Moseley 1979 cited Alaci, 2004). To the extents that improved access to essential services has become an accepted part of measure of development and standard of living (Alaci and Alehegn, 2009).

2.3.3 Water supply and convenience

Everybody wants water as close as possible to his home, simply because it is more convenient. Thus, convenience is an important consideration as health benefits. In some societies and situations, convenience is also related to the security of women, which is water supply closer to home can minimize the risk of abduction, rape and assault. Besides, when girls are forced to carry heavy loads of water over long distances, there is a danger of lasting spinal column and pelvis injury and deformations. Thus, closer water sources minimize these problems (UNICEF, 1999).

2.3.4 Water supply and energy saved

Studies have shown that women who walk long distances to collect water can burn as much as 600 calories of energy or more per day, which may be one third of their nutritional intake. Closer sources of water can thus improve the nutritional status of women and children and this in turn improves their health and wellbeing (UNICEF, 1999).

2.3.5 Water supply and time saved

Women and girls can spend many hours a day collecting water from distant sources and thus the time saved by having a safe water source closer to the household can be very significant. The time saved is used for other productive economic and social activities.

2.4 Impacts of urban water supply and distribution inaccessibility

Since adequate water supply and distribution are the primary need of human beings, inaccessibility of water supply and distribution services have many negative impacts on people's

livelihood. Among these, socio-economic, health and poor educational performance are few among the most.

2.4.1 Socio- economic impacts

Water supply has an important role in both social and economic development. Improved public health, better living standards and economic developments are intimately related to the availability and accessibility of adequate water supply with good quality (Hofkes, 1998, cited Yitayh, 2011).

Improving water supply and distribution programs is crucial to spurring growth and sustaining economic development. Incorporating water improvements into economic developments is necessary to end the severe problems caused by water supply shortage and to improve public health and advance the economic stability of urban areas.

According to the World Health Organization, more than 3.5 million people die each year from water-related disease, of which 84% are children (Prüss-Üstün, 2008). The same organization reported that nearly 90% of all death cases associated with diarrheal diseases occurs in the child population of the developing world (Prüss-Üstün *et. al,* 2008).

Lack of drinking water and sanitation kills about 4500 children a day and sentences their siblings, parents and neighbors to sickness, squalor and enduring poverty. Hundreds of millions of African, Asian and Latin American families are paying every day in lost income for their lack of access to improved drinking water and sanitation services. Women's physical and financial burdens are often greater than men's. Improvements bring immediate and lasting benefits in health, dignity, education, productivity and income generation (WHO-UNICEF, 2005).

Therefore, poor health robs the children of schooling and the adults of earning power, a situation aggravated for the women and girls by the daily chore of collecting water. For a family of six, collecting enough water for drinking, cooking and basic hygiene means hauling heavy water containers from a distant source for an average of three hours a day. All in all, the lack of water and sanitation affects every aspect of the family's life, and condemns people to a perpetual struggle to survive at subsistence level (WHO-UNICF, 2005).

2.5 Water supply and sanitation policy in Ethiopia

Drinking water is one of the indispensable human rights and governments have a duty to make their citizens water secure. These duties have different care components constituting water security right to sufficient, safe, physically accessible, affordable and acceptable water for personal and household uses **(**UNDP, 2004 cited Yitayh, 2011).

The policy recognizes the inseparable nature of water supply and sanitation and requests the promotion of both an integrated and sustainable framework. Therefore, according to this policy, all water supply institutional set ups have legal right to implement the integrated water supply and sanitation policy. In addition to these since the establishment of a Ministry for a water sector in 1995/96, a strategic and participatory approach has been introduced by bringing in to place key sector reform initiatives. The national Water Resource Management Policy also requires urban centers to cover their investment, operation and maintenance costs, while rural water supply and sanitation is required to cover operation and maintenance costs with some cost sharing up to 10 percent for initial investment cost. Importantly, the financial requirements to achieve water supply and sanitation targets are premised on the capacity to implement the approaches outlined in policy (MoWR, 2003).

2.5.1 Water sector policy and goals

The overall goals of the Federal Water Resource Management policy (1999) and Water Sector Strategy (2001) are to promote national efforts towards efficient, equitable and optimum utilization of the available water resources of Ethiopia in order to achieve significant socio-economic development on a sustainable basis. Some of the major principles of the policy are devolving ownership to lower tiers and enhancing management autonomy to the lowest possible level, promoting involvement of all stakeholders, including the private sector, moving towards full cost recovery for urban water supply systems and recovery of operational and maintenance costs for rural schemes; and enhancing urban water supply through autonomous bodies.

The water resources management policy 1999 in the section of drinking water supply clearly elaborated detail policies on institutional, financial, technical, and engineering issues that should be considered in provision and sustainable management of drinking water supply schemes.

Some of the detailed objectives of water supply and sanitation policy include:

- Provision of sustainable and sufficient water supply to all
- Carry out operations and maintenances of water supply and sanitation services in sustainable and sufficient manner.
- Promote sustainable utilization of water resources through protection of water sources, efficiency in use of water as well as control of waste water.
- Creating sustainable capacity building in terms of the enabling environment including institutions, human resources, development, land legislation and regular frame work for water supply and sanitation.
- Creating conducive environment for promotion of appropriate sanitation services (MoWR**,** 1999).

2.5.2 Institutional arrangements for water service delivery in Ethiopia

According to Federal Water Resources Management policy (1999) and Water Sector strategy (2001), the following institutions and institutional arrangements, are responsible for the delivery of water supply services.

2.5.2.1 Ministry of water resources

This institution is responsible for formulating national water policy, strategy and action plans, and establishing national standards pertaining to water quality, water infrastructure and other relevant standards. The Ministry is responsible for supervising and following up on the implementation of policy and strategy instruments as well as overall sector standards. In addition to its regulatory function, the ministry provides technical support to Regional Water Bureaus of Federal Water Resources Management policy (1999).

2.5.2.2 Regional Water Resource Development Bureaus

Regional Water Bureaus at regional level are executive organ responsible for the preparation of regional policies and regulations, the implementation of federal policies, strategies ad action plans through adapting them to the specific conditions of the region, study, design, supervision and regulation of water supply projects, build the capacity of zonal and woreda water offices, set

water tariffs, construction of schemes (including spring development, small and large gravity schemes, motorized schemes, boreholes and shallow wells) and contract out to the private sector. Besides, Water Bureaus exercise regulatory duties delegated to them by the Ministry (MoWR, 1999).

2.5.2.3 Zonal Water Resources Development Offices

Zonal Water Resources Development Offices are the supporting arms of the Water Bureaus and are mandated to give capacity building and technical support to Woreda Water Offices and Town Water supply offices. Besides, they are responsible for coordinating activities, consolidating plans and reports of Woredas and relaying requests from regional water bureaus and/or Woreda Water offices. In general Zonal Water Offices are the links between Regional Bureaus and Woreda Water Offices (MoWR, 1999).

2.5.2.4 Woreda Water Resources Development Offices

Woreda Water Resources Development Offices are responsible for the monitoring of construction done by regional bureau or private contractors contracted by the bureau, investigation, design and implementation of small scale water supply schemes, while study and design of big schemes are undertaken by bureaus of water. Moreover, Woreda level offices are responsible for providing technical support to town water supply offices, in towns where municipalities are not established. Woreda water offices are supported by a woreda water supply, sanitation and hygiene team consisting of representatives of sector offices of education, health, women and agriculture. Such teams are responsible for planning and implementation of water and sanitation activities (MoWR, 1999).

CHAPTER THREE

3. MATERIALS AND METHODS

3.1 Background of the study area

3.1.1 Location and historical background of the town

The study area, Rebu Gebeya town, is located in Eastern Gojjam zone, Amhara Region (Ethiopia). In the current administrative structure, the zone has 17 rural and 4 town woreda administrations. Rebu Gebeya town is the administrative center of Sinan woreda located at 10^0 33' 0" N latitude and 37^0 46' 0" E longitudes. It is located about 327 Km North West of Addis Ababa, 292 Km south east of the regional capital, Bahir Dar and 27 Km north of the zonal capital, Deber Markos town (Figure 3.1).

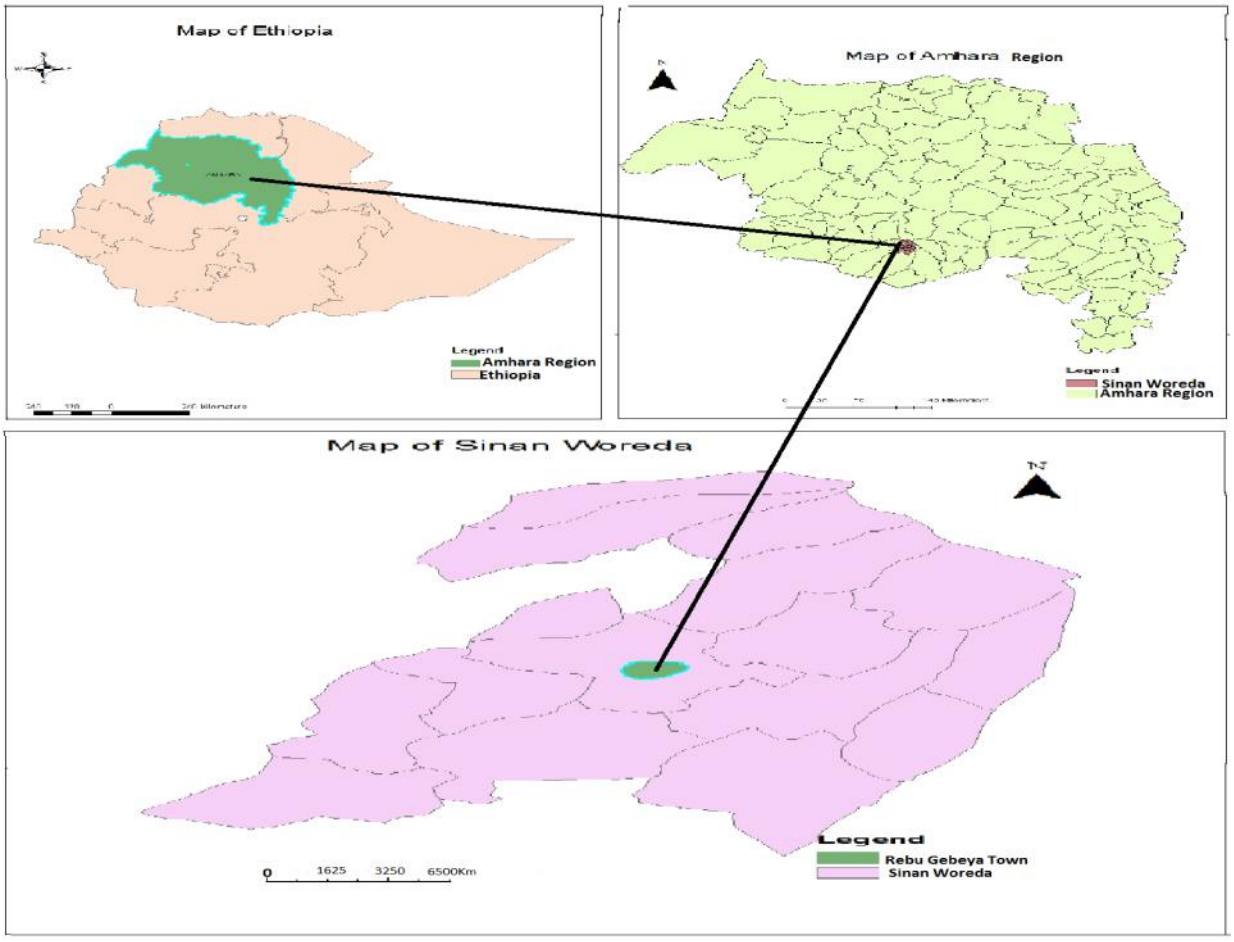

Figure 3.1: Map of the study area

Source: Arc GIS version 9.2

According to Sinan Woreda Culture and Tourism Office (2013) Rebu Gebeya was founded during the Hailesillase regime in 1957 and it covers 303.18 hectares of land. The name Rebu Gebeya is said to be associated with the weekly market held on Wednesday (”Rebu”) at that time.

Rebu Gebeya town like other small urban centers of Ethiopia include different institutions and infrastructures. This town was going to be selected for the fact that water supply problem is critical & burning issue requiring urgent attention in the area but probable causes, challenges and impact of water supply problem in the town were not yet assessed.

3.1.2 Physical Features

The landscape of the town area is known by plain, undulating slope and between plain and undulating slope with altitude ranging from 2300-2957 meters above sea level and it consists 30% plain, 25% undulating slope and 45% between plain and undulating slopes (Mengist, 2005).

Referring to the Geological Map of Ethiopia (Ministry of Mines, 1973) identified that the Choke Mountain and the surrounding areas consist of alkali basalts, tufts, and agglomerates of the shield group (Cenozoic-Tertiary-Miocene) which are part of Volcanic Trap Series. From this we can conclude that the town might have almost similar geology with Choke Mountain and the surrounding area because Choke Mountain is the near distance of the town and according to Mengist (2005), more than 75 % the town’s soil is red and about less than 5% is Nitisols.

In light of Ethiopian traditional agro-ecological classification system, the climatic features observed in the Rebu Gebeya town correspond with altitude and associated vegetation coverage’s. So the climatic condition of Rebu Gebeya town is Dega. The annual rainfall of the town is 1350 mm with unimodal rainy season on average. The rainy season extends from May to the end of September (National Meteorology Agency, 2012).

Streams that are found near the town Rebu Gebeya and give services for the inhabitants are Temzig, which is found 3 km east of the town, Kulech found 2 km west of the town and Atimena also found 2 km North West of the town. Besides, there are three springs with average distance of 1km from the town that serve as source of water for the inhabitants. These are Kerkehaw,

which is found west of the town, Ketemaw found south of the town and Gumzegen found east of the town (Mengist, 2005).

3.1.3 Potable Water supply system of Rebu Gebeya town

The water supply systems of the study area fall into two broad categories; these are traditional water sources and modern water supply system. Among the known different types of water sources streams (rivers), springs and wells are the major sources of water supply for the town. From the very beginning of the foundation of the town, water demand of the town was being met with the nearby rivers (streams) of Temzig, Kulech and Atimena and springs of Kerkehaw Ketemaw and Gumzegen and has been fetched and transported by human portage. Thus, any water source used by the urban people for domestic purposes that is not properly constructed by qualified people to protect from any possible contamination and from which untreated water is found constitute what we call traditional water sources. These sources of water are not actually safer and protected. Yet, the inhabitants of the town used the water without any treatment like boiling and filtration. These sources of water make the people vulnerable to various water borne diseases such as cholera, typhoid and the like. Furthermore, at that time the water demand was much smaller than it is today. However, with increasing size of population which at the same time resulted in greater demand for the provision of clean potable water, the construction of modern water supply scheme become quite necessary (RTWSO, 2015).

Modern water supply service or water supply with piped system for Rebu Gebeya Town was started in 1995, and fourteen years later after the town became a Woreda capital, another water source constructed in 2009, and the water sources for the town which were constructed during these years are borehole I and Baydegim well respectively. The water drawn from these individual stations are collected in different storage tanks which are both located at different points north of the town.

According to RTWSO (2015) the water production capacity of the borehole I and Baydegim well is 50 cubic meters and 60 cubic meters per day respectively. The construction of these modern water supply schemes is designed to give the inhabitants of the town reliable and more quality water than has been possible from the traditional sources. Initially, it was believed to satisfy the existing water demand of the town. But due to the growing number of the town's population the

amount of water that is drawn from borehole I and Baydegim well particularly during the dry periods, become insufficient.

The pumping station of the borehole I is supplied with electricity, whereas the pumping station of Baydegim well was and is still supplied with fuel oil (kerosene) and sends the water into the mains under enough pressure to carry it to every faucet. By this process water is distributed to end users. As a matter of fact, the town has a total of 9 kilometers length network, which includes both primary and secondary distribution pipe line and currently from the total 1647 households in the town, only 207_(12.5%) households have house connected taps (private pipes), which is very low coverage and also there are 13 public taps from which three public taps are belonged to government institutions of Rebu Gebeya junior secondary school, Rebu Gebeya senior secondary and preparatory school and Rebu Gebeya health center, which are distributed throughout the town. Thus, the remaining households get water from public taps and from their neighbors' or fetch from traditional water sources. Thus, water supply and distribution networks of Rebu Gebeya town are somewhat inefficient and insufficient as seen from the point of increasing need for wide spatial coverage (RTWSO, 2015).

3.1.4 Socio-Economic setting of Rebu Gebeya town

According to Sinane Woreda finance and economic development office (2014/15 budget year), the total population of the town is 6384 with a sex composition of 3181 males and 3203 females.

Table 3.1 Total population of Rebu Gebeya town from 2007-2015

No	Year	Male	Female	Total
1	2007	2273	2289	4562
2	2008	2345	2393	4738
3	2009	2409	2569	4978
4	2010	2577	2595	5172
5	2011	2688	2706	5394
6	2012	2803	2822	5625
7	2013	2924	2945	5869
8	2014	3050	3071	6121
9	2015	3181	3203	6384

Source: Sinane Woreda finance and economic development office (2015)

Almost all of the dwellers of the town are the follower of Christian and the speaker of Amharic language (Sinan Woreda culture and tourism office, 2013).

According to Sinan woreda civil service office, Sinan woreda Trade and transport office and Sinan woreda Technique, profession and enterprises development office (2015), of the total urban dwellers, 1251 (20%) engage in commerce (trade) activity, 884 (14%) engage in service activity, 50 (0.8%) engage in manufacturing, 10 (0.1%) engage in urban agriculture and the majority of urban dwellers 4099 (64.2%) engage in the other informal sectors (such as in preparing and selling tea, bread, "*Tella*", "*Areqi*" and the like) of the economy. Thus, just like other small urban centers of the country the dwellers of Rebu Gebeya town mostly engage in commerce (trade) activity and other informal sector activities (Mengist, 2005).

3.2. Research Design

In order to achieve the objectives of this research, the researcher applied descriptive survey research method. Descriptive questions like ''what'', "how" and "when" are more appropriate and help to describe the situation and find deep insights of the issue under study. Hence, it helps to describe the status of situation.

3.3 Sampling methods

The researcher applied both probability and non-probability sampling technique to obtain the samples of households and others. Thus, it helped to get necessary information from households of the town and other concerned bodies.

The theoretical population is the town dwellers of Rebu Gebeya. There is one kebele in the town and it is divided in to four sites. Thus, according to Sinan Woreda Finance and Economic Development Office (2014/15 budget year), the total population in the study area is 6384. And according to Rebu Gebeya town municipality (2014) the total household size of the town is about 1647. The four sites are taken and served as clustered site groups. Then, from these a total of 120 households were randomly selected by cluster systematic random sampling and by a sample size of seven percent, proportionally from each site in order to avoid over or lesser representations from each sites (Table 3.2).

Table 3.2 Sampling method and sample households' selection from each site

No.	List of sites	Total households per site	Sample households from each site
1.	01	435	32
2.	02	337	24
3.	03	474	35
4.	04	401	29
Total		1647	120

These 120 households were taken as samples for the study believing that the selected sample size represents the remaining households. The list of all households from each site was used as a sample frame from which the samples are drawn.

Besides, participants of focus group discussion were selected from the concerned offices based on non-probability sampling technique, through purposive sampling. These participants were purposively selected from different offices believing that they have deep and relevant information about the issue of the study (Table 3.3).

Table 3.3 Selection of focus group discussion participants

No	Offices from where the participants were selected	No. of selected participants	Method of selection
1	Rebu Gebeya town water service office	4	purposive sampling
2	Sinan Woreda health center office	3	purposive sampling
Total		7	

3.4 Data types and Method of data collection

Both primary and secondary data were collected and used for the assessment of water supply and distribution problems of the study area.

3.4.1 Sources of primary data

Primary sources of data were collected through questionnaire, focus group discussion and observation from selected sample households, different offices and the water supply issues respectively.

3.4.1.1 Household Survey: To generate information at household level the researcher used both closed and open ended questionnaires; and open response-option questionnaires to collect primary data concerning all relevant variables such as problems of urban water supply and distribution, communities' participation in the provision of water supply, factors affecting the sustainability of urban water supply schemes.

3.4.1.2 Focus group discussion (FGDs): The researcher conducted focus group discussions with people from different offices with different responsibility, knowledge and experience such as; Rebu Gebeya town Water and health offices about the town's water supply and distribution coverage, the balance between demand and supply of water in the town, the major challenges faced in the provision of these services, status of communities' participation in operation of the water supply schemes and the effects of water supply and distribution problems. For the focus group discussion, seven members were identified to participate. The researcher used checklists for the focus group discussion.

3.4.1.3 Observation: In addition to the above tools, the researcher also used observation methods to assess the current status of water supply and distribution in the town, the existing water sources of the town and their state of development, the condition of water supply interruption in the town, the round trip distances of water sources from the dwelling places, the condition of queuing and waiting turns for fetching water and the functional sustainability of the schemes and matched it with the checklists to assess the reliability of the data collected.

3.4.2 Sources of Secondary Data

Secondary data collections were the other main tools for research work, for which the researcher used journals, report from Woreda offices of water resource development, Zonal water offices and regional offices on the socio-economic conditions of the study area.

These data which were collected through questionnaires, focus group discussion, personal observation and reviewing relevant and pertinent documents were triangulated to ensure the accuracy and validity of the data.

3.5 Method of Data Analysis

Both qualitative and quantitative methods of data analysis were used to analyze the data gathered from field. Qualitative data that were gathered through personal observations and focus group discussion and secondary data (document review) obtained from different offices were analyzed qualitatively.

The primary data collected from household respondents through structured questionnaires were first checked for accuracy and tabulated and analyzed by using descriptive statistics. The data are presented in tables and figures.

CHAPTER FOUR

4. DATA ANALYSIS AND DISCUSSION

4.1 Background Information of Sample Households

Knowing the socio-economic and demographic background information about sample populations is very important to know their characteristics. As stated earlier the size of sample households for this study was 120. From the sample population 92_ (77%) were male head and 28_ (23%) were female head household respondents. With regard to age composition, the age of these household heads ranges from 25 years to 60 years old and 49_ (40.8%) of the respondents recline in the age category of 25-34, 33_(27.5%) in the age group of 35-42 years, and 26_(21.6%) of the respondents are in the age category of 43-51 years and 12_(10%) of the respondents are in 52-60 years.

4.1.1 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 4.1) reveals that that 85_(70.8%) respondents were married, whereas 8_(6.6%), 15_(12.5%) and 12_(10%) of the respondents were single, windowed and divorced respectively. Family size of households has to do with initial investment of water supply projects, water consumption and payment for it. With regard to the household family size, those respondents with family size less than 4 comprise about 37_(30.8%), family size between 4-6 constituted 68_(56.7%), and 15_(12.5%) of the respondents indicate that their family size between 7- 9. The average household family size of the respondents is 4.55 ranging from one up to nine members.

Table 4.1 Distributions of Respondents by Marital Status and Family Size

Marital status			Family size		
Category	Frequency	Percent	Category	Frequency	Percent
Married	85	70.8	Below 4	37	30.8
Single	8	6.7	4-6	68	56.7
Widowed	15	12.5	7-9	15	12.5
Divorced	12	10	Above 9	-	-
Total	120	100.00		120	100.00

Source: Sampled household survey, January 2015

4.1.2 Monthly Income of Sample Households

Household income is one of the most determinant factors of individuals' living standard in general and consumption in particular. As indicated in table 4.2, out of the total households, about 8_(6.7%) earns less than 400 Birr per month, 15_(12.5%) earns about 401-800 Birr per month, 20_(16.7%) earn about 801-1200 Birr per month and 10_(8.3%) of the respondents indicate that their family income is between 1201-1600 Birr per month. Meanwhile, the rest 25_(20.8%) and 42_(35%) of the respondents indicate that their family income is between 1601 - 2000 and above 2001 Birr per month respectively.

Table 4.2 Distributions of respondents by monthly income

No	Monthly income	Frequency	Percent
1	Less than 400	8	6.7
2	401-800	15	12.5
3	801-1200	20	16.7
4	1201-1600	10	8.3
5	1601-2000	25	20.8
6	Above 2001	42	35
	Total	120	100.00

Source: Sampled household survey, January 2015

4.1.3 Educational Status

Education is an instrument used to create educated citizens who works for the socio-economic development of a nation. It is a basic parameter for any development activity as in water supply and distribution programs. This is because literate citizens can be better participants and involve in projects targeted to water supply and distribution. Knowledge and technology transfer are also easier in a community that constitutes educated peoples. Educated individuals demand for better services and toward improvement of their living condition. As it is shown in Table 4.3, 16_(13.3%) of households were illiterate, 68_(56.7%) have finished their elementary education, which is from grade one to eight formal education and 20_(16.7%) of the respondents have finished their secondary education, which is from grade nine to twelve or high school educations.

Those households who are Diploma and Degree holders constituted 9_(7.5%) and 7_(5.8%) respectively.

Table 4.3 Distributions of respondents by Educational Status

No	Educational status	Frequency	Percentage
1	Illiterate (uneducated or untaught)	16	13.3
2	Elementary education	68	56.7
3	Secondary education	20	16.7
4	Diploma holders	9	7.5
5	Degree holders	7	5.8
	Total	120	100.00

Source: Sampled household survey, January 2015

4.1.4 Occupational profiles

Sample households were also asked about their current occupation (main sources of income) and the results of household survey are presented in Table 4.4, and 68_(56.7%) of the respondents report that trade is their main sources of income, 16_(13.3%) of the respondents are civil servants (government employees) and 7_(5.8%) of the respondents engage in daily labor. Whereas, those 12_(10%) and 17_(14.1%) of the respondents report that agriculture and trade and farming and daily labor were their main sources of income respectively.

Table 4.4 Distributions of respondents by occupational profiles

No	Occupational profiles	Frequency	Percentage
1	Farming	-	-
2	Trade	68	56.7
3	Government employees	16	13.3
4	Daily labor	7	5.8
5	Farming and trade	12	10
6	Farming and daily labor	17	14.1
	Total	120	100.00

Source: Sampled household survey, January 2015

4.2 Water Supply and Distribution level in Rebu Gebeya Town

Assessing the current situation of urban water supply helps to know the supply and distribution level, factors and challenges against the provision and to set directions aimed at adequate water supply to the target urban community on sustainable basis. Accordingly, data on water supply and distribution status and accessibility, causes of water supply interruptions, alternative water supply sources, distances traveled and time required for collecting water, means of water transportation, volume of water collected and consumed daily and health problems related to water supply inaccessibility were gathered to look at the existing urban water supply and distribution in the Town.

According to RTWSO (2015) the total daily discharge of water from the two water sources of borehole I and Baydegim well is 110 cubic meters (110000 liters) and the average per capita consumption of water is 17.3 liters per day which is less than the UN-HABITAT (2003) standard of minimum amount of water which is needed to satisfy metabolic, hygienic and domestic requirements usually about 20 liters of safe water per person per day.

Water supply coverage provides a clear picture of the water supply situation of one specific country or town and helps to compare one country with others and the inter and intra town distribution with in specific country. The percentage of population with or without piped water connection is a relevant indicator to compare the coverage of water supply in urban areas (UN-Habitat, 2003). Thus, water supply coverage is calculated simply by dividing the urban population served with potable water to total number population times 100 %.

In line with this, the focus group discussion made with Rebu Gebeya Town water service office officials and the researcher's personal observation indicted that, the current coverage status of water supply and distribution in the town is very low, which is only 28%, and the urban dwellers use several traditional sources of water such as unprotected well and protected hand dug wells, protected and unprotected springs and even from streams. Besides, the participants of focus group discussion underscored that the available sources of water are not enough to meet even the current water demand of the town. Therefore, big efforts should be done by Rebu Gebeya town water service office and the regional water resource development bureau to increase potable water supply coverage in the town and to meet the current and future water demand.

Water distribution is one of the most important tasks of any water service institution, which require a high amount of investment. Water distribution work starts when water is drawn from a source and piped into a treatment plant. Then the treated water flows to a pumping station, where it is pumped into large cast iron pipes called water mains. Water mains run beneath the streets. They carry water and connect with smaller pipes that lead to every home, office, building, factory, and restaurant. The pumping station of the borehole I is supplied with electricity, where as the pumping station of Baydegim Well was and is still supplied with fuel oil (kerosene) and sends the water into the mains under enough pressure to carry it to every faucet. By this process water is distributed to end users. As a matter of fact, the town has a total of 9 kilometers length network, which includes both primary and secondary distribution pipe line and currently from the total 1647 households in the town, only 207_(12.5%) households have house connected taps (private pipes), which is very low coverage and also there are 13 public taps, from which three public taps are belonged to government institutions of Rebu Gebeya junior secondary school, Rebu Gebeya general higher secondary and preparatory school and Rebu Gebeya health center, which are distributed throughout the town. The remaining households get water from public taps and from their neighbors' or fetch from traditional water sources and one public tap gives service at least for 160 urban dwellers of the town. Thus, water supply and distribution networks of Rebu Gebeya town are somewhat inefficient and insufficient as seen from the point of increasing need for wide spatial coverage (RTWSO, 2015).

Table 4.5 Level and progress of pipe connection

No	Types of connection and urban population	Years							
		1995	2009	2010	2011	2012	2013	2014	2015
1	No of private pipes	-	207	207	207	207	207	207	207
2	No of public fountains	4	9	13	13	13	13	13	13
3	Total urban population	-	4978	5172	5394	5625	5869	6121	6384
4	urban population served with potable water	-	1807	1807	1807	1807	1807	1807	1807
5	Urban potable water coverage (%)	-	36	35	33.4	32	29.4	29	28

Source: RTWSO, 2015

As shown in table 4.5 the number of private pipe connection and public fountains were slightly increasing from 1995 to 2009. However, there is no increasing progress after 2009 and the number of households who have no connection is more than eight times the connected one. In other words, there are only 207_(12.5%) households who have private pipe connection of the total of 1647 urban households and the current water coverage of the town which is the percentage of urban population served with potable water constitutes only 28%, which is very marginal.

4.2.1 Water Supply and Accessibility of Sample households

Provision of potable water is all about access to safe and adequate quality of drinking water to the people within a reasonable distance.

According to UN-HABITAT (2003) water accessibility can be explained as an adequate amount of water which is needed to satisfy metabolic, hygienic and domestic requirements at least 20 liters of safe water per person per day. In urban areas the water source may be either a public fountain or a stand pipe at least 20 liters of safe water per person per day and not more than 200 meters away from the dwelling place.

The sample households were asked whether they have or not a reasonable and good access to tap water supply at 200 meter distance, and from the total 120 sample households, about 42_(35%) of the respondents have a reasonable and good access to tap water supply at 200 meter distance and 78_(65%) of the respondents have no access (Table 4.6).

Table 4.6 Water Supply systems of Sample households have a reasonable and good access to tap

No	Water supply system of households who have a reasonable and good access to tap water supply at 200 meter distance	Number	Percent
1	Tap inside the compound	12	28.5
2	Tap inside neighbors' compound	7	16.7
3	Public tap/fountain	23	54.8
	Total	42	100.00

Source: Sampled household survey, January 2015

From those households who have a reasonable and good access to tap water supply at 200 meter distance, about 12_(28.5%) have a tap inside the compound, 7_(16%) get water from a tap inside neighbors' compound and the remaining 23_(54.8%) fetch water from public tap/fountain. In other words, about 30_(71.5%) of households do not have private pipe connection and depend on private sellers from a tap inside neighbors' compound and public tap/fountain. Furthermore, those 30_(71.5%) of the sample households who collect water by buying water from a neighbors' tap and public tap/fountain, were also asked about the distance of public taps from their homes and the majority 19_(63.3%) of the respondents reported that the public tap is more than 500 meters far away from their homes, which is much more than 2.5 times the 200 meters recommended by the standard of WHO (2004), 7_(23.3%) of the respondents responses between 300-500 meters and 4_(13.3%) confirmed that the public tap is far away from their home between 150 meters to 300 meters. In relation to time, it takes more than one hour for both waiting turns and round trip for those households who are far away from the public tap more than 500meters, 40-50 minutes for those households who are far away from the public tap between 300-500 meters and 25-40 minutes for those households who are far away from the public tap between 150 meters to 300 meters and most of the respondents indicated that, the problem of queuing and waiting turns at public pipes was more serious than that of the distance (Figure 4.1).

Figure: 4.1 People queuing and waiting turns to fetch water at public pipes

From 42_(35%) households who have a reasonable and good access to tap water supply at 200 meter distance, 37_(88%) were married and 5_(12%) were single and from 78_(65%) households who have no access, 48_(61.5%) were married, 3_(4%) were single, and 15_(19.2%) and 12_(15.3%) were widowed and divorced respectively. Besides, 38_(90.4%) of households who have a reasonable and good access to tap water supply were beyond the age of 43 and 4_(9.5%) were in the age group of 35-42 years; and from 78_(65%) households who have no access, 49_(62.8%) were below 34 years and 29_(37%) were in the age group of 35-42 years. Meanwhile, all households who have good access to tap water supply earn above 2001 Birr per month and, of those who have no basic access 53_(68%) earn less than 1600 Birr per month and 25_(32%) earn between 1601-2000. Furthermore, of those who have reasonable access 26_(62%) have finished their elementary education, 13_(31%) have finished their secondary education and the rest 3_(7.1%) have Diploma; and from 78_(65%) households who have no access 16_(20.5) were uneducated, 42_(54%) have finished their elementary education, 7_(9%) have finished their secondary education and the rest 13_(16.6%) have finished their tertiary level of education. Thus, it implies that the level of water accessibility is highly related to income, education, marital status and age of households since all, 88% and 90.4% of households have a reasonable and good access to tap water supply at 200 meter distance are those who earn above 2001 Birr per month, educated , married and beyond the age of 43 respectively.

As many of the participants of focus group discussion stated during a time of water shortage the urban dwellers collect water from the traditional sources such as unprotected well and protected hand dug wells, protected and unprotected springs and even from streams, which are not safe for drinking. From this one can deduce that the majority of household respondents have no a reasonable access and water accessibility standards were and are not applied in the town, and it is difficult for households to fetch water from these distances and through such long queuing and waiting turns at public pipes. And thus, they buy water at relatively high cost from a nearby water vendor. As a result, the high cost of water may force households of the lower income to use small quantities of water and alternative of poorer quality that brings a greater health risk too.

4.2.2 Challenges of water supply and distribution

Access to water supply is a fundamental human right. However, water supply and distribution is constrained by multiple factors related to socio-economic (population growth, lack of technological capacity and financial problems), institutional (lack of institutional capacity and weak sector coordination) and environmental (topography of the area and insufficient water resource).

Table 4.7: The main challenges of water supply and distribution

No	Possible reasons	Alternatives			
		Yes		No	
		No	Percent	No	Percent
3.1	Population growth and urbanization	35	29.2	-	-
3.2	Lack of institutional capacity	-	-	24	20
3.3	Lack of technological capacity	15	12.5	-	-
3.4	Insufficient financial resource	47	39	-	-
3.5	Insufficient water resources	-	-	9	7.5
3.6	Weak sector coordination	18	15	-	-
3.7	Lack of community participation	-	-	87	72.5
3.8	Topography of the area	5	4.2	-	-
Total		120	100.00	120	100.00

Source: Sampled household survey, January 2015

The problems of water supply and distribution in Rebu Gebeya town are multidimensional and stem from various sources. These are due to population growth and urbanization, lack of technological capacity; insufficient financial resource, insufficient water resources, weak sector coordination and topography of the area were the major ones.

4.2.2.1 Population growth and urbanization

The increasing number of people living in urban areas is associated with increasing water demand and difficulties for many people to access adequate supply of clean water and sanitation (Post, 2002). Increased population led to an increased pressure on the limited amount of

available fresh water. Accordingly, the population of Rebu Gebeya town during 2007 census was 4562, 5172 in 2010, 5869 in 2013 and 6384 in 2015. However, there is no additional water supply service for the Town dwellers after 2009 and 35_(29.2) of the sample household respondents confirmed that, rapid population growth and urbanization was and is still a challenge for water shortages in the Town.

Furthermore, the participants of focus group discussion underscored this issue during their discussion by stating as ‘‘the town is increasingly facing water crisis due to mounting water demand and inadequate measures to meet the demand. This particular situation is arising because of increase in urban population.’’ Therefore, it implies that immediate measures of supplying water service should be taken to meet the demands of rapid population growth and urbanization.

4.2.2.2 Lack of technological capacity

As Sijbemsa (1989) innovative technologies are essential to overcome barriers to water supply and distribution problems. Technological capacity includes the development and application of new technologies, the technical skills needed to efficiently construct, operate and manage a technical solution, the translation of information regarding to promote informed decision-making when implementing a technical solution, the availability and accessibility of spare parts. Thus, 12_(10%) of the sample household respondents reported that lack of technological capacity is one of the main challenges of water supply in the town even the pumping station of Baydegim well was and is still supplied with fuel oil (kerosene). The participants of focus group discussion underlined this as a great challenge because attempts of digging boreholes were made two times in the town. Yet, due to inappropriate technology the professionals unable to operate after 150 meters and 52 meters deep because of absence of water and hard rock; and they recommend that better professionals from the Federal government should study underground water potentials of the Town and technologies like electric power supply and rotary drilling techniques should be applied. Besides, the Town water office officials reported that, Regional technicians that came to the Town to study and operate the work did not make sound communication with the Town water office officials in providing information even about the geology of the Town and that is why the two boreholes failed.

4.2.2.3 Insufficient financial resource

As Montegomery et al (2007) pointed out that in many developing countries lack of financial resources and low prioritization of water supply constrain both the maintenance and expansion of water supply services. The majority of household respondents about 47_(39%) reported that, despite sharply increasing demands for urban water supply services has been constrained by insufficient investment. In line with this, the participants of focus group discussion also indicated that, there is low prioritization of spending money, which is assigning only a small fraction of money in to water supply and distribution service compared to other infrastructures and they stated as the town water service office is an autonomous body responsible for working independently and there is no assigned budget except the grants given by Woreda water service office during water system failure for repairing and maintenances of non-functional water supply schemes. But the study, design and construction of big schemes (including spring development, small and large gravity schemes, motorized schemes, boreholes and shallow wells) are undertaken by Regional Water Bureaus. Thus, lack of finance to be used is one of the major bottlenecks stopping water supply and distribution in Rebu Gebeya town.

4.2.2.4 Weak sector coordination

About 18 (15%) the household respondents reported that, there is weak coordination between different service delivery institutions such as Woreda level water offices and electricity institutions. The participants of focus group discussion also indicated that the pumping station of Baydegim Well was and is still supplied with fuel oil (kerosene) and thus, there is low sector coordination in the town.

4.2.2.5 Topography of the area

Topography or relief also affects water supply and transmission or conveyance of water and the pressure maintained in pipe lines which determines the efficiency of the distribution system. Thus, 5_(4.2 %) of the sample households reported that, the topography of the town influences water supply and distribution since the landscape of the town area is known by plain, undulating slope and between plain and undulating slope.

As many of the participants of focus group discussion stated and the data obtained from Rebu Gebeya town water service office indicates, the town water service office devised water supply scheduling as a temporary solution to make water supply shortages and interruptions by shifts and to create fair water supply and distribution among the residents of the town. Thus, the dwellers' of the town get and fetch pipe water three days a week except the weekend and other common religious holidays. The researcher's personal observations also approved that, there is water scheduling in the four Sites (Sefers) of the town, which means the water supply turned on three days a week for few hours (a maximum of three hours) and turned off four full days a week due to water shortages in the current water supply and distribution.

4.2.3 Water supply interruptions

In Rebu Gebeya Town inconsistency of water supply is also another factor that causes water supply shortage, which in turn, caused by either through intermittent sources or resulting from engineering inefficiencies. According to Vairavamoorthy and Mansoor (2006) in Kharti and Vairavamoorthy (2007) intermittent water supply (daily or weekly discontinuity) leads to many problems including severe supply pressure losses, great inequalities in the distribution of water, lower volume use and in-pipe contamination. Thus, households' water storage may be necessary, and this may lead to an increase in the risk of contamination during such storage and associated handling. Seasonal discontinuity often forces users to obtain water from inferior and distant sources.

Water supply interruption in Rebu Gebeya Town was and is now a big challenge and it affects the life of the residents in many ways. The frequency of water supply interruption revealed how much the water supply interruption is a very serious problem in the study area. Out of 120 surveyed sample households that are found in different sites of the town, all 120_(100%) households reported that there is a shift for water supply interruption that occurred four full days per week, which implies there is no water supply service 16 days per month or 208 days per annum (this means, there is no connection continuously almost for 7 months per year). In other words, the sample households fetch water three days a week except the weekend and other common religious holidays. The researcher's personal observations also approved that, there is water scheduling in the four Sites (Sefers) of the town due to water shortages in the current water

supply and distribution. Furthermore, the household respondents were also asked about the causes of continuous water supply interruptions and 45_(37.5%) of the total respondents could not know the reasons clearly and the remaining 75_(65.2%) gave different reasons like shortage of water sources and insufficient discharge (low yield), weak sector coordination, urban population growth and subsequent increase of water demand, power supply inconsistency and poor maintenance.

In line with this, the focus group discussion members expressed their views as; "in addition to the very low coverage of water supply in the town, long water supply interruption is another pressing problem of the town and say that, there are pipe lines with no running water at least for four days a week." They stated attributed interruption problems to insufficient water sources, breakdown of water supply schemes, power supply interruption and large number of households using the single water point.

4.2.3.1 Insufficient water sources and discharge

As stated earlier the total water production capacity of the borehole I and Baydegim well is 50 cubic meters and 60 cubic meters per day respectively. Thus, the total daily discharge of water from the two water sources is 110 cubic meters (110000 liters), which is very low when we compare it to the number of population and demand of water.

4.2.3.2 Power supply interruption

As stated above the pumping station of the borehole I is supplied with electricity and there is no reserve generator. Thus, in case of electric power interruption there is water supply interruption.

4.2.3.3 Urban population growth and subsequent increase of water demand

Urbanization and/or rise in living standard as a factor for water supply shortage increases urban population and water consumption. Water demand is escalating as the urban population is increasing and rapid urbanization is taking place in an area. As stated by Yimer (1992) the problem of adequate potable water supply for urban communities is intimately related to the growth of urban centers, mainly in respect to rapid population growth and people's changing sense of urbanism which implies having water using appliances/fixtures, frequency of bathing, using water for house/floor washing, etc. Thus, the population of Rebu Gebeya town is

increasing from time to time but did not the water supply service; this in turn brings mismatch between the dwellers water demand and supply.

Thus, the dwellers of the town use different mechanisms to cope up water shortage problems during interruption such as storage, buying from vendors and use traditional sources. Similarly, the sample household respondents stated that if the interruption is not in the whole town, and if people needed water and/or if they did not have the time or means to collect water from the public pipe, they bought it from other sites and pay between 1 to 1.5 birr per 20 and 25 liters respectively. If not, they collect from traditional sources of water such as unprotected well and protected hand dug wells, protected and unprotected springs and even from streams, which are not safe for drinking (Table 4.8).

Table 4.8 Alternative sources of water during interruption for sample households

No	Alternative sources of water during interruption	Frequency	Percentage
1	Use storage	32	26.7
2	Buy from uninterrupted areas	17	14.1
3	From unprotected sources	71	59.1
	Total	120	100.00

Source: Sampled household survey, January 2015

As shown in table 4.8, more than two-third 71_(59.1%) of the sample household respondents report that both protected and unprotected traditional sources of water were their main sources of drinking water due to inadequacy and frequent interruption of pipe water supply schemes. Besides, 32_(26.7%) and 17_(14.1%) of the sample household respondents confirmed as they use storage and buy water from uninterrupted areas respectively to overcome water scarcity during interruptions.

Therefore, to alleviate the problems of water supply interruptions in the town, both the concerned government offices like the Regional water resource development bureau, Zonal water resource development offices, Rebu Gebeya town water service office and the community should work together to answer the questions of water supply and distribution shortage.

4.2.4 Water Collection Tanks

Regarding the containers that the households used for fetching and carrying water, all 120_(100%) household respondents indicated that water is transported by human by using either *Insira* or plastic Jarrycans (Figure 4.2).

Table 4.9: Distributions of sample households' responses by water consumptions in liters

Size of the containers in liters		Frequency of fetching water per day					Total	
		1	2	3	4	5	Frequency	Percent
Below 15		-	-	-	-	-	-	-
20 liter		-	1	2	14	13	30	25
25 liter		-	9	12	38	31	90	75
Above 26		-	-	-	-	-	-	-
Total	Frequency	-	10	14	52	44	120	100.00
	Percent	-	8.3	11.6	43.4	36.6	100.00	

Source: Sampled household survey, January 2015

The household survey respondents in the study area indicated that most of the time they fetch water three days a week except the weekend and other common religious holidays. The researcher's personal observations also confirmed that, there is water scheduling in the four Sites due to water shortages in the current water supply and distribution of the town. Regarding to the frequency of fetching water per day, 10_(8.3%) of respondents have been fetching water two times a day, 14_(11.6%) of respondents collect water three times a day and the majority of household respondents about 52_(43.4%) fetch water four times a day. The remaining 44_(36.6%) of household respondents fetch water five times a day. Thus, the mean frequency of water collection is 4.08 times a day (Table 4.9).

Besides, the researcher has also seen the amount of water holding capacity of the container used to fetch in the single round. Thus, 30_(25%) of the respondents report that the holding capacity of the container used to fetch water is 20 liters and the remaining 90_(75%) of the respondent

confirmed that the water holding capacity of the container used to fetch water is 25 litter. When we see the mean amount of water collected in a single round trip was found to be 23.75 liters (Table 4.9).

Table 4.10 Sample households Perception about the current water supply of the town

No	Question	Perception		
		Response	Frequency	Percentage
1.	Are you happy at the current waters supply of the town?	Yes	8	6.7
		No	112	93.3
	Total		120	100.00
2	What makes you unhappy at the current water supply of the town?	Scarce	65	58
		Unsafe	-	-
		Interruption	42	37.5
		Cost	5	4.5
	Total		112	100.00
3.	How do you perceive the current problem of provision of piped water is an issue public worth discussion?	Extremely serious	78	65
		Very serious	27	22.5
		Serious	15	12.5
		Not serious	-	-
	Total		120	100.00

Source: Sampled household survey, January 2015

The sample households were asked whether they are happy at the current water supply or not? Concerning this, as it is indicated in Table 4.10, only 8_(6.7%) of the respondents were happy at the existing water supply situation of the town. Whereas, the majority of the respondents (93.3%) were not happy at the current drinking water supply service of the town. Thus, there is

dissatisfaction among the sample household respondents regarding the water supply and distribution of the town.

Regarding to the cause of dissatisfaction, most of the respondents about 65_(58%) are unhappy at the current water supply of the town due to scarcity and the rest about 42_(37.5%) and 5_(4.5%) of the respondents are dissatisfied due to interruption and cost. In line with this, the sample households confirmed that if they fetch water from the public taps, they are paying 30 and 40 cents per 20 and 25 liters of water respectively.

Regarding to the severity of water problem, the majority of the respondents about 78_(65%) stated that the current problem of provision of piped water is an extremely serious and the rest 27_(22.5%) and 15_(12.5%) of the respondents explained that the problem of water in the current water supply system of the town is very serious and serious respectively.

4.2.5 Impacts of water supply and distribution inaccessibility

It is impossible to have a clean and safety environment without water. Water is necessary in promoting personal hygiene and cleaning the environment. We use water to clean ourselves, our clothes, our dishes, our cars and everything else around us. Without an adequate and wholesome water supply, health cannot be maintained. Thus, inaccessibility of improved potable water supply influences everybody's health, wellbeing, life expectancy, education and social development.

Regarding to this, the sample households were asked whether their families have been faced any water related health problem or not, and the majority of the respondents about 92_(76.7%) reported that, they faced health problems caused by both water-washed diseases (these are risks of overall water scarcity) and risks arising from waterborne infections (Table 4.11). These comprise diseases linked to a lack of water for personal hygiene and risks arising from compromised water sources pertain to viable pathogens or their toxins not being completely removed in the treatment process, thereby causing an excess burden of infectious diseases like Guardia, Typhoid, Ameba, typhus, cholera and the like. The remaining 28(23%) reported that they have not ever encountered any water-washed and water born diseases.

Table 4.11 Sample households' response water related health problem

No	Question	Perception		
		Response	Frequency	Percentage
1	Have you and your families have been faced any water related health problem?	Yes	92	76.7
		No	28	23.3
Total			120	100.00

Source: Sampled household survey, January 2015

The focus group discussion conducted with Rebu Gebeya town water service office and health office officials also confirmed the presence of health problems caused by both water-washed diseases and waterborne infections (Figure 4.2). Furthermore, the health office officials stated that water related health problems are the major health problems in the town.

Figure 4.2: Focus group discussions with Rebu Gebeya town water service office and health office officials

According to the sample households own judgment and the focus group discussion held with Rebu Gebeya town water service office and health office officials; these diseases might be occurred when they use suboptimal water for drinking during long periods of water shortage and interruptions. The more compromised water availability is the greater the pressure will be on using suboptimal water supplies contaminated by pathogens. Thus, to prevent the occurrence of such waterborne diseases, water treatment is very essential. Therefore, big efforts should be made by Rebu Gebeya town water service office and the regional government to increase potable water supply and distribution in the town and to ensure the health of urban dwellers. And this in turn is; crucial to spurring growth and sustaining economic development. But poor access to water supply and distribution limits opportunities to escape poverty and exacerbates the problem of vulnerable and marginalized groups especially those affected by HIV/AIDS and other diseases.

4.3 Community participation in water supply and distribution

As stated earlier, participation comprises the notion of contributing, influencing, sharing, or redistributing power of control, resources, benefits, knowledge, and skill to be gained through beneficiaries' involvement in decision making. Water supply project activities are not likely to achieve their objectives without the active and continuous participation of the users. Users would have to be involved directly or indirectly in the development, planning implementation, operation and maintenance. It is a fundamental element of sustainability of water supply schemes. The water supply agencies have to initiate proactive measures like awareness building, community mobilization, constitution of community-based institutions like water user association and water committees, strengthening democratic process in them and broad basing involvement of community by transferring responsibility and authority to them in all aspects during water supply development, operation and maintenance of schemes (IRC, 1987 cited Yitayh 2011).

Table 4.12 Sample households' participation in water supply schemes

No	Question	Perception		
		Response	Frequency	Percentage
1	Have you ever been involved in the provision of water supply schemes?	Yes	97	81
		No	23	19
	Total		120	100.00
2	At what stage of the development process did you participate?	Planning (in site and schemes type selection)	6	6
		Construction	68	70
		After construction in the management aspect	5	5
		In all phase	-	-
		Leakage and theft prevention	18	19
	Total		97	100.00

Source: Sampled household survey, January 2015

According to the study result shown in table 4.12, of those surveyed 97_(81%) of the sample households had participated in one way or another in the water supply development schemes and the rest 23_(19%) of the sample households had not participated in water supply schemes.

With regard to the phase of community participation in the water supply development the findings revealed that out of participants 68_(70%) of the sample households had actively participated during the construction phase while 6_(6%) participate in planning (in site and schemes type selection), 5_(5%) actively participated in the management schemes after construction and 18_(19%) respondents actively participated in the leakage and theft prevention.

From this one can deduce that there is high level of community participation during the construction phase. But majority of the users did not participate adequately especially during planning phases, which is the more important phase and after construction in the management

aspects. In other words local communities' knowledge through their experiences is not considered in the planning phases which can have impact on sustainability. Regarding the need of communities to participate in site selection (IDRC, 1981 cited in Yitayh 2011) stated that if due consideration is not paid to social aspects while planning, the risk is high and the water supply system either will not be used or will be misused. Therefore, full participation of the community is needed in all phases of water supply projects and existences of an alternative traditional water sources.

Table 4.13: Types and nature of community contribution in water supply schemes

No	Question	Type, nature and level of Participation	Response	
			Frequency	Percentage
1.	What was your contribution in development of the water supply schemes?	Labor support	57	19.45
		Money support	36	12.2
		Local materials (stone, sand, wood) support	64	21.9
		Labor, money and local material support	93	32
		Information provision in site selection and money contribution	6	2
		Labor ,money, local material and information provision in site selection	37	13
	Total		293	100.00
2.	Who have participated in the development of water supply schemes?	Husbands	85	70.8
		Adult males'	12	10
		Women	23	19.2
		Adult females	-	-
		All with the collaboration	-	-
	Total		120	100.00

3.	How do you evaluate your over-all participation in water supply activities	Very high	23	19.1
		High	32	26.7
		Medium	65	54.2
		Low	-	-
	Total		120	100.00

Source: Sampled household survey, January 2015

With regard to the process of participations it is by natural that some of the households have participated and contributed in more than one ways. Thus, survey results revealed that 57_(19.45%) of the household respondents contributed in projects development through contribution of free labor, while 36_(12.2%) indicated contributions in money support, 64_(21.9%) reported contribution of supply of local materials (such as stone, sand, wood), 93_(32%) contributions were though both labor, money and local material support and the rest 37_(13%) and 6_(2%) referred to response to their participation in the support of providing labor, money, local material and information provision in site selection and in information provision in site selection and money contribution respectively.

As shown in table 4.13, out of 120 sample households, about 85_(70.8%) stated that husbands participated in the development of water supply schemes, while 12_(10%) and 23_(19.2%) confirmed that adult males and women participated in the development of water supply schemes respectively. The participation of women in the development of water supply schemes is low compared to that of husbands'. Thus, water supplying agencies should ensure the active involvement of women in all phases of the project.

With regard to the level of overall participation in water supply activities, most households about 65_(54.2%) stated that their level of participation were medium and the rest 23_(19.1%) and 32_(26.7%) reported that their level of participation is very high and high respectively.

The sample households reported that since active community participation is the core element in the provision of urban infrastructure like water supply by contributing to the construction activities through the provision of free labor, money and local material supports. Besides, they stated that, the town's water service office should give due attention to the issue and develop strategies to increase service provision and create awareness on the urban dwellers to increase

the level of participation and this in turn helps to improve provisions of water supply and distribution.

In line with this both the sample households and the participants of focus group discussion also stated that users' contribution in water supply schemes was good. However, the level of participation was meager in the town except the construction phase. Besides, the participants also confirmed that, there is no other institution (like NGO, civil society organization, community organization) which participates in water provision activities in Rebu Gebeya town. Therefore, the town's water service office and other government offices should create awareness, promote, mobilize and increase full community participation both in resource contribution and idea sharing in the provision of water supply facilities. Besides, the town's water service office and other government offices should work for dispelling the idea that only the state or water suppliers should address the situation of un-served groups and move from an attitude of "what can they do for us?" to "what can we achieve if we all work together?" to solve the problems and bring solutions.

CHAPTER FIVR

5. SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 SUMMARY

This study aimed to assess the existing situation of water supply and distribution of Rebu Gebeya town. It intended to assess the existing water supply and distribution progress, the major challenges of water supply and distribution in Rebu Gebeya town, level of peoples' participation and the impacts of water supply shortages in the study area.

Pipe water supply service for Rebu Gebeya Town was started in 1995, and fourteen years later after the town became a Woreda capital, another water source constructed in 2009, and the water sources for the town which were constructed during these years were borehole I and Baydegim well respectively. The water drawn from these individual stations are collected in different storage tanks which are both located at different points north of the town. The water production capacity of the borehole I and Baydegim well is 50 cubic meters and 60 cubic meters per day respectively. Thus, the total daily discharge of water from the two water sources is 110 cubic meters (110000 liters) and the average per capita consumption of water is 17.3 liters per day which is less than the UN-HABITAT (2003) standard of minimum amount of water which is needed to satisfy metabolic, hygienic and domestic requirements usually about 20 liters of safe water per person per day.

The pumping station of the borehole I is supplied with electricity, whereas the pumping station of Baydegim Well was and is still supplied with fuel oil (kerosene) and sends the water into the mains under enough pressure to carry it to every faucet. By this process water is distributed to end users. Surprisingly, the town has a total of 9 kilometers length network, which includes both primary and secondary distribution pipe line and currently from the total 1647 households in the town, only 207 households (12.5% households) have house connected taps (private pipes), which is very low coverage and also there are 13 public taps, from which three public taps are belonged to government institutions of Rebu Gebeya junior secondary school, Rebu Gebeya senior secondary and preparatory school and Rebu Gebeya health center. The remaining urban dwellers get water either from public taps or from their neighbors' tap or fetch from traditional water

sources and one public tap gives service at least for 160 urban dwellers of the town. The traditional sources of water such as unprotected well and protected hand dug wells, protected and unprotected springs and even from streams, which are not safe for drinking. Thus, water supply and distribution networks of Rebu Gebeya town are somewhat inefficient and insufficient as seen from the point of increasing need for wide spatial coverage.

Regarding to the progress of water supply and distribution, increased population led to an increased pressure on the limited amount of available fresh water. Accordingly, the population of Rebu Gebeya town during 2007 census was 4,562 and 5,172 in 2010. It increased to 5,869 and 6,384 in 2013 and 2015 respectively. In line with this, the number of private pipe connection was slightly increasing over years. However, there is no additional water supply service for the Town dwellers after 2009. Thus, there is no increasing progress after 2009 and at this time the number of households who have no connection is more than eight times the connected households. In other words, there are only 207 households who have private pipe connection of the total of 1647 urban households and the percentage of population with piped water connection (domestic water supply coverage) is only 28%, which is more than three times less when compared to the MDG targets of urban water supply coverage of 96% by 2015.

With regarding to water accessibility, it can be explained as an adequate amount of water which is needed to satisfy metabolic, hygienic and domestic requirements at least 20 liters of safe water per person per day (UN-HABITAT, 2003). In urban areas the water source may be either a public fountain or a stand pipe at least 20 liters of safe water per person per day and not more than 200 meters away from the dwelling place. However, the majority of households in Rebu Gebeya town have no a reasonable access and water accessibility standards were and are not applied in the town, and it is difficult for households to fetch water from these distances. And thus, they buy water at relatively high cost from a nearby water vendor. As a result, the high cost of water may force households to use small quantities of water and alternative of poorer quality that brings a greater health risk too.

As the study result indicated, the majority of household respondents about 93.3% were not happy at the current potable water supply service of the town and the causes of dissatisfaction are water scarcity, interruption and cost.

5.2 CONCLUSION

Safe and adequate quantity of drinking water is an essential input for life. However, the efforts made by the state government and other organizations have not been enough in covering all habitations of the town. From those small numbers of households who have a reasonable and good access to tap water supply at 200 meter distance, only small amount of households about 12 (28.5%) have a tap inside their compounds'. In other words, the majority of urban dwellers do not have private pipe connection and they depend on either from neighbors' tap or Public tap/fountain and also most urban dwellers travel to the public tap more than 500 meters far away from their homes, which is much more than 2.5 times the 200 meters recommended by the standard of UN-HABITAT (2003). In relation to time, it takes more than one hour for both waiting turns and round trip for those households who are far away from the public taps more than 500 meters and as most of the respondents indicated the problem of queuing and waiting turns is more serious than that of the distance.

The challenges of water supply and distribution in Rebu Gebeya town are multidimensional and stem from various sources. These are due to population growth and urbanization, lack of technological capacity; insufficient financial resource, insufficient water resources, weak sector coordination and topography of the area were the major ones.

Inconsistency of water supply is also another factor that causes water supply shortage in the town. There is a water scheduling in the four Sites of the town, water supply is turned off and interruption is occurred four full days per week, which implies there is no water supply service 16 days per month or 208 days per annum (this means, there is no water connection continuously almost for 7 months a year). In other words, water supply is turned on only three days a week for few hours and the urban dwellers fetch water only these days per week except the weekend and other common religious holidays due to water shortages in the current water supply and distribution. The main causes of water supply interruptions are insufficient water sources and insufficient discharge (low yield), weak sector coordination, urban population growth and subsequent increase of water demand and large number of households using the single water point, power supply interruption, breakdown of water supply schemes and poor maintenance.

Regarding to the impacts of low water coverage and accessibility, the majority of Rebu Gebeya town dwellers have faced water related health problems caused by both water-washed diseases (these are risks of overall water scarcity) and risks arising from waterborne infections. These comprise diseases linked to a lack of water for personal hygiene and risks arising from compromised water sources pertain to viable pathogens or their toxins not being completely removed in the treatment process, thereby causing an excess burden of infectious diseases like Guardia, Typhoid, Ameba, typhus, Cholera and the like.

Regarding to community participation, there is high level of community participation during the construction phase. But the level of community participation in the town is medium in all phases in general and is meager except the construction phase. The majority of the households did not participate adequately especially during planning phases, which is the more important phase. In other words local communities' knowledge through their experiences is not considered in the planning phases which can have impacts on sustainability.

5.3 RECOMMENDATIONS

Based on the findings of the study, the following practical suggestions are forwarded to improve problems of water supply in the study area.

The current level of water supply and distribution coverage and accessibility in Rebu Gebeya town is very low in any standards. Thus, to overcome the problems of existing water supply and distribution, there should be an urgent need for planned action to manage urban water resources and construction of additional water sources and simultaneously improving the current coverage of private pipe water distribution and also public fountains in favor of lower income groups.

Since water is the most important of all public services and it is the most essential necessity of life after oxygen, the town's water service office should give due attention to increase the availability and distribution of water supply. This helps to raise living standards and levels of income, employment, education and attention to cultural and human values.

Water access and access to water services in the town need to be improved dramatically and urgently. Thus, to increase the volume of potable water supply for daily use, better size reservoirs or tanks should be constructed by the concerned authorities.

The existing distribution of pipelines is following the main roads of the town. Thus, in order to make it easier access for people to have house connection, the water service office should stretch pipe lines through the feeder roads especially in the residential areas of the town.

The town's water service office should give due attention to improve the supply, multiplication and distribution of pipe water and provide the inhabitants with regular water supply by extending the services opening hours. This in turn helps to speed up economic and social development processes by raising the economic and social status of women by freeing them from hard work of traditional life (e.g fetching water from traditional sources) and making it possible for them to engage in other productive activities.

In order to save money, time and energy and exert more pressure for the distribution of excess water throughout the town, the pumping station of Baydegim Well should be supplied with electricity power other than fuel oil.

It is necessary to protect and control traditional water sources from pollution and contamination and the inhabitants must avoid throwing rubbish round the water sources to minimize the contamination of traditional water sources. Besides, to ensure more reliable supply of water all over the year town's water supply service office with the help of the government should make efforts to drill a borehole or to use the water from the nearby river.

Improving urban water services in the town require greater attention. Thus, it is important to stress that none of these barriers of water supply and distribution can be overcome by the sole actions of any one of the actors involved since the development of major water works is beyond the capability of single individuals/institution, so here more than ever there has to be an integrated effort between user communities, the concerned government offices like the Regional water resource development bureau, Zonal water resource development offices, Rebu Gebeya town water service office, engineers that design and construct the water works, and the public agencies that help fund and manage such works.

Since active community participation is the core element in the provision of urban infrastructure like water supply by contributing to the construction activities through the provision of free labor, money and local material supports, the town's water service office and other government offices should create awareness, promote, mobilize and increase full community participation in all aspects to involve the community both in resource contribution and idea sharing in the provision of water supply facilities. Besides, the town's water service office should encourage and ensure women participation in all aspects like resource contribution, decision making and post implementation management.

References

Adeyemo A.M and Afolabi, S.B, (2005). Inequality in the service provision between the Costal and Hinterland areas in the Niger Delta region; being a paper presented at the 47th annual Conference of association of Nigerian geographers held at the University.

Alaci A. and Alehegn, E,(2009).Infrastructure provision and the attainment of Millennium Development Goals (MDG) in Decentralize System of Africa; Experiences from Ethiopia and Nigeria. Abuja,Nigeria.

BassiNitin and Kumar M. Dinesh(2012). Environment and Urbanization in Asia, Addressing the civic challenge, Perspective on institutional change for sustainable Urban water Management in India.

Branco M. C.andHenriques P. D. (2010). Review of Radical Political Economics,The Political Economy of the Human Right to Water.

Caso. Frank (2010).Fresh Water Supply. Global issues. InfoBase Publishing. New York.

CSA. (2004). WefareMaonitoring Survey: AnalyicalReport Addis Ababa ,Ethiopia**.**

CSA (2008).Summary and statistical report of the 2007 population and housing census.

Dalhuisen, J., H. deGroot, and P.Nijkamp (1999).The Economics of water: A survey of issues. Series Research Memoranda.VrijeUniversiteitAmasterdam.

Federal Democratic Republic of Ethiopia National Water Resources Management Policy, (1999).Ethiopia, Addis Ababa.

GetachewBegashaw,(2002).Integrated water and land management research and capacity building priorities for Ethiopia, proceedings of MoWR/EARO/IWMI/ILRI international workshop held at ILRI, Addis Ababa,Ethiopia.

Hall P. (1995). Exploring Earth science, Third edition. United States of America.

Jiang, L.; Young, M.H.; Hardee, K. Population, urbanization and the environment 2008.*World Watch*, *21*, 34–39. Available online: http://www.cgd.ucar.edu/ccr/ljiang/pubs/ (accessed on 20 October 2014).

Khan H. and Siddique (2000): Khan, HamidurRahman and Siddique, QuamrulIslam'Urban Water Management Problems in Developing Countries with Particular Reference to Bangladesh', International Journal of Water Resources Development,16: 1, 21 — 33

McKinneyMichael L., Yonavjak Logan, Schoch Robert M.(2007).Environmental science systems and solutions, fourth edition, United States of America.

MengistTiruye (2005). Amhara National regional state, Town Development Bureau town plan study guide, RebuGebeya's town development plan report,Bahir Dar.

Kharti,K.Bvariavamoorthy K.(2007): Challenges for urban water supply and sanitation in the developing countries, Delft, The Netherland

Korkeakoski,(2006).A guide to sanitation and hygiene for those working in developing countries. Global dry toilet club. Finland.

Ministry of Mines.(1973). Detailed Geological Survey of Ethiopia. Addis Ababa, Ethiopia.

MoH, (2005).Federal Democratic Republic of Ethiopia National hygiene and sanitation strategy Ministry of Health, Ethiopia, Addis Ababa.

MoWR.(1999).Ethiopia Water Resources Mangement Policy. Addis Ababa: BerhanenaSelam Printing Enterprise.

MoWR,(2003).Ministry of Water Resource Water sector development program; main report volume 1.Ethiopa, Addis Ababa.

Mwendera E.J., Hazelton D., Nkhuwa D., Robinson, P. and Tjijenda K., (2003), Overcoming constraints to the implementation of water demand management in southern Africa.

National Metrological Agency. (2012). Monthly rain fall in mm from 2007-2011 RebuGebeya station, Bahir Dar branch, Ethiopia. .

PlatzDaniel (2011).Environment and Urbanization Asia; Tapping Capital for Water.The History in the United Statesand Implications for Asia.

Postel, S.L.; Daily, G.C.; Ehrlich, P.R.(1996).Human appropriation of renewable fresh water. *Science,271*, 785–788.

POST (Parliamentary Office of Science and Technology) (2002). *Access to Water in Developing Countries*; POST: London, UK, volume 178, p. 4.

Prüss-Üstün, A.; Bos, R.; Gore, F.; Bartram, J. 2008.*Safer Water, Better Health: Costs, Benefits, and Sustainability of Interventions to Protect and Promote Health*; World Health Organization: Geneva, Switzerland; p. 53. Available online: http://whqlibdoc.who.int/publications/2008/ 9789241596435_eng.pdf (accessed on 20 October 2014).

Public Health Protection,(2000).Safe water supply Vital to your Health, Sweden.

Puttaswamaiah S.(2005).Drinking water supply; Environmental problems, causes, impacts and Remedies- Experiences from Karnataka.

Rao R.(2002). Safe Drinking Water; the need, the problem, solutions and an action plan.Report of the Third World Acadamy of Sciences, Italy.

RTWSO (2015).The current water supply situation of RebuGebeya's town

RebuGebeya town municipality (2005)RebuGebeya's town development plan.RebuGebeya.

Sijbemsa W.(1989).What prices water Users participation in paying for Community Based Water Supply with particular emphasis on Piped system, The Hague, Netherlands.

SinanWoreda civil serviceoffice (2015).A diagram that shows the civil servants ofSinanWoreda.RebuGebeya.

SinanWoredaculture and tourism office (2013).Stories about the foundation of RebuGebeya town.RebuGebeya.

SinanWoreda Trade and transport office andSinanworeda Technique, profession and enterprises development office (2015). The economic profile of RebuGebeya town residents.RebuGebeya.

TesfayeGobena and ZeyedeKebede (2004).Water supply; produced in collaboration with the Ethiopia Public Health Initiative, The Carter Center, The Ministry of Health and Ministry of Education. Alemaya University

UN (1997).Comprehensive assessment of the freshwater resources of the world. New York: Commission on Sustainable Development.

UN (United Nation) (2008). A future within reach 2008: Regional partnerships for the millennium development goals in Asia and the Pacific. New York: United Nations.

UN-HABITAT,(2003).United Nations Human Settlements Program; improving the lives of 100 million slum dwellers, towards the millennium Development Goals, Nairobi, Kenya.

UN-Habitat (United Nations Center for Human Settlements .2003. Slums of the world: The faces of urban poverty in the new millennium.

UN-HABITAT,(2006).Options for Small Urban Centers in Developing Countries '(nearly a third of the world's population).

UNICEF,(2006).Meeting the MDG Drinking Water and Sanitation Targets; The urban and rural challenge of the Decade, Switzerland.

UNICEF,(1999).Towards better programming a water handbook. Water, Environment and sanitation Technical Guidelines Series - No. 2.

USAID/E,(2008). External Program Evaluation Water, Sanitation and hygiene WASH) program in Ethiopia final report, Addis Ababa.

WHO and UNICEF, (2008).A Snapshot of Drinking Water and Sanitation in Africa, A regional perspective based on new data from the WHO/UNICEF Joint Monitoring Program for Water Supply and Sanitation.

WHO-UNICE(World health Organization-United Nation International Children Emergency Fund)(2005). Water for Life.

WHO-UNICEF (2008).Progress on drinking water and sanitation: Special focus on sanitation. Joint MonitoringProgramme for Water Supply and Sanitation. Geneva: World Health Organization; and New York: United Nations Childrens' Fund.

WHO and UNICEF (2010). Progress on sanitation and drinking-water—2010 update. United Nations.

WHO(World health Organization) (2000).The global water supply and sanitation assessment Geneva.

WHO(2004).Water Sanitation and Health (WSH) water, sanitation and hygiene links to health, facts and figures, Geneva, Switzerland.

Wonder H. Doe (2007).Assessing the Challenges of Water Supply in Urban Ghana: The case of North Teshie. Master thesis, stockholm, Sweden.

World Bank Institute, Roland Liemberger, (2005), Training Module 6, Performance Indicators.

World book encyclopedia (2001) volume 21, A Scott Fetzer Company, United States of America

Yimer Mohammed (1992): Factors affecting household water supply and consumption in Nazareth, M.A. thesis, Addis Ababa University.

YitayhLeul (2011) ; Assessment of problems to sustainability of rural water supply and management systems in MachakelWoreda, Amhara region, M.A. thesis, Addis Ababa University.

Appendix I

Questionnaire for household survey

The purpose of the questionnaire is to generate relevant information on problems and prospects of water supply and distribution in Rebu Gebeya town. The research is going to be conducted for the partial fulfillment of MA degree in Geography and Environmental Studies at the Colleges of Social Sciences. It is only for the academic purpose and be sure that the information you provide will be used for this research only. Your full support and willingness' to respond to the question is very essential for the success of the study. Therefore, you are kindly requested to answer all questions and give reliable information on the issues.

Thanks in advance for your cooperation.

Personal profile of the respondents

1. Age ……

2. Sex M…… F ……

3. Current marital status A. Single B. Divorced C. Married D. Widowed

4. Household family size A. below 4 B. 4-6 C. 7-9 D. Above 9

5. Household monthly income A. below 400 B.401-800 C.801-1200 D.1201-1600
E.1601- 2000 F. above 2001 G. no response

6. Educational level

A. Illiterate B. Elementary

C. High school D. Diploma

E. BA/BSc Degree F. If other, please specify

7. Current occupation

A. farming B commercial /Trade C. Government employee D. Daily labor E. farming and trade F. farming and Daily labor G. If other, please specify

I. Questionnaires answered by sample households

1. Do you have reasonable and good access to tap water supply at 200 meter distance?
A. Yes B. No

2. If your answer is yes for question number "1" from where do you get?
A.tap inside the compound C. tap outside compound
B. tap inside neighbors' compound lic tap/fountain

3. If your answer is no for question number “1 ” and “2”, what do you think the main challenges of water supply and distribution of the tov

No	Possible reasons	Alternatives	
		Yes	No
3.1	Population growth and urbanization		
3.2	Lack of institutional capacity		
3.3	Lack of technological capacity		
3.4	Insufficient financial resource		
3.5	Insufficient water sources		
3.6	Weak sector coordination		
3.7	Lack of community participation		
3.8	Topography of the area		
	If others, please specify		

4. What is /are your major sources of water or where from you get water supplies for domestic purpose?

A. private pipe connection B. public pipe C. from water vendors’

D. well E. stream F. if others, specify----------

5. What are the containers that you use to fetch water?

A. pail B. barrel C. Jerrycan D. Insira E. other

6. How much water do you use on average per day in liter? ----------

7. How many times do you fetch water per day? ----------

8. How many Kilometers (meters) do you travel to get water from the water source and How long is the approximate time consumed in waiting turns fetching? ----------

9. How do you transport water from the source to home?

A. Human load B. Donkey C. Animal pulled cart D. If other, please specify

10. Do you use the same sources of water throughout the year? A. Yes B. no

11. Is there any water supply interruption in your village? A. Yes B. no

12. If your answer for Question No "11" is yes, what are the frequency and the average duration of water supply interruption? ----------

13. Based on Question No "11" above, what do you think the reason for the interruption?--------

14. When drinking water supply is interrupted which water source do you use?----------

15. Do you have private pipe connection? A. Yes B. no

16. If your response for Question No "15" is no, what is the reason?

17. Are you happy at the existing water supply of the town? A. yes B. no

18. If your answer for question number "17" is no, what is your reason? It is

A. Scarce (shortage) B. Unsafe C. Interruption D. Cost

19. How do you perceive the current provision of piped water is an issue public worth discussion?

A. extremely serious B. very serious C. Serious D. not serious

20. Have you and your family been faced any water related health problem? A. yes B. no

21. If your answer for Question No “20” is yes, what are they? ----------
---
---

22. What do you say about the overall supply and distribution progress of pipe water to satisfy the demand of the population at the present time and for the future? ----------
---
---

23. What do you recommend to alleviate the problems of water supply and distribution in your town?----------
---
---

24. Have you been involved in the provision of the water supply schemes? A. Yes B. No

25. If your response to question number “24” is yes, at what stage of the development process did you participate?

A. Planning
B. Construction
C. After construction in the management aspect
D. In all phases
E. Leakage and theft prevention
F. If other specify----------

26. What was your contribution in development of the water supply schemes?

No	Participation	Participation indicators			
		High	Moderate	Rarely	Not at all
26.1	Labor				
26.2	Money				
26.3	local materials (stone, sand, wood)				
26.4	Labor ,money and local material				
26.5	Information provision in site selection and money contribution				
26.6	Labor ,money local material and information provision in site selection				
26.7	If other, please specify				

27. Who have participated in the development of water supply schemes?

A. Husbands B. Adult males' C. Women

D. Adult females E. All with the collaboration F. If other, please specify----------

28. How do you evaluate your over all participation in water supply activities?

A. very high B. high C. medium D. low

29. What do you think should be done by the community to improve the problems related to the provisions of water supply and distribution of the existing schemes? ----------

---

Appendix II

Checklist for Focus group Discussion with Rebu Gebeya town water service office and health office officials

1. What is the status of existing water supply and distribution situation of the town?
2. What are the sources of water to urban dwellers in Rebu Gebeya town?
3. Do you think that, the sources of water have a reasonable access and adequacy to urban dwellers of Rebu Gebeya town?
4. Is/ are it/they enough to meet the current and future water demand of the town?
5. What are the challenges in providing improved water services to the urban dwellers?
6. What measures should be taken to overcome the problems?
7. Is there any water related problem on the life of urban dwellers?
8. If your answer is yes for question number 7, what are they?
9. Is there water supply interruption in the town?
10. If your answer for question number 9 is yes, how often and how long?
11. What do you think the causes of water supply interruption and what solutions do you have on the time?
12. Is there community participation in water supply activities in Rebu Gebeya town?
13. Is there any other institution (NGO, civil society organization, community organization etc) which participates in water provision activities in Rebu Gebeya town?
14. If your answer for question number 12 and 13 is yes, how do you evaluate the overall participation?
15. What do you say about the overall supply and distribution progress of pipe water to satisfy the demand of the population at the present time and for the future?
16. What strategy is set by your office to provide improved water supply and distribution facilities to the urban dwellers?

Appendix III

Personal Observation Checklist

1. What is the current status of water supply and distribution in the town?

2. Is/ are it/they enough to meet the current and future water demand of the town?

2. What is /are the sources of water in the town?

3. Is there water supply interruption in the town? How often and how long?

4. Who fetches water for domestic purpose?

5. What round trip distance and time they spend to fetch water from alternative sources?

6. What types of containers used to fetch water?

7. What is the peak time for water collection?

8. What looks like of waiting turns for water fetching?

9. How it is transported?

10. What looks like the duration of opening time of pipes for users?

Thanks once again!