ANALYSIS OF WATER SUPPLY AND DISTRIBUTION PROBLEMS: THE CASE OF BURAYU TOWN, OROMIA SPECIAL ZONE SURROUNDING FINFINE, ETHIOPIA

MA THESIS

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As thesis research advisors, we hereby certify that we have read and evaluated this thesis prepared, under my guidance, by Dawit Tadesse, entitled Analysis of Water Supply and Distribution Problems: The Case of Burayu Town, Oromia Special Zone Surrounding Finfine Ethiopia**'.**We recommend that it be submitted as fulfilling the Thesis requirement for the Degree of Master of Art in Geography and Environmental Studies.

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I dedicate this thesis to my beloved family and friends.

STATEMENT OF THE AUTHOR

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ACRONYMS

CSA	Central Statistics Agency
MDG	Millennium Development Goal
Psi	pounds per square inch
OWRMB	Oromia Water Resource Management Bureau
OWWDSE	Oromia Water Works Design and Supervision Enterprise
UN	United Nations
UNDP	United Nation Development Program
UNICEF	United Nation International Children Education Fund
WBE	World Bank Encyclopedia
WHO	World Health Organization
WPP	Water Partnership Program
WSSD	World Summit on Sustainable Development
WSUP	Water & Sanitation for the Urban Poor

BIOGRAPHICAL SKETCH

The author was born in 1980 in Arsi Zone, Sire Town and attended his elementary education at Felege Birhan Elementary School in Sire Town and completed his secondary and preparatory education at Sire Senior Secondary School, Sire. He then joined Mekelle University, College of Social Sciences and Humanities in 2006 and graduated with B.Ed. Degree in Geography Minor History in 2008. From 2009 up to 2011, the author has been teaching Geography at Grawa Secondary School in Eastern Hararghe Zone, Grawa Town. Since 2012, the author is teaching at Burayu Secondary School, Burayu Town. He joined the Post graduate Program Directorate of Haramaya University in 2015 as a graduate student for the Master of Art Degree in Geography and Environmental Studies.

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ABSTRACT

Access to quality water remains a key indicator of an improved social and economic life of any community. The objective of this study was to assess the challenges of water supply and distribution problems of Burayu town. Descriptive survey method was used to assess the area for its water supply and distribution schemes based on survey responses from a total of 303 households picked from three kebeles of the town. Descriptive survey method was used to select household respondents, while purposive sampling was attended for interviewing the key personnel. The primary and secondary data were collected by different methods. Questionnaire survey, key informants' interview, observation and document analysis data collection tools were used. The collected data were properly analyzed using descriptive statistics. It was found that there are water supply and distribution challenges like; inadequate access to pipe water, inefficient pipeline and frequent interruption in the area due to different reasons. Among the major causes of the challenge; population pressure, topography, poor distribution of water infrastructure, lack of technological capacity, weak sectorial coordination, and insufficient financial resource are some of the main undermining root causes. According to the survey results, the insufficient and interrupted water supply, poor quality and lack of proper distribution are raised due to difficulties in and administration problems. This study has attempted to examine the water supply and distribution scenario of Burayu Town. The water demand of the town is increasing due to urbanization and population growth.Better coordination between the different stakeholders, for instance, there is lack of coordination between the water sector, telecommunication department and the road authority; because of this, water pipes are frequently damaged during activities such as laying down telephone and internet lines, and during road construction.

Key words: *Burayu town, challenge, water, water distribution, water supply*

1. INTRODUCTION

1.1. Background of the Study

The sustainable provision of adequate and safe drinking water is the most important for all public services (World Bank, 2010). It is one of the essential necessities of life next to oxygen. Sustainability of water supplies is a key challenge, both in terms of water sources and service delivery. In today's world of 6 billion people (World Bank, 2010), providing water and sanitation facilities is already a serious challenge, straining management systems and institutions. Due to the rapid population growth and uncontrolled residential development witnessed in most developing countries the global urban environment is seriously being degraded in terms of service delivery (UN-HABITAT. 2017). Water supply is the public utilities that have been worst hit the rapid population growth and uncontrolled residential development scenario. These facilities are necessary commodities in household and municipal activities (FAO, 2008). Though continuity of water supply is taken for granted in most developed countries, it is a severe problem in many developing countries, where sometimes water is only provided for a few hours every day or a few days a week (UN-HABITAT, 2006).

Water intrinsically interconnected with the MDGs and basic sanitation was added to the catalogue at the 2002 world summit on sustainable development in Johannesburg. To halve by2015 the proportion of people without sustainable access to safe drinking water is one of numerical and time-bound targets defined for the MDG. (WSSD, 2002). Water supply and sanitation in Indonesia is characterized by poor level of access and service quality. Over 40 million people lack access to an improved water sources with only 2% have access to sewerage in urban areas is one of the lowest in the world among middle income countries (ibid).

In Africa, water shortage is occurring due to lack of availability of water resources and the uneven distribution of those resources. In addition, population growth rate of 3% per year which is a major factor in on-going water supply problems. More than 30% of the residents in urban areas currently lack access to be adequate water supply services and facilities (Water Utility Partnership, 2013).

The water supply sector in Ethiopia is one of the least developed and is mostly characterized by service deficiency of physical infrastructure as well as by inadequate management capacity to handle policy and regulatory issue and to plan, operate, and maintain the service.

Ethiopia has one of the highest urbanization growth rates in the developing World. According to data obtained from the Central Statistical Authority, the country's urban population was growing at 4.8 per cent per annum, between 1995 to 2000. The urban population in Ethiopia in 2007 was 16.1 per cent of the total population. Available data also indicate that in the next 25 years (1994-2020), nearly 30 per cent of Ethiopia's population will live in cities (CSA, 2006).This kind of rapid urban population growth will inevitably call for huge investments in housing, urban infrastructure, water and electricity supply, sanitation systems and environmental protection programs and programs to alleviate poverty and unemployment in the cities. This implies that the challenge will require well trained municipal management and resource capacity, responsive urban governance and well trained and motivated personnel and sustaining services such as water, electricity supply, local revenue collection and administration to meet the ever-growing demand for better and more quality services and infrastructures(CSA,2006).

However, in some larger urban centers the poor may lack access. The aforementioned information indicates that as a result of low level of development a significant proportion of the total urban population of Ethiopia in particular and total population of Ethiopia in general have no access to safe and adequate potable water supply. They still restrict themselves to use what nature has provided them with in the form of springs, rivers, lakes, ponds, traditional hand dug wells and rain water which are often unsafe, cause health hazards and are at considerable distance from households.

Among the main reasons given for the slow pace of progress in water supply services in Ethiopia, the following are net worthy: lack of comprehensive legislation; inadequate investment resources; lack of a national water tariff policy and the absence of beneficiary participation and community management (Dereje, 2014).

1.2. Statement of the Problem

Water is one of the most crucial and non-renewable environmental resources. However, many people across the world do not have access to safe and adequate water supply services which affects their life in various ways (Yibeltal, 2011). According to WHO-UNICEF(2008), providing potable water shortage 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.

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. Water supply distribution 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 (Yitayh, 2011).

One of the major challenges driving water stress in developing countries is rapid urbanization. However due to insufficient structures coupled with rapid population growth and urbanization, the gap between demand and supply of water continues to widen (Degnet, 2011). 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 stated that though Ethiopia is often referred to as the "water tower of Africa". Therefore, the provision of supply distribution of drinking water in the study area has been a challenging situation in the past five years and is composed of both formal and informal settlements. This situation in the study area, Burayu town, is not far from such realities. Burayu town water supply service office, the concerned body to supply for the town, has many problems as an institution to ensure a sustainable water supply and distribution. Shortage budget, lack of man power to handle policy and regulator issues and to plan operation and lack of coordination with stakeholders (Girma, 2018).

In addition to this the town has experienced an immense increase in uncontrolled residential development, coupled with low income and high poverty level of the residents are some of the overriding issues inviting attention related to the water supply and distribution problem in the

study area. In fact, different researchers have been conducted in relation to sustainable water supply, water supply planning and water supply management including environmental sanitation. Burayu city which is witnessing active industrialization, urbanization and population growth is also facing a challenge of providing basic services like drinking watersupply and Sanitation, urban land, and infrastructure developments like roads, waste removal, public utility and social welfare. It is therefore important to study the assessment of water supply and distribution problems in order to suggest ways that will improve supply and distribution and bring health growth in the city.

The problem of water supply in the town is not only the problem of distribution and reliability but also it has the problem of adequacy and accessibility. To this end, it will be a bridge in the existing research gap and come up with different planning solutions for the service distribution. There has been a wide gap, particularly in the water supply service even compared with other infrastructural developments like supply of electricity in the area. Burayu town is currently getting water once per week for just a few hours, which is inadequate for everyday activities of the house hold, like, drinking, cooking, cleaning and washing clothes. As a result, residents are forced to get water to their homes.

Thus, the issue of water supply distribution is critical when resources scarcity and equity matters are raised. The distribution of water supply projects and the benefits they deliver are some of the overriding concerns of the sector. Design and implementation of water supply projects has been unsuccessful and in efficient. It has short coming and follow ups, operation, maintenance and management issues. Therefore, in the light of the aforementioned problems, this paper assessed the challenges on accesses of water supply and distribution problems in Burayu town.

1.3. Objectives of the Study

1.3.1. General Objective

General objective of the study was to assess the challenges of water supply and distribution problems of Burayu town.

1.3.2. Specific Objective

The Specific objective of the study is;

- To assess the current urban water supply and distribution in the town.
- To identify the major challenges and causes in water supply and distribution problem in Burayu town.
- To assess the effects of water supply and distribution scarcity in the study area.

1.4. Research Questions

In order to achieve the above-mentioned research objectives and want to answers for the stated objectives the following research questions were designed:

- What are the current urban water supply and distribution situations in the town?
- What are the major challenges and causes of water supply and distribution in the town?
- What are the effects of water supply and distribution scarcity in the study area?

1.5. Significance of the Study

The study is believed to be important, since it assessed 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. The study could give a clue or serve as a reference for those working in the planning and design of water supply to manage the existing schemes in efficient and effective ways. Moreover, the outcomes of this study could serve as a stepping stone for other researchers who are interested in the area.

1.6. Scope of the Study

Primarily this study does not assess the entire population of all kebeles of the Town as it was time consuming and economically very expensive. Thus, according to the sampling technique, only three kebeles in Burayu town namely, *Melka Gefersa, Gefersa Burayu, and Gefersa Guje* were selected. Therefore, the scope of the study in terms of subject/theme/ was limited to assess the challenges on distribution of domestic water supply only. It does not include industries and consumption by other sectors.

1.7. Limitations of the Study

Due to some major challenges related with the collection of the data, the study was exposed for some limitations. The first limitation of the study was associated with availability of sufficient information regarding to the study area water supply and distribution system network condition which has been designed for the town. Secondly, the study suffers from lack of sufficient secondary data related with urban water supply design and the poor documentation of the water supply and sanitation authority offices.

1.8. Definition of Key Terms

Water: **-**is a foundation of life and livelihoods, and is key to sustainable development and it covers 70% of the planet – is false, as only 2.5% of all water is freshwater. Water also exists as vapor in the earth's atmosphere. It is considered as the universal solvent because of its ability to dissolve almost all organic and inorganic solids and gases it comes in contact with. For this reason, pure water is never found in nature. Even rainwater, the purest natural water, contains chemicals dissolved from the air. Pure water is obtained only by special methods of distillation and by chemical action in laboratories (WPP, 2012).

Water supply system: **-** means the structures, aqueduct, pipes, valves, pumps, meters or other appurtenances relating thereto which are vested and are used or intended to be used by it in connection with the supply of water, and includes any part of the system (Chris N, and Richard F., 2014)

***Safe water:* -** water that does not contain harmful chemical substances or micro-organisms in concentrations that cause illness in any form. Pure water is a tasteless, odorless and colorless liquid. Water in liquid form is most dense at 4° C, (39.2° F). The density of water at this temperature is used as a standard of comparison for expressing the density of other liquids and solids. At 4° C, one liter of water weighs 1 kilogram (a density of 1 gram/cc). In its gas form as a vapor, water is lighter than air, thus, it rises in the atmosphere (WPP, 2012).

***Adequate waters supply:* -** one that provides safe water in quantities sufficient for drinking, and for culinary, domestic, and other household purposes so as to make possible the personal hygiene of members of the household. A sufficient quantity should be available on a reliable, year-round basis near to, or within the household where the water is to be used (Khan and Siddique, 2000).
A well is a hole which has been dug, bored, driven or drilled beneath the ground for the purpose of extracting ground water (WPP, 2012).

1.9. Organization of the Thesis

This thesis organized in five chapters. Chapter one comprises the introduction part which included; the background of the study, statement of the problem; objectives of the study; research questions; significance of the study; scope of the study; limitations of the study; definitions of key terms and the organization of the thesis. Chapter two of this thesis work allows for the review of past research work adding more knowledge to the research study and comprises review of empirical data. Chapter three is the research methodology part which includes the description of the study area; research design; sources of data; sampling techniques and sample size; instruments of data collection and data analysis and interpretation. Chapter four presents a discussion on the results. Chapter five provides the summary, conclusion and recommendations of the research study. References and appendices are attached at the end of the thesis.

2. LITERATURE REVIEW

2.1. Concepts of Water Supply and Distribution

Water is a fundamental requirement for human life without which, life cannot be sustaining long. The supply of water includes the requirement for water services in agriculture, industry, domestic and other purposes (Jack, 2011), while distribution is the delivery of water to consumers with appropriate quality, quantity and pressure (Bibhabasu, 2010).Urban water supply 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. (Yitayh, 2011). Lack of access to adequate water supply leads human life to multidimensional problems. It affects different aspects of human life including their social, economic, health, education and dignity.

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).

2.2. Overview of Global Water Supply and Distribution

Though the global use of improved water sources showed progress from time to time but still 780 million people don't have access to safe drinking water which clearly shows the pressure of the population growth (WHO, 2012). According to the World Health Organization and UNICEF, in 2010, 89% of the world's population used drinking water from improved sources (54% from a piped connection in their dwelling, plot or yard, and 35% from other improved drinking water sources), leaving 605 million people lacking access to an improved source of water (WHO/UNICEF, 2012).

The United Nations' Millennium Development Goal (MDG) stated that drinking water target to halve the proportion of people without sustainable access to safe drinking water by 2015 in 2010, 5 years ahead of schedule (WHO/UNICEF, 2012). More than 2 billion people gained access to improved water sources from 1990 to 2010.

2.3. The Rationales of Urban Water Supply in Africa

In the year 2000 almost all African countries were adopted the millennium development goals and seeks to "halve by 2015 the proportion of people without access to safe drinking water and sanitation" (Todaro and Smith, 2011). However, in Sub-Saharan Africa it is anticipated to rich the target to the year 2040, after 25 year from the expected target (Sutton, 2012). That is why still, around 276.5 million of the people living in sub Saharan Africa left without access to safe water with a majority of them being women and children living in rural households. Sub-Saharan Africa has the lowest drinking water coverage and the lowest sanitation coverage in the world (WHO, 2012).

With only 56 percent of the population enjoying access to safe water, Sub-Saharan Africa lags behind other regions in terms of access to improved water sources. Based on present trends, it appears that the region is unlikely to meet the target of 75 percent access to improved water by 2015, as specified in the Millennium Development Goals (MDG). The welfare implications of safe water cannot be overstated. The estimated health and time-saving benefits of meeting the MDG goal are about 11 times as high as the associated costs. Monitoring the progress of infrastructure sectors such as water supply has been a significant by-product of the MDG, and serious attention and funding have been devoted in recent years to developing systems for monitoring and evaluating in developing countries (WHO/UNICEF, 2012).

Piped water reaches more urban Africans than any other form of water supply-but not as large a share as it did in the early 1990s. The most recent available data (WHO/UNICEF, 2012), for 32 countries suggests that some 39 percent of the urban population of Sub-Saharan Africa is connected to a piped network, compared with 50 percent in the early 1990s. Analysis suggests that the majority of those who lack access to utility water live too far away from the distribution network, although some fail to connect even when they live close by. Water-sector institutions follow no consistent pattern in Sub-Saharan Africa. Where service is centralized, a significant minority has chosen to combine power and water services into a single national multi-utility urban water sector reforms were carried out in the 1990s, with the aim of creating commercially oriented utilities and bringing the sector under formal regulation. One goal of the reforms was to attract private participation in the sector.

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.

In Africa despite there are recently positive trends regarding the water supply and coverage, still the problem is pervasive in the region and remains unsolved permanently. Even in the region for many of those who supposedly already enjoy an improved service, the reality is one of poor continuity, poor quality and premature failure. As a result Tens of millions of people face continuing problems with systems that fail prematurely, leading to wasted resources and false expectations (Lockwood, and Smits, 2011).

According to the report of WHO/UNICEF, (2011), 84% of people without access to improved drinking water sources live in rural areas of the region. In Africa the sustainability of water projects still remains the major challenge for continued provision of water to the rural population. The Water Supply Network indicates an average rate of non-functionality for hand-pumps in sub-Saharan Africa is 36% which is shameful wastage in the sector. Due to this fact huge amount money which estimated to be hundreds of millions of dollars over the last 20 years are wasted. Having recognizing such trends community managed projects has been envisaged but still the problem remains intact due to lack real participation of the community (Lockwood, and Smits, 2011). Regarding this, World Bank Group (2005:2) stated that though Ethiopia is often referred to as the “water tower” of Africa, only a quarter of the country’s population have improved access to water sources

2.4. Water Supply in Ethiopia

Ethiopia has long been characterized by limited access to safe drinking water services. For instance, only 19% of the country’s population had access to a safe drinking water supply by 2007 this figure had reached 52 percent in 2011 (Degnet*etal*, 2011). Ethiopia has plenty of water resources but the available water is not distributed evenly across the country and the amount varies with seasons and years. The challenge in any situation is to maintain a year-round supply that is adequate to meet people’s needs.

To ensure that supply meets demand the source of the water must be carefully chosen, taking into account present and future demand for water, and the costs. The cost of water supplies is heavily influenced by the distance of reliable water sources from towns. The challenge for many towns is finding nearby water sources (MoH, 2001; Ali and Terfa, 2012).

Planning for present and future demand has to consider population growth. The demand for water is increasing in cities and towns due to an ever-growing population and the migration of people from rural areas to towns in search of jobs and a better life. There are also increasing demands from industrial and commercial development. The quantity of water required for domestic use depends not only on the number of people but also on their habits and culture, and on how accessible the water is. On average, Ethiopians in urban areas use only about 15 litres of water a day for their needs (MoH, 2001; Ali and Terfa, 2012).

There is a difference between the WHO estimate and the daily water consumption per person in Ethiopian towns. The shortfall is perhaps due to the shortage of private water taps, which means that people have to collect water from public taps. If people have a piped water supply in their home they are likely to wash and bathe more frequently, and some may have water-using appliances like washing machines. As water supply systems improve and access increases, the consumption of water will increase also. It is therefore important for water supply planners to consider the expected changes in society and in living standards. Planning of water supply projects should also consider the water requirements of schools, hospitals and other health facilities, churches and mosques, hotels, public washrooms, and other community facilities (WHO, 2012).

The government of Ethiopia has set targets of 100% coverage of safe water supply in urban areas and 98% coverage in rural areas. These targets originated from the Universal Access Plan of 2005 and the Growth and Transformation Plan of 2010, and have been adopted by the One WASH National Programme (OWNP), which is being implemented with major funding from government and international donors (FDRE, 2013).

The planning criteria for water supply coverage in the OWNP are:

- Rural water supply: 15 liters/person/day, within 1.5 km radius
- Urban water supply: 20 liters/person/day, within 0.5 km radius (FDRE, 2013).

As you can see, these figures are still below the WHO recommendation and are more than current usage, indicating the scale of the challenge ahead. The targets for Ethiopia are that 4.4 million urban inhabitants and 26.6 million rural inhabitants, nearly 30,000 schools, and more than 7500 health posts/centers will gain access to safe drinking water (FDRE, 2013).

Even though coverage of safe drinking water supply has gradually increased at the national level, the rate is still very low. Inadequate quality of drinking water also remains a major cause of health problems and poor sanitation in rural areas of Ethiopia. The unavailability of safe drinking water in most rural and urban locations is one of the main causes of diarrhea among children under the age of five (CSA 2006). The negative health impact of contaminated water is exacerbated because more than 90 percent of households consume this water untreated. Previous empirical studies elsewhere also show that access to improved water is an important contributor to improved child health and mortality reduction (Degnet *et al.*, 2011).

In Ethiopia, the problem of drinking water supply is further compounded by physical distance. A recent estimate reveals that about 52 percent of the population traveled half an hour or more to collect water every day (CSA 2006). This long travel distance to the nearest water source directly affects women and children, who are mainly responsible for fetching water. This has an implication on the productivity of women. The long hours spent in fetching water taking a significant amount of time that could be employed in other income-generating activities. The human capital implication for young girls cannot be overlooked as well. Most girls in Ethiopia find it too difficult to attend and succeed in school because a significant amount of their time is used for domestic chores, including fetching water.

2.5. Sources of Water Supply

Water sources are generally classified according to their relative location on the surface of the earth. These are characterized as follows:

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 (Tesfaye and Zeyede, 2004).

According to WPP (2012), surface water is exposed to the atmosphere and subject to surface runoff. It comes from rains, surface runoff and groundwater, and includes rivers, lakes, streams, ponds, impounding reservoirs, seas, and oceans. The quantity of surface runoff depends on a large number of factors; the most important of which are the amount and intensity of rainfall, the climate and vegetation, and the geological, geographical, and topographical features of the catchment area. The quality of surface water is determined by the amount of pollutants and contaminants picked up by the water in the course of its travel. While flowing over the ground, surface water collects silt, decaying organic matter, bacteria and other microorganisms from the soil. Thus, all surface water sources should be presumed to be unsafe for human consumption without some form of treatment.

Rain water; according to WPP (2012), rainwater, or atmospheric water, is a product of water vapor that has risen due to evaporation and accumulated in the atmosphere, which condenses and falls on the Earth's surface. As the water vapor that has accumulated in cloud formations condenses, it forms drops of rain that fall to the Earth. 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 (Tesfaye and Zeyede, 2004).

Ground water; according to WPP (2012), Groundwater is that portion of rainwater which has percolated beneath the ground surface to form underground deposits called aquifers. The upper surface of groundwater is the water table. Groundwater is often clear, free from organic matter and bacteria due to the filtering effect of soil on water percolating through it. However, groundwater almost always contains minerals dissolved from the soil. Groundwater is often better in quality than surface waters, less expensive to develop for use, and usually provides more adequate supply in many areas in the country. For rural water supply systems, groundwater is generally preferred as a water source.

According to WPP (2012) the types and extraction methods are as follows:

- **Spring–** is a point where groundwater flows out of the ground, and is thus where the aquifer surface meets the ground surface. A spring may be ephemeral (intermittent) or perennial (continuous). Springs can be developed by enlarging the water outlet and constructing an intake structure for water catchment and storage.
- **Well–** is a hole constructed by any method such as digging, driving, boring, or drilling for the purpose of withdrawing water from underground aquifers. Wells can vary greatly in depth, water volume and water quality. Well water typically contains more minerals in solution than surface water and may require treatment to soften the water by removing minerals such as arsenic, iron and manganese. Well water may be drawn by pumping from a source below the surface of the earth. Alternatively, it could be drawn up using containers, such as buckets that are raised mechanically or by hand.
- **Infiltration Galleries/Wells–** Infiltration galleries are horizontal wells, constructed by digging a trench into the water-bearing sand and installing perforated pipes in it. Water collected in these pipes converges into a “well” from which it is pumped out.

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 water (Tesfaye and Zeyede 2004).

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 whereas 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.

2.6. 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 Lockwood and Smits (2011), 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 varies depending on whether it’s an urban or rural location and whether warm or hot climate.

2.7. Challenges for Urban Water Supply and Distribution

Water is the most widely occurring substance in the world. It covers more than 70 percent the earth’s surface. If this water is 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. 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 (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 (UNICEF/WHO, 2008). Despite international and local efforts towards improving water supply conditions, changes are not satisfactory in many African countries.

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 (Wonder, 2007).

The problem of water supply in urban areas of developing countries is a major concern. 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.

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).

Another key issue in urban areas is the reliability of the water supply. Consultations with the poor also highlighted this aspect vividly. Limited available information suggests that reliability of supply is likely to be quite poor, both in terms of quantity and frequency. Regarding access for the poor on the whole, relative level of access to water and sanitation in urban areas is estimated to be high in Ethiopia. However, in some larger urban centers the poor may lack access. The aforementioned information indicates that as a result of low level of development a significant proportion of the total urban population of Ethiopia in particular and total population of Ethiopia in general have no access to safe and adequate potable water supply. They still restrict themselves to use what nature has provided them with in the form of springs, rivers, lakes, ponds, traditional hand dug wells and rain water which are often unsafe, cause health hazards and are at considerable distance from households (UNICEF/WHO, 2008).

In the provision of adequate clean water to urban dwellers, the world faced many challenges, which are related to capacity of the nations, (i.e. technological knowhow and institutional), inadequate finance, rapid urbanization and declining of global water resource (ibid).

2.7.1. Lack of Capacity

According to Wallace et al (2008), capacity is a flexible concept and encompasses the public sector, academia; community based organizations and the private sectors, and ranges from the individual to institutions to society as a whole. Capacity can be described in terms of the human, technological, infrastructural, institutional and managerial resources required at all levels from the individual through to national governance.

Not only does capacity have to be built within each of these levels, but it has to be institutionalized and local communities need to be empowered to use it effectively.

According to Wallace et al (2008), additionally, capacity building incorporates the followings:

I. The capacity to engage, educate and train; including community awareness building, adult training and formal education; so as to provide sufficient numbers of competent human resources to develop and apply enabling systems within the local environment.
II. The capacity to measure and understand aquatic systems through monitoring, applied research, technology development and forecasting, so that reliable data are used for analysis and decision making.
III. The capacity to develop policies and programs and to legislate, regulate and achieve compliance through effective governmental, non-governmental and private sector institutions and through efficient enforcement and community acceptance, particularly for rural areas.
IV. The capacity to identify and provide appropriate and affordable water technologies, infrastructure services and products through sustained research, investment and management.

2.7.1.1. Technological Capacity

Innovative technologies are essential to overcome barriers to water service provision**.** Technological capacity includes the development and application of new technologies, the technical skills needed to effectively construct, operate and manage a technical solution; the translation of information regarding technologies to promote informed decision-making when implementing a technical solution; the availability and accessibility of spare parts (Chala, 2011). However, technology providers need a better understanding of local conditions and policies.

2.7.1.2. Institutional Capacity

There is a need for institutions that bring together many disciplines, such as the natural sciences, public health, engineering and the social sciences. Integration and interaction between institutions and different sectors of the population, at decision-making, executive and participative levels is required to plan and execute actions in a coordinated way. This integration is the basis for multi spectral approaches to ensure that planned goals are achieved and actions converge to solve environmental, water and health problems (Wallace et al, 2008).

2.7.2. Inadequate Financing

Historically, water has suffered from severe under financing. This results from inadequate internal financial capacity in the poor countries to achieve water goals; poor political decisions for allocation of development aid; an overall reduction over time in development aid; and the limited cost recovery potential in poverty-stricken regions (Wallace *et al.*, 2008).

For example, for 2005 Water Supply Millennium Development Goal-Needs Assessment Report by the government of Ethiopia estimates the investment requirements for water at US$297 million per year for the next ten years (2006-2015). Per capita investment for water in urban and rural areas is US$105 and US$41 respectively. Total government allocation and commitment for WSS over the next seven years has been projected at US$12 million (US$5.4 million for rural, and US$6.6 million for urban). Given the cost recovery policy for capital, operations and maintenances costs, community investment is projected at US$16 million over the next ten years. Projected ODA is US$75 million per year for the next ten years, based on commitments from a variety of donors. Still, this leaves a financing gap of US$197 million per year (Challa, 2011).

In addition, poor targeting of aid and a multiplicity of actors and structures compound the financial shortfall. Prioritization of spending plays a key role, with many developing countries investing only a small fraction of money into water compared with military spending. For instance, military spending in Ethiopia is 10 times greater than that spent on water and sanitation and in Pakistan the discrepancy is even greater 47 times (Challa 2011). Wallace et al (2008) also stated that, to ensure that resources for safe water and sanitation are used effectively at the local level, the local capacities to design, finance and manage improved service delivery must be greatly enhanced. To this end, the Camdessus Panel and others have urged that corruption, managerial capacity, sustainable cost recovery and legal and contractual aspects of safe water and sanitation management within developing countries be addressed.

2.7.3. Population Growth and Urbanization

Population growth and rapid urbanization will create a severe scarcity of water as well as tremendous impact on the natural environment. According to UNPP (2006) in Challa 2011, in

less developed countries, urban population will grow from 1.9 billion in 2000 to 3.9 billion in 2030, averaging 2.3% per year.

Besides having less or not invested in urban infrastructure, Africa is urbanizing faster than any other region. Between 1990 and 2025, the total urban population is expected to grow from 300 to 700 million; and by 2020, it is expected that over 50% of the population in African countries will reside in urban areas. According to Cleophace (2007), in order to meet the established millennium development goal of 'halving the unsaved population by 2015'; urban Africa will require 80% increase in the numbers of people served. This objective would require, on average, about 6,000 to 8,000 new connections every day. Political commitment to these goals, backed by resources and action is essential if utilities are to prevent a widening of the gap between 'saved' and 'unsaved' households.

According to the 1994 Ethiopia population census report showed, the total urban population was 7,323,122 (13.7% of the total population), after ten years (i.e. 2004) the total urban population increased to 17,588,735 (32.89%) and by the year 2015 urban population is going to increase by 22,925,177 (32.26%) Ethiopia Central Statistical Authority (1994, 2004 and 2015 projection). In order to meet the future water demand, cities will need to tap their water supply either from a deep ground or surface sources situating a far distance away from the urban area (Chala, 2011).

2.7.4. Increasing Global Water Scarcity

UN-HABITAT (2006) stated that, not only is the numbers of those requiring better water supplies very large, water itself is becoming scarcer. The number of people living in water stressed and water scarce over the world is estimated to increase approximately six-fold from 1995 to 2025 to reach 2.8 billion. In addition to these challenges, Bereket (2006) states that the single most influential factor related to the sustainable provision of basic water service in turn is that of poverty. The lack of availability of basic services is a primary measure of poverty and poverty is the primary obstacle in the provision of basic services.

Poverty affects basic water supply in a number of ways, ultimately being so all pervasive that it overwhelms the application of even the very best practice incorporating all the lessons learned. It is therefore important to understand the full significance of poverty

2.8. Challenges of Urban Water supply and Distribution

WHO-UNICEF,(2008)revealed that providing water security is a serious challenge of the twenty-first century world considering that about 0.9 billion survive without access to improved water supply. 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 demands 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 (UNICEF/WHO, 2008).

Problems with water supply stem from various sources. One of the major challenges driving water stress in developing nations is rapid urbanization. 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 UNICEF/WHO, (2013).

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. 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 (Challa, 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. 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.

Among the main reasons given for the slow pace of progress in water supply services in Ethiopia, the following are net worthy:

- Lack of comprehensive legislation;
- Inadequate investment resources;
- Lack of a national water tariff policy and the absence of beneficiary participation and community management Dessalegn, (1999)12).

In relation to this, MWR (2002:13) stated that issues of poor sector capacity and low level of expenditures for WSS are interlinked and lead to a vicious circle – as low level of investments create low demand for technical and manpower inputs in WSS sector, the capacity remains underdeveloped.

The resulting low sector capacity, means low allocations and expenditures are curtailed. The sustainability of water supply facilities mainly depends on a timely and regular maintenance and operation of the system. However, in most developing countries, including Ethiopia, it has been found out that operation and maintenance of water supply facilities is in a poor state of condition and the sustainability of the scheme is at stake. Regarding this, MWR (2002:13) identified the following underlying problems:

- Inappropriate tariff setting without emphasis on full cost recovery;
- Lack of clear guidelines for urban tariff setting including issues related to fairness, and financial sustainability;
- Inappropriate or lack of institutional incentives for urban WSPs to achieve financial viability and improved operational performance;

- Poor technical and financial capacity among the urban service providers that leads to high levels of unaccounted for Water (UFW); and
- Poor or nonexistent consumer services and grievance handling system that leads to a lack of willingness to pay user charges.

According to the feedback gathered from the participants of the workshop conducted in Bahir Dar in April 1999, the following were pointed out to be the main causes or challenges for the Operation and Maintenance problems in Ethiopia in order of importance:

- Poor organizational setup in the sector coupled with the absence of trained manpower;
- Low community awareness regarding the importance of clean water;
- Absence of adequate repair parts, spare parts, and hand tools;
- Financial shortage to support O & M , and the limited funds that are available are used for new installations;
- Low participation of the beneficiaries in the decision making process;
- Substandard designs, poor construction quality, and inappropriate technology;
- Absence of coordinated supervision and monitoring mechanisms;
- Unwillingness to pay for services;
- Low attention paid to local skills and minimal support to Artisans and private sector

Women and children bear the greatest burden related with inadequate water supply, sanitation and hygiene. More than 768 million people worldwide, most of them in developing countries are lacking access to any form of improved water supply sources within one-kilometerradiusof their home (WHO and UNICEF, 2013). Poor access to potable water has negative impact on development. According to Challa (2011).the majority proportion of drinking water supply are consumed almost exclusive by household users. Mohammed et al, (2013) revealed water shortage affects women as female members are traditionally responsible for water fetching. The effects of poor water supply in urban areas of Ethiopia have high impact on the living condition of the towns, communities and economic development of the country (OWRMB, 2010). Therefore, this chapter deals with the theoretical overview of accesses of water supply and distribution. It assesses the sources of water supply, urban water supply accessibility, major challenges of water supply and distribution, urban water supply and distribution problems in

developing countries in general and in Ethiopia in particular, benefits of access to safe, reliable, adequate and affordable access of water supply and impacts of inaccessibility of urban water supply and distribution facilities.

2.9. 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. 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 (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 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 (Yitayh, 2011).

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).

2.10. Impacts of Water Inaccessibility

Although water is a primary need of human being, unimproved water service has many negative impacts on people livelihood. Among which; health, socio-economic, environmental degradation and poor educational performance are the major.

2.10.1. Health Impacts

The improvement of water and sanitation in developing countries is largely driven by the need to reduce the incidence and prevalence of infectious disease caused by pathogenic microorganisms. The majority of pathogens that affect humans are derived from feces and transmitted by the fecal-oral route. Pathogen transmission may occur through a variety of routes including food, water, poor personal hygiene and flies Chala, (2011).

According to USAID/E Statement of Work (SOW) for the Millennium Water Alliance (MWA) Water, Sanitation & Hygiene (WASH) program evaluation, "approximately 3.1% of deaths worldwide are attributed to unsafe water, sanitation and hygiene practices.

Africa carries the heaviest burden, with 4 to 8% of all disease in Africa being related to poor water, sanitation and hygiene. In Ethiopia, water and sanitation related diarrhea accounts for approximately 20% of all deaths in children under the age of five, taking the lives of close to 100,000 children annually. Thirty two percent of this diarrhea could be prevented by improving sanitation interventions such as pit latrines, septic tanks and composting toilets."

According to FDRE (2005) Demographic and Health survey, only 8% of Ethiopian households have water on their premises and only 38% have a toilet. In addition, poor water and sanitation is the source for many other health problems including chronic intestinal parasites that attribute to high prevalence of malnutrition, anemia, diarrhea, cholera, malaria, trachoma, intestinal helminthes retarded growth.

2.10.2. Socio-Economic Impacts

Poor access to water supply and sanitation limits opportunities to escape poverty and exacerbates the problems of vulnerable and marginalized groups especially those affected by HIV/AIDS and other diseases (Chala, 2011).

According to Ethiopian Ministry of Health (2005), the well-known negative synergy of diarrheal disease, malnutrition and opportunistic infections are known to have short-term health impacts and long term debilitating effects. In the long term, child development is impaired resulting in growth retardation and diminished learning abilities. It is estimated that 4 in 10 children will not realize their educational potential which ultimately inhibits socio-economic development. In addition, there is a potential productive time lost to illness caring for the sick and attending clinics. There are also the financial costs of treatment for medicines and clinic attendance.

2.10.3. Environmental Degradation Impacts

Besides being pollutants of surface waters (necessitating higher treatment costs), faces and urine are a potential (under-exploited) source of compost and fertilizer which could help address decreasing soil fertility and reduce the high cost (both financial and environmental) of chemical fertilizers.

They can also be used to produce biogas (a renewable energy source) which as well as safely containing excreta could contribute to reducing deforestation which is a key environmental issue. Biogas digesters can also be ‘fed’ with organic solid waste in urban areas as an efficient treatment and use of ‘waste’ (MoH, 2005).

2.10.4. Poor Educational Performance

According to the Federal Democratic Republic of Ethiopia National Hygiene and Sanitation Strategy of MoH, (2005), Ministry of Health 2005 as well as the diminished learning abilities mentioned above, it is widely believed that a significant number of school days are lost due to diarrhea. This mainly affects girls who end up staying at home to care for siblings. Worm infestations, anemia and vitamin A loss have been shown to decrease learning abilities among 4

in 10 girls. Lack of separate, private, secure, hygienic latrines, particularly in adolescence (during menstruation) is associated with a high dropout rate of girls.

2.11. Conceptual Framework of the Study

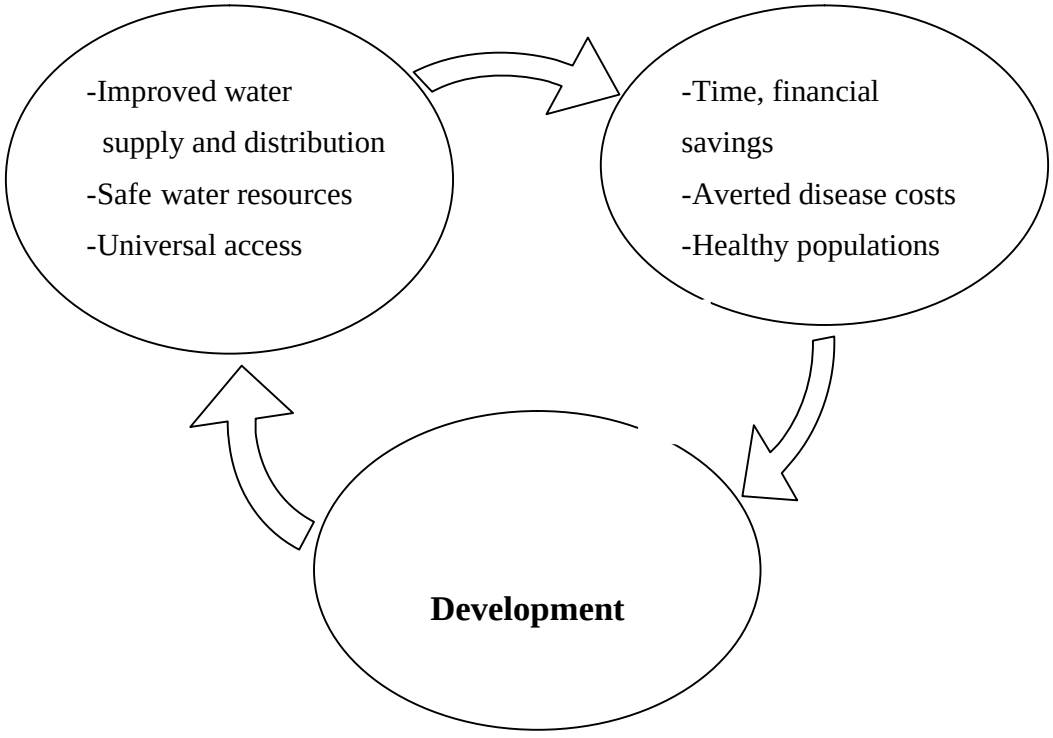

Figure 1. Improved water supply and distribution as motor for development (Source: slightly modified *from (Bereket, 2006)).*

3. RESEARCH METHODOLOGY

3.1. Description of the Study Area

3.1.1. Location of the Study Area

The study area Burayu town is found in Oromia special zone surrounding Finfineand situated very closer (15 km from Piassa) to Addis Ababa city administration office. Astronomically the town is located in between a 9° 00′ 00″N- 9° 06′ 00″ N latitude and 38° 34′ 30″E -38° 43′ 30″ Elongitude. Relatively it is found north of Sebeta town and South of Sululta and MuloWoreda West of Addis Ababa City administration and East of Wolemeraworeda.

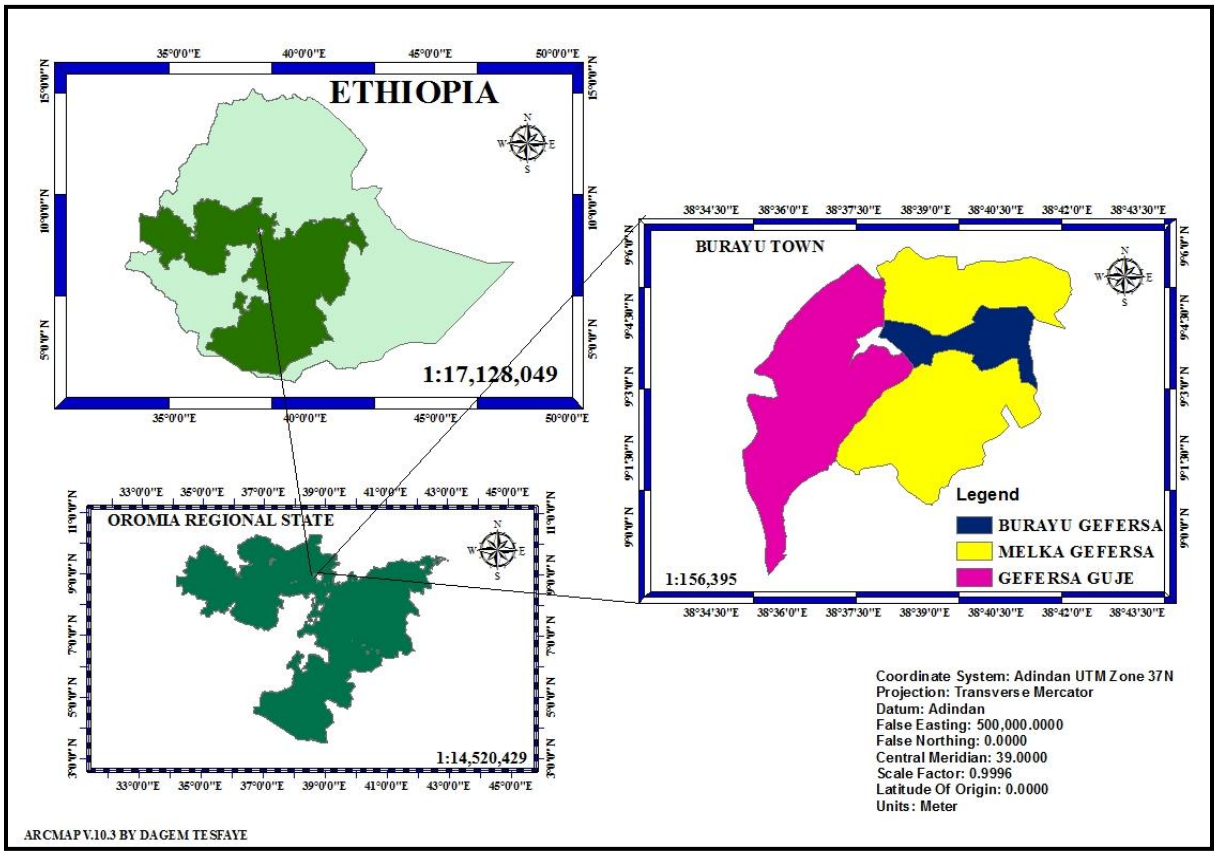

Figure 2. Map of the study area

3.1.2. Climate

Just like other central part of the country, the area has diverse climatic characteristics. As data on climatic condition of Burayu town is not available, attempts have been made to adapt the climate condition of Addis Ababa where the nearest metrological station is located. The mean annual temperature, the mean annual maximum and the mean annual minimum temperature of the area is reached to be about 14^{o}C, 22^{o}C and 6^{o}C, respectively, (BTARDO, 2019).

3.1.3. Topography and Drainage

As the town situated at south west foot of Entoto Ridge, most of the existing built up areas of the town lies on rugged terrain (land profile with steep slopes, or river valleys with steep gradient, gullies and ridges) with limited flat lands. On the other hand, the altitude of the area ranges in the north from 2600m a.s.l.to 2400m.a.s.l in the south at TinishuAkaki River valley .Regarding drainage, the town is found in the Awash River drainage basin, and it is particularly drained by TinishuAkaki River. There are many other small stream rivers in the TinishuAkaki River catchments. Burayu, Laku, and Sego are the major one.

3.1.4. Population

Burayu town is located almost at the center of the Oromia regional state which is closer to Addis Ababa city administration because of this there are many people migrating to this area that enables to have large population. The population and housing census conducted in 1984 and 1994 population census put the population size of the area is 4,138 and 10,027 respectively while according to the population count made by Keble in 2002 and 2005, the size of the population count made 22,744 and 29,216 respectively. According to 2007 national population and housing census of Ethiopia the population of the area reached 63,873 of which 31,504 male and 32,369 are female.

Generally, based on population data which obtained from 1984 to 2007 national population and housing census it is possible to argue there is rapid population growth in the area. (CSA, 2007).

3.2. Research Design

In order to understand the existing water supply and distribution problem in the study area descriptive survey research design was used. For such a research, both longitudinal and cross-sectional approaches can be used, as the longitudinal study involves a series of measurements taken over a period where as cross-sectional studies take place as a single point in time. However, for this study the cross-sectional survey method was employed since longitudinal approach is coasty and time taking.

3.3. Types and Sources of Data

Both primary and secondary data sources were collected for the assessment of water supply and distribution problems of the study area. Primary source of data was obtained through observation, questionnaire and focus group discussion from selecting sample households and different offices with water supply issues, respectively.

The researcher used journals, report from town offices and regional offices on the water supply and distribution problems of the study area as a secondary data.

3.4. Sampling Techniques and Sample Size Determination

One of the central objectives of this research was to assess the water supply and distribution challenges in Burayu town. Burayu Town has six kebeles. To get the representative population out of the six kebeles of Burayu town, the investigator takes three kebeles purposively, as per the investigator's knowledge these three kebeles face serious shortage of water supply and distribution for decades. The total household size of the three kebeles was 3290. The required sample household size is determined based on sample size determination of Yamane (1967) at confidence level 95% and precision level 0.05. Thus, the total determined sample size was 303 households.

Table 1.Sample size and sampling techniques

Representative kebeles name	Head of households	Representative sample size households
BurayuGefersa	1080	99
MelkaGefersa	1150	106
GefersaGuje	1060	98
Total	3290	303

Source: Own Computation, 2019

$$n = \frac{N}{1 + N(e)^2}$$

Where, n – is No of sampled households.

N – is total target population/total no of household.

e- is level of precision. (0.05)

Hence, according to the formula, sample size determined at 5% precision and 95% of confidence levels were 303 households.

That is $n = 3290/1 + 3290(0.05)^2 = 303$

In order to determine the sample size of each kebele, systematic sampling techniques was employed. Accordingly, to Kothari (2004) in stratified sampling technique, the sample size of different stratum is determined proportional to the size of population. Hence, the sample size of each kebeles (nv) was determined by;

$$Nv = \frac{\text{no of households}}{\text{Total target population}} \times \text{sample size}$$

Hence nv for BurayuGefersa 1080/3290 x 303 = 99hh, nv for MelkaGefersa 1150/3290 x 303 = 106hh, and nv for GefersaGuje 1060/3290 x 303 = 98hh.

So, in this method each stratum is representative according to its size.

3.5. Instrument of Data Collection

The assessment of water supply and distribution problems was gathered through multiple methods including questionnaires, focus group discussion, interview and personal observation and vigorous instruments to directly observe the existing water supply and distribution problems

in the study area. Before the actual collection of data, pre-testing of the materials was made to check its validity and clarity. The pre-testing of the questionnaires has helped in the administration and implementation of the actual survey and in restructuring the questionnaire format and content.

3.5.1. Questionnaires

The structured questionnaire was distributed to 303 households'respondents of the three Kebeles. In using a questionnaire, the aim is to try and get valid, reliable and unbiased information from the respondents. The types of information that are usually gathered in a questionnaire are attributes, behavior, events, beliefs and attitudes or opinions. The questionnaire contains both closed and open ended questions. Primarily, the questionnaire was prepared in English and translated to Afan Oromo and Amharic languages to make it easy to understand (Appendix 1).

3.5.2. Focus Group Discussion (FGD)

Focus Group Discussions (FGDs) with 2 (two) group from each target Kebele containing 6 (six) members was held.

3.5.3. Key Informants'Interview

A key informant is a primary data source with prior knowledge of the affected community who can provide information on behalf of the community.Thus, the investigator used semi-structured interview for 11 key informants for the research; Kebele officers of each Kebeles (three), 1 (one) Key Informant from Burayu Town Water Supply Bureau, Burayu Town Mayor office (one) who know about the water supply and distribution scheme and two elders from each Kebeles (six).

Table 2.List of key informants

Description of office/community leaders	Gefersa Burayu	MelkaGefersa	Gefersa Guje	Number of key informants
Kebele Administration Officers	1	1	1	3
Community/local elders	2	2	2	6
Burayu Town Water Supply Office				1
Burayu Town Administration Mayor Office				1
Total				11

Source: Own Computation, 2019

3.5.4. Personal Observation

The investigator has consolidated the data obtained from the questionnaire and interview by personally observing the situation of water supply and distribution problem in the study area.

3.5.5. Document Survey

Different documents were assessed to gather information that is relevant to the study. Pertinent information on the water supply and distribution schemes of Burayu Town Administration were collected from various publications (government magazines and reports, published articles and other relevant documents), unpublished documents from different government organizations and from thesis and dissertations papers.

3.6. Method of Data Analysis

The study analyzed both qualitative and quantitative data to give clear understanding about the problem. Therefore, the qualitative data collected using open ended questionnaires, interview, and personal observation were also analyze through description, narrating and interpreting the situation contextually so that the city‘s drinking water supply and sanitation service delivery situation were properly shown. Photographs were also used to describe the existing situation of water and sanitation supply. Regarding the quantitative data, data were analyzed and presented using tables, frequency and percentages to give clear understanding of the issue quantitatively.

The Statistical Package for Social Science (SPSS) model V.20.00 program was used to process the inertial statistics of the collected data. The outcome of the qualitative analysis was integrated with the other findings in view of substantiating the result. Finally, the result obtained were summarized, concluded and recommended on the basis of the data analyzed.

3.7. Ethical Considerations

There are ethical considerations when the researcher conducts questionnaires, focus group discussion, interview and personal observation with respondents. This might be ethical responsibilities for following and obeying societal norms, culture and traditions to the subject of a research. All the participants were communicating about the study in order to obtain their verbal agreement before administrating the questionnaires. Interview, focusing group discussion and interview was digitally recorded with permission professionally transcribed.

4. RESULTS AND DISCUSSION

4.1. Background Characteristics of the Sample Respondents

Table 3.Background information of the respondents

Variable	Description	Frequency	Percent
Sex	Male	203	66.9
	Female	100	33.1
Total		303	100
Age	20-39	163	54.0
	40-59	123	40.5
	>60	17	5.5
Total		303	100
Marital Status	Single	70	23.3
	Married	169	55.8
	Divorced	28	9.2
	Separated	4	1.2
	Widowed	32	10.5
Total		303	100
Number of Family	1-3	164	54
	4-6	102	33.7
	7-9	33	11
	≥10	4	1.3
Total		303	100
Education Status	Cannot Read and Write	18	6.1
	≤ 8th Grade	60	19.7
	High School Graduate	74	24.5
	College Education	69	22.7
	Degree Holder	78	25.8
	Master's Degree & Above	4	1.2
Total		303	100
Occupational Status	Farming	29	9.5
	Government salary	66	21.9
	NGO salary	32	10.7
	Trade	115	37.9
	Livestock raring	11	3.6
	Daily wedge	27	8.7
	Other	23	7.7
Total		303	100
House Ownership	Own house	186	61.3
	Kebele rent	30	9.8
	Private rent	87	28.9
Total		303	100

Source: Field Survey: 2019

As the data in Table 3 shown, 66.9% of the respondents are males and the remaining 33.1% are females. In terms of age, about 54% of respondents are found in the age group of 20-39, 40.5% in the age group of 40-59, and the remaining 5.5% of the respondents are above the age of 60.

Regarding the respondent's marital status about 55.8% are married, 23.3% are single, 10.5% widowed, 9.2% divorced and the remaining 1.2% are separated (Table 3).

Looking at the family size of the respondents as shown in Table 3, 87.7% of the them have family size up to 6 members and the remaining 12.3% have a family size of more than 5 individuals. With respect to level of education, the data in Table 3 showed that the 93.9% of the respondents of this study are educated. Only 6.1% of the respondents cannot read and write, 19.7% of the respondents are found in the range of grade 1 up to 8th grade, 24.5%are high school graduates, 22.7% have attained college level education, 25.8% have first degree while the rest 1.2% of the respondents have second degree education and beyond. Therefore, it is reasonable to suggest that more of the educated respondents could justify the impact of on development and assumed to have a better life. Besides, to this, education could be associated with a greater perception and better understanding of problems.

Concerning the house ownership of the respondents, as shown in Table 3, 61.3% of the respondents own a private house whereas 28.8% and 9.8% of the respondents are living in private and Kebele rented houses, respectively.

4.2. Overview of the Water Supply and Distribution System in the 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 Burayu 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 Burayu 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, 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.

Safe drinking water is the birth-right of all humankind (as much a birthright as clean air) (Rao, 2002), while access to clean water can be considered one of the basic needs and rights of a human being. The two main water sources of Burayu town are lake and ground water. Lake

Gefersa is treated and distributed to urban residents through a piped system. The non-piped system includes hand dug wells.

4.2.1. Household Source of Water

The information regarding the primary sources of water, availability of the sources within the residence compound of the respondents was exclusively examined in this study. Out of the total sample household heads, 23% obtained water from private tap connection regardless of its frequency, 45% used water from public tap and 24% get water from Water Well and the remaining 8% got water from water venders (Figure 3). This signifies that, the majority of them do not have their water source in their compound and largely depend the public taps and shared sources for their survival. It is also to be noted that the households which were unable to get private meter connection or private tap, were forced to depend and use the alternative water supply sources.

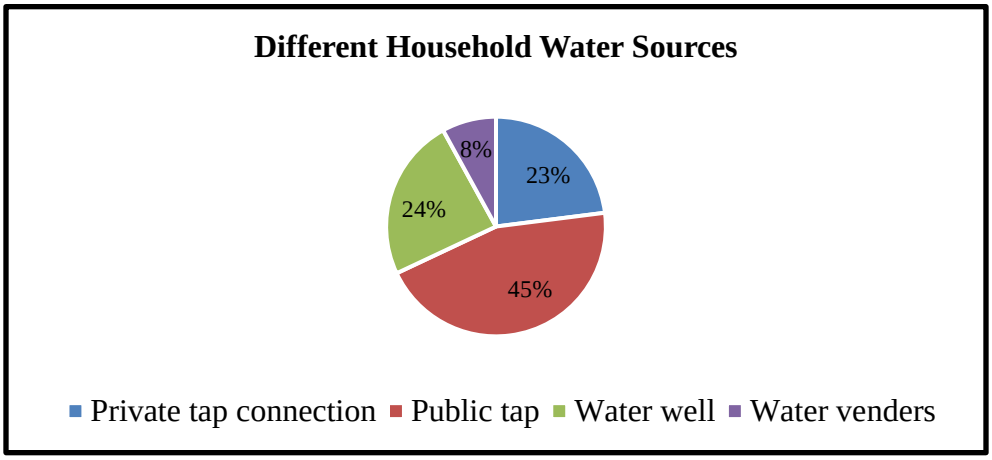

Figure 3. Primary Household Water Sources

Source: Field survey, 2019

According to household residence response, the other alternative water source in the study area is rainwater which they collect during rainy season. It was observed that those respondents using rainwater collect from the corrugated iron sheet roofs and collect the water using open buckets.

Figure 4.A water well inside household's residences

Source: Field Survey, (2019)

4.2.2. Consumption Related Issues

The average family size of the households was found to be 4.4 Household heads and the evaluated average daily consumption of water per household per day is 53.8 Liters and per person per day was 12.24 Liters. The average water consumption of the respondents per day in liters was investigated, as depicted on Table 4 and it was found that about 26.8% of the household heads consumed less than 25 Liters, 47.8% of the household heads between 25-50 Liters, 14% of the household heads and 7.6% of the household heads were between 50 to 75 Liters and 75 to 100 Liters, respectively. The remaining 3.8% of the household heads consumed more than 100 Liters per day. The data indicated that majority of respondents used water between 25 to 50 Liters per day on average. This was compared with the National Minimum Daily water requirements of 20 Liters/Person/day, and it indicated that the water consumption level was higher relative to the amount of water required per each individual for home consumption per day.

Table 4. Household water consumption per day

Consumption per day	Frequency	Percentage
Less than 25 Liters	81	26.8
Between 25-50 Liters	145	47.8
Between 50 to 75 Liters	42	14.0
Between 75 to 100 Liters	23	7.6
More than 100 Liters	12	3.8
Total	303	100

Source: field Survey (2019)

4.3. The major challenges in water supply and distribution in Burayu town

4.3.1. Inadequate Access to Piped Water

Water accessibility is 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). It is noteworthy, to state that, the quantity of water that is being supplied to the town, did not match the demands of the residents, and serious water scarcity is prevailing whereby the residents are forced to buy from other sources. Result obtained from the focus group discussion also depicted that the piped water coverage increment in the town is very small as compared to the population size.

The World Health Organization (2004) indicated that basic indicators for water accessibility 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). This reflects the extent to which the accessibility challenges time, distance and affordability.

In this study, the respondents were asked about the distances and time taken for fetching water to for household consumption of the family. The investigation facts explained by the respondent indicated that the travel distance required for fetching water for 33.8% of the households was

within 100 meters. For the remaining 24.8% of the households and 41.4% of the households, it was found to be between 100 to1000 meters and above 1000 meters respectively (Table 4).

The results found from the focus group discussion also described that the towns' residences use human load, donkey carts and yellow plastic jars 'Jerry cans' to fetch water from long distances to meet their water demand from public taps.

Figure 5.Water transported from long distance using pack animals

Source: field fieldssurvey (2019)

Table 5.Households' Travel Distance to Fetch Water

Travel distances to fetch water	Frequency	Percentage
Less than 100 meters	83	27.39
Between 100 to 200 meters	75	24.8
200 to 500 meters	97	32.01
Greater than 500 meters	48	15.51
Total	303	100

Source: field Survey (2019)

As the above table (5) the (32.51%) of households traveled between 200 and 500 meters distance to fetch water ,(24.8%) of households traveled between 100-1000meter to fetch water and (27.39%) of households are fetched water within 100 meter distance.

4.3.2. Inefficient Pipe Line

The utility is responsible for maintenance of the piped network and for regular replacement of meters (every ten to fifteen years where well-managed with good water quality). This will require access to the necessary spare parts and staff with the technical capacity to keep the infrastructure operationalWSUP (2014).The information obtained from the focus group discussion depicts that much of the water distribution infrastructure remains in a state of disrepair due to lack of funds, knowledge and/or parts to perform the necessary maintenance. Many taps are old and need to be partially or completely replaced. These broken taps are a major source of leakage in the water distribution system.

Table 6. Privet connection of pipe

Questions	Frequency	Percentage
No supply in area	97	32
I cannot afford	75	24.7
Not reliable water supply	23	7.6
Bad equality of water supply	90	29.7
have access to enough water	18	6
Total	303	100

Source: field Survey (2019)

As show on the above (table 6) 32% of households have no supply area of water, 24.7% of households in the study area they cannot afforded,7.6% of households in the study area have no reliable water supply,29.7of house hold have no equal water supply and 6% of households have enough water supply.

Table 7. Containers that you use to fetch water

		Frequency	Percent
Containers that you use to fetch water	Pail	62	20.4
	Barrel	20	6.6
	Jerry-can	213	70.3
	Insira	8	2.7
	Other	-	-
Total		303	100

Source: Field survey, 2019

As show on the above (Table 7) the majority of house hold in the study area they used jerry can (70.3%) ,20.4% of households used pail to fetch water,6.6% of households and 2.7% of households used barrel and Insira they used to fetch water respectively.

Table 8. Frequency of fetch water per day

		Frequency	Percent
Times to fetch water per day	Once	240	79.2
	Twice	32	10.5
	Three times	20	6.6
	More than three times	11	3.7
Total		303	100

Source: Field survey, 2019

As show on the above (table 8) 79.2% of households are fetched one times per day, 10.5% of households are fetched twice per day, 6.6% of house hold are fetched water three times per a day and 3.7 % of households in the study area they are fetched water more than three times per day.

Table 9.Responsible for fetching water in your household

		Frequency	Percent
Responsible for fetching water in your household	Adult woman	140	46.2
	Adult man	-	-
	Female child	105	34.6
	Male child	25	8.2
	Housemaid	30	10
	No one, we get water directly to our house	3	1
Total		303	100

Source: Field survey, 2019

As shown on the above table (9) adult woman (46.2%), female children (34.6%) have high responsibility to fetch water in the households and adult man has no responsibility to fetch water in the households.

Table 10. Means transport water from the source to home

		Frequency	Percent
Means transport water from the source to home	Human load	102	33.6
	Donkey	95	31.3
	Animal pulled cart	105	34.8
	Others	1	0.3
	Total	303	100

Source: Field survey, 2019

As shown on the above table (10) (33.6%) of households, (31.3%) households,(34.8%) of households and (0.3%) of households used human load, donkey, animal pulled cart and other means used to transport water from the source to home respectively in the study area.

Table 11.The same source of water throughout the year

		Frequency	Percent
Do you use the same sources of water throughout the year?	Yes	72	23.7
	No	231	76.3
Total		303	100

Source: Field survey, 2019

As shown on the above table11 (76.3%) of households in the study area have no the same source of water throughout the year and (23.7%) of households have the same source of water throughout the year.

Table 12.Access to water supply nearby

		Frequency	Percent
Do you have access to water supply nearby?	Yes	92	30
	No	211	70
Total		303	100

Source: Field survey, 2019

As shown on the above table 12 (70%) of households in the study area have no access to water supply nearby and (30%) of households has access to water supply nearby.

4.4. The Major Challenges of Water Supply and Distribution in Burayu Town

Result obtained from the focus group discussion showed that the following are the challenges of water supply interruption in the town:

4.4.1. Urbanization and Population Growth

It is noteworthy, to state that, the quantity of water that is being supplied to the town, did not match the demands of the residents, as the population of the town is increasing rapidly, thus, serious water scarcity is prevailing.

4.4.2. Topography and Water Pressure

For a residential pipeline, the minimum distribution pressure is 40 psi while the maximum distribution pressure is 80 psi. Head loss is a situation by which energy loss due to friction as water moves through the distribution system; pipes, fittings (elbows, tees, reducers, etc.), and equipment (pumps, etc.). This results in major losses of pressure of the water, i.e. head loss associated with friction per length of pipe and minor losses, i.e. head loss associated with bends, fittings, valves, etc (PLTW, 2006).

Another factor responsible for the challenge on water supply and distribution in Burayu Town was identified as topography of the town and the pressure of the water from its source. With a mean score of 2.21 it shows that the 46.2% of the respondents agreed that topography and water pressure also contributed significantly to the challenge on water supply and distribution in Burayu Town.

4.4.3. Climate Change

According to, the respondents 40.8% with a mean score of 3.92 disagreed strongly climate change as contributing to be the cause of the challenge on water supply and distribution in Burayu Town. This outcome is contrary to the study made by Koech, (2016) in Kenya.

4.4.4. Management Problems

The respondents representing 61.7% with a mean score of 1.09 of those sampled strongly agreed that management problems are the chief factors that cause the challenge of water supply and distribution in Burayu Town. Moreover, the information obtained from the focus group discussion depicts that management problems caused by inefficient organizational structure, understaffing, low salaries and lack of staff motivation and inability of the WSS office to retain trained and experienced staff is the main constraint to service delivery.

4.4.5. Lack of Institutional Coordination

This is further exacerbated by the lack of institutional coordination in the study area. According to the, respondents representing 55.5% of those sampled agreed that major stakeholders in

Burayu Town water supply activities, have no coordinated linkages among the Regional water bureau and WSS office except for technical support, implementing construction works of water which is its responsibility and in Board decision in which the Town's mayor is the chairman. Different professionals are not incorporated as Board members to exploit their technical knowledge. The community is represented by the two-delegated members. Thus, the poor institutional coordination hampered the efforts to achieve WSS office goals.

4.4.6. Limited Budget and Funds

Respondents, representing 75.5% recording a mean score of 1.41 strongly agreed that limited budget and funds to the water sector is a major cause of the challenge in water supply and distribution process in Burayu Town. Delivery of urban water supply requires a high level of investment. Lack of sufficient funding has limited the quantity of water supply service of the WSS office. Even though, the current cost recovery mechanism of Burayu Town WSS, office seems better and able to cover expenditure costs it is not sufficient to invest in some areas and to sustain even the existing service and fulfilling its mandates.

4.4.7. Limited Capacity

Capacity can described in terms of the human, technological, infrastructural, institutional and managerial resources required at all levels from the individual through to national governance. Thus, Table 7 shows that 52% of the respondents with a mean score of 2.49 agreed limited capacity contributing to cause challenge on water supply and distribution in Burayu Town.
In addition to this, the data obtained from the interview with officials from Burayu Town WSS office shows that; inadequate equipment facilities and other material resources are a critical issue faced by the WSS office. Chemicals and spare parts for the pumps of boreholes do not easily provide to the concerned bodies. The workers do not have sufficient place to work relaxed in the treatment plant.

They have only one narrow room for everything office, store and chemical coagulation, which is dangerous for workers' health. Even when the office is capable of providing the required money, there is a problem of delay in purchasing the materials. In addition to this shortage of

skilled man power further exacerbated nature of the problem. These constraints are the most limiting factor in the fulfillment of its desired service provision.

4.5. The Impact of Water Supply and Distribution Scarcity

4.5.1. Water Treatment and Health Impact

Some of the respondents also reported that due to water shortage they incur additional costs and face health problems like diarrhea as they forced to use alternative sources of water of poor quality. Hunter et al. (2010) reported that a poor water supply impacts human health by causing diarrhea and non-diarrheal disease, limiting productivity and the maintenance of personal hygiene.

It stated that safe water supply is a platform for the wellbeing of individuals and further development activities. One of the basic objectives of providing piped water is to make available to the consumers pure and wholesome drinking water.

However, the absence of this crucial element in Burayu Town has forced the inhabitants to use different alternative sources, which have exposed them to waterborne and water-borne diseases in different times. Water in the whole parts of the study area do not continuously flow in each individual's house at any time, at a required amount and is not accessible everywhere.

Regarding water-borne diseases, the output of the household survey and the information from the Focus Group Discussion shows that even though particularly in recent years the quality of water is a bit getting better and better, but still because of the low amount of water received per day, sometimes water-borne diseases occur in the area.

Table **13**.Households usage of any treatment system to clean the water for use

Category	Frequency	Percentage
Yes	25	8.3
No	278	91.7
Total	303	100.0

Source: Field Survey, 2019

Based on the information obtained from the households related with quality problem, as showed in Table 13, 91.7 % use no any treatment mechanism to make their water safe but the remaining 8.3 % responded that they add “water agar” (water treatment chemical) and boil their water in conditions that they observe sands and gravel.

4.5.2. Economic Impact

The monthly income and the expenditure towards water, education and health studied to investigate the financial strength and the living conditions of the respondents. The ranges of monthly income of the respondents studied under five classes ranging from below 1000 Birr to above 4000 Birr. From the data on Table 13, it observed that 29.9% of the household heads of them were having their average monthly income below 1000 Birr. The monthly incomes of 38.9% of the household heads was between 1000 and 2000 Birr, 14.6% of the household heads was between 2001 and 3000 Birr, 9.6% of the household heads was between 3001 and 4000 birr and 7% of the household heads were getting monthly earnings of more than 4000 Birr respectively.

Table 14.Income of the household heads

Income of the household’s heads	Frequency	Percentage
Average monthly income below 1000 Birr	91	29.9
Average monthly income between 1000 and 2000 Birr	118	38.9
Average monthly income between 2001 and 3000 Birr	44	14.6
Average monthly income between 3001 and 4000 Birr	29	9.6
Average monthly income more than 4000 Birr	21	7
Total	303	100

Source: Field Survey, 2019

Moreover, the information obtained from the focus group discussion indicated that the majority of the respondents are earning meager incomes and are spending considerable amounts towards water. Due to the constraints on water consumptions, they are in turn paying huge loss to cope up with the health-related issues such as, kidney problems, poor hygiene and others. It is very important to note that in spite of higher usage, the respondents with higher income are spending fewer amounts towards water, due to nonexistence of slabs in the tariff charges. This indicated

an inequality in terms of economy and signified the key area with a need to levy charges based on usage.

4.5.3. Social Impact

The majority of households i.e. 32.01% Table 5did not have basic access of water for their domestic needs. It implies that water accessibility standards are not well exercised in the town. These problems were more severe in the driest seasons, mostly girls and women spend more time standing in long queues and at times fetching water from long distances. Due to this, the school absenteeism of female and children is severe.

4.6. Household Involvement in Water Supply Schemes

Result obtained from interviews and focus group discussion depicts that there is a limited community participation in decision-making. Individuals and communities, the private sector and NGOs have very important roles to play in the implementation of WSS activities and in achievement of water supply schemes. However, there is limited participation of these important stakeholders in Burayu town water supply service activities.

The town's WSS office is the only mandated government body to supply water for Burayu town inhabitants to satisfy their needs. Thus, it is difficult for WSS office alone to meet the ever-growing demand of the population. Involving the community during planning, implementation and operation phases of the scheme and delegating those helps to create a sense of ownership to ensure the sustainability of the water supply scheme. In addition to this, it is also important to establish a water committee with membership of women and well-developed reporting format and system to get feedback on issues of water supply.

5. SUMMARY AND CONCLUSIONS

5.1. Summary

Urban water supply and distribution challenges are the widespread problems in most of the developing countries such as Ethiopia. The objective of this study was to assess the challenges of water supply and distribution problems of Burayu town. Descriptive survey method was used to assess the area for its water supply and distribution schemes based on survey responses from a total of 303 households picked from three kebeles of the town. Systematic random sampling was used to select household respondents, while purposive sampling was attended for interviewing the key personnel. The primary and secondary data were collected by different methods. Thus, questionnaire survey, key informants' interview, observation and document analysis data collection tools were used. The collected data were properly analyzed using descriptive statistics.

It was found that there are water supply and distribution challenges like; inadequate access to pipe water, inefficient pipeline and frequent interruption in the area due to different reasons. Among the major causes of the challenge; population pressure, topography, poor distribution of water infrastructure, lack of technological capacity, weak sectorial coordination, and insufficient financial resource are some of the main undermining root causes. According to the survey results, the insufficient and interrupted water supply, poor quality and lack of proper distribution are raised due to difficulties in and administration problems.

To minimize the existing challenges on water supply and distribution schemes of Burayu town; the present and future population projection should be done to design and build suitable water supply schemes which will provide potable water to the various sections of the community in accordance with their demands. The Ethiopian water supply system fails due to inappropriate design of the system and lack of population projection when designing water supply. Most of the projects were implemented by considering only the existed population. The pipe installations, did also not consider the population pressure.

5.2. Conclusion

This study has attempted to examine the water supply and distribution scenario of Burayu town. The water demand of the town is increasing due to urbanization and population growth. The survey revealed that the town water supply could not fulfill consumer demand for water. The challenges of water supply and distribution in Burayu 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. The average per capita consumption was found to be less than 20 L/person/day which is less than the recommended standard. In line with this, according to the survey results, the most frequent complaints by water customers are regular interruption of water supply and unfair water distribution. The findings of the data lead to the conclusion that there is a huge gap between the water supply and demand of the town. The quantity of fresh water available is sufficient to satisfy the need, but the real problems lie in the supply chain. Disruptions in this supply chain can result from strained and undeveloped infrastructure or deliberate interferences in water supply. This can pose difficulties in finding solutions to increasing population pressures.

There are still many challenges ahead but the following changes will all contribute to future success:

- an increase in funds for the expansion of water supply services to satisfy the demand of growing populations, particularly in small towns
- a reduction in bureaucracy to facilitate the spending of funds that are committed (currently only around 60% of budgeted finances are actually spent)
- a reduction in the turnover of personnel, and an increase in human resource capacity and expertise at different levels
- better coordination between the different stakeholders (for instance, there is lack of coordination between the water sector, telecommunication department and the road authority; because of this, water pipes are frequently damaged during activities such as laying down telephone and internet lines, and during road construction)
- the presence of more experts to monitor sector performance at all levels
- better information management systems, giving early warning of requirements.

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APPENDICES

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 Burayu 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 (Mark "✓" on the box)

1. Age ……
2. Sex Male ☐ Female☐
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 1000 ☐ B.1001-2000 ☐ C.2001-3000 ☐ D.3001-4000☐ E. above 4000☐ G. no response☐
6. Educational level

A. can't write and read☐ B. Elementary☐

C. High school ☐ D. Diploma☐

E. BA/BSc Degree ☐ F. If other, please specify_____

7. Current occupation

A. Agriculture☐ B commerce/Trade ☐ C. Government employee☐ D. Daily laborers ☐

E. NGO worker☐ F. If other, please specify_____

8. House ownership of the respondents?
   1. Owned ☐
   2. Rented from Kebele/government ☐
   3. Rented from private/individual ☐
   4. If other, please specify_____

I. Questions concerning water supply and distribution

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

A. private pipe connection/Private tap B. public pipe C. from water vendors'

D. Water well (Bore Hole) E. stream F. if others, specify_____

2. If you don't have a private connection to piped water in your house, what are the reasons? (check all options that apply)

a) No supply in the area ☐ b) I cannot afford ☐ c) Not reliable water supply ☐

d) Bad quality of water supplied ☐ e) I have access to enough water ☐

f) Other, please specify_____

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

A. pail ☐ B. barrel ☐ C. Jerry-can ☐ D. *Insira* ☐ E. other ☐

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

A. <25 liter ☐ B. 25-50 liters ☐ C. 50-75 liter ☐ D. 75-100 liter ☐ E.>100 ☐

5. How many times do you fetch water per day?

A. Once ☐ B. Twice ☐ C. Three times ☐ D. More than 3 times ☐

6. How many meters do you travel to get water from the water source?

a. <100m b. 100-200m c. 200-500m d. >500m

7. Who is responsible for fetching water in your household? (check all that apply)

a) Adult woman ☐ b) Adult man ☐ c) Female child ☐ d) Male child ☐

e) Housemaid ☐ f) No one, we get water directly to our house ☐

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

A. Human load ☐ B. Donkey ☐

C. Animal pulled cart ☐ D. If other, please specify_____

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

II. Questions concerning the challenges in water supply and distribution (Mark "✓" on the box)

10. Do you have access to water supply nearby?

A. Yes ☐ B. No ☐

11. If your answer is “No” for question number “9”, what do you think the main challenges of water supply and distribution of the town?

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		

12. Is there any water supply shortage in your village? A. Yes ☐ B. no ☐
13. If your answer for Question No “11” is “Yes”, what are the frequency and the average duration of water supply shortage?

    A. Hourly ☐ B. Daily ☐ C. Weekly ☐ D. More than a Week ☐
14. Based on Question No “9” above, what do you think is the reason for the shortage?

    a) Drought ☐
    b) High demand ☐
    c) Low supply ☐
    d) Inadequate water resources ☐
    e) High wastage ☐
    f) Inadequate distribution systems ☐
    g) Poor adoption of conservation measures ☐

    If other, please specify_____
15. Are you happy at the existing water supply of the town? A. yes ☐ B. no ☐
16. If your answer for question number “14” is “No”, what is your reason? It is

    A. Scarce (shortage) ☐ B. Unsafe ☐ C. Interruption ☐ D. Cost ☐ E. If other, please specify_____
17. Do you face difficulties in accessing enough water for the following daily activities? (check all that apply)

    a) Drinking and cooking ☐ b) Washing and cleaning ☐

c) Sanitation ☐ d) Idon‟t face any difficulties ☐

18. Do you use water for productive purposes/income-generating activities?

a) Yes, I use it for_____(specify)

b) No ☐

19. Do you face difficulties with getting sufficient amount of water for these productive activities?

a) Yes ☐ b) Sometimes ☐ c) No ☐ d) Not applicable (respondent doesn't use water for productive purposes) ☐

20. How do you compare the current quality of water supply with a few years ago?

a) It improved substantially ☐ b) It improved moderately ☐ c) It is the same ☐

d) It deteriorated moderately ☐ e) It deteriorated substantially ☐

21. How do you perceive the current provision of potable water as an issue worth publicdiscussion?

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

22. 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? _____

_____

_____

III. Questions concerning the impact of water supply and distribution problems (Mark "✓" on the box)

23. Do you treat water for household consumption?

a) Yes ☐ b) No ☐

24. If you don't treat water, why not? (check all that apply)

a) I don‟t think it is necessary ☐ b) Ican‟t afford it ☐

c) I don't know how to do it effectively ☐ d) I don't have to because I only drink bottled water ☐ e) Not applicable (respondent treats water) ☐

25. If you do treat water how do you do it? (check all that apply)

a) I boil it ☐ b) I sieve it through cloth ☐ c) I let it stand and settle ☐

d) I add chlorine ☐ e) I use water filter ☐ f) Other, please specify_____

26. Has any member of your household suffered from the following diseases in the last months?

a) Diarrhoea ☐ b) Malaria☐ c) Cholera☐ d) Typhoid☐

e) Intestinal worms ☐ f) Skin infection☐ g) Other diseases☐ h) No diseases☐

27. How often did you suffer from these diseases?

a) Once a week☐ b) Once in 2 weeks ☐c) Once a month ☐d) Once in a few months ☐e) Not applicable (household didn't suffer of any of the diseases)☐

28. Do you think that these diseases could be the result of using unsafe water?

a) Yes☐ b) Unsure☐ c) No☐

d) Not applicable (no diseases in respondent's household)☐

IV. Questions concerning active involvement in water supply schemes (Mark "✓" on the box)

29. Are there any community initiatives concerning water supply schemes in your area?

a) Yes, specify_____ (water user association etc.?)

b) No☐

30. If your answer is "Yes" for the above question, who have participated in the development of water supply schemes from your household?

a. Husbands☐ b. Adult males'☐ c. Women☐

d. Adult females☐ e. All with the collaboration☐ f. If other, please specify_____

31. How do you evaluate your overall participation in water supply activities?

a. very high ☐b. high ☐ c. medium ☐ d. low☐

Appendix II

Checklist for Focus group Discussion with Burayu townwater service office and health officers

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 the Town?
3. Do you think that, the sources of water have a reasonable access and adequacy to urban dwellers of the 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 onthe time?
12. Is there community participation in water supply activities in the Town?
13. Is there any other institution (NGO, civil society organization, community organization etc) which participates in water provision activities in the 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?