Assessment of the Potable Water Supply Challenges in Jigjiga Town, Eastern Ethiopia.

Jawhar Sheekh Ibraahin

A Thesis Submitted to The Department of Architecture,

School Of Civil Engineering and Architecture.

Presented in Partially Fulfilment of the Requirement for the Degree of Master's

in Urban Planning and Design

Office of the Graduate Studies

Adama Science and Technology University

September, 2022
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Declaration

I declare that this research thesis entitled "**Assessment of the Potable Water Supply Challenges in Jigjiga Town, Eastern Ethiopia."** Is my original work. that is, it has not been submitted for the award of any academic degree, diploma or certificate in any other university. All sources of materials that are used for this thesis has been duly acknowledged through citation.

_____	_____	_____
Name of student	Signature	Date

Recommendation

I, the major advisor of this thesis, hereby certify that I have closely read the revised version of the thesis entitled "**Assessment of the Potable Water Supply Challenges in Jigjiga Town, Eastern Ethiopia.**" prepared under my guidance by (Jawhar Sheekh Ibraahin) submitted in partial fulfilment of the requirements for the degree of Masters of Science in Urban Planning and Design. Therefore, I recommend the submission of the revised version of the thesis to the department following the applicable procedures.

_____	_____	_____
Major Advisor	Signature	Date

Approval of advisor

I, the advisors of the thesis entitled "**Assessment of the Potable Water Supply Challenges in Jigjiga Town, Eastern Ethiopia.**" and developed by Jawhar Sheekh Ibraahin, hereby certify that the recommendation and suggestions made by the board of examiners are appropriately incorporated into the final version of the thesis.

_____	_____	_____
Major Advisor	Signature	Date

Approval of M.Sc. Thesis

We, the undersigned, members of the Board of Examiners of the thesis by Jawhar Sheekh Ibraahin have read and evaluated the thesis entitled "**Assessment of the Potable Water Supply Challenges in Jigjiga Town, Eastern Ethiopia.**" and examined the candidate during open defense. This is, therefore, to certify that the thesis is accepted for partial fulfillment of the requirement of the degree of Master of Science in Urban Planning and Design.

Chairperson	Signature	Date
Internal Examiner	Signature	Date
External Examiner	Signature	Date

Final approval and acceptance of the thesis proposal is contingent upon submission of its final copy to the Office of Postgraduate Studies (OPGS) through the Department Graduate Council (DGC) and School Graduate Committee (SGC).

Department Head	Signature	Date
School Dean	Signature	Date
Office of Postgraduate Studies, Dean	Signature	Date

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LIST OF ACRONYMS

MoWR	Ministry of Water Resource
JWSSA	Jigjiga Water Supply and Sanitation Authority
BH	Borehole
WRDB	Water Ressources Développent Bureau
CSA	Central Statistical Agency
UNDP	United Nations Développent Program
WWDSE	Water Works Design and Supervision Enterprise
WHO	World Health Organisation
NGOs	Non-governmental Organizations
UNHCR	United Nations
JMP	Joint Monitoring Program
UNICEF	United Nations Children's Emergency Fund
OECD	Organisation for Economic Co-operation and Development
WWSSAR	World Water Supply and Sanitation Association Authority
MDG	Millenium Development Goals
SRS	Somali Régional State
USAID	United State Agency for International Development

Abstract

The study was conducted Assessment of the Potable Water Supply challenges, with the objectives of assessing drinking water supply coverage and mode of service, investing water quality and also identifying major root causes and challenges of water supply in the study area. Urban water supply is one amongst the highly challenging sector in urbanization. Jigjiga town is facing a critical and serious situation regarding its deficient water supply service, which is being prolonged for many years and with no effective improvements due to climate change, population growth, water management, deteriorating infrastructure, inefficient water supply, and its rapid expansion. The research was mainly focused on water supply coverage, mode of service, water quality investigation and identifying major root causes and challenges of water supply in Jigjiga town. The data used in this study were mainly primary which were obtained from field survey questionnaire, interview, observation and personal involvement and secondary data obtained from the concerned Authorities, annual report, books and other documents. The study used systematic sample random sampling method to obtain information from number of 400 sampled households' respondents. The data collected were analyzed by both qualitative wider description by using Laboratory test and GIS software and quantitatively by using SPSS. The study revealed that water supply service could not cover the demand of the town, because of, insufficient water sources, poor distribution, frequent interruptions and unequal services of the town. As a result, the study discovered the spence gap between water supply and demand of the residents in the study town. 97% of Jigjiga town residents unanimously approved their daily fulfilment of water demand using mostly unprotected sources of water from vendors and the high cost of the water, instead of safe, protected and water supply services. Generally, the results of this study may be significant to the decision makers of the Authority to achieve effective, efficient and sustainable water supply system, it may contribute to in depth research rooting and other researchers may use as a reference to other urban areas.

***Keywords** : accessibility, challenge, JWSSA, potable water, water quality, water supply.*

1. INTRODUCTION

1.1 Background of the Study

Ethiopia is one of the member countries that has adopted the Millennium Development Declaration with the main objective of eradicating poverty (UNDP, 2008). This has resulted in prioritizing access to improved water supplies. Previous research has shown that access to clean, safe and hygienic water is an important factor in poverty alleviation (Water Aid, 2009). Water is the most essential for all utilities worldwide. It is most important for life besides oxygen (Rathnayaka et al, 2016). Therefore, anything that affects the water supply tends to disrupt the existence of humanity and its life. Water is a basic need for human life. Adequate supply of drinking water is a gateway to sustainable development through economic and social aspects. However, in most developing countries, access to water is limited with poor water supply, sanitation and hygiene spreading poverty, like Ethiopia. Even so, Ethiopia is a country of vast area and groundwater potential with 12 major watersheds, including the Blue Nile and 11 major lakes, making the country the "water tower" of east Africa (Kassa, 2017).

However, access to the benefits of local safe water supply, sanitation and hygiene in some parts of the country is among the lowest in sub-Saharan Africa. As an urban area in many developing countries, there are serious challenges in addressing the difficulty of rationally demonstrating reasonable satisfaction to all urban dwellers in Ethiopia. There is another challenge affecting water consumption that is not accessible to all people in urban areas. due to structural mismatch combined with rapid demographic growth and urbanization as well as the gap between water demand and water supplies of urban communities for their functioning (Temitope and Oyedotun, 2017).

Water is an essential resource for the life and development of a city (Emenike et al, 2017). Ethiopia is a capital with huge water source with potential for groundwater and surface water, but access to residential water supplies is limited due to the physical, financial and social problems of people. this influence appropriate arrangement of water management, environmental change and influences the amount of water consumption extremely household for drinking water supply and different potable activities, high measures of urbanization and improvement, per capita consumption, population distribution in the town and financial elements are considered as large difficulties in Ethiopia, especially in the study area.

According to the data from the Somali Regional Water Resources Development Bureau (2021), average of the drinking water coverage in Ethiopia was 68.5% of the total population with 91.5% and 65.8% having access to drinking water in both urban and rural areas. but average drinking water coverage in the Somali Regional State is 33.6% of the total population with 42% and 30% having access to drinking water in urban and rural areas, respectively below the national level. The problem is even worse and multidimensional in Somali Regional State (SRS) in Ethiopia. For the sake of that, many urban centers are facing challenges with quantity and quality of the drinking water supply system. The demand for water supply often increases during the dry season, especially during times of drought in a recent year.

Jigjiga town is one among the 11 pilot cities in Ethiopia, the capital of Somali Regional State, the administrative center Fafan Zone and also local Council. Most of the residents meet their needs through water vendors and traditional hand dug wells. This is due to rapid urbanization, strong population growth, high levels of investment and trade due to its potential and proximity to the Jigjiga University and other governmental and non-governmental institutions, the border with Somalia (Tog-Wajale). Flows, rural-urban and suburban migration within and around cities are increasing problems in accessing accurate and timely water supply in cities. According to information from the Jigjiga Water Supply and Sewerage Authority (JWSSA), 25% of HHs got their water needs from water supply services, while the remaining 75% of HHs got their needs from other alternative sources such as water vendors.

The study identified critical water supply and domestic water needs and water supply levels, recognizing the real problem of residential water supply in this city. Furthermore, the interpretation of the determinants that influence the water needs of households in the cities studied will depend on the existing water supply system. In addition, Jigjiga City is one of the fastest growing cities in the country with a rapidly growing population due to a high percentage of foreign immigrants from refugee camps in neighboring Somalia (Kebribayah (13,234), Shedder (16,184) and Owbare (11,738) (UNHCR report 2019), within and outside of Jigjiga, Somali region and other regions of Ethiopia, among internal migrants, governmental and non-governmental educational institutions.

Jigjiga town is facing a critical and serious situation regarding its deficient water supply services, which is being prolonged for many years and with no effective improvements despite the various efforts attempted to mitigate the crisis. Its original piped system dates back to the early mid 1970s

when the town's population was small. Since then, Jigjiga has grown at a high rate and has become a large city, being not only the capital city of Somali Regional State but also an important hub for commerce, trade and services. The first serious attempt to upgrade and expand the existing water supply system dates back 2001, when the Somali Regional State Water Resources Development Bureau (WRDB) retained the services of the consultant water works design supervision enterprises (WWDSE).

This project originally had a design period of 20 years 2004-2024, Phase I for the period 2004-2014 and Phase II 2014-2024. However, this project was not implemented as a planned and was considerably delayed. In 2008 the project was updated and completed with a revised design period of 2010-2020 for Phase I and 2020-2030 for Phase II. The population projections considered for this design were 176,281 for 2020 and 255, 656 for 2030. The works for the Jigjiga phase I project were completed in 2015, which provided a significant improvement to the existing water services. Due to the emergency facing the water supply services, the WRDB initiated the urgent implementation of Jigjiga phase-II project in 2017 with the works at Fafen well fields. The works were carried out in a combined effort between a civil works contractor and the WRDB, under the supervision of (WWDSE). However, the works were stopped in 2018 and have not resumed. Currently the water supply system has two main sources: the Jerer (Waji) well field with seven production wells located some 20 km south west of the town and total production of about 91 l/s and the Feda'ad well field with four Boreholes located about 20km north of the town and a total production of about 28 l/s. Therefore, the total installed capacity of the town systems combined is 119 l/s (10,282m^3/d).

The municipal water supply and sanitation administration of the city of Jigjiga is the reliable governing body for the delivery of water supply services to the municipality. The hierarchical boundary of the water supply and sanitation authority as well as the municipal boundary of the city is an essential factor in realizing significant concealment of the communication area. But the city involved only the chief of the office in the water supply exercises, who acted as a board member and technical pioneer for the expansion of pipelines according to the city's development plans. The maintainability of water supply plans depends significantly on the management plans for operating and managing the equipment of better water supply plans.

Jigjiga city water supply and sewerage authority (JWSSA) structural structure is composed of six departments with the manager and deputy manager, namely Head/Manager, Deputy Manager, Legal Service, Audit Service, Finance and Procurement, Customer Service and Public Relations, Planning, Core Process Human Resources Development and Water Supply and Sanitation, which is responsible for the manufacture, treatment, transmission, distribution, sale of the city's drinking water supply, maintenance, operation, installation of new pipelines, management and construction of new water supply structure. In this way, questionnaires-collected data from interviewed households showed that limited effort and consideration influenced the administration to solve the current urban drinking water supply problems. The authority does not preserve all the work of water supply structures without the necessary unique equipment and skilled workers.

1.2 Statement of the Problem

This problem is common in most developing countries and as in Ethiopia, the problem is particularly worsened and multidimensional. All the resources that sustain life have their existence in water" from the tiniest algae to giant mammals as well as everything they live, feed on and can reproduce are creation of water (Kabiso, 2015). An adequate supply of clean water and sanitation improves health by reducing the incidence of water-related diseases such as bacteria, diarrhea, cholera, etc. reducing morbidity will help reduce the need for innovative medicines and alleviate the balance of payments problems faced by least developed countries. Therefore, a safe, adequate and accessible water supply and adequate sanitation are certainly basic needs and essential elements of primary health care (MoWR, 2011).

Supply of drinking water is one of the basic urban services that have a positive impact on the health of the people and their economic progress. High water demand due to water scarcity, unbalanced demand and supply and poor water distribution system is a major problem in the study area due to population growth and unpredictable scale of urban expansion and financial organization of urban communities. Residents of the city face water shortages, distribution systems problem and inadequate management, with the majority of surveyed households obtaining drinking water from alternative unprotected sources and paying high prices for providers. They confirming that they purchase water with high price from unprotected sources. The consequence of the water supply and distribution system problems in Ethiopia, especially in the city of Jigjiga, can be explained by the lack of control over the physical framework and the incompetence of the authorities.

The problem with using traditional hand-dug wells is that they are often 10 meters from the toilet pit, so most from these alternative sources are unprotected and unsafe according to the result of the questionnaire, field observation and personal involvement of the researcher in the study area. As a result, water pollution and contact with contaminated toilet faeces is so high that it impacts the health of the entire community. the problem of water supply in cities is not only a question of adequacy of quantity and quality, but also of unequal distribution, technology, finance, management and reliability. Also, water distribution in Ethiopia is limited to a few hours. Jigjiga, one of the cities in Ethiopia, that has had problems with water supply and distribution to households. The problem is inadequate water production and many other disruptions in power, engineering, unequal distribution, administration, finance, etc. that limit the supply of sufficient quantity and quality of water for domestic services. resident of the city were unable to provide sufficient water for various drinking water supply activities. For these reasons, communities routinely source water from remote and alternative sources. Because the growth rate of the study city community is very fast, in a year due to various factors.

1.3 Objectives of the Study

1.3.1 General Objective

To evaluate of the drinking water supply challenges in Jigjiga town and to identify the root causes affecting the town's potable water supply.

1.3.2 Specific Objectives

The specific aims of this study are:

1. To assess the drinking water supply coverage and mode of service of the study area.
2. To investigate the quality of the drinking water sources in the area.
3. To identify the major root causes and challenges of water supply in the study area.

1.4 Research Questions

1.How much is the extent of water demand and supply of the study area in connection with adequacy and quality?

2. What are the main sources and coverage of potable water supply in Jigjiga town?

3. What are the major causes and challenges of potable water supply in the study area?

1.5 The Scope of the Study

This study was limited to residential water supply and won't include industrial and other needs due to the study duration and city size. This survey was limited to the water supply of Jigjiga town. Particularly, the study was focused on identifying challenges of adequate water supply of the city, including the four districts called Karamarda, Duda-hidi, Kordere and Garab'ase, consisting of the 20 kebeles which known as 01, 02, 03, 04, 05,06, 07, 08, 09,10, 11, 12, 13, 14, 15, 16, 17, 18, 19 and 20 in city, excluding other kebeles outside the town. The scope of the investigation was related to the topic that has the limit to the assess the problems of the potable water supply and pipe system only in terms of equitable in all parts of the city, its adequacy, quality and its availability to the whole community.

1.6 Significance of the Study

Water is one of the essential things in human beings' life and water supply research is very important to provide clean and safe water to the community to help achieve sustainable development under all circumstance.

Household connection water supply is the leading problem of the worldwide, particularly less developed countries, similar to sub-Saharan Africa, especially Ethiopia. This study was investigated extent, coverage, and essentials of the city's water supply system to assess key causes and challenges. The main goal of this study was to identify the main drinking water problems of the communities that did not have adequate drinking water, safe and hygienic, especially low-income/cash-poor people of the community. Therefore, the results of the research were important for the following reasons:

- Generally, in Somali regional; state, particular regional water bureau, the offices of jigjiga municipality, water supply and sewage Authority of the town, may be the conclusion of this theses identify the major causes and challenges of the city's existing water supply system,
- the result of this thesis may contribute to in-depth research on rooting and overhauling the drinking water supply of Jigjiga town, and
- also, the study may use for other researchers as a reference to other urban areas.

2.LITERATURE REVIEW

2.1 Definition of Key Terms

The following words or phrases are used in this document and each has the following definition:

Water demand: the volume of water requested by users to satisfy their needs.

Water supply: the provision of water by public utilities, commercial organizations, community endeavors, or by individuals, usually via system of pumps and pipes.

Piped water: tap water from the distribution lines of a piped-water supply station.

Public faucet: community faucet from which individuals draw water. Some low-income home units, mostly in rural areas, which cannot afford the cost of home connectivity, depend on it.

Faucet: a regulation for controlling the flow of a liquid/water from a reservoir.

Emergency water truck (EWT): a short term, life-saving intervention that is used to cover interruptions in water service or access to sufficient quantities to meet survival requirements.

Water seller (beyollie): who collects water from alternative source or from government or private water tanker and sells it at a premium to other communities during water scarcity.

Potable water: water that is safe to drink, free from microorganisms and harmful substances, regardless of whether it may have color, odor or taste problems due to minerals.

Household: all people who live under the same roof or have different lodging unit, having either guide access to the outside.

Household consumption: water used for various household activities, such as food preparation, drinking water, bathing, ketchup, for sanitation purposes.

Residential connection: plumbing service connection inside the pipes of the house to at least one faucet, for example, in the dining room and toilet or one faucet inside the complex.

Kebele: smallest organization of residential units living in a town or city in Ethiopia government-managed orders.

Urban: built-up residential area covers one county with overall population of at least 2000.

2.2 Urban Water Supplies

Water is a necessary basis for human existence and economic development, the arrangement of an adequate supply of water in urban areas in developed and developing countries is the basis for their livelihoods (Kassa, 2017). In this context, providing countries with an adequate supply of drinking water even for drinking, sanitation, bathing, etc., improves human services by reducing the incidence of water-borne diseases and water-related diseases, for example, amoeba, diarrhea, cholera and typhoid (Karimi, 2016). It also limits both mortality and distress as well as lost work days and reduced work capacity. Reducing morbidity will reduce interest in improving treatment and make it easier to balance disbursements, especially challenging less innovative countries. Water is one of the fundamental powers required for the manageable development of any town or city and also of the nation, on which the financial, social and ecological improvement depends. largely on improving satisfactory local water supply management agencies. Access to water, sanitation and hygiene is a basic need and human right (Adegbehin et al., 2016).

Water is a primordial natural resource and an essential human need. Without access to an adequate water supply, every human action is futile and the privilege to use other elective sources will be abused (Chalchisa et al., 2017). Access to a water supply is a basic need and stands out among the most pressing of human rights. The life and vocation of individuals depend on water. In this way, a protected or clean, adequate and readily available water supply, as well as legal cleanliness and sanitation, are indeed basic and essential needs of the major health services for people. people. In line with this, the Ethiopian Water and Sanitation program introduced the idea of a link between DWSS and poverty alleviation (Abdisa and Reddy, 2014). The Ministry of Water Resources also considers supplements as one of the core benefits that women in particular get from their bodies of water. These are: Saving time and energy because they are interested in further development exercises, for example, generation, training arrangements, procurement of clean water and satisfactory population so that can be potable, clean, cooking and sanitary and therefore better welfare and a niche among open households in accordance with the type of water tank they use (Yongsi, 2010).

2.3 Access to Safe Water

Access refers to the ability to spend money and a separate, easy and energetic way to access facilities that improve living conditions (Emenike et al., 2017). Access to facilities, for example, residential water supply, social insurance, clothing, cooking, and guidance can make some homes virtually inaccessible (Temitope and Oyedotun, 2017). Regarding the WHO assessment, families established in low-wage areas are many times more likely to need access to a better water supply than household units in low-income areas. high of a similar country (Hussien et al.., 2016). Access to a potable water supply is estimated to the extent to which a population has access to an adequate amount of potable clean water located in a physically segregated area of the client's home.

The revised WHO/UNICEF Joint Audit is characterized at the country level as “access” understood as actual use by people. Access to a water supply in an urban area no more than per 200 meters from an HHS to an open stop can be considered functional access to water. despite the fact that it cannot contain calories or natural supplements. Access to an adequate and protected supply of drinking water has improved since over the past decades attracting most regions of the world, but at the same time approximately one billion people do not have access to a safe and adequate water supply and 2.5 billion need access to legitimate sanitation and hygiene. According to WHO/UNICEF report in 2014, only 16% of the population in sub-Saharan Africa has access to supplies of clean and adequate drinking water through an association of households, a private or public association.

Their access is not limited to just a timely, open supply of drinking water, however, when water is accessed in these communities, there are risks of contamination due to many factors such as displacement unsuitable wastewater, solid waste and lack of adequate water supply, eg piping for water distribution framework (Eytan and Dorothee, 2018). Access to potable water means that people have functional access to a full range of measures provide potable water, drinking water, including treated surface water and treated groundwater however the water is not contaminated contamination, such as sources and boreholes (Asgedom, 2014). Access to water is essential to people's lives and occupations, which is why the MDG target is detailed to improve the good quality of water supplies, sanitation and Sanitation basics are considered by many to be a fundamental part of human rights, economic and social development (Ahmed et al., 2016).

2.4 Household Water Supply

Household water supplies are characterized as water used for all purposes by residents, including required for drinking, cooking or food preparation, laundry, bathing, cleaning and sanitation (Arturo et al., 2017). For each use in this residential area, a specific amount of water must be accessible. In any case, there is a problem with distinguishing a less obvious water measurement for per residential action. The daily drinking water requirement per individual for their basic needs is 20 to 50 liters per day, but more than one in six people do not access such measures of drinking water. An example is household water supply in Africa, where only 62% of the urban population has access to an improved water supply. Rural areas have more than difficult conditions because they account for only 47% of the total population of the country. In this way, urban and rural people are more vulnerable to needs and diseases and are also responsible for the deaths of more than a huge number people consistently. The most affected are children and the elderly (Kefale et al., 2014).

The results show that around the world, around 2.6 billion people are lacking basic sanitation and hygiene services due to lack of clean and adequate water supply resulting in the permanent death of more than 1.5 million people, most affected are from East Africa and Sub-Saharan Africa (Ahmed et al., 2016). Sufficient supplies of drinking water for specific households are often used as facts to estimate the size of economic development and the health service status of people. To assist the nation's people in achieving their economic goals, the need was to have an unshakable new supply of high-quality water. Providing reliable drinking water to the community helps those involved in the process, such as women and children (Aynalem, 2015). In particular, households, commercial and industrial enterprises all depend to a considerable extent, on access to potable water, a reasonable and affordable supply of potable water (Rathnayaka et al., 2016).

In any case, large portions of the whole populace meet deficiencies of this critical need. This trouble occurred from each city and rural zones, especially, from much fewer growing nations networks nonetheless below the maximum extraordinarily critical circumstance. Preferences, Ethiopia man or woman character absence of adequate, secure consuming water deliver and suitable easy and sanitation (Ermias, 2016). When we noticed, as explained by the Joint Monitoring Program (JMP) in 2016, the local water supply in Ethiopia affected the health, education, production of individuals, preventing the country achieves development in different ways, because of a large population such as consuming water and using it for various activities

Locally hazardous water sources (Kumar and Desta, 2018). In this way, most of the sections have little access to improved residential water, which is estimated to be 37% of the total population in both urban and rural areas. Thus, diseases are related, for example, water and related pollution, lack of cleanliness and hygiene; This is a really frequent and fleeting disease. Most of the time this affects the women and children of the country.

2.4.1 Household water supply in a developing country

One of the fundamental challenges of the Millennium Development Goals (MDGs) is expanding access to an adequate and secure supply of potable water, combined with the management and development of water resources. in urban and rural areas (Dagnew et al., 2017). Domestic water will be comfortable water for drinking, cooking and bathing for people's activities. According to the United Nations World Water Assessment Program, demonstrates that it is essentially a well-founded fact that water is not equally distributed to all people around the world (Mactaggart et al., 2018). Important issues are environmental change, monetary status, developing exercises on human obstacles, currency and country problems of the world, professional problems, Water consumption, water resources and associated money are direct or indirect influences on water management.

Significant poverty in less developed countries, including Ethiopia, may be related specifically to the lack of openness to water supplies. In this sense, the extraordinary feeling for sub-Saharan Africa, in a comparable way, demonstrates that the population and rapid urbanization in Africa has increased weights of the local water supply (Schleich and Hillenbrand, 2009). Today, Africa has households, nearly a billion people, about 15% of the world's population. Forecast to 2025, according to which water shortage in African countries will be alleviated in several numbers. Likewise, "without an adequate and efficient water supply, where water shortages and demand reduction measures are unlikely to succeed". This is why the importance of providing adequate and safe water to reduce demand has attracted the attention of specific governments and world associations.

It is essential to see the link between water supply and demand (Adane et al., 2017). Among these African countries are enriched by shared water resources, but are most notable for their population, rapid expansion of urban areas, and lack of access to supplies. clean, protected and potable water

earlier its accessibility is political and regional problems predict better management of this fragmentation of water authorities. This situation, coupled with the rapid and unceasing growth of the population in and around the city, compels them to respond appropriately and favorably the need for urban water supply management (Farah et al. Yonis, 2015).

2.5 Experience of Developing Countries

The developing populations in most developing countries are disproportionate in their urban areas; this places a significant weight on the official expenditure plans involved to build an adequate and safe water supply and wastewater treatment facility. In addition, there are almost no resources left to supply and improve domestic water in urban areas. Adding to this problem, money is not an opportunity for concentrates that are not updated, plans developed but instead never implemented (Hassan et al., 2016). As a result, the provision of adequate and clean water as well as sanitation and hygiene in developing countries is still severely lacking. For example, in Africa, more than 47% of urban families do not have access to a safe, adequate and hygienic water supply, a situation much more frightening in the country and its regions pre-urban area (Kabiso, 2015).

The 2016 World Water Supply and Sanitation Assessment report further estimates that more than 33% of urban water supplies in Africa, Latin America and the Caribbean, and much of Asia, operate intermittently. (Adane et al., 2017). Intermittent water supply framework is a key requirement for access to water for sanitation and uplifts low-paid urban dwellers to make choices, such as water traders. These water providers often charge more than the official water fee for water that is typicallyof lower quality and insufficient quantity. The Organization for Economic Cooperation and Development (OECD) recommends more use;

- Forecasting future water consumption for the water supply system
- Estimating appropriate water resources and re-evaluating and transferring water rights
- Different administrative measures of non-price demand value and integrated control action to create and realize successful approaches to water consumption management.

Essential water shortages are effective when populations no longer affect potable water supplies, for example, lack adequate access to water management and are powerless to deal with related impacts water, such as water- and water-related diseases.

2.6 Sources of Drinking Water in Developing Country

Developed countries do not have water supply problems, whether in urban or rural areas. There are already enough water treatment plants to use to ensure the population's capacity for individuals; for example, can drink water (Iraj and Rao, 2016). As a result, the level of waterborne and water-related medical problems is surprisingly low in developed countries. However, in the developing world, people are pressured to rely on conventional water supplies from untreated and unprotected sources, which affects the health of communities. Thereafter, more than thousands of populations systematically spread disease because of unsanitary drinking water supplies. In this way, it does not consider the quality parameters along with the natural quality in relation to the water source. Either way, the source of household water supplies in urban areas in developing countries is rainwater, rivers, streams, groundwater, surface water, and traditional hand-dug wells. That is:

Rainwater: This is one of the reliable water supplies during the rainy season, where water is collected and stored on rooftops for drinking. Depending on the amount of precipitation in the particular area, the range of the water tank may be extended.

Surface water: it starts from the water source. It is mainly obtained from the earth, e.g., wells, springs, and it will result in often difficult microbiological qualities (having undergone conventional soil filtration). In any case, it is often difficult to remove. Need more innovation and energy unlike other water sources with water transport from earth to surface (Singh and Turkiya, 2013).

Traditional hand-dug well water: It is one of the traditional strategies for building national water supplies in urban and local areas and remains the most basic to this day. These dug wells are made by hand, for example, from mud, sand, rock and mixed soil, where a small stone has sunk.

Groundwater: is fresh water (from rain or melting ice) that enters the soil and is stored in the small spaces (pores) between rocks and soil particles. Groundwater makes up nearly 95% of the country's freshwater resources. It can lie underground for hundreds of thousands of years or can rise to the surface and help fill rivers, streams, lakes, ponds and wetlands. Groundwater can also rise to the surface in the form of a spring or be pumped from a well. These are two common ways to get groundwater for drinking. About 50 percent of our municipal, domestic and agricultural water supplies are groundwater.

2.7 Equitable Accessibility of Water

Availability must be seen in terms of how easily people can manage a facility and, for their purposes, increase availability as demand decreases, both physically and socially. festival. And moreover, openness lies between caring and delivering customer benefits in a single terrain space and minimizing any interference between geographical management areas (William et al., 2015). Sources and economic benefits of private water supply, sanitation for units, individuals, families and mainly for children is substantial. Uncommon, most important for the poor to save time, easily and proudly has improved water and sanitation. Without access here are the poorest and the startling smallest.

Access to the poor is an important factor in improving economic resources and returns and is a fundamental part of any effort to reduce need. Having a watering point closer to the home area will reduce the distance that women and children have to walk every day, along these routes allow various exercises including preparation, take care of children, develop activities and generate income. The latter can be combined with the development and management of rural water supply and sanitation offices (Manoj and Junil, 2015). Access to an adequate quality water supply is essential for every human, organisms and vegetation, overexploitation of common resources and high population growth present central difficulties. with limited hard water resources and sophisticated biological systems (Rathnayaka et al., 2016).

Successful management of these resources on a real basis is essential where we need to ensure manageable improvement. Overall, there is enough water is accessible. Either way, meeting the demand requires water to be supplied when and where is needed. Spatial, ephemeral and subjective attributes are the most important constraints in addressing increasing water demand across all segments (Bekele and Leta, 2016). Effective management of these resources on a sustainable basis is the driving force for to ensure sustainable development. Generally, there is enough water. But not reaching the consumption of domestic water in most developing countries, such as Ethiopia.

2.8 Access to Household Water as Observed by International Association

It has taken an impressive measure of documenting the problems identified with water resources, their management, strategy, provision, assessment and use in all areas of life. Some gatherings, discussions and speeches globally and nationally are also in full swing because of its fundamental

importance to humanity. Partnership groups include administration, supervisory offices, public services, representatives of the poor, workers' organizations, business analysts, environmentalists, NGOs Governments (NGOs), global monetary organizations, professionals, academics, experts and market women all gathered together and talked and explained water issues (Mactaggart et al., 2018).

As noted by the World Bank's regional reports for Africa 2018, mentioned in, there is a link between rapid population growth and urbanization and a lack of capacity on the one hand. accessibility to water (Mactaggart et al., 2018). This is more evident in developing countries. For example, these records show that the urbanization rate in Africa is the most astonishing in the world while the rate of urban economic development is the lowest. In many African countries, 40 to 70 percent of urban dwellers live in low-wage neighborhoods and most lack access to an adequate and safe essential water supply because rate exceeds the amount.

This situation and related situations cause the poor to pay normally the amount the rich pay for water supply according to the unit price and total expenditure since they buy water from water suppliers while the rich pay less because they have tap water that is clearly connected to their homes. The truth for is this; "The poor can want and can afford all the costs for the ultimate goal of normal water flow." He still recognized it; " The lack of self-sufficiency of water supply organizations is one of the main causes of the lack of responsibility of the managers, which is ingenious and incapable of exceeding the regulations. specified in introduced by the administrative authorities to the general population " (Ermias, 2016).

2.9 Water Supply and Sanitation Policy in Ethiopia

There are 12 major rivers in Ethiopia with an annual water volume of 122 cubic meters of and a predicted groundwater potential of 2.66.5 billion cubic meters (Kumar and Desta, 2018). Then each individual can access a huge amount of water each year, of which is equivalent to the normal 1575 cubic meters of water. However, as mentioned above, due to the landscape and geology of the country, the contrast between spatial and global precipitation and capacity shortage, water is not available anywhere and when this is needed. Of the potential general water supply, only 3% of the water source is used, or about 11% of (0.3% of the total) is used for residential water supply. In this sense, to deal with this water problem, the household water supply and sanitation strategy

started in in Ethiopia in 1988. Around these arrangements, the government must provide water and sanitation through its own open water fractionation platform with a supply-side methodology. In this way, with the ultimate goal of quality, the government owns institutions, the military government nationalizes the private drilling machine, and its equipment was previously consumed by the Works Development Authority. Ethiopia, then used to alternative for autonomous Drilling Wells Agency.

The Department of Water Resources distinguishes the entire water supply division, which is largely seen as providing "free" administrative agencies that neglects to reflect the idea of water scarcity in the country (Rathnayaka et al., 2016). Tariffs and cost offsets were also not fully considered due to the communist economic agreement made in the state. Likewise, Sanitation Section of the Water Resources Management Agreement defines the common system by which sanitation aims to improve the well-being and efficiency of the general population through the establishment of satisfactory and strict hygiene management agencies. New Sanitation Process focuses on providing open space around the development and public offices rather than unit level funding of households in urban and rural areas village.

The approach observes the solid idea of water supply and sanitation and the needs of the development of a system that is both coordinated and rational. Along this line, as indicated by of this approach, all water supply institutional configurations have a legal ideal for realizing an integrated arrangement of water supply and sanitation. Even so, since the establishment of d' a ministry on water segmentation in 1995/96, an important and participatory methodology has been a presentation that establishes key segment change activities. important (Feleke et al., 2018). The National Water Resources Management Policy also requires that urban centers cover the investment, operation and maintenance costs, while the local WSS needs to assume tasks and support costs, with a Costs are shared up to 10% of the cost of starting a business. The National Sanitation Strategy calls for a redirection to funding for "sanitation progress and asset use", and the separation from equipment and supply funding would facilitate specialist arrangements least.

The financial needs required to achieve the goals of the WSS are preceded by the ability to implement the methodologies described in the approach (Marson et al., 2015). Like this provision of adequate water and sanitation, the strategy is a fundamental part of the country's water management arrangement. As part of the arrangement report, strategy was agreed to donate and is

currently available. realizing the development of water supply for human and living needs (Chalchisa et al., 2017). It focused on expanding inclusion, quantity, consistent quality and satisfactory quality, and sourced current and future materials from the country. Once implemented, the strategy was needed to achieve the goal of Ethiopians having access to clean, sufficient water and small benefits to support water consumption of customers.

Strategies to provide free water to any venue except an emergency, the actual managers talk about an unwarranted case. Since there were not enough resources to provide such free administrative agencies, the rural and urban poor were the first to accept. A significantly better and more objective way is to collect water bills from buyers, and then improve and expand the framework. Likewise, as agreement demonstrates, imagine providing the water authorities of urban areas with mandate structures established on a “full reimbursement” basis. cost and trust”. In time for this, demonstrates that a comprehensive price recovery program has the advantage of creating an incentive to promote rational use, reducing spending and the high demand for water resources (Khwairakpam and Abraha, 2015).

2.10 The States of Urban Water Supply in Ethiopia

The water sector in Ethiopia is one of the least developed and is generally described as lacking the physical framework of the governments and moreover not having the administrative capacity to deal with the water supply problems. arrange and manage as well as organize, work and maintain governments. On the World Bank side, the World Bank Group reports that Ethiopia is frequently referred to as East Africa's "water tower", yet only a quarter of the country's population of have better access to resources of water. The floodwaters of Ethiopia are major countries originating in the tributaries of the Blue Nile, Tekeze, Awash, Omo, Washable, and Baro Akobo rivers flowing through the edges of neighboring countries (Girmay et al., 2017).

Ethiopia is six billion cubic meters short of the Blue Nile in Sudan and in Egypt. However, as recurrent droughts increasingly push locals from of their conventional farmlands to focus on cities, Ethiopia faces the challenge of developing urban water emergencies town. Ethiopia has one of the highest rates of urbanization development in a manufacturing or developing region. As indicated by information obtained from the Measurable Focal Expert, the country's urban population grew at a rate of 4.8 percent per year between 1995 and 2000. Urban population in Ethiopia in 1984, the

primary record period was 4.3 million, representing 11 percent of the total population. In 1994, the second registration period was 7.4 million. In addition, the urban population was an increase of 12% compared to 1984. For urban households in 1984, Ethiopia has 312 urban centers with populations over 2,000. In 1994, the second census for the country's urban centers increased to 534, an increase of 71% compared to 1984, but the significance of the two censuses does not equate to (Kibret and Tulu, 2014).

The rapid growth of urban population has placed a great burden on the administrative limits of regions on the transportation of administrative agencies and on the economic development of the neighboring regions. This vibrant development also affects many districts with the problem of inadequate housing, poverty and unemployment, insufficient electricity and water supply and poor sanitation and hygiene framework (Kabeer, 2016). The accessible information further proves that in the next 25 years (1994–2020), almost 30% of the Ethiopian population will live in urban areas (Dagnew et al., 2017). These types of rapid urban population growth will include the inevitable attraction for substantial gains in housing, urban establishment, water and electricity supply, sanitation frameworks, and conservation projects eco-insurance and projects aimed at reducing poverty and unemployment in urban areas.

This suggests that testing will require thorough preparation by the city government and resources. the need is ever-changing for administrations and the foundation is getting better and better (Wade, 2012). Due to this population weighting and the different factors specified by the jurisdiction, the inclusion of potable water supply and sanitation benefits in Ethiopia is very low. Among the lowest in the world, particularly for local regions, among key markers of the overall improvement goal, Ethiopia takes a 'sustainable' approach to adequate water and hygiene and safety authorities are among the most notoriously poor in the region (William et al., 2015). In Ethiopia, impacts have been deployed to improve the situation through decentralization. In any case, in there was no improvement in the supply of potable water and sanitation. The poor performance of the Addis - Ababa Water Authority can be reflected in the fact that it is only able to meet 60% of the withdrawal and discharge needs.

Regarding the arrangement of water supplies, the 1996 welfare audit survey estimated that 36% of households used a public faucet while 61% used a public faucet or “Bono water” (Eytan). and Dorothee, 2018). The previously mentioned data show that due to the small improvement aspect,

a significant extent of the total urban population of Ethiopia alone and the addition of Ethiopians, when all told, is not capable of supplying provide safe and adequate local drinking water. Regardless of whether they use water from select sources, such as springs, springs, lakes, lakes, hand-dug wells, and non-potable rainwater, cause waterborne diseases and to an impressive degree of separation from their home units. The management capacity of water offices is largely based on the support and proper functioning and standards of the framework. However, in most developing countries, including Ethiopia, people are has found that the operation and maintenance of the water offices are in poor condition and the maintainability of the plan in question.

For its part, MWR acknowledges the basic issues that need to be supplemented; Improper tax setting without attention to full cost recovery, lack of clear rules for setting municipal taxes, low financial and expertise constraints among city government suppliers street, resulting in abnormal amounts of unaccounted for water (UFW) and trivial customer management agencies and complaints in favor of the framework inciting inability to pay charges to customers (Jeandron et al., 2015). For the most part, urban water supply in Ethiopia is problematic due to poor and risky residential water supplies and advice on poor sanitation and hygiene, including due to lack of skilled labor, experts, Financially, the rate of rapidly growing and unorganized city population of the city and beyond the duties and support of domestic water supply management agencies.

2.11 Water Sector Policy and Goals in Ethiopia

The common goals of federal water resources management policy and water sector strategy are to advance national actions toward efficient, equitable, and ideal uses of accessibility. Ethiopia with the ultimate goal of achieving a significant fiscal improvement on the basis of the country's ability to support (Misgena, 2015). Some of the important planning standards of Ethiopia's Water Resources are;

- creates ownership at the lower levels and keeps the management of autonomy as small as possible,
- includes before all else being equal, including private equity expenditures. maintenance fees for local plans Improving urban water supply through self-organization

In addition, the Republic of Ethiopia, based on the popularity of the government, adapted a national approach to water resource management, water supply and sanitation methods and a water area improvement program, establishing sub-sectoral targets for water supply and sanitation, water supply system and hydropower. The common purposes of the water and sanitation approach are to improve the well-being and efficiency of Ethiopian individuals through the establishment of adequate and clean water and sanitation management bodies and to encourage encourages 's substantive commitment to the economy by providing water benefits that satisfy the pets, industry and consumption of another customers (Haziq and Panezai, 2017). In addition, for this strategy in Ethiopia, all water facilities have the right to implement an integrated system of water supply, sanitation and hygiene.

2.12 Review of Empirical Studies

Kebede (2015), studied on the urban water supply system in Hosanna town, Ethiopia. The result revealed that the main factors attributed to lower supply of water were shortage of water provision, high cost of piped water connection, rapid population growth, frequent interruption and lack of narrowing gap between the communities. Mekonnen and R. Uttama (2014), studied on the assessment of potable water supply in Awadey town, Ethiopia. The study showed that, insufficient water supply, poor standards and absence of correct allocation were caused due to high interruptions in electric power supply and administration problems.

In this study, it was felt that, the causes and effects of water interruptions were necessary for a better understanding. Mushir (2012), studied on water supply and consumption relating to home functions, in Nekemate town, Ethiopia. It was found that the economic backwardness and topographical features of the land determined the supply of water consumption in the study area. Assefa Delesho (2006), studied on the difficulties in availability of potable water supply in Assosa town, Ethiopia. The town was unable to meet the demand and supply. The common root causes for urban water supply problems were institutional, financial, human and material resources constraints as you can see this study and the above other previous studies.

2.13 Research and Knowledge Gap

The common root causes for potable water supply accessibility for this study and the previous other studies were institutional, financial, human and material resources constraints. Therefore, in this study, it was found similarities to the previous studies with the following problems and limitations: Institutional, financial, human and material resource constraints. But the surprising thing of this study was the revealed spence gap between supply and demand.

As shown the result 97% of sampled HHs responded that they did not find a daily water need accessibility and meet their daily needs through other unprotected alternative sources such as water vendors or hand dug wells. Insufficient water resources and poor distribution of water infrastructure, lack of technical capacity, weak coordination between sectors, administration and financial problems and lack of skilled labor are the main reasons for the shortage of drinking water supply in Jigjiga town. In addition, water supply coverage and service availability existed in the city center or the old 10 Kebele, but not in the rest of the city, the new Kebeles or suburbs. Most of the victims were in poor residential areas. so, what makes common problem and challenges to the different studies with different geographical locations, population, financial and natural resources, administrations of the towns, is the nature of work system and misunderstanding of the working water behavior, related knowledge gap and experience.

2.14 Conceptual Framework

A. Accessibility is described as the quality of being at hand when required, as the degree of which a product, device, or service and commodity is available to as many as possible.

B. Mobility refers to the ability to move between any two points in space, it involves the movement of people, information, materials and goods.

C. Proximity as nearness and it is often quantifying with the world close.

D. Connectivity in a house connection is ultimately the goal of every individual and population at large this is because water will always be available with good quality and quality.

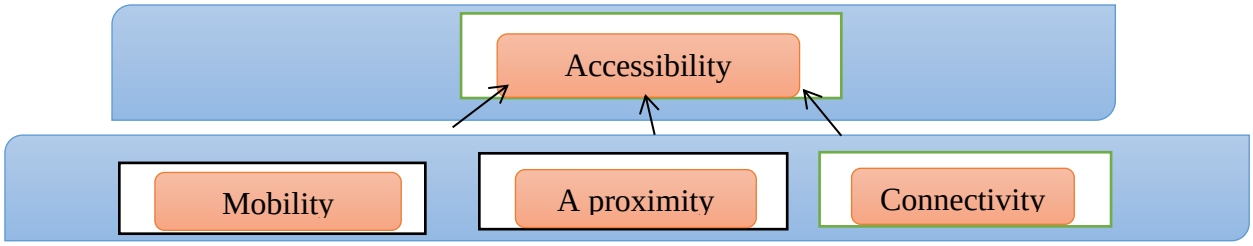


Figure 4.1 Conceptual Framework. Source: extracted from Levine, Grengs and Shen, 2009.

3. METHODOLOGY

To achieve the objectives of the study, applications, outcomes, and information on the causes and assessments problems of accessibility of the potable water supply quality problems must be examined. The method described in this research is more inductive in nature. It includes the relevant elements needed to understand the causes and solutions of water scarcity problems in the study area. This study is a systematic study of the causes and problems related to the accessibility of drinking water in the distribution network. On the other hand, it is the process of collecting, analyzing and interpreting information to make recommendations on the problems studied in the delivery system. The study carried out across the entire city of Jigjiga consisting of the four districts, with in the 20 Kebeles having access to a water distribution system.

3.1. Description of the Study Area

3.1.1. Geographic Location

The study was focused on the assessment of the potable water supply quantity and quality at Jigjiga town which is the administrative city of the Somali Region, Fafan Zone, and the municipality city located at 634km from Addis Ababa in the eastern of Ethiopia. It became the capital city of Somali regional state in 1995 after being transferred from Godey. Jigjiga town located in the Fafan zone area, 60km (37mi) west of the border with Somalia, the town is 1,934 meters above sea level. The town located at latitude of 9º21'24.4224" N and longitude 42º 47' 43.8684" E. the average monthly minimum temperature varies 8.2ºC in November to 14ºC from July to September and maximum temperature the monthly mean temperature varies from 25ºC in July to 29ºC from March to April.

The area experiences a bimodal type of rainfall classified as a short rainy season from July to September and a main rainy season from March to April. The topography of Jigjiga town has a range of lowland to midland agro-ecologies. Based on figures from the projected (Central Statistical Agency in 2021), Jigjiga has an estimated total population of 191,889. at the current administrative structure, jigjiga city municipal council is divided in to four districts which are **Karamarda**, **Garab'asse**, **Dudahidi** and **Kordere** with twenty kebeles, the total area of the city is around 2,470.64 hectares. (Administration boundary of the town and its kebeles).

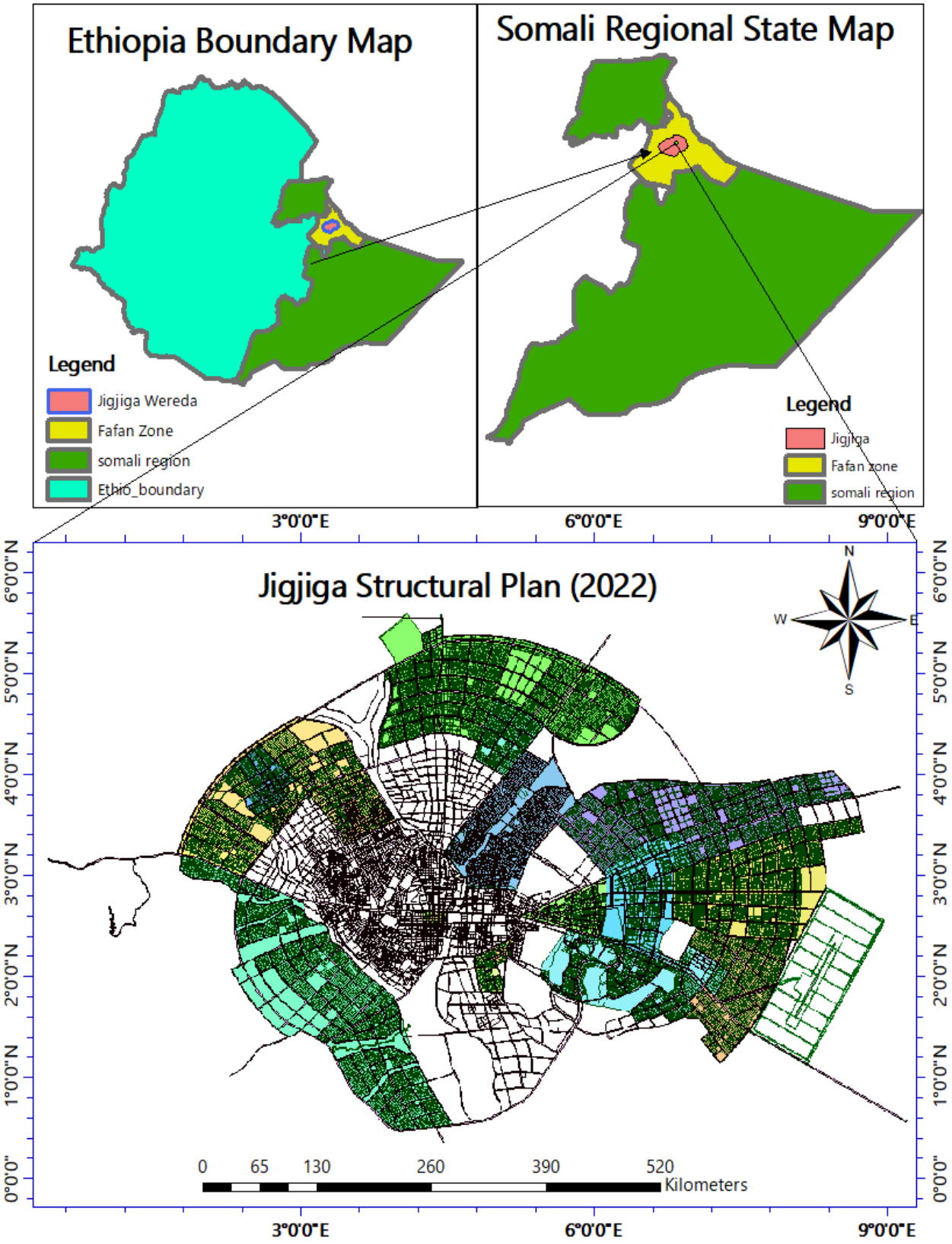


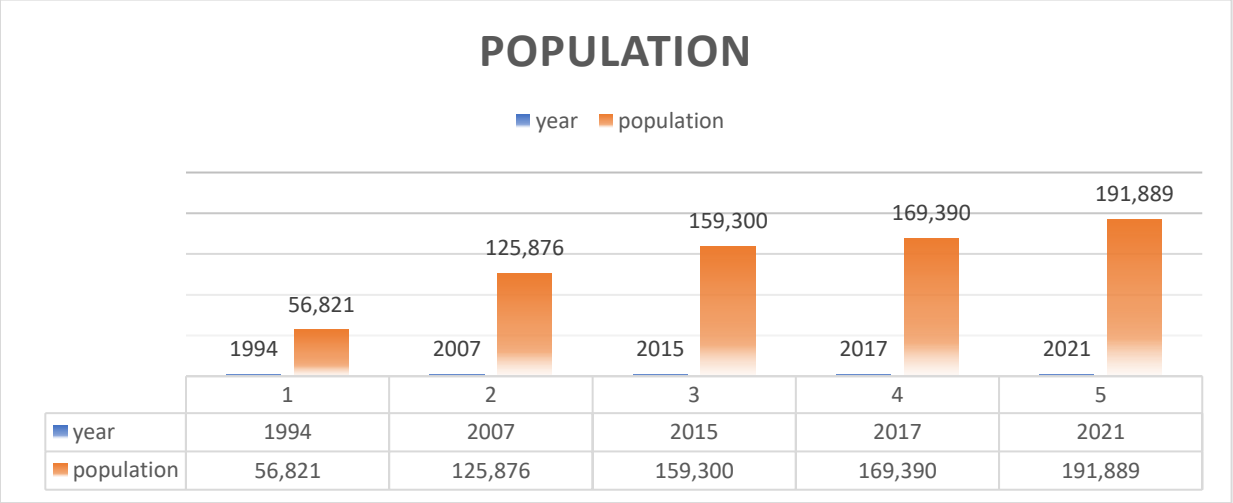
Figure 4.2 administration boundary of the town and its kebeles

3.1.2 Climate and Topography

According to the metrological information acquired from the National Metrological administrations Agency, the maximum yearly precipitation at study town is 712mm and its minimum monthly precipitation is 6mm. the average monthly minimum temperature varies 8.2ºC in November to 14ºC from July to September and maximum temperature the monthly mean temperature varies from 25ºC in July to 29ºC from March to April. The greatest temperature is happened from February to Aril and the most minimal temperature is recorded during Decembers and January months (Meteorological organization, 2018).

3.1.2 Population

The population of Jigjiga town is very large compared to the land area and investments of infrastructures, such as drinking urban water supply. The population of the study city is increasing rapidly due to the population movements from rural to urban and pre-urban to urban areas, as well as the steady increase in the population of people in the inner city from the city. People move to the city in search of better jobs, better education and health facilities, better transport and standard of living since the study area is the capital city of Somali Regional State, administrative center of Fafan province and also Municipality. Regarding the central statistical agency (CSA), the number the base population of the city has grown rapidly from 1994 to 2007 of the city was 56,821 and 125,876 respectively, as shown below chart.



	1	2	3	4	5
year	1994	2007	2015	2017	2021
population	56,821	125,876	159,300	169,390	191,889

Figure 4.3 population size increase. Source: CSA

This rapid growth of the town has greatly increased interest in the urban supply framework, in particular supplying with adequate quantity and quality, respectively.

3.3 Study Methodology

The general methodology of this study was used two techniques. These are quantitative and qualitative methods which are used collecting the most essential primary and secondary data from sampled households' respondents and some offices using different data collection methods. After data collection to analyses on table and figure by cross-checking detail explanations of the methodology of the study.

3.4 Design of the Research

The research design of the study used quantitative methods and qualitative techniques that considered that individual household responses and key data collected by questionnaires and interviews depended on the current drinking water supply situation in the study area and on the variables for which proposes adequate water supply and protection arrangements and furthermore this research strategy hopes to provide an appropriate description of the Current status of water supply for domestic use in the study city.

Quantitative Method: it aims to describe and interpret the current state of the water supply in and around the study city, a strategy used with the ultimate goal of representing the conditions of the issues and components change. The ultimate goal of examining, comparing, contrasting, classifying, analyzing and interpreting comparative data and events with different fields of observation, it helps to describe states of problems. The supply of drinking water depends on the existing water source.

Qualitative Method: qualitative analysis involves differentiating the structure of water supply, accumulating household water use practices and synthesizing socioeconomic information depends on qualitative data, which is collected between sampled households and certain offices selected in the study city.

3.5 Data Sources and Type

Two types of data were used for this study. These were primary and secondary data sources, collected from different sources, such as:

3.5.1 Primary Data Sources

Primary data was collected from questionnaires, interviews, discussions and field observations. The source site was visited and observed for borehole condition, pipeline distribution network,

reservoir service by imaging, point latitude, longitude and elevation, and other existing challenges of the main water supply system of the city.

3.5.2 Secondary Data Sources

Secondary data was collected from relevant research sources such as: city boundary maps, pipeline distribution maps, design documents, annual reports, academic papers, articles, books and other materials related to this topic have been collected with quality suitable quantity.

3.6 Sampling Size and Sampling methods

The researcher was applied a systematic random sampling system that was used to select a sample representing the population of people in the study area and all kebeles in the city. It is better to use a sample of household's respondents because it is impossible to include the total population and households in the city being surveyed. This is because the total population and the number of households are large. according to the Central Statistical Agency (CSA), the projected total population of the city is 191,889, the city is split into four districts and 20kebeles closers together. Thus, out of a total population size for this study, only 5% of the total population in the study city were included out of the sampled household's respondents, i.e., 400respondentsin total.

this respondent represents a total of remaining population in the city.

Once the sampling method is determined, the household's respondents sampled from each of the nearest are selected using a random sampling technique. Exact random selection is the most convenient method for sampling is to select from each item on the snapshot in each kebele.In this way, the components of randomness are included in this sampling by taking random numbers and sampled household's respondents are selected with reference to the first number in each group. samples were taken from each kebele taking into account the sex of the families, marital status, education, family size, income source, monthly income and their positions, sample measurements were taken from each sampled group for their number of respondents, Sample size of the population calculation formula Yamane (2009) is:

$N = {}^{\mathbb{N}}/_{1} + N(e)^2$

n=sample

N=population

e=level of significance

$$Thus\ n = \frac{191{,}889}{1} + 191889(0.05)$$
$$= \frac{191{,}889}{479.725}$$
$$= 400$$

3.7 Method of data collection

The data collection methods of this study included questionnaires, interviews, field observations, focus group discussions, related to the objectives of the study.

Questionnaire

An open and closed questionnaire was prepared to collect data according to the objective of study and previous research related to this study on the challenges of potable water in the study city. With the ultimate goal of collecting pertinent data on the issues under investigation, the questionnaire was distributed to sampled households, selected respondents, and selected offices for collection. Data collection is consistent and certainly dependent on potable water consumption, adequacy, quality and accessibility and health of the city. All questionnaires were first compiled in English and translated into Somali to make the sampled respondents selected from the city's community accessible and understandable. This was done for the sake of simplicity, acceptance, and less duplication of ideas during the data collection period. After data collection is complete, translate into English for analysis and interpretation, as well as to solve learning problems. These questions are presented in Appendix 1.

Interview

Explanation of the use of semi-structured interviewing was used to create facilitation conditions in which a new question was transmitted during the meeting according to the responses of the interview. The interview was conducted in Somali language to avoid language barriers and backed up with an audio recorder to reduce audio data loss. The recorded information was divided according to the similarity of the responses and converted into English languages during the interpretation. This provides more meaningful and robust data from sampled households respondents and offices selected during data collection in the study area.

Field Observation

The researcher made field observations to see the actual situation existing on sources and reservoirs, take pictures, GPS points, distances from the city and collect, transport and request interpretation were used by agents with the ultimate goal of collecting additional or supplemental data for data approval of the planned meeting with households and offices were selected according to the existing drinking water challenges of the study city. to assess the current status of water supply and distribution in the town, the existing water sources of the town, water supply coverage and their state of development, the condition of water supply interruption in the town, the round-

trip distances of water sources from the dwelling places, the condition of queuing and waiting turns for fetching water and the functional sustainability of the schemes and were matched it with the checklists to assess the reliability of the data collection.

Group Discussion

Group discussions were held with JWSSA technical and management experts, WRDB engineers, other Agency stakeholders, and customers in their offices, households, and cafeterias to confirm previously collected information and present new ideas, challenges, and data. Supply-focused group discussions were used to generate relevant data that focused the conversation on selected topics related to Jigjiga City's water operations, e.g. production, supply, quantity, quality, accessibility and waterborne diseases in the city's urban communities.

3.8 Data Analysis

To analyze the data both qualitative and quantitative methods of data collection were used. To give clear understanding about the problem. the researcher wrote five request letters from the department to different offices like MoWR, WRDB, CSA, WWDSE and JWSSA to collect effective and valid data from the above offices like documents, design, annual and project reports to evaluate the potable water supply challenges in Jigjiga town. To assess the drinking water supply main sources, coverage and mode of service in the study area, well questionnaire was prepared to represent the context of the urban water supply situations.

The study was applied a systematic random sampling system that was used to select a number of 400 sample representing the population in the study area and all kebeles in the city and questionnaires were administered to household respondents using Sample size of the population calculation formula Yamane (2009). On the other side, of the interview three different boreholes samples were selected and sent to laboratory to investigate the water quality of the main sources and also it was identified the major existing root causes and challenges of the study area, with the interview of the authority’s administration and other concerned officers. therefore, quantitative data collected using open-ended questionnaire, interview and personal observation were also analyzed through SPSS and GIS the descriptive statistical methods like frequency, percentage and extracted the existing pipe network maps in order to come up the appropriate result.

In addition to that, open and closed questionnaires, semi-structured and structured interviews and document analysis were made. Upon completion of data collection, coding, organizing, interpreting, correctly interpreting, and describing precision techniques using percentages, tables, charts, figures, numbers, frequencies, and classification requirements were obtained using as data analysis methods quantitative and qualitative methods. In addition, information was collected using a variety of data collection methods.

3.9 Ethical Consideration

When the researcher conducts questionnaires, focus group discussions, interviews, and personal observations with respondents, there are ethical considerations. This could be ethical responsibilities for adhering to and obeying societal norms, culture, and traditions related to the subject of a study. The researcher used to explain to the respondents that the questions were only for educational purposes. Before administering the questionnaires, all of the participants were communicating about the study in order to obtain their verbal agreement. The interview, focusing group discussion, and interview were all digitally recorded and professionally transcribed with permission.

4. RESULTS AND DISCUSSION

This section mainly focused on data collected through questionnaires, interviews, field observations, focus group discussions, and literature review. These informative discussions and the resulting mainly focused on the characteristics of the selected from sampled households depending on the current situation of the drinking water supply services in the study city, such as outcomes of water supply major sources, distribution network, water shortage root causes, major challenges and also the gap between water supply and demand and complementary activities was undertaken to better improve the city's water service over current water conditions in the future by looking at the city's current population numbers and future population projections.

For the important maintenance work the water supply and sewerage authority office reports to the regional water resources development bureau, which entails requirements of the equipment, technical and financial support for the operation and maintenance of the city's water supply systems. The manageability of water supply systems depends primarily on the mission and support of the framework. However, it was found that the operation and maintenance of the facilities are in poor condition. In this context, the additional situation was recognized as problems identified with the operation and maintenance of elements of the city's water supply and sewerage authority office such as: -

- Lack of additional materials for water supply
- Lack of water quality test laboratory
- Lack of equipment's for maintenance and operation
- Insufficient planning of the supply and circulation system of the distribution
- Insufficient skilled technician and
- urban water management professionals.
- Lack of spare parts

The salary rates, quality of the technicians and water management professionals are extremely poor and not aligned with income and benefits. For these reasons, the works do not meet the interest of the city households in having enough water for all neighborhoods, and the operation and maintenance of water supply services do not function properly because their skill and short number makes instead of the total number of works. The municipal WSSA office has wasteful

and insufficient human resources for successful administration of the potable water supply. There are 219 permanent workers, a large proportion of who do not have skills, adequate training and preparation for promotion from the water supply administration. Because107 are guardians, 24 operators, 11 storekeepers, 23 drivers, while the authority denounces the service cars serving the water network from wells to consumers and while only 5 plumbers and 4 engineers Includes 219 permanent employees, this indicates that the authority does not perform all jobs in a timely and correct manner and does not serve all consumers in the city well.

4.1 Characteristics of the households (HHs) in the town

Table 4.1 Genders of sampled households

		Frequency	Percent	Valid Percent	Cumulative Percent
What is your gender	Male	255	63.7	63.7	63.7
	Female	145	36.3	36.3	100.0
	Total	**400**	**100.0**	**100.0**	

Source: Survey data

According to table 4.1 from item one, 63.7% of the sampled HHs were male and 36.3% of the sampled HHs were female from total (400) of sampled HHs in the town uses of potable water supply. The major numbers of the sampled households were male, but this does not mean that the more water consumed by male compared with female. Most of the time females works different works in house such as cooking, cleaning and washing clothes by using high amounts of water consumption every day inside and outside the home in studying area.

Table 4.2 Age of the sampled households

What is your age	15-24	70	17.5	17.5	17.5
	25-54	278	69.5	69.5	87.0
	55-64	39	9.8	9.8	96.8
	65 and above	13	3.3	3.3	100.0
	Total	**400**	**100.0**	**100.0**	

Source: Survey data

Regarding to table 4.2 from item one, 17.5% of sampled HHs were explained their age 15 to 24 years, 69.5 of the sampled HHs was mentioned their age 25 to 54, 9.8% of the sampled HHs were mentioned 55 to 64 and the remaining 3.3% of the sampled HHs were explained their age 65 and

above years of age living in the study area. The ages of most tested HHs were between 25 to 54 years of age. These indicates that most of the HHs are understands the important challenges and problems of existing water supply shortage for town population and they should be responding around the exact answer with related to the past and present insufficient quantity and quality of drinking water supply in the study city.

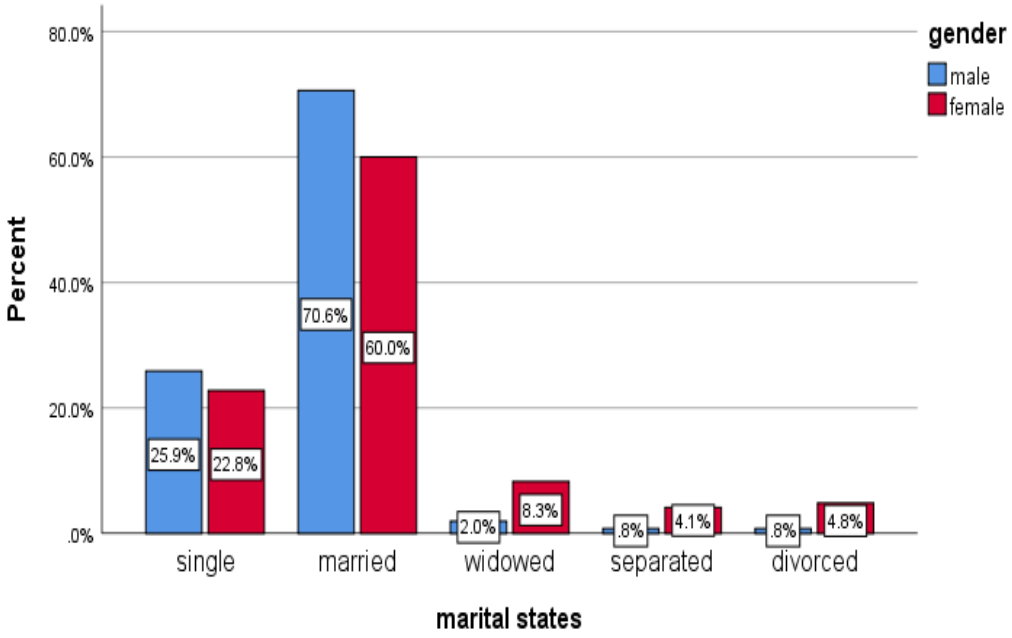


Figure 4.4 Marital status of sampled households

According to figure 4.4 from item one, 24.8% of the sampled HHs were single,66.8% of the sampled HHs were married, 4.3% of the sampled HHs were widowed, 2% of the sampled HHs were separated, and 2.3% of the sampled HHs were divorced from the total (400) of sampled households in the study area. The majority of sampled households were married, which have the highest numbers of family units, these effect the demands of the town water supply because of their requirements of high amounts of water quantity for their daily consumption of different activities.

Table 4.3 Educational background of the sampled households

Item	Categories	Frequency	Percent	Valid Percent	Cumulative Percent
What is your educational background	Illiterate	83	20.8	20.8	20.8
	1-8	43	10.8	10.8	31.5
	9-12	51	12.8	12.8	44.3
	Diploma	77	19.3	19.3	63.5
	B.Sc.	84	21.0	21.0	84.5
	M.Sc. and above	62	15.5	15.5	100.0
	Total	**400**	**100.0**	**100.0**	

Source: Survey data

According to table 4.3 from item one, 20.8% of the sampled HHs were illiterate, 10.8% of the sampled HHs were said1-8 grade, 12.8% of the sampled HHs were mentioned high school level 9-12 grade,19.3% of the sampled HHs were mentioned diploma level, 21% of the sampled HHs were Bachelor and 15.5% of the sampled HHs were master and above, from the total (400) of sampled HHs in the study town. As mentioned above table 4.3 most of the sampled HHs were educated that indicates that more than half of the selected sampled households were educated. This is good for the response and reasoning explanation of the past and present existing situation of the town water supply accessibility. Therefore, educations level one of main determinants that is directly related to the water demand and consumption of the potable water supply of the town. In addition to that most of the most of the sampled HHs were higher educational levels that mean they could understand the purposes of water for living things on the land and the development of one town and also, they were know public water borne diseases related to the inadequate potable water supply in the town.

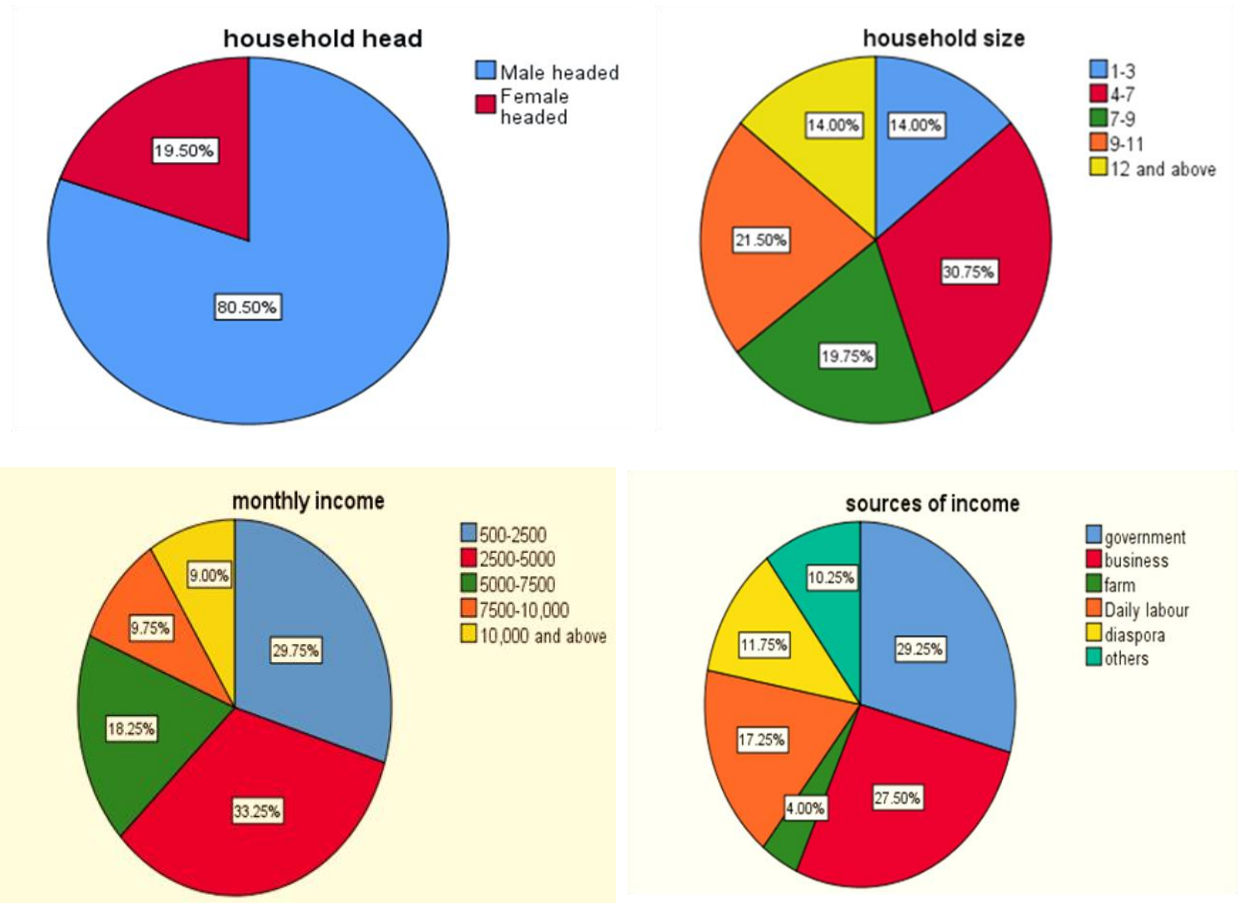


Figure 4.5 household Head, Size, Sources and Income.

Regard from the pie chart item one 80.5% of sampled HHs were explained as male-headed families but 19.5% of the sampled HHs were mentioned female-headed families. Majority of the sampled HHs were male-headed in study town. This indicates many numbers of tested have great numbers of family size and required high amounts of daily water consumption. In others words, this is good for developments of infrastructure in the town for instance implementations of the additional distribution of water supply and sources of water supply and sources of water as well as any other components of town water supply schemes starting from sources up to consumers. More than 80.5% of the households of the study city is male-headed because it is a traditional and regional way of the population in the town and to take the responsibility of the family, in addition to that, the traditional culture of the people in the city of the family's men is responsible for the administration and finance even if they their sources of income in very low while most of the female-headed families are widowed or separated

According from pie chart item two 14% of the sampled households were said their family sizeas 1-3, 30.8% of the sampled households were explained their family size as 7-7, 19.8% of sampled households were explained from their family size as 7-9, 21.5% of the sampled households were mentioned their family size as 9-11, 14% of the sampled households were shown their family size as 12 and above. Major parts of the sampled households have more numbers of family size in the study area. The numbers of family sizes are increasing required high amounts of daily water demands, and also the high community is required more amounts of daily water consumption of their daily drinking activities.

Generally, the size of the family is the major factor of the town water supply, due to this reason consumption of the town water supply depends on family size and economical levels of households, that means they have more family size and economy they could be need highest amounts of water consumption per day but their economy level is low and also required less amounts of water consumption depends on their economy level. The jobs and income level of sampled households of the study town is very low when compared to the family size, especially the income compare to other towns of the country.

Households size of the families in the study town were high in their numbers when it's compared to other populations of the country because of their traditional and religion believes of the study area. Income of the population in the study area income is very low that is directly related of the water supply consumption of the family sizes. The family sizes of study area and its population number is very high compared to the other parts of the country. As shown pie chart, item three the sources of income of the households depends on their job positions, 29.3% of the sampled households were mentioned their jobs as government employers, 27.5% of the sampled households were explained business, 17.3% of the sampled HHs were daily labors, 11.8% of the sampled HHs were Diaspora, 10.3% of the sampled HHs were depending on their daily living to others and 4% of the sampled HHs were farmers.

The majority of the sampled HHs sources of income depend on government employers and business, which is dominant section of the town population. Other is depends on daily workers, Diaspora, farmers and others. Daily laborer and other households are challenging to have private pipe connections water supply, operation and maintenance services due to their low-income

sources of income and financial related problems compared to high- and medium-income parts of the people. The income levels of the sampled households are very low compared to their family size. The majority of the sampled households has 2500-5000, which is 33.3% of the sampled HHs. This indicates most communities have no access the piped water supply due to their monthly income.

4.2 Main Water Supply Sources

The city's current main source of water was groundwater. The city's current water sources are two major pipeline systems, one of which is from Waji wells (7 BHs) and Feda`ad wells (4 BHs), another 33 which were directly connected to the Households. The Waji Wellfield is the city's primary water supply with a discharge of 67 liters per second and the Feda'ad wellfield which were the city's secondary water supply with a discharge of 28 liters per second. Water lines are treated in curing tanks and only chlorinated thickeners are added. At this time, water is supplied to customers through the water distribution system.

However, it was insufficient for both quantity and quality for the various life activities of urban communities. In addition, the well has a salinity test and this well affects the overall water quality as the water is collected from the supply reservoir at the same time and then transported, which is harmful to health. Most of the city's communities receive water through the two main sources, the piped system and the pipe less system. The water source from the pipe system is protected and reliable, but the overall quality has not improved. Unprotected and dangerous unprotected systems such as traditional hand-dug wells and uncleaned providers associated with unprotected water sources. Therefore, Jigjiga is a capital city of Somali regional state, that has grown rapidly over time. Households are supplied with tap water, but not all households are supplied with tap water.

Similarly, most households in the community sample in the study area have daily water interruptions and can easily obtain water from other alternative sources, but a minority use the water supply system. According to 400 sampled households, 37% of the city residents had private tap connection, but 97% of respondents did not meet their daily water needs from their home connections. However, it was surprising that 50% of the sampled households indicated that they had pipe connection in their homes but no water. This increases government revenue from the annual bills of JWSSA customers, unfortunately, city dwellers are willing to pay any price, but

water is not efficient. Water connections are unsatisfactory for reasons such as poor management, manufacturing, engineering, financial, energy and infrastructure, topographical location and water distribution issues.

The majority of all households in the city's study area did not have tap water and used other alternative water sources, due to, inadequate tap water supply system. These indicate that certain water sources are not suitable and robust for all city water users. In this way the whole city is used for the mutual benefit of private house connections, private garden connections, shared garden connections, public fountains, traditional fountains and water vendors. Water supply system These are increasing due to lack of water supply. Therefore, they use select sources to meet their daily consumption needs for drinking activities. As noted by the researchers above, the city's existing water supply is primarily supplied by wells in two well areas, with capacity estimates of:

4.2.1 Existing Reservoirs

The existing distribution network supplying water to the population is served from two existing reservoirs with capacities of 1,000 and 3,000 m^3 and located to the west and east of the city respectively. In addition, there is also an area of the city that is served directly from 33 boreholes located in and around the corners of the town, traditional hand dug wells, water trucks and donkey suppliers that vendor water mostly from both protected and unprotected Boreholes and hand dug wells.

3,000m^3 Storage Reservoir

For this reservoir water comes from the Waji well field at a rate of about 67 l/s (3,645 m^3/d). This storage reservoir is the main water source for the population of the town. It is located on east part of the town around the regional administration office. The reservoir is located at an elevation of 1,738 m above mean sea level (amsl) as shown table 4.5 and Figure.

Table 4.4 geographical location of the 3,000m^3reservoir

Storage (m^3)	**Location in (m) WGS84**			**minimum water level (m)**	**maximum water level (m)**
	X	Y	Z		
3,000	262,653.2	1,033,711	1,738	1,738.2	1,743.2

Source: Survey data

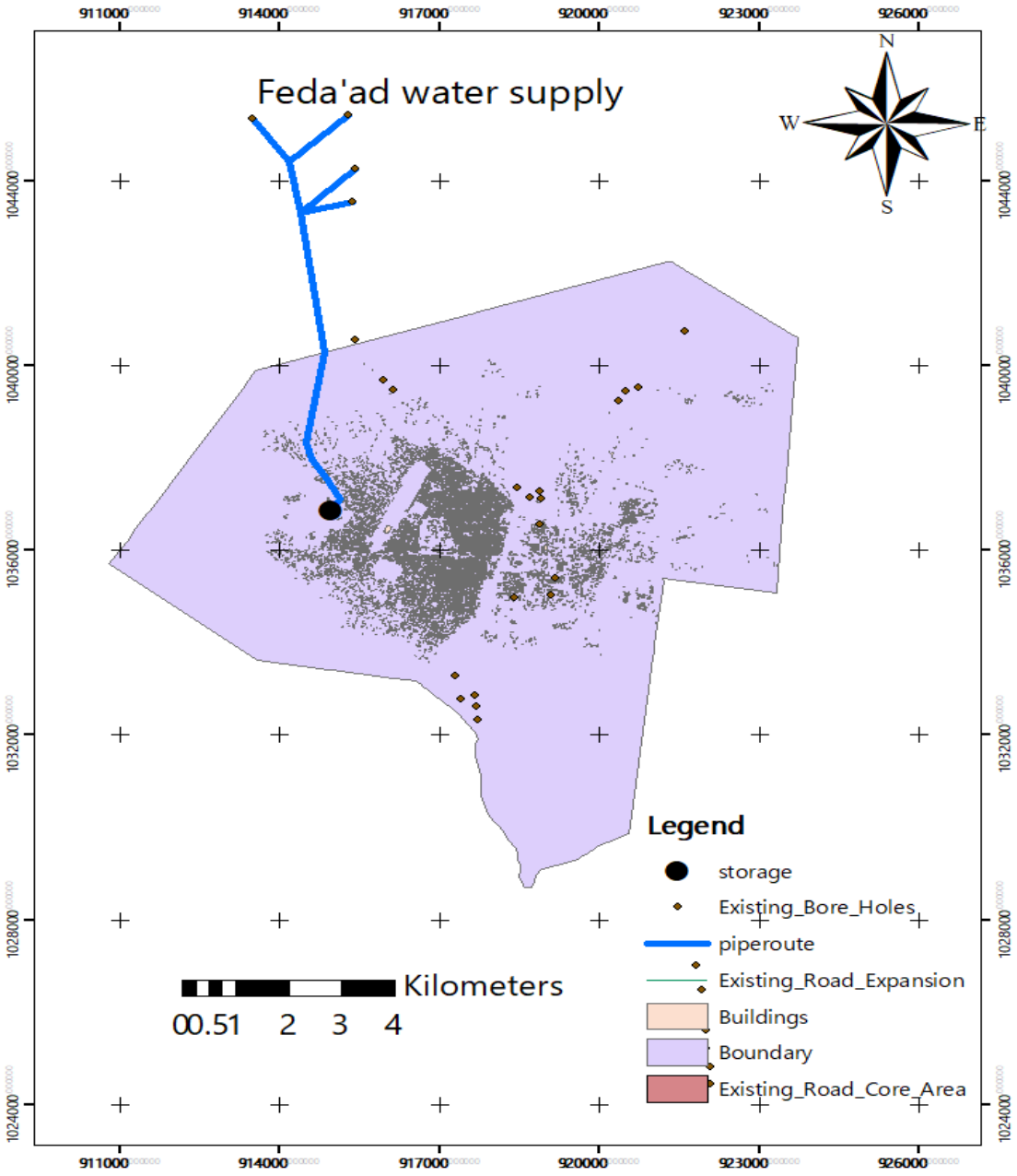


Figure 4.7 location map of Feda'ad well field pipeline route.

The water coming out of this tank is routed to the distribution system using a uPVC ND 400mm pipe, a 250mm UPVC ND pipe top at the top and a 150mm uPVC ND pipe down along Harara Road.0

1000m³ Storage Reservoir

For this reservoir, the water comes from the Feda`ad basin field. For this reservoir, an estimated 28 l/s (1,375 m³/d) of water came from the four boreholes. The boreholes are located approximately 18 km north of the reservoir and west of the city at Kebele 11. Reservoir is located at an elevation of 1725.4 m above mean sea level (amsl).

Table 4.5 geographical location of the 1,000m³reservoir

Storage (m^3)	Location in (m) WGS84			minimum water level (m)	maximum water level (m)
	X	Y	Z		
1,000	254,804.63	1,036,800.24	1,725.4	1,725.6	1,730.6

Source: Survey data

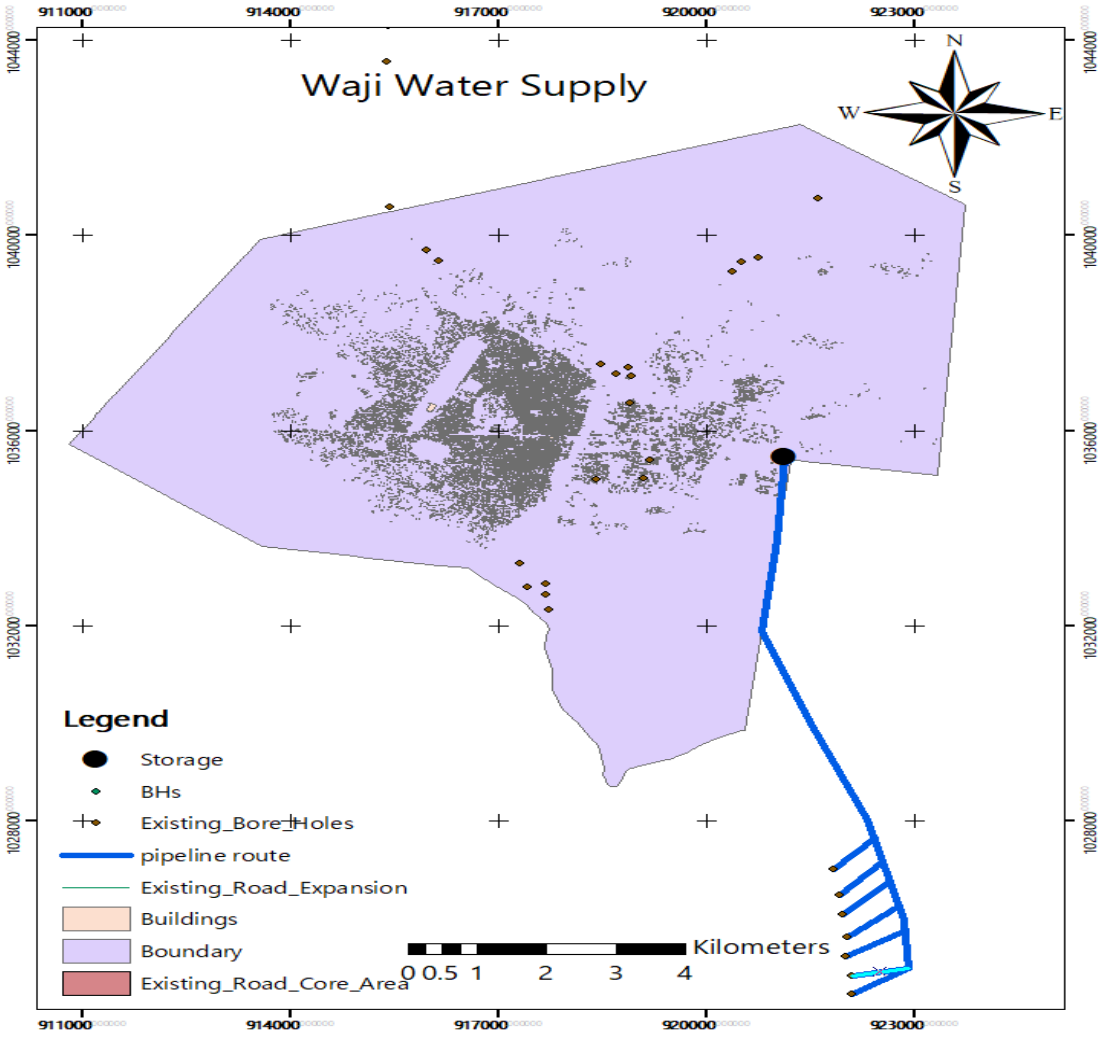


Figure 4.8 location map of Waji well field pipeline root

4.2.2 Directly Servicing 33 Boreholes

There are also 33 older shallow water wells that have been serving directly and constructed in the alluvial deposit and weathered section of the basement rock of Jerer basin. Most of the wells are old and have low yields. According to the document made by WWDE in 2010, the yield of the most of the wells are less than 4L/s. the towns settlement has also to intrude on to the well field and there by bringing into multiple sources of contamination to the area.

4.2.3 Traditional Hand Dug Wells

The traditional hand dug wells remain dominant sources of drinking water especially the South and North parts of the town along the Jerer Basin. These dug wells are made by hand, for example, from mud, sand, rock and mixed soil. In the study area unfortunately, hand dug wells are unprotected water sources since it locates mostly near the latrine less than 10 meters regarding to the researcher's observation and involvement of the community in the study area.

4.2.4 Water Vendors

Water trucking and donkey water vendors have been using watering shared connection fiberglass tanks located the corners of the town for the poor part of the community, private water trucking for economically middle part of the population and the donkey suppliers those vendors water from protected and unprotected sources to cover the water shortages and interruptions in water services and access to meet survival requirements.

Referring to figure 4, 37% of the sampled households explained that their water sources is from tap water supply, which means that tap water is house connection, private yard connection, communal yard connection and public water points, but 97% of the sampled households responded their insufficient for all domestic consumptions, 1.5% of the sampled households said their water sources is from a traditional dug well, but this is unprotected sources, 42.75% of the sampled households explained that their water sources is from a dangerous donkey water vendors (Biyole), daily water is hand dug well but is unprotected and far from their homes and 18.75% of the sampled households reported that their water supply is from water vendors (trucking), and far away from the study city at least 30km(Fafan). However, the majority of the sampled households do not use enough water at all times, because the existing water supply is not sufficient for the needs of the population.

Potable purpose's, which means that the city's water supply system is an intermittent system due to lack of power through various means. Therefore, all the households in the city use alternative water source for their daily living. Most of the sampled households faced these difficulties due to water supply shortages which is:

A. Sampled HHs explained that they couldn't get enough water supply
B. Cleaning indoors and outdoors
C. Economic decline occurred, in addition, in adequate sanitation problems for 191, 889 people can lead to a deadly diarrhea disease, including cholera and typhoid fever and other water-borne illnesses

Sampled households explained the existing water supply system problems such as: -

- Insufficient production of water sources
- High demand of water consumption due to:
- Shortage of Water quantity and poor-quality facing problems in the study area such us:
    - People in the study city couldn't get enough water to drink
    - Cleaning in and out doors and
    - Economic decline
- There is a price to JWSSA organization and connectivity issue
- No new distribution system was established due to the expansion of the city
- The existing pipeline is old, no longer of good quality, reducing the quality of water by breaking each time due to the diameter of the GI pipe, salty water supply.

In this way, sampled households want to use alternative water sources because it is available in a high quantity but more expensive than the tap water sources and is used more from nearby sources than other water sources. No safe quality, it causes waterborne, water related and wash water diseases in the community, affects their lives and financial system and also affects the development of the city.

Jigjiga town authority mentioned that the water supply problems in the town are expected to be due to various causes. Lack of large quantities of water, lack of financial limits of JWSSA, lack of skilled labor, lack of basic technical support, lack of other relevant agencies such as municipalities, NGOs, and private associations. The main challenge water scarcity in this city is the population growing rapidly over time no gap due to:

- Climate change

- Population growth and
- The development of industrialization and urbanization and also
- Without prior planning or population forecasting.

Jigjiga city not used different methods to accurately determine population and reduce community water supply problems. In addition to that, there is no direct coordination, participation and Material support between the city community and JWSSA to alleviate existing water shortages and build new water supply systems.

4.3 Water Supply Accessibility

For the sampled household's survey, access to a protected water supply is a primary human need and a fundamental human right. These rights include the right to existence, health, adequate education and housing as well as access to an adequate water supply, which means water is live and live is water. Therefore, each person must have at least 20 liters of drinking water per day to meet its basic needs as a minimum prerequisite for respecting the right to water. But in the study city, there is drinking water every time because the existing house connection water source is not sufficient quantity and quality, it causes many diseases to the community of the city, these diseases are deadly diseases than students, children and women such as Amoeba, Diarrhea, Typhoid and cholera. In addition, women and children spend school time and working ever day to obtain water from different alternative sources. The condition of the existing water supply such as drinking, cooking, cleaning and others.

Table 4.6 Access of water supply of sampled households

Item	*Description*	*Categories*	*Frequency*	*Percent*	*Valid Percent*	*Cumulative Percent*
1	Do you get daily water demand access for your household?	yes	12	3.0	3.0	3.0
		No	388	97.0	97.0	100.0
		Total	**400**	**100.0**	**100.0**	
2	How many days did you get water?	Every 2-3 days	64	16	16	16
		Every 4-5 days	70	17.5	17.5	33.5
		Every 6-7 days	28	7	7	40.5
		None	238	59.5	59.5	100
		Total	**400**	**100**	**100.0**	
3	If no to previous, how can you fulfill your daily demand using by?	Water Vendor	389	97.3	97.3	86.3
		Hand dug Well	6	1.5	1.5	87.8
		Water Fetching	5	1.3	1.3	100.0
		Total	**400**	**100.0**	**100.0**	

Source: Survey data

According to table 4.6 from item one, 3% of the sampled households are supplied with water daily from tap water for drinking use, but the quantity and quality of water is lower and remaining households 97% of the sampled households not have access to their house connection water supply from tap per day. However, the majority of the sampled households do not have access to daily water supply from city water pipes for their various house connection consumption needs. This shows that, given the problems of the existing tap water, the sampled households explained the main challenges of the tap water service of the existing water service that is: -

A. JWSS Authority Lacks of proper organization
B. Insufficient Water supply production in the city
C. electricity interruptions to pump water from the sources
D. low skilled labor in JWSS Authority
E. distribution framework is not installed correctly.
F. Lack of connection between JWSSA and city communities' participations

Due to these reasons water supply shortage is occurred on town communities, it is difficulty situation, to solve easily these challenging, because it requires high budget, skilled labor to supply and redesign the water supply system from population projections to all components of the water supply system.

For table 4.6 from item 2, 16% of the sampled households used tap water once week, 17.5% of the sampled households used tap water 1 or 2 days per week, 7% of the sampled households have access to tap water for their daily activities 3 or 4 days a week, 59.5% of the sampled households have no access to tap water supply in a week because of the water supply interruptions, but water quality and quantity are not high. However, the majority of sampled households do not have water for daily use: this indicates that there is a shortage of water demand in the study area water supply system. Therefore, the sampled households explained that they get water from other self-selected water sources for their drinking use. Adding to this quantity, the water supply and demand relationships are not proportional to the city's community quantity. For these reasons, most of the community in the city has lost unwanted money to buy more materials to get water for a longtime to buy water from donkey and truck vendors with very expensive and economically difficulty to the city citizens, in addition to that some parts of the vendors fetch water from unprotected sources.

Regards to table 4.6 item three, 97.3% of the sampled households were explained that they used water vendors, 1.5% of the sampled households were mentioned their water sources from hand dug well, 1.3% of the sampled households were mentioned their water sources from both dug well and public fountains collecting by hand, it is unsafe and unprotected water sources though the year, to fulfill their daily demands of water consumption. Since, the majority of the sampled households had no use the piped water supply sources and also the piped water sources users said that they are not used continuously sufficient amount of water because the existing water supply is insufficient demand for potable purposes. The system of the city water supply intermittent system due to shortage of water sources by various means. There for all the town households are used alternative sources of water for their daily consumption.

In general, these impacts have a more negative impact on the community due to socio-economic status and health care. Due to socio-economic city people lose a large amount of money to buy raw materials to get water, it takes a lot of energy to get water daily from different sources far

away, it takes time jobs, trade and education to get daily water and very difficult for people who don't have money, children and energy to collect daily water supply and lose a large amount of water because days arrival water is not fixed for this reason they take more water on time and they also drop this to collect water when new water arrives randomly and also take new water, this kind of action is continuous until the water shortage is resolved. Due to health care issues, long-term collection of water sources is causing numbers of water-borne diseases in communities and others coming from unsafe and unprotected sources which is affected by water borne and water related diseases day to day in the study area.

4.4 Demand of Water Supply

Water demand is a measure of urban water demand for residential, commercial, institutional, industrial, and water loss. Household water use is measured by population, climatic conditions, socio-economic conditions, government policies, and other related items. According to the designer's preparation, the estimated water supply is 50 liters per day, but the currency daily water consumption is 20 liters per day capital. This shows that the estimated and actual water supply does not meet the needs of the households because the actual needs are very small and do not meet the needs of the daily household's activities. Total households water demand for the city in 2017 and 2021 is constant at 8,706.4m^3/day or 162 l/s, but the population is growing rapidly due to the cities growth rates of 169,390 and 191,889 in general, but not water supply sources, the households water consumption of cities is not satisfied with the population growth rate of cities because the water demand is always fixed, but due to the movement of from cities to cities and from countries. The population grows from time to time to the city. The city is the capital city of Somali Regional state, Fafan zone administration center and municipality and is suitable for living due to good air condition, so more people can find better jobs, better education and medical facilities, and transportation

Table 4.7 assess of water supply consumption of sampled HHs

Item	*Description*	*Categories*	*Frequency*	*Percent*	*Valid Percent*	*Cumulative Percent*
1	Water consumption of HH per day	20-50liters	356	86.3	86.3	89.0
		51-80 liters	34	8.5	8.5	97.0
		Above 80 liters	10	2.5	2.5	100.0
		Total	**400**	**100.0**	**100.0**	
2	HHs are satisfied on existing water supply	Yes	3	.8	.8	.8
		No	397	99.7	99.7	100
		Total	**400**	**100**	**100.0**	
3	If not satisfied reason for disproportional water supply	Unequal distribution	86	21.5	21.5	21.5
		Not scheduling	46	11.5	11.5	33.0
		Water shortage	139	34.8	34.8	67.8
		No water	129	32.3	32.3	100.0
		Total	**400**	**100.0**	**100.0**	
4	There is water problem in the study city	Yes	397	99.3	99.3	99.3
		No	3	.8	.8	100.0
		Total	**400**	**100.0**	**100.0**	

Source; Survey data

According to table 4.7 from first item, 86.3% of the sampled households were mentioned their daily water demands 20 to 50 liters, 8.5% of the sampled households were explained their daily water demands 51 to 81 liters, and 2.5% of the sampled households were described above 81 liters. However, major parts of the sampled household's daily water demands were between 20 to 50 liters per day but not usually, sometimes they may not get this amount of tap water supply consumption. This indicated the existing water supply shortages in the town that means some of the sampled households mentioned that they couldn't get one Jerrican(20liters) per day they get once a week while some other sampled households didn't get even one liters of water supply from their tap till years using other unsafe and unprotected sources from vendors and other alternatives.

This amount of water demand is low because of the population of the town need more amount of water demands for daily activities of their household use aims. All in all, demands of water supply of the sampled households were different from one water supply customers to the other according to the location of household and its finding water supply accessibility due to the reason of the distribution system that does not distribute all parts equally.

Regard to table 4.7 from second item, 0.8% of the sampled households were mentioned to their satisfaction of every day water supply consumption and 99.3% of the sampled households were not satisfied and gotten their daily water supply demands. This improves that almost the population of the town were not got corresponding water supply with their everyday household's activities. These problems were expressed into three different ways, all from JWSS Authority, the major challenges explained from the sampled households of the town regard to water shortage demands are: -

1- Water supply shortage quantity and quality
2- Insufficient financial, specialized technicians and also unequal distribution problems
3- Lack of labor capacity of JWSS Authority such as water supply and hydraulic engineers.
4- Unbalanced existing water sources production demand and rapid population growth of the town due to different types of institutions are implemented in to the population of the town such as Jigjiga University, private and governmental colleges and small industries which consists of high numbers of workers additional to the present and migration populations.
5- Exactly inappropriate laying pipeline distribution system beginning from services reservoirs up to customer services, this causes unequal distribution
6- Lack of connection between JWSS Authority higher management officials and stakeholders' participation.

Generally, the major problem of the JWSS Authority is financially insufficient and water Shortage production which affects both JWSS Authority and population of the town. Due to these reasons small number of households got continuous water consumption. Therefore, Jigjiga water supply and sewerage authority must create awareness from the community, NGO's, private institutions and regional WRDB officials to support financial and other supports to solve these constraints starting from the sources up to the consumers.

As indicated table 4.7 from item three, 21.5% of the sampled households were mentioned their reason of un satisfaction is unequal distribution, 11.5% of the sampled households were described their reason of unsatisfaction not scheduling, 34.8% of the sampled households were explained their reason of dissatisfaction water shortage, 32.3% of the sampled households were mentioned their reason of dissatisfaction without water. However, majority of the sampled households were expressed their reason of dissatisfaction in to three parts which are without water, water shortage and unequal distribution of the system because of these reasons majority of the population in the study area cannot use pipe water supply. For the sake of, unequal distribution and water shortage that causes the persons with high income could be used tap water supply but who have low income could not use tap water supply because they cannot buy high price of the materials and other financial requirements of Authority and its plumbers. This case, affects both poor part population of the town and JWSS Authority to give pipe water supply through all parts of the town.

Regard to table 4.7 from item four, 0.7% of the sampled households were described that there is no water problem but 99.3% of the sampled households were mentioned that there is water problems in the study town due to different factors like quantity and quality of water cost of operation, maintenance, connection of new pipelines and distribution system of the existing water supply systems. In addition to that, there is lack of technicians, skillful manpower, frequent interruptions of services such as pump, generators, power, pipeline system and fitting. Therefore, as the above table 4.7 only small households may fulfilled their daily water demands from the existing water supply system of the city but majority of the community were not satisfied their daily consumption, instead of that, they use unsafe and unprotected other alternative water sources for their daily households' activities.

4.5 Water Supply Production of the Town

Water production of the study city at this moment is Waji water supply and Feda'ad water supply, and 33 Boreholes which are directly connected to the households, which coordinated different water supply lines but managed by JWSS Authority. The total production of these sources was 137.66 l/s or 8,706.4m^3/day. But the exact production of water supply sources is less than the estimated values during the last borehole tests, because the designer estimated working hours of the boreholes is very long which is 20 hr. for each however, at the current situation working hours of the boreholes is 12hr, 10hr, 6hr respectively, their total production per day is 8,706.4m^3/day

respectively for the sake of the climate change, lack of proper operations and maintenances and other interruptions. The difference between the estimated working hours and the exact working hours of the boreholes, shows that the expected yield and actual yield are not equal because the actual pumping hours is very less than from the expected hours

Table 4.8 discharge, expected and real yield of Water supply sources of the study area

S/No	Name Sources	Installed Capacity (L/S)		Estimated Yield (M^3/D) Sep.2019	Actual Yield June.2022
		2019	2022		
1	Waji Boreholes (7BHs)	91	67	7,862m^3/day	3,645m^3/day
2	Feda'ad Boreholes (4BHs)	30	28	2,592m^3/day	1,375m^3 /day
3	HHs Directly connected (33 BHs)	66	42.66	5,702m^3/day	3,686.4m^3/day
Total		**197.00**	**137.66**	**16,156m^3/day**	**8,706.4m^3/day**

Source: JWSSA

According to the table, more than half of the of the estimated yield is not used at the present condition that means 75%, due to this reason of water shortage problem occurred daily in to the sampled households of this town. One of the major challenges for this situation are electric power interruption to pump and production of insufficient water sources. Therefore, only 25% are covered from the total expected demands of water sources, so that community of this town requires 75% of water demands to meet their daily household consumption activities without considering the population size of the town (JWSSA). As a result of the generation rate and permanent interruption is depends on working times of boreholes, the real production of water is considerably less than the estimated quantity of generation and consumption of the water. On the other hand, there is seasonal Water production due to occasional fluctuation of water yield and total working hours of the boreholes.

Usually, water consumption is depending on discharge of the boreholes, operational maintenance, spare parts, employees' loyalty, functioning time and number of the functioning boreholes. As respect to this case the meted sampled households and various parts of the population approved the existing contradiction of the water supply with the population growth rate and the increase of development and industrialization of the town time to time, in addition to that, there is every day interruptions of water supply particularly winter season depending on the rainfall variation and

the limit managerial power of the JWSS Authority in terms of skilled manpower, financial, spare parts, electrical power, pipeline breaks are considering as significant issues.

4.6 Water Supply Coverage and Distribution network of the Town

Pipeline distribution network is the main critical part of water supply in any city. Kind of distribution network and proficiency of potable water supply is significantly influenced the rate of the household's consumption. Procedure of the distribution system starts from the location of the water supply sources; therefore, the starting points of this system is from boreholes located Waji water supply from 20km, Feda'ad water supply 16km and 33 direct connected households located in and around the town. From the two (2) water supply and other boreholes, all was working by using diesel generators which is difficult to buy every day its oil, filters and other assessors which is increasing and not match with income of the Authority and electric intensity of the town but does not work properly with the time of boreholes functioning.

This shows that one of the water interruptions is the power problem to pump from water sources to service reservoirs every day, due to the Waji water supply system the electric power line works with the system of Wajale, Kebribayah and other towns that makes interruptions such as when rain raining, pole fall and other case that can cause the pump of the borehole to stop the pumping of the water and it's difficult to get every day. The result of this issue is the disconnection of the pumping hours and daily interruption from the town water supply system in the study area. So, to reduce the power problem it's to substitute the diesel generator and electric power in to solar system to pump water from sources to service reservoirs every day when there is no electric power of the town and this system is reducing the cost of diesel generator and filters and better for the economy of the Authority and development of the city.

The water pumped from each borehole, there are of the two main rising pipelines, one is running from Waji water supply to two booster stations to the constructed service reservoir with the capacity of 3,000m^3 and the other water supply which is running from Feda'ad water supply to one booster station to the service reservoir with the capacity of 1000m^3. the total capacity of the two reservoirs is 4,000m^3. From those reservoirs the chlorination disinfectant is dropped to prevent water microorganisms. But there is no other additional treatment before or after chlorination treatment, due to this reason most of the sampled households mentioned that water quality is not

good means the water is salty. So that desalination is required before chlorination treatment to reduce the salty of the water.

Water distribution network of the town including, sources, raising main pipelines, booster stations, service reservoirs, and distribution pipeline (main pipe, sub-main pipes and branches of pipelines). But distribution of the pipelines of the town has not pressure zone divisions, which is used to prevent water pressure from distribution pipelines, to know easily the problems of distribution system of each zone and easily to protect unaccounted loss for water and also to know service reservoir and to distribute equal water for insufficient water supply parts of the city. with various pipe size, types of pipes, and with various duration life spans but there is no good quality to translate quantity and quality water for community. Clearly, the importance of reservoir service is an important aspect of the water distribution framework, which is designed to ensure an uninterrupted water supply in the event of an interruption during the time spent.

This depends on the number of service reservoirs; capacity and relative surface level, when water is distributed to consumers by gravity system, types of energy from the supply reservoir are not needed. The locations of these reservoirs are one in East of the city, the other in the West of the city, on the highest around the city. Therefore, in addition to this problem, there is a major compliance about the issue of an unequal distribution of water between the kebeles of the town that causes a decline in production, high demand of the present, cause's water shortage every day and no water is collected in the reservoir. The ongoing interruptions underway combined with controlled capacity of the reservoir, and the unfair allocation of water to private connections and water supply points, and there is an imbalance gap between the supply and demand of water in the city produce. This imbalance gap between the supply and consumption is due to the various problems faced by people in urban areas every day. These challenges are:

- Water scarcity led to poor personal hygiene and pollution
- The community was forced to pump water from unprotected water sources every day this is for the community various water systems such as diarrhea, amoeba and typhoons caused infectious diseases and water-borne diseases.
- Urban communities walk along distances daily to obtain daily water consumption from different alternative water sources. This affects time, energy and production, especially for women and children. it also affects the development of the city as whole in many ways.

- ❖ Inadequate water supply has forced communities to buy water at high price daily from various water vendors or distributers or birkas/plastic tanks to meet their daily water consumption.

In general, water shortages affect community health, production hours, and the economy of the community, and are costly due to unplanned payments to collect water daily for the purposes of the households from variety of alternatives and unprotected sources. Water supply shortages of the town caused unequal distribution of the households due to the income of the society, which is affects mostly the poor part of the population and corners of the city. It will reduce the attractiveness and place of residence and various infrastructure of the town. According to the report of JWSS Authority in 2019, the existing pipelines that make up the city's distribution network are from 60mm to 400mm ND (nominal diameter).

The total expected length of the distribution network pipelines of the study area is about 122km, Material and pipe diameter. About 91km of PVC and 31km of GI pipe made up of old galvanized iron pipe dating back to 1975, and 74.5% in made up of PVC pipes. This means that the entire pipe length is composed of 74.5% PVC and 25.5% Galvanized iron (GI) most of the pipe diameter is 90mmND, and the total length is 122km, about 77km 63% as shown in table below. These are the distribution grid pipelines severely inadequate capacity to bring water. Figure 4 illustrates the current network of distribution layout and table 4.13 provides a summary of the details of the main pipes including length, nominal diameter and materials.

Table 4.9 summary of piping in the existing distribution network

Item	**Diameter**	**Total Existing Distribution Length (m)**			**Percentage**
		UPVC	**GI**	**Total**	
1	DN60	3,465	12,865	16,330	13.39
2	DN75		6,198	6,198	5.08
3	DN90	65,406	11,755	77,160	63.26
4	DN110	2,127		2,127	1.74
5	DN150	8,454	322	8,776	7.19
6	DN225	4,928		4,928	4.04
7	DN250	3,498		3,498	2.87
7	DN400	2,963		2,963	2.43
Total Length		**91,841**	**31,140**	**121,980**	**100**

Source: Asset management plan of Jigjiga town

The distribution of water services in the city is mainly in the center of the city, near the government households of the previous ten (10) kebeles but couldn't get their daily water demand consumption from the piped water supply. The total coverage of water supply is 40% in all municipalities in the city. According to official data from the city's WSS Authority, the city has a total of 12,514 from the city's total households (38,109). 12,293 are private households, 26 is government and 195 are commercial, which makes the total customers of JWSS Authority 12,514. Despite the fact that this number is sometimes extended to, there are still many protocols for getting water from a private meter connection. Most of households do not use the city's water supply.

The consumer's daily consumption, either from other alternative sources such as privately owned hand-dug wells, or by pumping from the boreholes, or from vendors collecting water alternative sources. The main condition for pipeline expansion is the distribution of a sufficient amount of water to the community. The productivity of the determined water demand depends on the mass of the pipeline around areas and other factors which are socio-economic status of the community and the physical structure of the urban terrain. Among these major challenges are the poor distribution of water supply and the reduction in the number of water bonuses for the low-income community living in the area. According to the extension of this pipeline, the entire city is of paramount importance in supplying the right amount of water to all communities.

Most people in the city don't have enough pipelines around them. For these reasons, they travel far to meet the daily needs of various households' chores, and the loses time and energy every day throughout the year. There is no guidance on the other issues with the city's water coverage, the density of the distribution network pipeline, but in interviews with the most of the sampled households interviewed and selected, the current distribution network laying is illegal and most states that the pipeline is in place Located in the heart of the city and in the old town. In addition to these, most of the distribution network pipelines are for government homes and some institutions and for these reasons, commercial areas and some private institutions, NGOs and government sector are at very high cost of new pipeline connections for low-level economies. The issue of route expansion is an additional issue in the stable and rapidly expanding of the city.

The problem of the people explain is why most communities walk because the newly expanded, the number of water points is small compared to their numbers, and the amount of water entering

this area is less. Long distance to find a better water source, tap water connections, water stations, public fountains, government and private connections.

The house connection includes the house connection and garden connection (private and shared), the only difference is where they were found the location of the connection tap in the garden is on outside of the house. However, the house connection used more water than garden connection. It does not take a lot of energy and time to get, this is easy for all household members and the cost is so high that poor communities can't use this type of connection in the study area. However, installing a new household connection in the study area is very high price that does not take into account the entire population of the city. This is because most people living in the new expansion area are very poor. Why most municipalities don't use house meter connections this city can. In general, the number of household meter and private meter connections for tap water users is very small compared to the total number of the residents or households in the city, but the number increases from time to time throughout the year. The water supply volume of the surveyed cities is shown in table below.

Table 4.10 water supply coverage of the sampled households

What kind of connection do you have?					
Item	**Categories**	**Frequency**	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	public water point	80	20	20	20
	Private connection	200	50	50	70
	No. Connection	120	30	30	100.0
	Total	**400**	**100.0**	**100.0**	

Source: Survey data

According to table 4.10, 20% of the sampled household were described their water coverage from public water points complaining their usage of other alternatives due to water shortages, 30% of the sampled households mentioned their non water coverage of the piping water supply, using other alternative sources and 50% of the sampled households were explained that private pipe connection exist in their residential plots but during the interview sampled households gave different answers some get water two to three days a week, once a week, but majority of the

respondents mentioned that they don't have pipe water accessibility in years. Most of the households' respondents did not used tap water from the city's water services in the study area.

This indicates a lack of water supply for a variety of a reason. These are unequal access to water, lack of affective water use, and lack of sufficient quantity of water sources. Another problem is lack of uniform distribution of water and a sufficient amount of distribution network for the population of all parts of the city, especially in newly expanded areas considering the population of the next expedition. It's lack as a result, the amount of water distributed to most of the townships is inadequate. However, the majority of the population does not have enough water from the water services to carry out various household chores every day. For these reasons, most people get water daily from alternative sources, which are unsafe or unprotected sources. Tap water consumption varies from one household to the other household, and also from closer to closer, they use the same connection type. This difference is due to the different reasons: the household's income level, pipeline network density, Source location, and water volume. These challenges are causing serious water shortages in the study town. As a result, most people were able to collect water from a variety of other sources and buy it at high prices from water vendors and private birkas. This also affects economy, time, energy and productivity, especially for women and children.

The total distribution range of water services is only 40% of the total urban population. There is not enough to cover their daily consumption. In this study, the degree of private connection of water supply depends on its economic feasibility and its household size. This allows people with a large number of households and high economics to use more water prices. Generally, the type of water supply system (mode of services) mainly depends on the financial situation of the population supplied. Most of the population is low-income and under consumed, but the efficiency of water stations depends on the number of users and amount of water distributed daily from the water stations. Currently, there is no any functioning water point in the study city because of water supply shortage but there are plastic fiberglass tankers available in to the corners of the town providing water service to the poor part of the community by fetching emergency water trucks which is very small compared to the total population of the area at that time.

Mode of Service

Mode of service for house connection (HC), Meter Connection (MC) and public tap (PT) is shown below.

Table 4.11 mode of services in the town

Year	Mode of Service (%)		
	HC	**MC**	**PT**
2011	37%	35%	28%
2015	41%	34%	25%
2020	60%	30%	10%

The dominant part of the community is the lack of private water pipe connections. It is a city water supply; the prescribed number and discriminatory distribution of public water is focused on reducing the number of public connections consumers, with constant water interruptions. This unfair and distant location of this of plastic tankers in the house made. Households' residents in the order of time, electricity, and financial system, and influenced the development of the city. Thus, the people of the city hang out on other selective water resources on a regular basis. Most of the water in the city's water services comes from a variety of alternative sources. The alternative water sources in the city are very difficult before and after fetching.

These plastic shared tanker locations are difficult to service, especially for older women and children. Because it's far from their home and hard to fetch due to unbalanced community size and plastic tankers capacity, disputes occurred and it's also hard for the health of the community, for the sake of its inner clearance and the hot climate. These water sources are unprotected water sources, causing many types of illness throughout the year. Majority of the town population, which make up about 97.3% of the sampled households clearly mentioned their unsatisfaction of the water supply and used other alternatives to fulfill their daily household's water consumption activities.

The downside is that it uses unprotected water sources with some communities using alternative water sources from vendors that buy at high price, as water disruptions can occur during turnaround time affects the community. in addition, the ideal water supply arrangements to meet such development needs was equipped with an appropriate water distribution arrangement, taking into account the separation between the population density and water points and the stand channels in determining sufficient demand. Expansion of pipelines, locations and number of plastic fiberglass. In such situations, it is essential to transport self-improvement through the population that can support the establishment of public water services through labor and monetary donations, or can provide physical support to improve better public water services from different parts of the town to fill of the water supply shortage. Figure 7 of water supply coverage in the town.

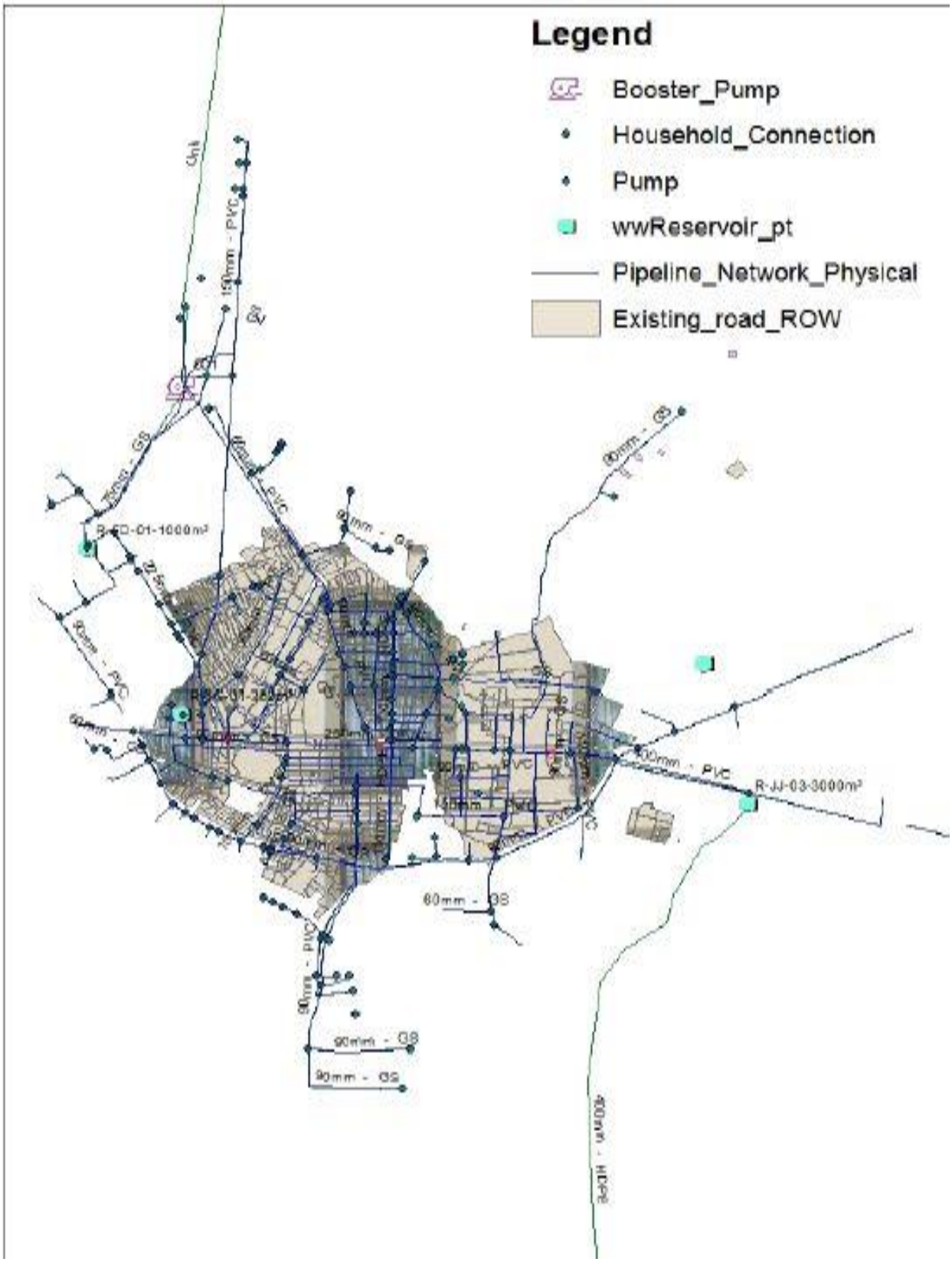


Figure 4.10: water supply distribution coverage

4.7 Water Supply Challenge and Delivery Service

Absence of access to protected and clean water supply is a major challenge of the distribution system (Emenike et al.,2017). Despite the fact that the challenges of water are seen as a universal issue for both the urban and rural population, especially ladies and children are more affected due to loss their time, energy and productivities to gathering water from far distance for their family unit. Therefore, in the study area the women and children are affected by water borne diseases and have limited their productivities and women cannot participate social and political issues. These challenges are stated below.

Table 4.12 water supply related challenge and delivery service

Item	Classification	Description	Frequency	Percent	Valid Percent	Cumulative Percent
1	What are the water supply delivery challenges of the town?	Administration	241	60.3	60.3	60.3
		Technical	89	22.3	22.3	82.5
		Financial	60	15.0	15.0	97.5
		Facilitation	6	1.5	1.5	99.0
		Others	4	1.0	1.0	100.0
		Total	**400**	**100.0**	**100.0**	
2	How do you think the current tap water supply is a matter of discussion?	Extremely serious	76	19.0	19.0	19.0
		Very Serious	296	74.0	74.0	93.0
		Serious	24	6.0	6.0	99.0
		Not Serious	4	1.0	1.0	100.0
		Total	**400**	**100.0**	**100.0**	
3	For what reasons do you face severe water shortages?	Drinking	339	84.8	84.8	84.8
		Cooking	8.0	2.0	2.0	91.3
		Cleaning/washing	18	4.6	4.6	88.5
		All	35	8.8	8.8	100.0
		Total	**400**	**100.0**	**100.0**	

Source: Survey data

According to table 4.12, from item one, 60.3% of the sampled households were mentioned their water supply challenges related to municipality administration specially the water supply authority because of their mismanagement, lack of qualified people and unequal/ un scheduling of water supply distribution system of the town,22.3% of the sampled households explained their water supply problem related to technical problem due to distribution system, for instance one JWSS Authority, one expert explained that one up on a time some customers complained their water shortage so to solve their problem Authority officials ordered the technicians after that technicians recommended the only solution is to change the households pipeline network and customers prepared the pipe and operational cost, what is surprising is the result which changing the pipeline system and connecting new pipe within three different times because of the same problem of water shortage whenever they make a change that caused some of the customers to reconnected their previous pipe system because three different times were expanded the distribution network of the town with three different agents without match to the structural plane, 15% of the sampled households described their water shortage financial problem of the Authority because the serving cars of the utility were in garage, salary of the employees were not available permanent, water quality test laboratory were restored, no spare part available the Authority's stores and its without encouragement and other subsidies, and 2.5% of the sampled households were explained their water problems facilitation and other issues.

Regard to table 4.12, from item two,19% of the sampled households were mentioned their existing water supply problem extremely serious challeneges,74% of the sampled households were explained their existing water problem as very serious challenge, 6% of the sampled households described their tap water problem as serious, and 1% of the sampled households described their pipe water supply have no problem. However, the great part of the sampled households explained the present pipeline water supply have many problems which is very serious for all the population and required to get their daily water consumption activities in study town through the year. This influences their time, energy, economy and development of the town, reducing the quality and health of the study compare to other towns of the country.

As shown table 4.12, from item three,84.8% of the sampled households were explained the current existing water supply is a very serious insufficient for drinking, 2.0% of the sampled households were mentioned their inadequate pipe water for cooking, both cleaning and washing, 4.6% of the

sampled households were described their present tap water problem for both cleaning and washing indoor and outdoor, and 8.8% of the sampled households were explained the shortage of water supply for all demand activities. The majority of the sampled households were explained the existing water supply deficient water supply for drinking and cleaning purposes in the study area and the quality is low. This shows that the water supply problem in the town is very serious for all the town population for their daily consumption of the household's purposes. This problem is the main problem of the town community at the past and present time in various portions of the town. Because the existing distribution pipeline is distributing inefficient quantity and quality for the whole city citizens.

4.8 Water Supply Dissatisfaction of the town

Basic access is characterized by the availability of at least 20 liters of drinking water per person per day, a minimum distance of 0-500 meters to a maximum of 30km from the water supply, hand dug wells, Birkas, plastic fiber glasses/water points using by hand, donkey and water truck vendors taking various times to get water from different locations to the house. UNDP also states that the basic daily water requirement is 50 liters per person per day, including 5 liters for drinking,20 liters for sanitation/cleaning, 15 liters for showering and 1o liters for cooking (Kumar and Desta,2018). However, in the study area, there is a daily water shortage for all types of household activities that meet their needs, and for this reason they are unable to provide sufficient quantity and quality of water supply to meet their daily needs.

Unattainable and losing over 30 minutes to 3:00 hr. to collect daily water supply for various household activities. according to this result, wasteful relocation of water service under its settlement in the city is more difficult. because of this reason, there is no water supply around the new areas of the town. the reason of unhappiness of sampled households on the current water supply is shown below show the reason for dissatisfaction with the current water supply of the sampled households.

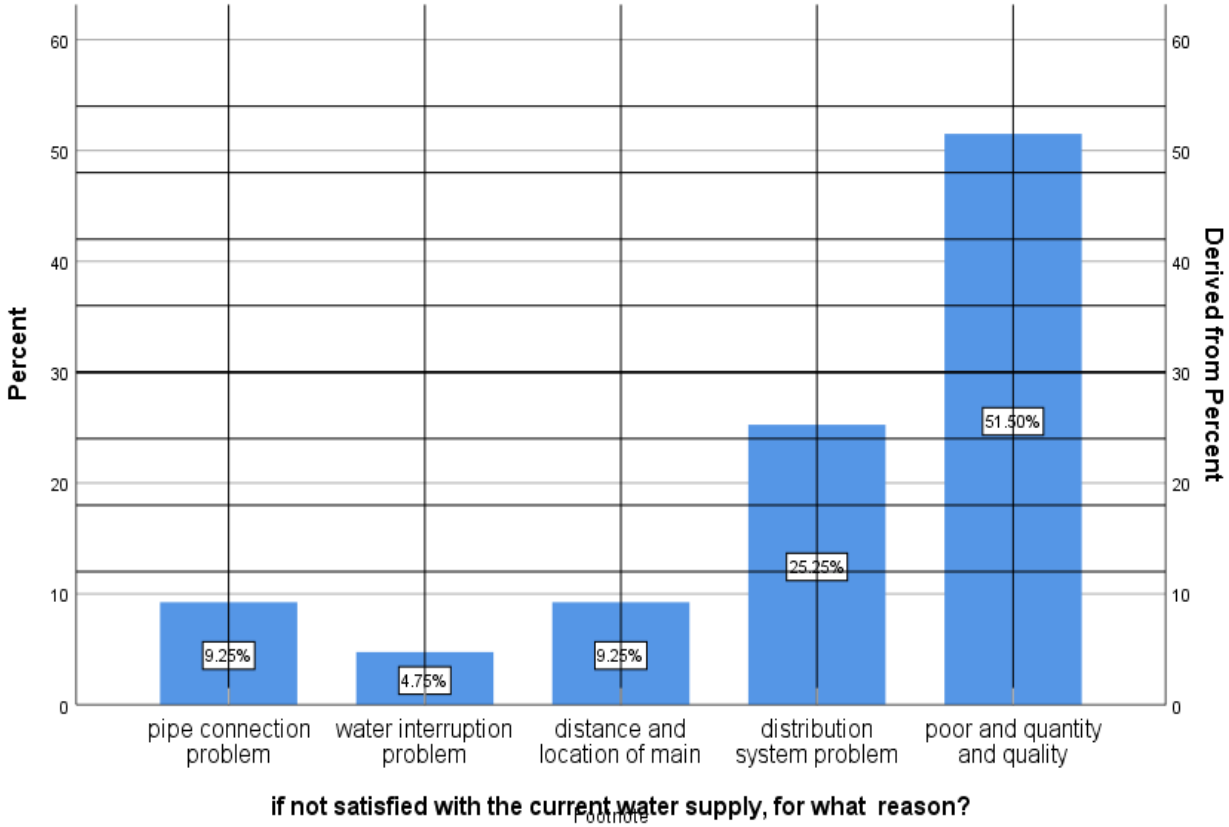


Figure 4.11 dissatisfaction on existing water supply

According to figure 4.11, 9.3% of the sampled households declared dissatisfaction with their existing water supply system due to pipe connection problems, 4.8% of the sampled households reported that they were dissatisfied with their existing water supply system based on the distance from the water interruption problems such as electro power, 9.3% of the sampled households said they were dissatisfied with their current water supply system due to problems related to the main pipe location, 25.3% of the sampled households were mentioned that they were dissatisfied with their existing water supply system based on the distribution system problem and 51.5% of the sampled households were dissatisfied with their existing water supply system due to poor water quantity and quality. However, more than half of the surveyed households mentioned the major problem of their dissatisfaction due to the existing water shortage problem; water production is the biggest challenge for water supply in the study city, which is out of water for more than a Week, Month or Years. This indicates that all the town 100% of the surveyed households in the city are dissatisfied with the current condition of the water supply system.

4.9 causes of water supply shortage of the study town

The study town have many problems that lead to water shortages. production issues, Pipeline connectivity issues, water disruption issues, main line distance and location, distribution system issues, quality and quantity issues, cost and unskilled labor costs issues, the number of total force water workers, the nature of the urban landscape, the rate of urban expansion, interruption in the water supply, seasonal exchange or climate conditions, economic growth, and population behavior consume water supplies. Due these factors, the consumption for water supply is increasing day by day. Therefore, this leads to insufficient water supply for various household needs in the surveyed city. Rapid population growth, in particular, will affect the water supply system, creating different types of jobs for JWSS Authority to repair pipeline failures due to high water pressure every day during the hourly peak flow. Therefore, the reasons for water shortage in the surveyed city are shown in below table 4.13

Table 13 causes of water supply shortage

Item	Categories	Frequency	Percent	Valid Percent	Cumulative Percent
Causes of Water Supply Shortages	poor and inefficient distribution system	21	5.3	5.3	5.3
	financial problems	34	8.5	8.5	13.8
	rapid population growth	43	10.8	10.8	24.5
	frequent pipe breaks	36	9.0	9.0	33.5
	electrical interruption	40	10.0	10.0	43.5
	unbalance demand/supply	226	56.5	56.5	100.0
	Total	400	100.0	100.0	

Source: Survey data

Regarding to the table 4.13, 5.3% of the sampled households was explained their water shortage problem as poor inefficient and distribution system, 8.5% of the sampled households were mentioned their existing water supply shortage as a financial problem, 10.8% of the sampled households were described their existing water supply shortage problem as a rapid population growth, 9.0% of the sampled households were explained their existing water supply shortage as a frequent pipe break problem, 10% of the sampled households were explained their existing

water supply shortage problem as a electrical interruption from the pumping of the water from the sources to the households and 56.5% of the sampled households were mentioned the existing water supply shortage problem in the study area as a unbalanced demand/supply. One of the surveyed household respondents said the Jigjiga city is growing for both population and built-up area rapidly but not the water sources production and basic infrastructures.

However, majority of the surveyed households were said explained their water supply shortage in the study city were related to unbalanced demand/supply problem. This is because the number of urban dwellers is increasing rapidly as people moved from rural areas to cities and from suburban to cities. Jigjiga city is therefore, the capital city of SRS, administration center of the Fafan zone and Municipality city. therefore, many people move to this city in search of various jobs, and the air conditioning of this city which more livable than other cities around it. Others are regularly caused by a variety of factors, such as poor-quality network pipelines, increasing water pressure to increase peak demand in the city, and insufficient water pressure at various points in the distribution network increase city. There are two other major causes of water scarcity in research city which were water demand disruptions and seasonal water changes.

4.10 causes of water supply interruptions of the study town

Interruptions in a drinking water supplies due to water sources or technical problems are important determinants of the entrance and nature of drinking water supplies. Daily or weekly disruptions are caused by hydropower. If such an unexpected power interruption leads to a complete reduction of water from the city, households will suffer various consequence such as reduced durability and water quality, reduced user consumption, and harmful effects on urban cleanliness and sanitation of the town. City’s water interruptions is a major past and present problem that affects the lives of the population in several ways. The population number is growing rapidly at times without gaps and the city is also growing rapidly. Problems of this water interruptions are shown below table.

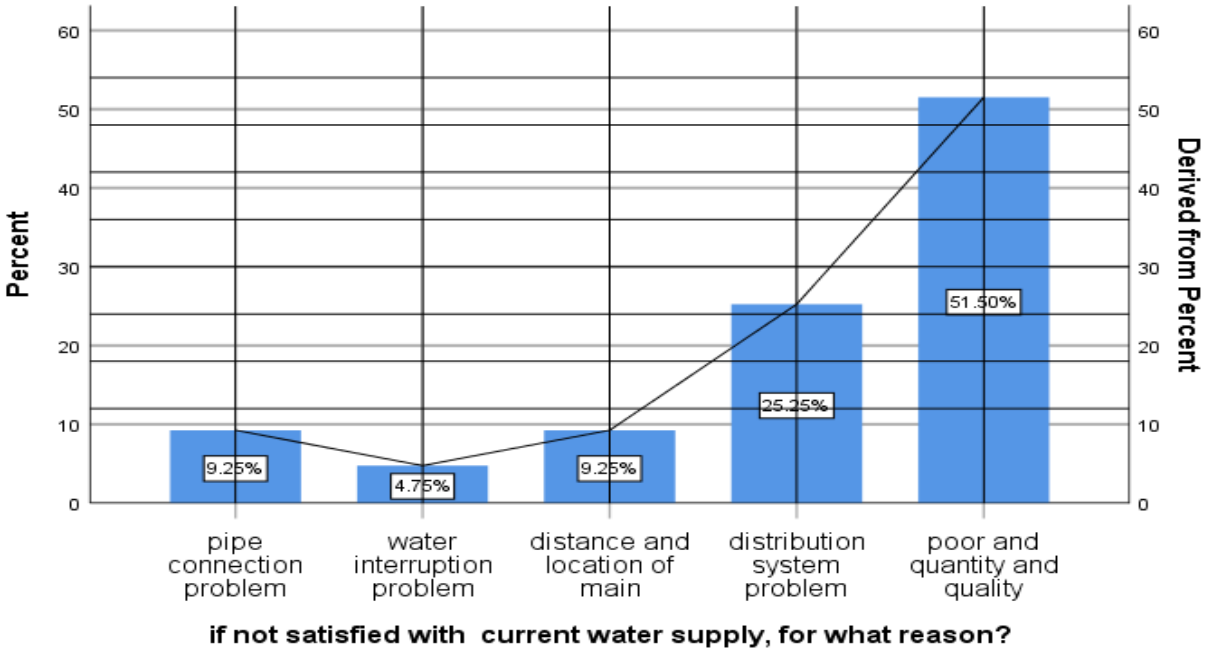


Figure 4.12 causes of water supply shortage

Regard to figure 4.12, 11.0% of the sampled households were mentioned the reason of the existing water supply interruptions in the study area problem as a financial problem, 23.3% of the sampled households were explained the reason of existing water supply interruptions in the study city as a technical problem, 39.3% of the sampled households were described reason of water interruptions in the study city as a water production problem, 11.8% of the sampled households were said the reason of water interruptions in the study town of the existing water supply as a electrical power problem, 12.5% of the sampled households were explained the reason of their existing water supply interruption as a distribution problem, 2.3% of the surveyed households were mentioned the their reason of the existing water supply interruptions in the study area as a winter(dry season) problem.

Majority of the sampled households expressed their reason of the existing water supply Interruption of the town as water production. During field study, interview JWSS Authority of the city were explained that the main cause of water supply interruption is the source production which is related to the discharge of the boreholes, and also technician issues affect the frameworks through unequal supply of water from various kebeles of the town. Some part of the town particularly the new pipeline system of the distribution network/ corners of the town, can't

get water for some week, month or years. However, the central part of the town, high income part of the population and other official areas such as government buildings, NGO, hotels and private institutions in the town get water.

4.11 Result of Insufficient Water Supply Situation in the Study Area.

From the study town women were mainly responsible for water collection of the household in order to fulfil the water consumption problem caused by water shortage and sometimes men gathering water but it is not usually, this condition of problems was seen in the study town, the consequence of the insufficient water supply in the study town, is a prolonged problem that have been facing Jigjiga city for many years that affecting health and wellbeing of the population, educational time of the children and productivity of the and development of the town. In addition to that, the cost of the distributors/ water vendors is very high which is difficult to the poor part of the society affecting their low-income shown below table.

Table 4.14 effects of water deficiency in study town

1	Who is responsible water collection to use in your HH?	Men	39	9.8	9.8	9.8
		Women	340	85.0	85.0	94.8
		Children	21	5.3	5.3	100.0
		Total	**400**	**100.0**	**100.0**	
2	How far distance is your water sources from your HH?	500m-1km	170	42.5	42.5	42.5
		1.5-3km	173	43.3	43.3	85.8
		3-5km	4	1.0	1.0	86.8
		5km and above	53	13.3	13.3	100.0
		Total	**400**	**100.0**	**100.0**	
3	How much time does it take to collect water?	Less than 30'	67	16.8	16.8	16.8
		30'-1:hr	218	54.5	54.5	71.3
		1:30-3:00hr	63	15.8	15.8	87.0
		3:00 and above	52	13.0	13.0	100.0
		Total	**400**	**100.0**	**100.0**	
4	How much you buy one Jerrican(20ltrs) of water in your HH?	5-10 ETB	18	4.5	4.5	4.5
		10-15 ETB	348	85.0	85.0	91.5
		15 and above	34	8.5	8.5	100.0
		Total	**400**	**100.0**	**100.0**	
5	Have any water related disease occurred for your HH?	Yes	25	6.3	6.3	6.3
		No	375	93.8	93.8	100.0
		Total	**400**	**100.0**	**100.0**	

Source: Survey data

Water collection responsibility were taken women according table 4.14 from item one, 9.8% of the sampled households were mentioned their water collection responsibility to men, 85% of the sampled households were expressed that water collection is responsible for women and 5.3% of the sampled households were expressed their water collection is responsible for children. Majority of the surveyed households were mentioned their daily water consumption gathering responsibility as a woman in the study city reasoning that it is traditional. but sometimes men collect water but not usually as a woman and children. This influences women and children by direct or indirect, either their health care, energy, times of education from school and productivities from in and outside of their households. distance is an important parameter for measuring water accesses regarding to the table 4.14 from item two, 42.5% of the sampled households explained their water source distance between 500 meters to 1km in the study town, 43.3% of the respondents described the distance between their water sources and households 1.5 to 3kilo meter which is most, 1% of the sampled households explained the distance from their source of water 3 to 5kilo meter and 13.3% of the sampled households mentioned their distance from their water sources above 5kilo meter.

majority of the surveyed households described that the distance between water sources and their households is 500 meters to 1.5 kilo meter and also 1.5kilo meter to 3.0kilo meter. it is very obvious that most of the population in the stud area have in water scarcity problem to meet their water demand. time to collect water depends on water quantity and quality. this is because water that is gotten from the water supply boreholes is cleaner than water that is gotten from the hand dug well. The result obtained from table 4.14 from item three, 16.8% of the sampled households were explained their time taken collecting water as 30 minutes, 54.5% of the sampled households were mentioned their time to collect water as 30 minutes to 1:30 hr, 15.5% of the sampled households were described the time taken to collecting water as 1:30 to 3:00hr and 13% of the sampled households as 3:00 and above hr. but most of the water source not good quality for drinking which is the most severe for the study town community because it’s unsafe and unprotected due to the source location, entering of different particles. This happened due to shortage of water production, frequently electrical power interruptions to pump water from sources to service reservoirs, lack of proper laying of distribution system and absence of skilled manpower in JWSS Authority.

This causes health care problems, educational and production challenges on children and women by direct or indirect effects. It reduces the development of the town and financial status of the households. Though, the distance from different water sources is varying from one household to the other household and their quality and quantity from one alternative water sources to the other water sources every season. According to table 4.14 from item four, 4.5% of the sampled households were mentioned the cost of one jerrican (20ltrs) of water as 5 to 10 birrs, 85.0% of the surveyed households explained the price of one jerrican water costs as 10 to 15 birr and 8.5% of the sampled households were described the cost of one jerrican(20ltrs) of water as 15 to 20 birrs. Majority of the sampled households were explained the price it takes to buy one jerrican(20ltrs) of water from the vendors or water distributors 10 to 15 birr that means one barrel of water in the study a price between 100 to 150 birr which is difficult to the poor part of the population. Even though, the price of the water and pipeline connection are increasing time to time from kebele to kebele affecting the income of the households.

According to table 4.14 from item five, 6.3% of the sampled households were described that the occurrence of water related diseases as Yes and 93.7% of the sampled households mentioned their water related diseases occurrence as No. majority of the sampled households indicated that there is no water related diseases occurrence in their family but there is a water related diseases in the study town such as amoeba, diarrhea and sometimes cholera due to the contaminated water finding unprotected various alternatives. According the water supply shortage of the study town are due to its cost and lack of understanding of population according to the result of using elective sources of water, this causes different health problems on household members of the study area community that affects their economy and development. however, water is an important for the existence of healthier society and financial development. So, the arrangement of sufficient potable water supply.

4.12 Water Quality Test Result

Three boreholes of Water samples collected from these three selected areas Waji, Feda'ad and Kordere were sent to Ethiopian Construction Design and Supervision Works Corporation Laboratory to determine physical and chemical parameters.

The measured physical and chemical parameters of the water samples taken from the aforementioned boreholes in these areas is generally good because almost all samples fall in to the maximum allowable concentration level set by WHO, except the Total Hardness ($CaCo_3$), which has exceeded the limit.

In the case of Sulphate (SO_3) exceeded the maximum allowable limit. this may be a cause for concern in future, hence closer monitoring of the Sulphate (SO_4) is necessary as irrigation practices are intensifying in the area which in turn increases the use of fertilizers which is one of the major sources that contribute to rise the sulphate content in the shallow groundwater of well fields.

Remark 1.the test result can be compared with the WHO maximum allowable concentration (mg/L) presented on the right column. The water sample is collected and submitted to the laboratory by the researcher. 2. ND= Not detected

Table 4.15 test result of BH-5

No	Tests	Test Results	Unit	Test Method	WHO Maximum Allowable Concentration(Mg/L)
1	pH	6.92	-	potentiometric	6.5-8.5
2	Electrical conductivity	1878.00	uS/cm	potentiometric	_
3	Total solid 105ºC	1034.00	mg/L	Total solid 105ºC	_
4	T. Dissolved solid	1033.00	mg/L	Potentiometric	1000.0
5	Turbidity	<0.1	NTU	Turbidimetric	5.0
6	Sodium (Na^{+})	95.1	mg/L	Flame photometric	200.0
7	Potassium (K^{+})	3.5	mg/L	Flame photometric	_
8	Total iron (Fe^{2+} & Fe^{3+})	0.1	mg/L	Flame AAS	0.3
9	Manganese (Mn)	0.1	mg/L	Flame AAS	0.4
10	Ammonia (NH_3–N)	0.64	mg/L	Nessler	_
11	TotalHardness($CaCO_3$)	815.76	mg/L	Titrimetric	500.0
12	Calcium (Ca^{2+})	183.75	mg/L	Titrimetric	200.0
13	Magnesium (Mg^{2+})	85.53	mg/L	Titrimetric	150.0
14	Alkalinity ($CaCO_3$)	436.7	mg/L	Titrimetric	_
15	Carbonate (CO_3^{2+})	Nil	mg/L	Titrimetric	_
16	Bicarbonate (HCO_3)	532.80	mg/L	Titrimetric	_
17	Chloride (Cl^{-})	216.1	mg/L	Mohrargentometric	250.0
18	Sulphate (SO^{2-}_4)	273.84	mg/L	Turibidimetric	400.0
19	Nitrate (NO_3-N)	3.6	mg/L	Cadminium reduction method	10.0
20	Nitrate (NO_3-N	0.1	mg/L	Diazotizationmethod	3.0
21	Fluoride(F^{-})	0.5	mg/L	Ion-selective electrode	1.5
22	Phosphate (PO_4^{3-}-P)	0.4	mg/L	Ascorbic acid molybdate blue	_

Table 16 test result of BH-6

No	Tests	Test Results	Unit	Test Method	WHO. Maximum Allowable Concentration(Mg/L)
1	pH	7.03	-	potentiometric	6.5-8.5
2	Electrical conductivity	2920.00	uS/cm	potentiometric	_
3	Total solid 105ºC	1280.00	mg/L	Total solid 105ºC	_
4	T. Dissolved solid	1278.00	mg/L	Potentiometric	1000.0
5	Turbidity	0.6	NTU	Turbidimetric	5.0
6	Sodium (Na^{+})	146.2	mg/L	Flame photometric	200.0
7	Potassium (K^{+})	4.3	mg/L	Flame photometric	_
8	Total iron (Fe^{2+} & Fe^{3+})	0.1	mg/L	Flame AAS	0.3
9	Manganese (Mn)	0.1	mg/L	Flame AAS	0.4
10	Ammonia (NH_3–N)	0.9	mg/L	Nessler	_
11	TotalHardness($CaCO_3$)	1093.86	mg/L	Titrimetric	500.0
12	Calcium (Ca^{2+})	264.50	mg/L	Titrimetric	200.0
13	Magnesium (Mg^{2+})	103.82	mg/L	Titrimetric	150.0
14	Alkalinity ($CaCO_3$)	407.9	mg/L	Titrimetric	_
15	Carbonate (CO_3^{2+})	Nil	mg/L	Titrimetric	_
16	Bicarbonate (HCO_3)	497.61	mg/L	Titrimetric	_
17	Chloride (Cl^{-})	274.4	mg/L	Mohr argentometric	250.0
18	Sulphate (SO^{2-}_4)	545.58	mg/L	Turibidimetric	400.0
19	Nitrate (NO_3-N)	1.3	mg/L	Cadminium reduction method	10.0
20	Nitrate (NO_3-N	<0.1	mg/L	Diazotization method	3.0
21	Fluoride(F^{-})	0.4	mg/L	Ion-selective electrode	1.5
22	Phosphate (PO_4^{3-}-P)	0.5	mg/L	Ascorbic acid molybdate blue	_

Table 17 test result of BH-8

No	Tests	Test Results	Unit	Test Method	WHO Maximum Allowable Concentration (Mg/L)
1	pH	7.11	-	potentiometric	6.5-8.5
2	Electrical conductivity	2200.00	uS/cm	potentiometric	_
3	Total solid 105ºC	1102.00	mg/L	Total solid 105ºC	_
4	T. Dissolved solid	1011.00	mg/L	Potentiometric	1000.0
5	Turbidity	<0.1	NTU	Turbidimetric	5.0
6	Sodium (Na^+)	117.9	mg/L	Flame photometric	200.0
7	Potassium (K^+)	4.4	mg/L	Flame photometric	_
8	Total iron (Fe^{2+} & Fe^{3+})	0.1	mg/L	Flame AAS	0.3
9	Manganese (Mn)	ND	mg/L	Flame AAS	0.4
10	Ammonia (NH_3–N)	<0.1	mg/L	Nessler	_
11	TotalHardness($CaCO_3$)	838.42	mg/L	Titrimetric	500.0
12	Calcium (Ca^{2+})	206.82	mg/L	Titrimetric	200.0
13	Magnesium (Mg^{2+})	77.13	mg/L	Titrimetric	150.0
14	Alkalinity ($CaCO_3$)	387.3	mg/L	Titrimetric	_
15	Carbonate (CO_3^{2+})	Nil	mg/L	Titrimetric	_
16	Bicarbonate (HCO_3)	472.48	mg/L	Titrimetric	_
17	Chloride (Cl^-)	213.2	mg/L	Mohr argentometric	250.0
18	Sulphate (SO^{2-}_4)	439.77	mg/L	Turibidimetric	400.0
19	Nitrate (NO_3-N)	4.4	mg/L	Cadminium reduction method	10.0
20	Nitrate (NO_3-N	ND	mg/L	Diazotization method	3.0
21	Fluoride(F^-)	0.4	mg/L	Ion-selective electrode	1.5
22	Phosphate (PO_4^{3-}-P)	0.4	mg/L	Ascorbic acid molybdate blue	_

4.13 Major Causes and Challenges of Water Supply

There are many challenges and root causes of water supply shortage from the study city at past and current situation that is encouraging to the future, because there is no immediate improvements of this potable water supply problems in the study area.

4.13.1 Major of water supply causes

Potable water supply services should be sufficient quantity and quality, efficient, reasonable and accessible in terms of distance, time and price for the entire population of the city before and after the connection of private pipelines. it must also be safe that requires the quantity and quality of water sources, sufficient for water supply facilities, financial and skilled human resources, advanced and cutting-edge technological innovations, and institutional restrictions. As a result, the lack of these elements, the unsustainability of urban water supply management, and the consumption of significant amounts of public water are ineffective, unfair and unachievable. Therefore, in the study city, there are many factors that influence the consumption of urban water supply. These are:

Administration problem: administration problems are due to ineffective structure of the organization, a smaller number of technicians workers in Authority, low salary of workers relative to their occupation, and absence of a key workers requirement for properly serving in the city

Lack of institutional coordination: key employees of Jigjiga water supply and sanitation authority, regional water resources development, members of the city water board, local municipal administration, non-governmental organizations. The water Authority and its various stakeholders are not joined in board and not being put together by committee, but individuals misusing their specialized expertise.

Water production shortage: water resources production shortage is one the biggest causes for the gap between water demand and supply of the study area. Insufficient water production and water shortage were related to the operation and maintenance of the system starting from the boreholes to the consumers. climate change, population growth, electrical power interruption may change the water production.

Unequal distribution of water: these are also other major challenges in the local government WSS Authority. The power distribution system and line connection pressure in the city did not cover its daily consumption of the community necessary for household activities in the study city. Central and particular residential areas, government offices, private institutions and NGOs, but not all parts of the city's residential areas, especially the newly expanded kebeles. The pipeline cannot currently reach the most parts of the city's outskirts. These indicate that the study city's distribution system is unequal or unfair. In addition to these, the city's water distribution system has many challenges to has many challenges to the past city's water supply system and the current situation. Because the distribution pipeline is not laying properly with landscape due to these reasons water pressure has caused distribution lines to breakdown the distribution pipelines always through the year.

Poor financial planning and funding: water supply requires a huge investment. Due to lack of adequate funding, the WSS Authority water system is limited in quantity. Even if the current prices of WSS Authority in the study city do not cover the cost of equipment and the cost of restoration of sufficient quantity and quality of water consumption, because there is no other money to support except the subsidy of the Regional WRDB, it meets the current needs of the city's municipality to solve challenges from different parts of the water supply components of the urban water supply system.

Lack of skills: lack of skilled manpower/technician is a fundamental problem addressed by WSS Authority. This concerns the proper management of various workers and water supplies, and orderly and planned distribution of water to all the population of the city.

Lack of community participation: communities and community-based organizations, private agencies, government and non-government organizations play key roles in implementing water supply and sanitation activities and realizing water plans fulfil. However, the city of Jigjiga, with exception of the city's board member, who was selected, has no such Authority to identify and resolve the major causes and challenges of this city water service, where the WSS Authority is located. There is no participation between the community and WSS Authority which is the primary agency mandated to supply water to meet the needs of city residents. As a result, it is difficult for WSS Authority to distribute sufficient water needs to all brought, without the participation of all other government-supported funds, and other necessary material. Access to adequate water quantity and quality for all therefore, requires the participation of all communities and

organizations to address current and future household water consumption problems, from the sources to urban water supply distribution system that need to resolve.

4.13.2 Major water supply Challenges

There are basically two common major challenges of urban water supply resources management. The first is to provide everyone with enough water, in the right amount, anytime, anywhere and at an affordable price. A second emerging challenge relates to adaptation and adequate resilience. For extreme climatic conditions of floods and droughts. These challenges are common in cities, due to, rapid urbanization and large-scale land-use change. but, in this study area additional challenges existed, which were major challenges in Jigjiga Water Supply and Sewage Authority. These are:

Rapid growth rate of population: the size of the populations is increasing rapidly by both natural and migration from per-urban to urban and rural to urban area without any gap in the study town every year, because the study town is better for finding job, education facilities and health care facilities, better for transportation and good air condition to live the people rather than around rural and per-urban areas. this influence on the population, creating unbalanced water supply and demand every day, because of the increasing number of the population. These causes many problems on town household water supply consumptions time to time through a year. Generally, the numbers of the population in the town are the basic to design any infrastructures of the town, particularly, water supply components such as distribution lines from water sources to consumer services must be redesigned according to the number of residents in the study city.

Old infrastructure system: leakage of water in a distribution system. in order for the urban water distribution to work effectively, it needs to be supported by appropriate infrastructure in good working condition. Protecting the infrastructure used to treat and transport water (i.e., boreholes, service reservoirs and distribution systems) is an important step in ensuring the safety of drinking water. However, in this town there have been years of neglected maintenance to water reservoirs, booster stations, sources and distribution systems. Poorly maintenance water supply system can generally trace to insufficient financial resources and poor management.

Inadequate water supply: insufficient water supply leads to limited water production Waji and Feda'ad well field water sources. In other words, the actual water production from wells did not match to the estimated water production of urban water supply plans. This results in a daily water shortage, mostly in winter, with frequent interruptions in the water supply system, especially during the dry season. Due to this reason, all bodies of water were reduced in volume due to lack of rainfall. Additionally, water supply network regularly breaks down, reducing water production starting from the boreholes to the households. This results in water shortages. Therefore, water sources did not correspond to the current household water consumption of the city dwellers, as the aquifer is depleted every season by various mechanisms.

Electric Power disruption: electric power disruption one of the biggest challenges in the city causing the city water shortages because of pumping water from the sources to the households. To solve this problem, stand by generator must be installed at each borehole specially the boreholes located in and around the city to pump water from the collection chambers to the reservoirs when the electricity is not available. Another better solution is to use a solar system instead of a generator. Because solar system lowers electricity bills and buying of generators oil, filters and other accessors every day. It is found that solar system was the optimal pump power for the water supply of research cities developing low-income cities.

Finance: finance is one of the biggest challenges existing the study area. Because everything needs money whether it's to work with operation and maintenance of old pipe system, to hire skilled man power, electrotechnical and electric power interruptions, pipeline expansion to cover whole the town, constructing of new reservoirs, investigating and drilling new boreholes.

4.2 Discussion

This study area has the potential to provide water from groundwater to provide drinking water to households (MoWE), the main source of drinking water in the study area is groundwater. This is because 33 wells in and around the city are directly connected to homes. 4 wells in Feda`ad water supply connected to 1000m³ reservoir located west of the city and 7 wells in Waji water supply project (Phase I), connected to 3000m³ reservoir service, traditional hand-dug wells, state and private water trucks, such as the local water distributors (Beyollie).

But the current situation of drinking water quantity is not enough for the community, which covers more less of the total community of the city. 97% of the people in this study area meet their daily water demand from water vendors (i.e., truck and donkey) and traditional hand dug wells whereas the remaining 3% of the sampled households has safe water supply accessibility. But these sources are dangerous and unprotected, causing many water-and water-related illnesses in the city citizens. particularly, the traditional hand-dug wells which is located mostly near the latrine; no more than 10 meters. 2021Regarding to the researcher's observation and involvement of the town, unless this problem is resolved urgently the overall socio-economic development of the town will be jeoparded and creates socio-economic problems, such as health implication. In addition to that, poor part of the community will be highly affected by this problem.

Residents of the city face severe water shortages that caused that majority of these residents to obtain water from unprotected alternative sources, purchasing expensive costing for one Barrel (200ltrs) 100 to 200 of Ethiopian money according to the time and distance from their households. ETB household location and water availability. Waji and Feda'ad were the main sources of drinking water supply for Jigjiga city. Shortages in water production and rapid population growth (i.e., massive rural-to-urban migration and rising urban birth rates) have created a gap between supply and demand. Additionally, the power interruption shut down the pumps and the entire system, reducing working hours of the pumps and the water production from the borehole sources. Water quality investigation was taken from the three samples and sent to a laboratory that got result that approved the existence of excessive Organics and salts dissolve the water.

Similar to the previous studies, this study also revealed that the main root causes of urban water supply have been institutional, financial, material resources, and human capacity. Also, the biggest challenges were shortage of water production, rapid population growth, water interruptions, distribution network, technical, financial and water management problems. The study found that the majority of surveyed households were unable to achieve their daily water supply accessibility other than vendors from unprotected and unreliable other alternative sources like traditional hand dug wells. The study also found that water supply issues are related to gaps between supply and demand, power outages, production shortages, disconnections, distribution network, technical, financial, and management system issues.

A similar study was conducted in Awaday town, Mokenen and R. Uttama (2014) discussing low water production, population growth, frequent interruptions, and inadequate quantity and quality of water supply. It also endorses the same root causes and challenges existing water supplies. According to the investigation, currently the service cars were in garage, using rental cars, and the office of the authority was rent, but have not been paid for the past 3 consecutive months, lack of spare parts, electromechanical and laboratory to prove the water quality. As discussed, salaries were not paid permanently.

The study uncovered socio-economic data for the city, revealing discrepancies between household numbers and low monthly incomes of the community. Over 90% of the population obtains their daily needs from other unprotected sources, such as water vendors. The survey found that 99.7% of households surveyed answered "no" about their satisfaction with water supply quantity and quality and that water production was inadequate, due to rural-to-urban migration and urban growth rates Which caused the water scarcity (i.e., supply is less than demand). In addition, there are problems in the water distribution system due to the aging of the distribution pipes, which were GI pipes and nominal diameters, and the influence of salt water and soil due to lack of maintenance. Moreover, the distribution system did not cover the entire city. There were many challenges and causes such as administration, technical, finance, distribution, insufficient production from the sources, climate change, old infrastructure, power interruption, and population growth.

5. Conclusion and Recommandation

5.1 Conclusions

The existing water supply source in the study city is groundwater (well). Jigjiga water supply works started in the 1970s. All types of existing water supply in the study city, including water sources, transmission lines, supply reservoirs and water distribution systems. According to an interview survey with the manager of the city's water and sewerage Authority, there are many problems with the current water supply system. Water scarcity, Inadequate piping frameworks for supplying reservoirs from wells to consumers due to burst pipes, lack of expertise and materials, lack of funding, lack of up-to-date daily data, and inadequate water sources. This serious problem results in the need for proper work and repairs, resource management, personnel management, and proper planning management. In this way, the Jigjiga Water and Sewerage Authority must transform the water supply source, water distribution system, water quantity and quality, expertise and financial, as well as sewerage management in the city in a short period of time through communication with townships and local residents. without enough quantity and good quality water in cities, we cannot provide good health services to individuals, develop our economies, and even improve our cities through various infrastructures.

A supply of water in a sufficient quantity and acceptable quality is one of the basic human needs, yet providing drinking water in the city of Jigjiga is insufficient. the situation is exacerbated by population growth and urban sprawl, overwhelming the ability to provide adequate water to households. The available drinking water sources are groundwater, reaching the customer private meter connections and public water points. However, production is short supply even for those who have access, especially during the main dry season, when the amount of production water is reduced. Reduced well by less working hours, a limited number of wells, and losses such as electro mechanical, frictions, pressure, and leakage further reduce production. Furthermore, the city’s water supply does not meet the required standards in terms of spatial and population-related supply, reliability, accessibility and sustainability.

The rate of private tap connection is low and inefficient power distribution system. the main limitations of the identified water distribution system are the low density of the pipeline network, the limited number of public water points and their unequal distribution, insufficient pressure in the pipelines, and well-prepared water distribution. Lack of pipeline map, as a result, urban water

use is influenced by these physical factors as well as socio-economic factors such as population growth, household income and scale that have influenced water use with the existing water supply so poorly functioning, most households in the city are willing to pay higher rates for improved water supply if the government provides it. This willingness to pay means two things: there is a need for more and the existing water supply is inconvenient for customers. They have the ability to pay if the water is offered at a relatively higher price than the current price. This indicates that if the WSS Authority could provide a better water supply than the existing water supply, it could have made a significant profit. Jigjiga's water supply problem is therefore multidimensional in respects, Efficiency and fairness.

Inadequate water supply, unfair and inefficient water distribution system, low coverage, unfair prices and resultant restrictions on consumption are among the biggest identified challenges. These problems have created various challenges for residents, including loss of time, energy and money. Exposure to water related illnesses lowers health care costs and penalizes the high costs paid by water vendors and hand dug wells. Some of these problems and challenges are due to management problems, lack of human resources, lack of sufficient funding and capacity, and the introduction of water by local governments, private, community-based organizations and non- governmental organizations, due to the lack of involvement of supply activity.

In summary, sustainable water supply takes into account the customer's choice of service type, of the study area, such as equitable distribution of water between different social groups, profitability of different community members, compliance with national and international drinking water standards, full participation of society, existence of well-protected and functioning ecosystem, etc. the situation is different. Many people wait in the suburbs to connect to their own meter, travel long distance each day, and spend a lot of time fetching water. Especially women are involved in the planning, implementation and decision-making process and there are no environmental protection and conservation organizations, providing society with the necessary amount of water at all times.

5.2 Recommendations

Generally, from this specific study the following points are recommended:

- There is rapidly population growth and expansion of Jigjiga city, therefore, water supply and demand in the city has a gap presently. In order to meet the demand in future, additional production of wells water sector should be carried out with detailed investigation such as Fafan well field or investigate another water sources.

- Equal distribution system and time scheduling must be made to the distribution system network to installs high quality pipes evenly in all parts of the city to consume water in sufficient quantity and quality to the community without daily water interruption.

- Construction of additional service reservoirs is required, especially around the North-South part of the city, to balance the supply and demand of the city's water supply, distribute water evenly across all kebeles, and easy distribution system problems to be able to deal with reduces water pressure in distribution networks, especially main and secondary lines.

- Municipality is not aware of the risk of groundwater contamination mainly due to low awareness of groundwater contamination, the land around the well was made available for residential of use by residents, particular attention should be given to community participation activities and environmental protection by relevant stakeholders.

- Jigjiga city council need to upgrade their water pumping system to enhance water supply to all households especially those on elevated locations and corners of the town, who usually are not reached by tap water due to low pressure.

- The main pipe of the distribution system should make some change to diameter and direction by some degree to balance the water pressure from each distribution pipeline of the town and protects their duration or life span of working.

- Modification of the pipeline reduces daily water supply interruptions, improves water quantity and quality, reduces additional operating and maintenance costs and purchases of new pipes, valves, elbows, and benefits WSS Authority employers and communities. reduce the work

load, conflicts between the Authority and its customers, conflicts between the community particularly for women and children. Overall, it helps the economic development of the community at the city level and prevents water diseases within the community.

- To install good quality the pipeline with constant diameter for old kebeles and balance the diameter of new expanded kebeles match with their daily water intake relies upon their numbers of population and thinking about subsequent growing population of the city for decide capability of the main pipe to sub-main pipe, sub-main pipe to branches and branches to household pipeline connection.

- It should be sought external funding to finance the maintenance of El-bahay Dam which can be used by all household water consumption activities except drinking and to reduce borehole dependency of the town.

- Residents with boreholes or hand dug-well located within the vicinity of potential pollution sources should conduct water quality test regularly so as to minimize faecalis contamination.

- JWSS Authority should apply various methods commonly used in Ethiopia, for population projection or forecasting, to predict future population numbers and to estimate the population numbers by using the best of these methods such as Arithmetic increasing, Incremental increasing, Geometric increasing and exponential growth method.

References

Abdisa, M., & Reddy, R. U. (2014). Assessment of potable water supply in Awaday town in Ethiopia. International Journal of Social Science ISSN, 2305-4557.

Adegbehin, A., Yusuf, Y., Anumonye, E., & Shehu, A. (2016). Problems of domestic water supply in dutsen kura gwari, chanchaga local government area of niger state, Nigeria. J Geogr Environ Earth Sci Int, 7, 1-9.

Ahmed, K., Pylsy, P., & Kurnitski, J. (2016). Hourly consumption profiles of domestic hot water for different occupant groups in dwellings. Solar Energy, 137, 516-530.

Ameeq, M., Hassan, M. M., & Jabeen, M. (2018). ASSESSING THE ENVIRONMENTAL IMPACT OF HOUSEHOLD CONSUMPTION: A CASE STUDY OF SOUTH PUNJAB DISTRICTS.

Chakkaravarthy, D. N., & Balakrishnan, T. (2019). Water scarcity-challenging the future. International Journal of Agriculture, Environment and Biotechnology, 12(3), 187-193.

Chalchisa, D., Megersa, M., & Beyene, A. (2018). Assessment of the quality of drinking water in storage tanks and its implication on the safety of urban water supply in developing countries. Environmental Systems Research, 6(1), 1-6.

Emenike, C., Tenebe, I., Omole, D., Ngene, B., Oniemayin, B., Maxwell, O., & Onoka, B. (2017). Accessing safe drinking water in sub-Saharan Africa: Issues and challenges in South–West Nigeria. Sustainable cities and society, 30, 263-272.

FAHIM, F. A., MOUSA, S. A., & ALEEM, M. A. (1997). Oceanological Studies No. 2-3. Oceanological Studies, 26(2-3), 127.

Farah, K., & Yonis, T. (2015). Challenges of sustaining water supply for rapidly growing post war city-a case of Hargeisa city, 38th WEDC. International conference Lough borough University,

Hussien, W. e. A., Memon, F. A., & Savic, D. A. (2016). Assessing and modelling the influence of household characteristics on per capita water consumption. Water Resources Management, 30(9), 2931-2955.

Iraj, K., & Rao, P. (2016). water resources and sources for safe drinking and improved sanitation in Ethiopia. International Journal of Applied Research, 2(5), 12-15.

Izquierdo, P., Esquena, J., Tadros, T. F., Dederen, J. C., Feng, J., Garcia-Celma, M. J., Azemar, N., & Solans, C. (2004). Phase behavior and nano-emulsion formation by the phase inversion temperature method. Langmuir, 20(16), 6594-6598.

Kabiso, K. (2015). Urban Water Supply in Hossana Town of Hadiya Zone, SNNPR. A master thesis, in regional and local development studies, haramaya university, 24-56.

Kassa, M. (2017). Evaluation of water supply and demand: The case of Shambu town, Western Oromia, Ethiopia. International Journal of Water Resources and Environmental Engineering, 9(5), 96-101.

Kibret, F. D., & Tulu, F. D. (2014). Socio-economic impacts of bahir dar tannery: Bahir dar, ethiopia. Natural Resources and Conservation, 2(4), 51-58.

Kumar, D. M., & Desta, G. T. (2018). Assessing the challenges of water supply and consumption systems of Tora town, SNNPR, Ethiopia. International journal of creative research thoughts, 6(2).

MEKA, G., & GEMECHU, L. (2018). SEASONAL VARIABILITY OF GROUND WATER QUALITY IN HAWELLA TULLA, HAWASSA. Ethiopian Journal of Environmental Studies & Management, 11.

Mesgaran Karimi, J., Azari Takami, G., Khara, H., & Abbaspour, R. (2016). Influence of trout farm effluents on water quality parameters and benthic macroinvertebrates. Iranian Journal of Fisheries Sciences, 15(1), 133-143.

Naik, P. K. (2017). Water crisis in Africa: myth or reality? International journal of water resources development, 33(2), 326-339.

Oyedotun, T. D. T. (2017). Ensuring water availability in Mekelle City, Northern Ethiopia: evaluation of the water supply sub-project. Applied Water Science, 7(7), 4165-4168.

Rose, A. (2009). Domestic water supplies an evaluation of the impact's challenges and prospect on women in rural house hold, Uganda. LUMES, Lund University.

Shuma, E. C. (2021). Water Management Practices Influence on Quality of Service among Water Service Providers in Nairobi Environs United States International University-Africa].

Singh, Omvir; Turkiya, Sushila (2013). A survey of household domestic water consumption patterns in rural semi-arid village, India. GeoJournal, 78(5), 777–790.

Sundqvist, P., & Andersson, L. (2007). A study of the impacts of land fragmentation on agricultural productivity in Northern Vietnam. In: Nationalekonomiska institutionen.

Yigezu, I. (2013). The Challenges and Prospects of Potable Water Management at Edja Woreda-Ethiopia.

Yongsi, H. B. N. (2010). Suffering for water, suffering from water: access to drinking-water and associated health risks in Cameroon. Journal of health, population, and nutrition, 28(5), 424.

Appendix 1

Dear respondents

I am a student at Adama Science and Technology University, College of Civil Engineering and Architecture and I am conducting a study to assess the accessibility and quality of drinking water supplies: Jigjiga Case Study. The results of this study are expected to improve the quantity and quality of water supply in the study area. I understand that you are currently aware of the quantity and quality of your home water supply based on your involvement with theJigjiga community and your observation in water access.

I am interested in your experience in the Water Accessibility Research Area, so I have attached a questionnaire asking you to respond to a series of statements and questions. The questionnaire items focus on the decision to assess the accessibility of your household water supply.I would like to emphasize that your participation in this study is voluntary and every effort will be made to protect your identity and keep your information confidential. I have attached a consent form for your review.

Please read the application form and do not hesitate to contact me if you have any questions about the research. If you choose to participate, please sign, initial, and date the consent form and return it with the completed questionnaire.

I look forward to hearing more about your experience assessing Jigjiga's accessibility to a drinking water supply. Your participation will be greatly appreciated and ensure that the purpose of this questionnaire is for educational purposes only.

Student Name: - Jawhar Sheekh
Phone No: +251915006680
Advisor Name: Dr.Andinet

Signature; -_____

Date: -_____

Name of the Town: -_____

Name of the Kebele: -_____

Questionnaires

Part A: Respondent Background Information

1. **Gender** A. Female B. Male

2. **Age:** 15-24 years B. 25-54 years C. 55-64 years D. 65 and above years

3. Marital status of the respondent A. Single B. Married C. Divorced D. Widowed

4. educational qualification of respondents

A. Illiterate B. 1-8 Grade C). 9-12 D). diploma E). BSC F). MSC and above

5. Household type: A. male headed household B. Female headed household

6. Household size of the respondents A.1-3 B.4-7 C. 7-9 D. 9-11 E. 12 and above

7.Your source of income

A. Government B. Merchant C. Farming D. Dailly labor E. Diaspora F. Others

8. The average monthly income distribution of the respondents

A.500-2500 B. 2500-5000 C. 5000-7500 D. 7500-10,000 E. 10,000 and above

Part B: Existing Water Supplies,WaterDemands, Sustainability, Adequacy And Accessibility, Root Causes, And Main Challenges

1. What is the main water source in your household town?

A) Piped water B) Hand dug well C) donkey vendor D) water truck vender

2. Can you get daily water demand access for your household? A) Yes B) No

3. If your answer to question #2was no, how many times did you get water?

A) every 2-3 days B) every 4-5 days C) every 6-7 days D). None

4. On average, how much water do you need per day in liters?

A) 20-40 liters B) 41-80 liters D) More than 81 liters

5. Is your water supply satisfied with your daily demands? A) Yes B) No

6. If your answer is no to the question (Q5), what is the reason for the proportional?

A) Unequal distribution B) Not scheduling C) water shortage D) water availability

7. If your answer is No to question 5, how can you fulfill your demand using by?

A) donkey vendor B) hand dug well C) water truck D) others

8. Are you satisfied with the city's existing water supply? A) Yes B) No

9. If you answered yes or no to the previous question, what kind of connections do you have?

A) From public tap ☐ B) From Yard Connection ☐

C) House connection ☐ D) Without connection ☐

10. Can you say that there are problems with water supply in to Jigjiga town?

A) Yes, there is a problem B) No, there is no problem

11. If your answer is yes to the tenth question, what's the problem?

A) Administration B) Technical C) Financial D) Facilitation E) Other

12. If you don't have a private connection, what do you think is the reason?

A) Distance from pipeline B) Unequal distribution C) Unable to cover costs D) Water inefficient

13. How do you think the current tap water supply is a matter of discussion?

A) Very serious B) Serious C) Not Serious D) Good

14. For what reasons do you face severe water shortages?

A) Drinking B) Washing C) Cleaning D) Cooking E) None

15. If you are not satisfied with the city's current water supply, what is the reason?

A) pipe connection problem B) water interruption problem C) distance and location of main
D) distribution system problem E) poor quality and quantity

16. What causes Jigjiga town water shortage?

A) Poor and inefficient distribution B) financial problems C) Rapid population growth
D) Frequent pipe breaks E) Electrical interruption F) Unbalance Demand/Supply

17. What are the main causes of water supply interruption problems?

A) Financial B) Technical C) Production D) power E) distribution F) Winter (dry reason

18. Water service interruption lasting

A) 1 to 3 days B) 4 to 6 days C) 6 to 8 days D) More than 10 days

19. How reliable is your hand dug well water during the dry season?

A) None B) Somewhat C) Fairly reliable D) Very reliable

20.Who is responsible for collecting allocating use of water in your household?

A) Husband B) Wife C) Children

21. How far distance is your water sources from your household?

A) 500-1km B) 1.5-3km C) 5-10km D) 10km and above

22. How much time does it takes to collect water per day?

A) Less than 30 minutes B) 30-1:00hr C) 1:30-3:00hrs D) 3:00 and above hrs.

23.Have you and your family occurred any water disease? A) Yes B) No

24. If your answer of question 23 is yes what type of disease?

A) Diarrhea B) Typhoid C) Malaria D) Amoeba

25. How much you buy a jerrican (20lts) of water outside your HH water supply connection?

A) 1–5-birr B)5-10birr C)10-15birr D) 20 and above

26.Is the House hold satisfied with the quantity of water? A) Yes B) No

27. Is the HHs satisfied with water quality? A) Yes B) NO If no what is wrong with quality?
A) Muddy B) Contains insects/worms C) salty D) smells bad test E) hard for washing

28. How do you store water in the house? A) Tanks B) Barrel B) jerricans

29. Is the storage covered? A) Yes B) No

30. How often do you clean the storage container?

a. Daily B) Weekly C) Monthly D) Never

31. What are the major challenges of urban water supply at the study area?

_____
_____
_____
_____

32. What are the major root causes of Jigjiga drinking water supply scarcity?

_____
_____
_____