



**COLLEGE OF URBAN DEVELOPMENT STUDIES**

**URBAN INFRASTRUCTURE PROVISION AND  
MANAGEMENT**

**Appraisal of Urban Water Supply Service: In Somaliland**

**Case of Hargeisa City.**

**By**

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**A thesis Submitted to the College of Urban Development Studies  
And Engineering, Ethiopian Civil Service University, in Partial  
Fulfillment of the Requirements for the Award of a Masters  
Degree in Urban Infrastructure Provision and Management**

**June, 2019**

**Addis Ababa, Ethiopia**

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## **Declarations**

I, **Barkhad Baashe Ahmed**, Registration Number/I.D. Number ECSU1700989., do hereby declare that this Thesis is my original work and that it has not been submitted partially; or in full, by any other person for an award of a degree in any other university/institution.

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## **Approval**

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## **Abstract**

*Water scarcity is one of the major challenges faced by dwellers of many developing countries. Hargeisa city, like other cities in developing countries, is presently facing numerous challenges on how to handle and improve water system to achieve sustainable water supply for the city. This study was carried out to appraise the urban water supply in Hargeisa city. It employed descriptive survey type of research using qualitative and quantitative research approaches using with Primary and Secondary data. Primary data was collected through questionnaire, structured interview and field observations targeting sampled households and water agency and ministry of water resource officials. The collected data were analyzed and interpreted in consistency with the research objectives. The findings showed that the current water supply is both inadequate and inaccessible of water supply. In addition, piped water covers 37% of the total population. Furthermore, the findings revealed that urban dwellers could not afford the water service as 63% of the studied population paid monthly water expense of more than 5% of their monthly income. The current monthly water consumption is twice lower than the standard minimum urban water consumption rate at households of medium family size.*

***Key terms:*** *Urban water, Water sources, water supply, demand management, stakeholders, Community participation, potable water supply, Availability, Acces water.*

## Acknowledgement

All praises and thanks are due to **ALLAH**, the creator, sustainer, and the most merciful, who gave me the courage, endurance, willingness and ability to complete this paper successfully.

I would like to express my appreciation, thanks and extend my indebted gratitude to my genuine advisor, **Amdemariam Shiferie**, without his valuable and constructive advice, patience, and rich contribution; this paper would not have succeeded. He encouraged the development of this paper from the beginning and suggested throughout for improvement. Therefore, this paper is the result of two persons.

I also would like to express my indebted gratitude to my research instructor **Dr. Kassa Moges**, without his valuable instructions of how to conduct research especially descriptive and inferential statistics, this paper would not have succeeded.

I am particularly gratifying to and my special thanks are reserved for my uncle and the member of Somaliland parliament **Mr. H.E. Saleeban Awed Ali**, for his outstanding care and instrumental support in my life, and for that I shall remain eternally grateful to him. My warmest appreciation goes to my beloved family, my mom **Safiya**, my Father **Baashe**, my big brother **Daahir**. I fully acknowledge their patience, understanding and ceaseless support, because they put up with my absence and seeming lack of due attention during the writing of this research paper. I heartily thank you and will never forget your contribution as far as I am alive. I wish you long life and paradise.

I would lastly, but not the least, like to thank and gratefully acknowledge my dear friends **Mr. Amir Abdullah Hadaflow**, **Ahmed Farah Isse**, and **Abdikhadar Ali**, who were available and committed to make life easier to me while studying ECSU, and not only for that but also for their enthusiastic support, motivation and moral backing to complete this program successfully. Thank you all.

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## List of Acronyms & Abbreviations

AMCOW	African Ministry's council on Water
ECA	Economic Commission for Africa
ECSU	Ethiopian Civil Service University
EU	European Union
EUISS	European Union Institute of Security Studies
GDP	Growth Domestic Product
GWCL	Ghana Water Company Limited
GWCRs	Global Water Consumption Rates
HUWSUP	Hargeisa Urban Water Supply Upgrading Program
HUWSUP	Hargeisa Urban Water Supply Upgrading Project
HWA	Hargeisa Water Agency
MWR	Ministry of Water Resource
MDGs	Millennium Development Goals
MMEWR	Ministry of Mining, Energy and Water Resources
MWA	Millennium Water Alliance
WSPs	Water Services Providers
NASAC	Network of African Science Academies
NGOs	Non-Governmental Organizations
SPSS	Statistical Package for Social Sciences
UN	United Nations
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
WASH	Water, Sanitation and Hygiene
WHO	World Health Organization
WSF	Water Security Framework
JPLG	Join program for local governmnet
FAO	Food and agriculture Organization
SNWP	Somaliland national water policy

## CHAPTER ONE: INTRODUCTION

Water is the lifeblood of the arena and is considered as a country wide aid of maximum importance, next to oxygen, water is the maximum crucial element for human survival it is the maximum crucial of all public offerings, water shortage impacts the complete network, so anything that disturbs the provision and deliver of water tends to disturb the very survival of humanity, water deliver is vital in each rural and concrete areas, therefore the accessibility to good enough clean water, to provide meals for both rural and concrete populace, is simply one factor of the function performed by way of water in meeting fundamental wishes and contributing to improvement Asgedom, (2014).

### 1.1 Background of the Study

Due to the fast population increase and uncontrolled residential improvement witnessed in maximum growing international locations, the worldwide city environment is seriously being degraded in terms of provider transport UN-Water, (2007). Water deliver is the public utilities that have been worst hit by way of this state of affairs. These facilities are essential commodities in household and municipal sports FAO, (2008). Though continuity of water supply is taken for granted in maximum evolved countries, it is an intense hassle in lots of growing countries, where in a few instances water is simplest provided for some hours every day or a few days a week, water is intrinsically interconnected with the MDGS and fundamental sanitation turned into brought to the catalogue at the (2002) world summit on sustainable improvement in Johannesburg. ‘to halve by way of (2015) the proportion of humans without sustainable get right of entry to secure drinking water and basic sanitation’ is one of the numerical and time-sure targets described for the mdgs. Maina, (2014)

Africa’s fast urbanization will result in new water management demanding situations for cities and over the subsequent twenty years, the city population of sub-saharan-Africa will double Un-habitat,(2011). Effective water supply provision and management can be vital to towns as emerging project as mismatch between potable water call for and deliver is growing at alarmly. The potable water demand is growing at a higher velocity than population growth as profits ranges of city dwellers rise and the demands for better services increase while water availability is shrinking due to competing needs from special direction which includes agriculture, mining, and enterprise and from deteriorating water first-class and weather alternate Ayanie, (2014).

Over 65% of the predicted a million people in Somaliland mainly capital town of Hargeisa are presently relying on water trucking and lack of water from unprotected and poorly maintained water resources around Hargeisa metropolis for day by day water use and the poorest households spend almost five instances extra than others who have get entry to main water because of the high fee of the trucked water. Subsequently, the Hargeisa urban water supply upgrading assignment is presently underway next few years to replace the tumble down and inadequate water infrastructure that become constructed 1970s to deliver when became a metropolis of a 180,000 inhabitants. The project is mainly funded by way of the European Union (EU) with supplementary fund from the Somaliland development fund (SDF) and world financial institution in partnership with the Hargeisa Water Agency and un- habitat. African, (2016)

The Hargeisa Water Agency is a parastatal agency mandated to provide adequate and accessible water supply services to the citizens of Hargeisa. The post conflict of Hargeisa city is the biggest urban destroying in Somaliland, with a rapidly growing population; it is also the hub of private trade and the seat of the Government of Somaliland. According to the Ministry, (2013) Hargeisa was estimated number of people living in Hargeisa is approximately one million, with an estimated 5-7% per annum growth rate. As a consequence of this growth rate, the city has expanded exponentially towards all directions, and there are new suburbs emerging, the resultant of increasing in combined of inefficiency of the city's water management has mean that the availability of safe and adequate water supply has become critical. The demand for water has increased enormously, and water scarcity has become acute in Hargeisa. Compounding this is are concerns regarding the uncertainty about the government's ability to sustain funding levels in the water sector, Yonis & Farah,( 2015).

## **1.2. Statement of the Problem**

Lack of access to safe water is one of the manifestation observed in the heart of the poverty, the provision of adequate of water supply in the study area has been through challenging situation in the last decade Asemet, (2016).

Water supply conditions in Somaliland are not different from the general situation of developing countries specially sub Saharan African countries as a whole, Hargeisa water agency(HWA) remains unable to fully meet an estimated demand of 16,000m<sup>3</sup>

to 20,000m<sup>3</sup> per day and only 35% of Hargeisa population have some sort of piped water supply access, the Corporate Governance Advisory Services inception report EY/WSP,(2014) stated that at in April 2014, there were 28,676 active and metered water connections with an annual consumption of about 2.5 million m<sup>3</sup> SDF, HWA, & HUWSUP,(2014).

The Somaliland estimate says the 55% of the Somaliland community lives in rural areas while the 45% remaining lives in urban areas but less than 20% have access to improved water supply system while other have poor adequate of water supply. This must be addressed and complicated significantly by continued conflict, low rainfall and very complex hydro-geological of the country, weak or absent of local government institutions African, (2016).

Somaliland Development Fund reports SDF,(2014) show that 65% of the estimated one million people in Hargeisa currently rely on water trucked by privately owned tankers, and donkey cars who fetch the water from unprotected and poorly maintained water sources in the kiosks, while the tanker trucks is fetching the water from different sources which have no good maintenance of water around Hargeisa including hand dug, open shallow wells, and from seasonal river beds of the neighboring small towns and villages mostly in the East and West of Hargeisa. There is no another option of water delivering system except the some sort of water pipe line which is provide by the water agency and most of the it is difficult to take a poor and small income group in the town.

### **1.3. Objectives of the Study**

#### **1.3.1 General Objective**

The general objective of this study is to appraise urban water supply Service of Hargeisa City.

#### **1.3.2. Specific Objectives**

In line with the general objective of the study, the specific objectives are:

- 1) To assess the current status of water supply in the study area.
- 2) To examine the gaps in water Demand and supply.
- 3) To find out the challenges in water supply service in Hargeisa City

- 4) To identify roles of stakeholders and avenues of community participation in promoting adequate water supply.

#### **1.4. Research Questions**

- 1) What is the status of urban water supply in the study area?
- 2) What are the gaps of water Demand and supply service?
- 3) Which challenges are highly affecting the performance of water supply in Hargeisa City?
- 4) To what extent stakeholders and community are playing their roles in promoting water supply?

#### **1.5. Significance of the Study**

Studying the extent, coverage and dynamics of urban water supply service in Hargeisa helps to identify the pressing problems in service delivery. Thus, the findings of the study are significant for the following reasons:

- ❖ the all Somaliland stakeholders and Wash sector, Ministry of Water Development ,Hargeisa Water Agency ,especially policy making Bodies, and the Hargeisa municipality can use the findings of this thesis for designing a more effective method of water supply system thereby contributing to Narrowing the knowledge gap between supply and demand for safe water supply service;
- ❖ the research findings can help private institutions to engage in the delivery of This service, provided and implemented the water service sector.
- ❖ Non-governmental organizations (NGOs) which have interest in assisting Hargeisa town with financial and technical support in the area of urban water supply can use the research outcomes as reference for their objective

#### **1.6. Scope of the Study**

In terms of delimitation, the study focuses on two dimensions, the Spatial and thematic scope as follows:

**1.6.1. Spatial Scope** -The scope of the study was spatially limited to Hargeisa city Administration of Maroodi-jeex Region. The spatial study focuses on geographical coverage of the two village of koodbuur district namely Xero-Awr and Lixle which is the town significantly expanded.

**1.6.2. Thematic Scope-** This research was focus on appraising of urban water supply service in the Hargeisa City. The town Hargeisa contain seven Main sub city and is difficult to study all sub city due time and cost restriction and researcher was select only one main Sub city of Hargeisa because the above factors specially (koodbuur district). The researcher is visiting Koodbuur sub city where can be find the real situation of the society and household condition and also government offices which is related to the problem to find reliable data.

## **1.7. Description of the Study Area**

### **1.7.1 Demographics**

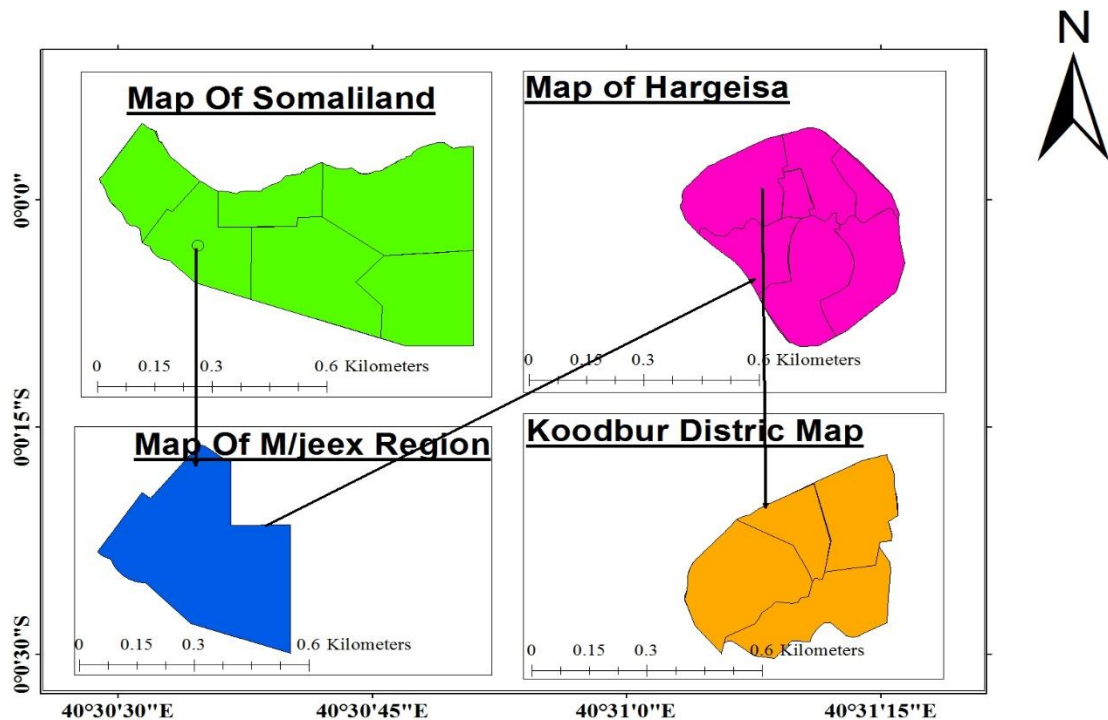
According to the UNDP (2005) the city had a population of 560,028, while according UNFPA (2013-2014) Hargeisa has estimated population of around 735,852. It is the 700th largest city in the world by population size. The urban area occupies 75 square kilometer (29 sq mile), with a population density of 12,600 inhabitants per square kilometer (33,000/sq mile). It is primarily inhabited by the Isaaq Somali clan Contributors, (2018).

### **1.7.2 Geographic Location**

Hargeisa is located at a mountainous area, in an enclosed valley of the northwestern Galgodon (Ogo) highlands. It sits at an elevation of 1,334 meters above sea level Geographically, it is located between latitude 8° to 11° 27' North of the Equator and longitude 42° 35' and 49° East. The city used to be surrounded by forest when it was smaller in size, but the country side around it still has small junipers Near Hargeisa are the fertile Sheikh and Daallo mountains, which receive large amounts of rain. South of the city is the Haud savannah (Baligubadle), which attracts many different species of wildlife to graze in the area. Hargeisa is situated near the town of Gabiley, which serves as an agricultural centre in Somaliland. That town's Allay-Baday area produces tons of tomatoes and onions each month during the rainy season. The city of Arabsiyo is also located nearby, and is noted for its lemon production Contributors, (2018)



**Figure 1.1: Map of Study Area**



**Researcher Developed, (2019)**

### **1.7.3 Climate**

Hargeisa has a semi-arid climate, the city generally features warm winters and hot summers. However, despite its location in the tropics, due to the high altitude Hargeisa seldom experiences either very hot or very cold weather. This is a trait rarely seen in regions with semi-arid climates. The city receives the bulk of its precipitation between the months of April and September, averaging 500 millimeters of rainfall annually. Average monthly temperatures in Hargeisa range from 18 °C (64 °F) in the months of December and January to 24 °C (75 °F) in the month of June Haas, (2017).

### **1.7.4 Economy**

Hargeisa is the financial hub to many entrepreneurial industries ranging from gem stonecutters, to construction, food processing, retail, and import and export firms. In June 2012, the Partnership Fund for the private sector in the Somaliland region was launched at Hargeisa's Ambassador Hotel. Part of the larger Partnership for Economic Growth program, the initiative will see \$900,000 USD allocated to 13 private local businesses, as well as the creation of 250 new full-time jobs, half of which are to be earmarked for youth and one third for women. The fund is expected to improve job opportunities for 1,300 entrepreneurs through ameliorated product distribution and

investment in new technologies and processing facilities. Eligibility is determined through a competitive and transparent selection process overseen by the Partnership program, the Somaliland Chamber of Commerce, and government officials. Contributors, (2018)

### **1.8. Organization of the document**

The document is organized in the way that consists of five chapters; the first chapter is introductory that depicts the over view of the research with the background of the study, statement of the problem, objectives of the study, research questions, significance of the study, scope and description of the study area which include demographic, geographic location, climate, economic characteristics of the study area,. The second chapter discusses about related literature reviews from various hard and soft or electronic sources. The third chapter comes up with the research methodology, consisting of Research design (includes research types, strategy and approach) and methods of data collection, sample design (population, sampling frame, sampling unit, sampling technique and sampling size), sources of data, data analysis and interpretation also ethical consideration are included. The fourth Chapter contains the main results /finding and Discussions of the study, the last chapter draws the conclusions from the findings of the study and makes necessary recommendations.

## **CHAPTER TWO: LITERATURE REVIEW**

### **2.1 Introduction**

Literature review is a comprehensive search of present secondary sources to provide the historical overview of the issue, in this study literature review part provides background information on appraisal of urban water supply. It reviews the theoretical and empirical literatures related to urban water supply and the concept of sustainability issues of urban water supply.

According to Tapio S et al, (2018) water and water furnish to people is of essential significance to human lifestyles and the everyday function of communities. The priceless function of water services is yet, fantastically poorly recognized, typically because they are usually taken for granted, only if water services fail do they get recognized by means of lay human beings consisting of citizens, policy-makers and decision-makers, as evidence of this global.

### **2.2 Theoretical Review**

#### **2.2.1 Water Supply Management**

Water is a useful resource administration which entails a variety of actors interacting in numerous methods and at various levels. According to the World Bank (1995) policy paper, "Water useful resource management that follows the standards of comprehensive analysis, probability cost pricing, decentralization, stakeholder participation, and environmental safety and investments across sectors, promote conservation, and improve the efficiency of water allocation World, (1955).

Integrated Water Resources Management (IWRM) is worried with the management of water resources, demand and provide (Global Water Partnership (GWP), 2000). At the international Conference on Water and Environment held in Dublin January UN, (1992) additionally diagnosed the significance of IWRM and proposed that direct interest must be paid to the following six areas. These are namely the following: Integrated water assets development and management, Water property appraisal, and safety of water resources, Water quality and marine ecosystems, Drinking water grant and sanitation, Water and sustainable metropolitan development, and, Water for sustainable food manufacture and rural improvement.

In the absence of the proper management of water, conflicts within countries often arise from competing water uses, and from overlapping and competing jurisdictional

mandates of agencies dealing with water issues Yilma & Donkor, (1997). An integrated approach has therefore important institutional dimensions that would help to avoid conflicts related to water management. Continuing water scarcity that is experienced in most sub-Saharan countries necessitates the adoption of IWRM approaches Woldemariam, (2009).

### **2.2.2 Sustainable Water Supply**

It usually involve a long-term view towards water sufficiency. Water sustainability could be defined as:

*“supplying or being supplied with water for life or, perhaps more precisely, as the continual supply of clean water for human uses and planning and implementing water supply systems with Accessibility, Adequacy, Viability and Safety principles in mind”* Jerald, (2010).

In the same vein, the supply and demand for water, and therefore its abundance or scarcity, depend significantly on the management of the resource and its use. For example, the timing of water availability is critical in many cases. Much of the world has distinct rainy seasons, where there is an abundance of rain followed by an almost complete absence of precipitation. In these places, the timing and volume of the rains can make or break a farming season the same amount of water can be either a benefit or a detriment depending on timing. Drought may be a part of the normal climatic cycle, and ecosystems and humans have adapted to this variability. The management of water supplies in these situations is critical poor management may create functional water scarcity in a country with seemingly abundant supplies of fresh water Fita, (2011).

### **2.2.3. The Status of Urban Water Supply**

Aschalew, (2009) Stated water is important in a number of ways; these include domestic and productive uses. Domestic water use takes the form of drinking, washing, cooking and sanitation, while productive water uses includes those for agriculture, beer brewing and brick making etc. Safe drinking water matched with improved water supply contributes to the overall well-being of people; it has significant bearing on infant mortality rate, long life and productivity. However, the majority of the world’s population in both rural and urban settlements does not have access to safe drinking water. Water Utility Partnership Africa Abera, (2003) stated that the primary goal of all water supply utilities is to provide customers with a “private” connection to the piped water supply network, for many public officials, policy makers and politicians a

household or yard connection or private connection is considered the most satisfactory way to meet the following key objectives:-

- Public health objectives: by ensuring better quality and access.
- Commercial objectives: by facilitating cost recovery and revenue generation.
- Social objectives: by improving access for the poorest and enhancing security and safety.
- Environmental objectives: by enabling better demand management and water conservation Abera, (2003).

## **2.2.4 Sources of Urban Water**

According to UNHabitat, (2003) water sources fall into three general categories such as Rain water, surface water, and Ground water

### **2.2.4.1 Surface water Source**

Surface water originates from rain water. It is the main source of water supply in many areas. It includes rivers, tanks, lakes, manmade reservoirs and sea water. Surface water is prone to contamination from human and animal sources. As such it is never safe for human consumption unless subjected to sanitary protection and purification before use.

According to Biixi, (2017) Surface water supply in Somaliland is mainly dependent on rainwater in the months of April to June (the Gu season), and August to October (the Deyr season). The pattern of the rainy seasons is however changing with time, with periods of prolonged rain and drought now being frequently experienced. Rains can last for several hours, sometimes resulting in flash floods, which, if harvested, can provide water for months afterwards. Hills and highlands generate most of the runoff water. The potential for harvesting runoff water for agriculture, livestock and human consumption is quite considerable, in Somaliland, springs are mostly found in the mountainous and coastal regions, they are used to irrigate farm land, like DurDur in Awdal, and supply urban centers like Berbera, where spring water provides up to 40% of the city's needs. Springs are also an important source of water for livestock.

## **2.2.4.2. Ground Water Sources**

### **2.2.4.2.1 Spring**

Groundwater seeping from the ground to the surface at springs provides excellent water supply source if it is developed appropriately and remains free from pollution. Springs have variable flow so their low regime must be checked to determine whether it is sufficient for the demand. Low flows coincide with the very beginning of the rainy season or at the end of the dry season. According to WaterAid, (2012) a flow of 0.1 liters per second (Lps) would result in a daily flow of about 3,000 liters which would supply a community of 150 people with their water requirements (20L per person per day). However, an addition of a spring collection box or tank would allow even lower flows (< 0.1L) to be considered for water supply. Pollution is a serious concern during development and use. Therefore, the construction site should be selected where runoff cannot enter the spring; latrines have not been constructed upstream, and children and livestock are prevented from entering the site. Furthermore, the construction site should not experience saturation or be subject to flooding and eroding processes WaterAid, (2012).

### **2.2.4.2.2 Hand dug well.**

Hand dug wells (HDWs) are a common technology employed for rural water supply because of its relative ease in construction, low cost input and its familiarity to most communities. Nowadays, the technology has been modernized by using better linings and more efficient pumps in order to improve a well's performance. HDWs are shallow ranging in depths up to 20 meters and approximately 1.5 meters in diameter, which accommodates the digging process. These wells most often are dug down to tap water stored in perched water tables, clay or other impermeable layers on which percolated water collects above the main water table. The addition of a lining to the HDWs decreases the likelihood of a well collapsing and excessive loss from seepage. From the Technology Notes published by Water Aid (2010), four different linings have been suggested: pre-cast concrete caissons (cylinders), reinforced concrete, brick, and galvanized iron. When using caissons, the initial concrete cylinder is pressed into the excavation site and the soil extracted from within the cylinder, and as the depth of the well increases, concrete caissons are added as the depth increases (Water Aid, 2010). However, caissons of smaller diameters should be used when the well reaches depths below the water table, Gravel is used to line the base of the well and to pack the sides

of the concrete cylinders in order to prevent sand, silt and other materials from entering the well water , Finally to prevent surface runoff from flowing over into the well, an apron of concrete or puddle clay is constructed around opening, and a concrete slab is used to cover the well WaterAid, (2010).

#### **2.2.4.2.3 Shallow well and Borehole.**

Shallow wells are deeper than 30 m but lesser in depth than Boreholes which are much deeper (up to > 100m) and have a smaller diameter, approximately 100 to 150 mm Water Aid, (2011). Boreholes or shallow wells often reach the main aquifer where sufficient water can be obtained.

However, pumping is the only option to extract the water from these wells. Similar to HDWs, a borehole will have an internal lining, an apron and cover for situating a pump. The actual

Excavation of the well is the challenge Water Aid's Technology Notes (2011) describe three excavation methods including auguring, sludging and drilling. In Somaliland's highlands, drilling is common because of the rocky subterrain. Percussion, rotary percussion, rotary drilling with flush and jetting are different drilling methods described by Water Aid (2011), Hand or other mechanized pumps must be installed to extract the water because of a borehole's depth. Seifu, et al (2012).

Groundwater is water used by humans comes mainly from land such as wells, springs, etc. It tends to be of higher microbiological quality (having undergone natural soil filtration). However, it is relatively difficult to extract. More technology and energy is needed (compared with other water sources) to bring water from within the earth up to the surface.

According to strategic water point's inventory survey conducted by FAO, SWALIM and Ministry of Mining, Energy and Water Sources in Somaliland (2008), many of the groundwater sources were found to have high salinity which limits the usefulness of such water for human and animal consumption, as well as crop production. The survey identified 877 ground water sources: boreholes, shallow wells and springs in Somaliland Region.

**Table 2.1: Strategic ground water sources summary by Region in Somaliland**

Region Name	Borehole	Dug well	Spring	Total
Awdal	25	104	37	166
Togdheer	40	86	20	146
Maroodi-jeex	43	212	34	289
Sanaag	32	107	30	169
Sool	18	86	3	107
<b>Total</b>	<b>158</b>	<b>595</b>	<b>124</b>	<b>877</b>

*Source: MMEWR, (2008)*

The above table shows the different ground water source of Somaliland regions as well as the different sources the maroodi-jeex region which is including Hargeisa Capital City is highest ground water sources of Somaliland.

### **2.2.5 Access of Urban Water Supply**

The Sustainable Development Goals (SDGs) mark a notable shift from the access-focused Millennium Development Goals (MDGs) to a new international monitoring approach that places greater emphasis on the quality of that access. With quality of access in mind, two key measures stand out in the analysis. First, an average of 97 percent of the poor have access to improved water service in the seven cities. The average access to piped water by poor households is 90 percent. In four of these cities shared pipes are the main way of serving the poor, and in Dakar and Nyeri, 75 percent or more of poor customers have water piped to their premises. Second, in most of the cities, residents received piped water for more than 18 hours a day. Both accessibility (including the quantity of water) and reliability of water supply are important. Remarkably, good water service for the poor is found in large, poor, and rapidly growing cities with arid climates, such as Ouagadougou and Niamey, and in countries with low governance effectiveness according to the World Bank's Worldwide Governance Indicators. Clearly, serving poor people in fast growing and poor African cities is possible, even in countries that are poor, arid, and suffer from governance problems. Chris, et al , (2016)



**Table 2.2: City with relatively good service**

No	City	Reliability (hours/day)	Access to improved water (poorest 40%)
1	eThekwni (Durban)*	24	100 %
2	Lusaka*	20	98 %
3	Ouagadougou*	23	98 %
4	Dakar*	24	97 %
5	Nyeri*	24	96 %
6	Niamey*	24	94 %
7	Kampala*	18	93%
8	Nairobi	20	86 %
<b>9</b>	<b>Hargeisa</b>	<b>20</b>	<b>76 %</b>
10	Tanga	24	75 %
11	Accra	18	65 %
12	Addis Ababa	16	100 %
13	Maputo	12	97 %
14	Kinshasa	11	93 %
15	Mombasa	4	92%
16	Dar es Salaam	8	89%
17	Kaduna	14	29 %

**Sources:** Chris, et al , (2016)

**Notes:**

The above table shows as the access service of different city in African countries which have the poorest service access and less service provider.

**(\*) indicate the most cities who have the most water service access and reliable.**

### **2.2.6 Water Supply Availability.**

In per-capita terms, water availability is declining rapidly, from 17,000 cubic meters (m<sup>3</sup>) per person in 1950 to 7,044 cubic meters in WRI, (2000). Currently, by some definitions, water stress and scarcity exist in many places in the world, and many experts predict widespread water scarcity over the next century Revenga, et al., (2000) Gardner et al, (1997); UN CSD (2001). Hydrologists often describe water stress as water supplies of between 1,000 and 1,700 m<sup>3</sup> per person per year. This is thought to represent a situation in which disruptive water shortages may occur frequently. A country is said by some experts to be in water crisis if it has supplies of less than 1,000 m<sup>3</sup> per person per year, a situation that is predicted to lead to problems with food production and economic production. The population in these countries represents about 11 percent of the world's population. Despite these alarming numbers, however, the level of aggregation hides an enormous amount of variability. As is discussed later

in this report, the measures described here are too simplistic to be useful in any meaningful way. Boberg, et al,(2005).

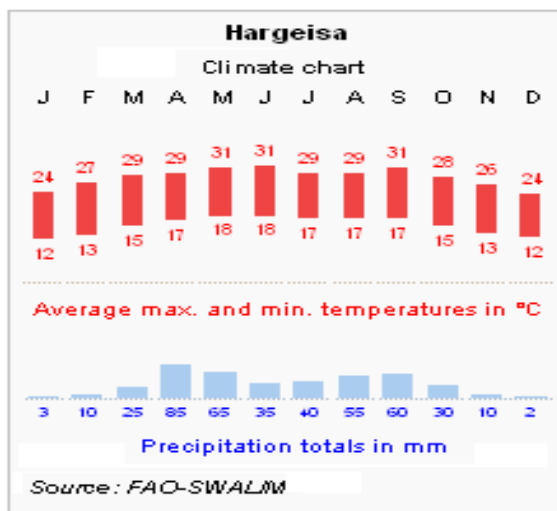
### **2.2.7 Challenges of Urban Water Supply.**

According to Kelay. et al , (2006) Cities all over the world are facing a range of dynamic global and regional pressures. They are facing difficulty in efficiently and transparently managing ever scarcer water resources, delivering water supply services. There are equal challenges on disposing of wastewater and minimizing negative impacts to the environment. In order to develop solutions to manage urban water more effectively, these global and regional pressures must be recognized and used to drive the design and management processes of urban water systems, Climate amendment is foretold to cause important changes in precipitation and temperature patterns, touching the supply of water, population growth and urbanization are imposing speedy changes resulting in a dramatic increase in high-quality water consumption. Frequently, this demand for water cannot be happy by the domestically accessible water resources, whereas the discharge of insufficiently treated waste matter will increase prices for downstream users and has prejudicious effects on the aquatic systems, existing infrastructure is aging and deteriorating. It's a technological and money challenge to take care of and upgrade it in such the way that quality water will still be delivered to any or all sectors and waste matter may be adequately collected and treated.

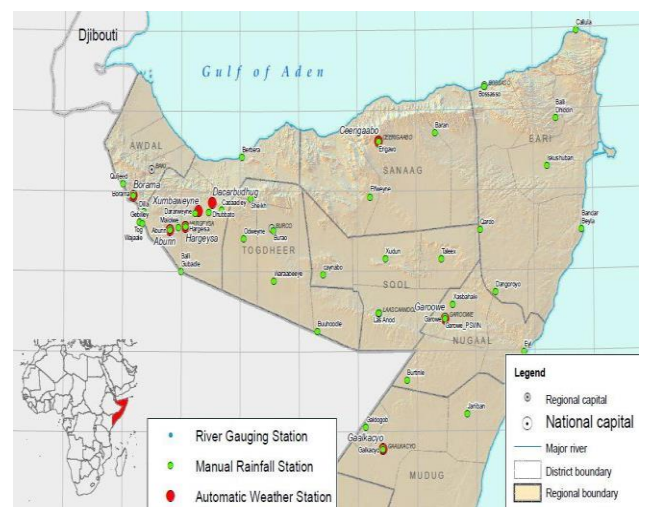
#### **2.2.7.1 Climate Change and Situation Analysis.**

There is little dispute that the earth system is undergoing very rapid changes as a result of increased human activities. As a result of these changes, it is generally accepted that we have begun to witness changes in the natural cycles at the global scale. Clearly these changes will severely impact the urban water cycle and how we manage it. Components of the urban water cycle, like water supply, wastewater treatment, and urban drainage etc. are generally planned for life-spans over several decades. Hence there is a need for us to pay attention to these changes in the context of how these systems will be designed and operated in the 'city of the future'. The frequency and severity of droughts could also increase in some areas as a result of a decrease in total rainfall, more frequent dry spells, and higher ET, Climate change will affect different cities in different ways with some experiencing more frequent droughts and water shortage while others will have more intense storm events with subsequent flooding issues. Flexible and adaptable solutions are hence required to reduce the vulnerability of cities to this change

Hellmuth, & Kabat, (2002). According to SWALIM,(2012).Somaliland and Puntland feature an arid to semi-arid climate, changing with location and topography, Mean daily maximum temperatures throughout the region range from 30°C to 40°C, except at higher elevations and along the Indian Ocean coast. Mean daily minimum temperatures vary from 20°C to more than 30°C. The region experiences the greatest temperature extremes, with readings ranging from below zero in the highlands in December to more than 45°C in July in the coastal plain skirting the Gulf of Aden, There are four main seasons, dictated by shifts in the monsoon wind patterns (Jilaal) from December/January to March the harshest dry season of the year (Gu) April to May/June the main rainy season (Xagaa) Jun/July to September the second dry season (Deyr) October to November/December the shorter and less reliable rainy season Most of the area receives less than 500 mm of rain annually, and a large area receives as little as 50 to 150 mm. Certain higher areas however receive more than 500mm a year. Generally, localized torrential rains and is extremely variable. A climate chart for Hargeysa widely is shown in (Figure 2.1 & 2.2.)



**Figure 2.1: Climate chart for Hargeysa (SWALIM, 2012).**

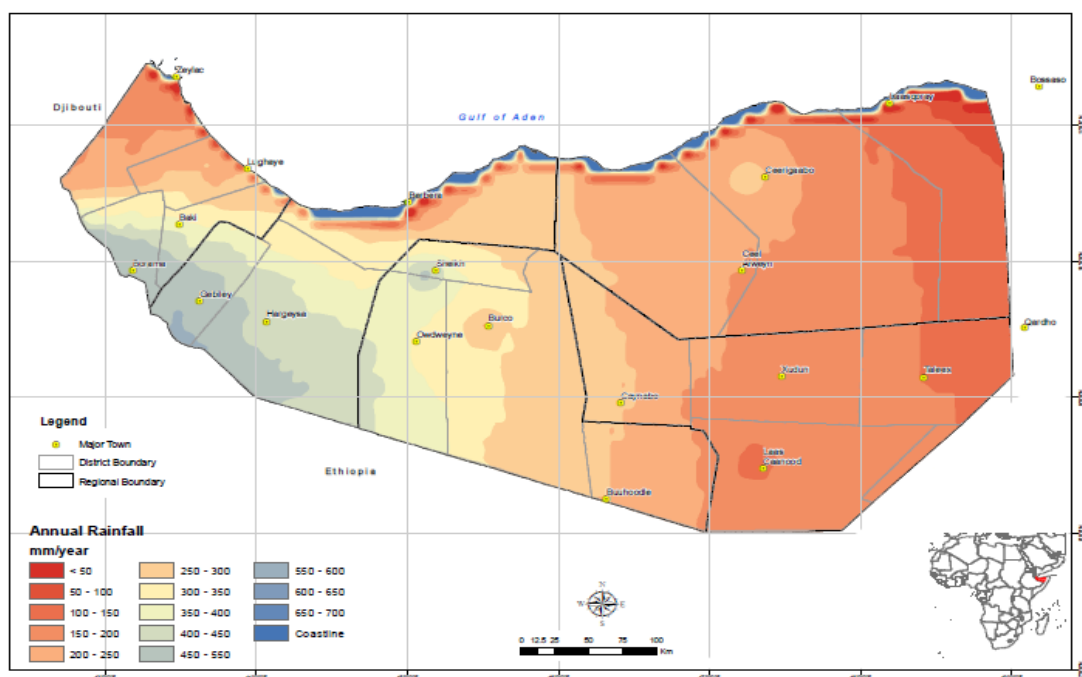


**Figure 2.2: Overview of rainfall stations in Somaliland and Puntland (SWALIM, 2012).**

### Somaliland Rainfall

Somaliland has a bimodal rainfall distribution (Gu and Deyr). The first main rainy season (Gu) occurs between April and June, when around 60 percent of rain falls, and the second rainy season (Deyr) from August to November. The months of highest

rainfall within these seasons are generally from April–June and October– November. The two dry seasons in the country are Jilaal and Hagga, which occur between December and March and July and August, respectively. Rainfall is low and erratic. The amount of rainfall received annually reduces further to the north except for areas around Sheikh, Hargeisa and Borama that receive between 500 mm and 600 mm per year. The area around Ceeregaabo receives up to 400 mm annually. The northern coastline is characterized by low rains of less than 100 mm per year. The rest of Somaliland receives an annual rainfall of 200 to 400 mm (Refer to Figure 2.3) Ministry.N.P (2011).



**Figure 2.3 - Rainfall-intensity in Somaliland**

**Source: Ministry.N.P, (2011).**

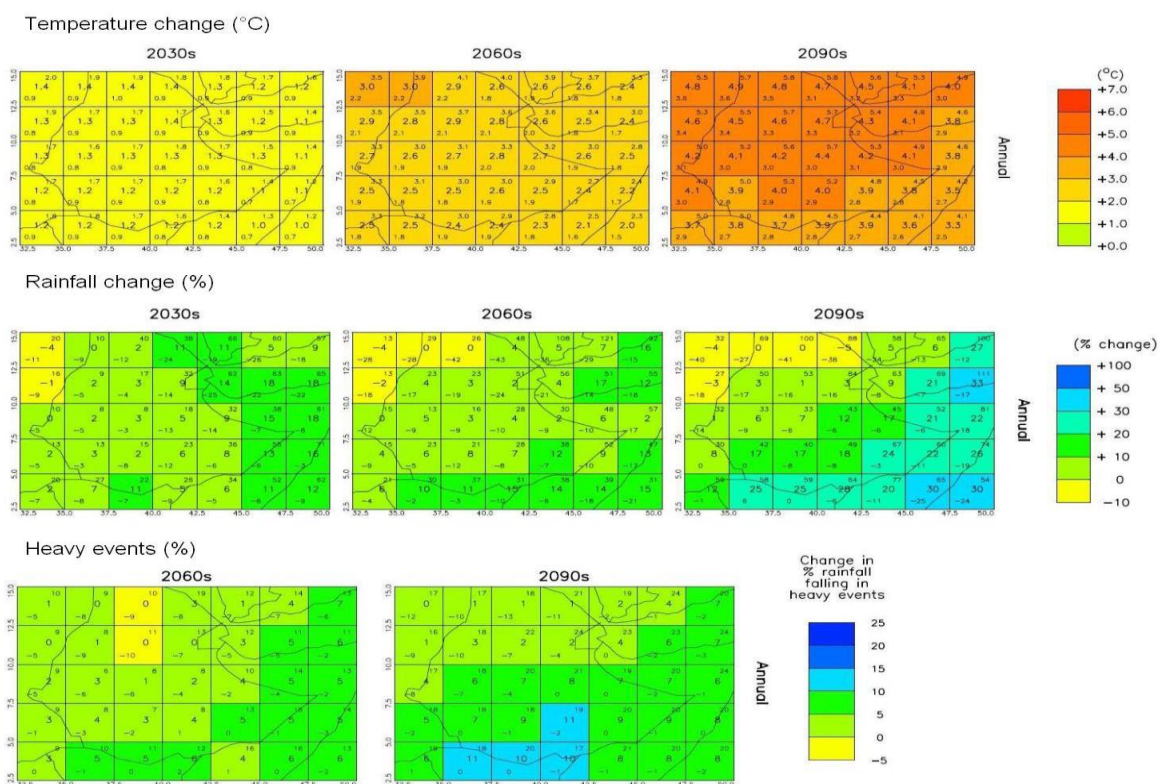
### **Predictions**

Climate predictions for Somaliland and Puntland are based on global circulation models and carry their uncertainties. Detailed analysis or regional downscaling is not available for the region so information has been based on the IPCC AR4 projections detailed evaluation of the regional climate predictions (Figure 2.4) show the following picture for Somaliland and Puntland for 2090:

- Annual mean temperature is projected to rise by 2.5-3.0 °C
- Annual mean precipitation is projected to rise by 15-20% (15-30% in winter, 5-15% in summer)

There is a certain agreement between the models that precipitation will increase on an annual basis though with more confidence in the winter month and high uncertainty in the summer months, summarized climate predictions from UNDP Climate Change Country Profiles

Ethiopia (2010), for representative cells for Somaliland and Puntland (annual means, inland regions) based on SRES A2 scenario. All values are anomalies relative to the mean climate of 1970-1999.



**Figure 2.4 - Prediction of Rainfall and temperature in Somaliland & punt land (SWALIM, 2012)**

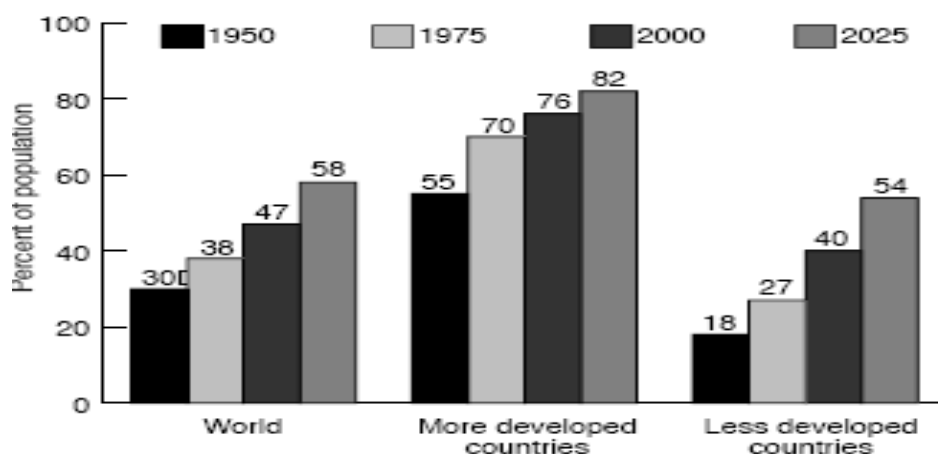
### 2.2.7.2 Population Growth and Urbanization.

Population growth and urbanization will be one of the world's most important challenges in the next few decades. United Nations population prospects report (2006) illustrates the higher rate of population growth in urban area in the developing countries. In less developed countries, urban population will grow from 1.9 billion in 2000 to 3.9 billion in 2030, averaging 2.3% per year. On the other hand, in developed countries, the urban population is expected to increase, from 0.9 billion in 2000 to 1 billion in 2030 overall growth rate 1% Brockerhoff, (2000).

In 1950, New York City and Tokyo were only two cities with a population of over 10 million inhabitants. By 2015, it is expected that there will be 23 cities with a population over 10 million. Of the 23 cities expected to reach 10 million plus by 2015, 19 of them will be in developing countries. In 2000, there were 22 cities with a population of between 5 and 10 million; 402 cities with a population of 1 to 5 million; and 433 cities in the 0.5 to 1 million categories. Almost 180,000 people are added to the urban population each day. It is estimated that there are almost a billion poor people in the world; of this over 750 million live in urban areas without adequate shelters and basic services Khatri.K.B, (2007).

The population of Somaliland is estimated at around 3.85 million. The average population growth rate is 3.1%. Population density is approximately 25 persons per sq. kilometer. Fifty-five percent of the population is either nomadic or semi-nomadic, while 45% live in urban centers or rural towns, Ministry.N.P, (2011).

In 2005 according to the UNDP the city had a population of 560,028, while according UNFPA (2013) Hargeisa has estimated population of around 735,852 it is the 700th largest city in the world by population size. The urban area occupies 75 square kilometer (29 sq mile), with a population density of 12,600 inhabitants per square kilometer (33,000/sq mile). It is primarily inhabited by the Somali clan (Contributors, 2018).



**Figure 2.5: Percent of Population Living in Urban Areas in Major World Regions, 1950, 1975, 2000, and 2025 (United Nations, World Urbanization Prospects: The 1999 Revision 2000)**

**SOURCE: Khatri.K.B, (2007).**

### **2.2.7.3 Deterioration of Infrastructure Systems.**

In order for the urban water cycle to function effectively, it needs to be supported by appropriate infrastructure in good working condition. Protecting the infrastructure used to treat and transport water (including sources, treatment plants, and distribution systems) is an important step in ensuring the safety of drinking water. However, in most cities worldwide, there has been years of neglected maintenance to water storage, treatment, and distribution systems. Poorly maintained water supply systems can generally be traced to insufficient financial resources and poor management. This deterioration in the water infrastructure threatens the quality and reliability of all water services, In particular there has been little or no management and maintenance of the underground infrastructure. A large proportion of this infrastructure is over 100 years old, placing it at increased risk for leaks, blockages and malfunctions due to deterioration. For example, water mains break in hundreds of thousands of locations each year in the United States, leaving water customers without a supply, or with a supply that is unsafe for consumption without special treatment Yan, & Vairavamoothy,(2003).

### **2.2.8 Role of Stakeholders in Water Sector**

The waters sector has several institutions charged with the responsibility of ensuring adequate water services to the entire citizens of the country. These mainly came after the enactment of The Water Act,(2002) which looked forward to.

- The separation of the management of the water resources from the provision of the water services.
- The separation of policy formulation on water issues from the day to day administration and regulation.
- Decentralization of the functions in the water and sanitation sector to the lower level state organs.
- The involvement of non-governmental entities in the management of water resources.
- The involvement of the non-governmental entities in the provision of water services.

#### **2.2.8.1 Role of the government.**

The government has put down many measures and various institutions in the past decade to ensure that the community members and the entire citizen fraternity receive

adequate water and sanitation supply in the country. There was the establishment of the Water Sector Reform Secretariat (WSRS) whose responsibility was to cover the transitional gap during the period which the water reforms institutions were being established. Water Services Trust Fund (WSTF) was established in 2004, to provide financial assistance towards capital investment costs in areas lacking adequate facilities which are often inhabited by the poor. The transfer of the central government staff and the assets were realized through the development of the transfer plan of 2005 in which the services were delegated Ministry of Water, (2007).

## **2.3 Empirical Review**

### **2.3.1 Water Supply management at the global scale**

“Freshwater resources around the world have been over used, polluted, fought over and squandered, with little regard for the human and ecological consequences” (Glieck, 1998). Unsustainable use of water is the order of the day throughout the globe. Conflicts over scarce water are mounting. Dramatic drops in the water table as well as the seasonal drying up of large rivers before reaching the sea are signs of the unsustainable use creating havoc for millions of people. (Glieck (1998: 574) defines the sustainable use of water as “the use of water that supports the ability of human society to endure and flourish into the indefinite future without undermining the integrity of the hydrological cycle or the ecological system that depends on it”). However, the layers of complexity that underpin that definition can be found in the diversity of human society, which is divided by political, social, cultural and economic boundaries. According to the United Nations Water Conference (1977:127) “all peoples, whatever their stage of development and their social and economic conditions, have the right to have access to drinking water in quantities and of a quality equal to their basic needs” (UN, 1977 cited in Gordon et al., 1994: 127). It is also recognized that human excreta and sewage are important causes of the deterioration of water quality in developing countries, and the introduction of available technologies, including appropriate technologies, and the construction of sewage treatment facilities could bring significant improvement (McGranahan & Satterthwaite, 2004). During the past few years there has been an increasing realization of the importance of water management in the continuing well-being and development of the developing countries, especially those located in the arid and semi-arid regions (UN, 2001). Furthermore planners and decision-makers have started to realize the critical importance of efficient water management for the



sustainable development of their countries. While water covers some 70% of the planet's surface, less than 3% of this is freshwater Samson and Charrier, (1997). Much of the world's freshwater resources are frozen in the polar ice caps or deep underground (Biswas, 1991). Surprisingly, in most parts of the world availability and quality of freshwater is taken for granted. "Without being overly alarmist, figures and trends appear to indicate otherwise; serious questions relating to global freshwater quantity and quality are rapidly emerging-apparently unknown to the general public and authorities in general" (Falkenmark, 1994:16). New sources of water are becoming scarce, more expensive to develop, and requiring more expertise and technological know how for planning, design and implementation (Anderson, 1998). Accordingly, water can no longer be considered a cheap resource, which can be used, abused, or squandered without much consequence for mankind's future as (Woldemariam, 2009) cited (Glieck, 1998, United Nations Water Conference, 1977, Mcgranahan and Satterthwaite, 2004, Biswas, 1991, Falkenmark, 1994, Anderson, 1998).

### **2.3.2 Water Supply in Africa.**

While Africa is among the most gifted continents in terms of freshwater resources, its people have the lowest access to clean water for drinking and other purpose, the lowest per capita food production; and the lowest access to the water-dependent services such as electricity (hydropower). More than 40% of Africa's population has inadequate access to water as opposed to 15% in Latin America and 20% in Asia World Bank Council and Global Water Partnership, (2001).

Africa has over 50 significant water basins spanning nearly all countries. For 14 of these, practically their entire national territories fall within shared river basins. There are also large inland water bodies such as lakes Victoria, Chad and Kariba. In Sub-Saharan Africa (SSA), international river basins constitute the principal source of water resources. About one-third of the world's international river basins are found in SSA. Thirty five countries in the region share the 17 major river basins. Furthermore, international rivers also include 11 river basins between 30000 and 100000 sq. km. Yilma, & Donkor, (1997).

About 50 percent of the total surface water resources of the continent are in one single river basin (i.e.) the Congo basin and 75 percent of total water resources are concentrated in eight major river basins (i.e.) the Congo, Niger, Ogoague (Gabon), Zambezi, Nile, Sanga, Chari-Logone and Volta Yilma, & Donkor, (1997). In Africa,

only a minimal amount can currently be used as viable fresh water. In the past 20 years, available freshwater resources in Africa have greatly declined due to severe and prolonged drought. Water pollution resulting from industrial effluent, urban run-off, sewerage and agro-chemicals are on the increase and continue to deteriorate freshwater quality and affect its quantity.

More than 50% of the lake basin of East Africa's population does not have access to piped water WHO/UNICEF.,(2004).They depend on natural sources like springs, streams and rivers. Such sources should be protected from any form of degradation. Unfortunately, urban centres along the shores of the lake and river throw their industrial and domestic waste into the river and other water bodies. Government departments that are supposed to control pollution or degradation of water resources are still not decentralized in their operations. They lack finance and human resources to effectively carry out their mandates.

### **2.3.3 Water Supply in Somaliland.**

The hydro-geophysical assessment of Hargeisa water supply and distribution system, boreholes field conducted by UHL & Associates stated that the current water supply system of Hargeisa was installed by the Chinese Government in the early 1970's and expanded in 1986-88. "The system was designed to deliver 8,000 to 10,000 m<sup>3</sup>/day with the annual production of about 3.1 million m<sup>3</sup> (UHL& Associates, 2012)." The water is extracted from a network of 13 boreholes at Geed-Deeble water field and pumped through two twin underground 300mm diameter pipelines over a 20km distance and at a 260m elevation to in-ground storage tanks overlooking the city UN-Habitat & HUWSUP,(2014). The water supply infrastructure was badly damaged during the civil war in the late 1980's, and has gone through several rehabilitation works over the years. Despite this the pipelines, as well as critical components of the water production and transmission system, are outdated and at risk of failure due to a lack of maintenance.

#### **2.3.3.1 Demand and Access of Water Supply in Hargeisa.**

Despite donor-supported investments through small scale projects in last two decades, HWA remains unable to fully meet an estimated demand of 16,000 - 20,000 m<sup>3</sup> per day and only 35% of Hargeisa as population have some sort of piped water supply access, this includes the 10% of the population who rely on water from kiosks supplied by HWA (see Photographs fig, 5 & 6). Somaliland

Development Fund reports show that 65% of the estimated one million people in Hargeisa currently rely on water trucked by privately owned tankers, who fetch the water from unprotected and poorly maintained water sources around Hargeisa including hand dug open shallow wells in seasonal river beds of the neighboring small towns and villages mostly in the East and West of Hargeisa SDF (2014). Moreover, “the current water production of HWA is 47% below the WHO international standards of demand level at minimum urban consumption level of 35 liters per day per capita/person Unicef, (2012), points out that most African water utilities are facing enormous challenges in meeting the water needs of growing urban populations, many of which are poor and living in informal and unplanned settlements. Additionally, because of the high price of trucked water the poorest families in Hargeisa spend almost 5 times more on water than others who have access to mains. According to the current tariff chart of HWA, families with piped household connections pay \$1.50 per 1 m<sup>3</sup> to HWA and the average low-income family without piped water connections pays \$7.5/ 1m<sup>3</sup> to the private vendors. The paper posits that patterns of current urban water supply in Hargeisa are inequitable, and that the existing water supply is not fairly distributed around city’s residents. In Hargeisa there are 9 informal settlements known as Internal Displaced People (IDPs) Settlements with an estimated population of above 70,000. The HWA piped water supply distribution network, does not cover the IDPs settlements Unicef, (2012) and furthermore, the existing 400 water kiosks which were aimed at serving the poor are not appropriate to serve them due to the location of the kiosks; more than 50% of the kiosks are located where there are piped water connections in economically well-off areas of the city. The kiosks are also poorly designed and exposed to hygiene hazards. There are no professional poor water supply delivery policies or regulations that protect the right of poor people to access equitable and affordable safe to drink water.



Figure 2.6 A donkey Car Vendor @water kiosk



Figure 2.7: A girl fetching water @ water kiosk

SOURCES Yonis & Farah, (2015)

### 2.3.4 POLICY OBJECTIVES AND STANDARD OF WATER

According to MWME, (2002) concerned that the main objectives policy and standards to promote the rehabilitation and construction of new water facilities in order to improve human living conditions through enhanced accessibility, management, and awareness within a context of environmental sustainability.

- To promote the rational and socially equitable rehabilitation, development and sustainable management and use of the freshwater of Somaliland through;
- To formally invest the Ministry of Water & Mineral Resources as the lead Ministry in the water sector with the appropriate authorities to ensure that Somaliland's freshwater resources are developed and managed according to this Policy and subsequent legislation and regulation to be developed.
- To promote the appropriate involvement of the private sector in the production distribution and delivery of water services.
- Policy and Standards are constantly evolving and shaping one another. Policy points to overall goals, but focuses on realistically achievable first steps in responses to the tensions that have arisen from previous and on-going intervention in the water sector.
- Environmentally sustainable development is a necessity and requires a movement towards greater social and gender equity.

### **2.3.3.2 The Hargeisa Water Supply Improvement Investment Project.**

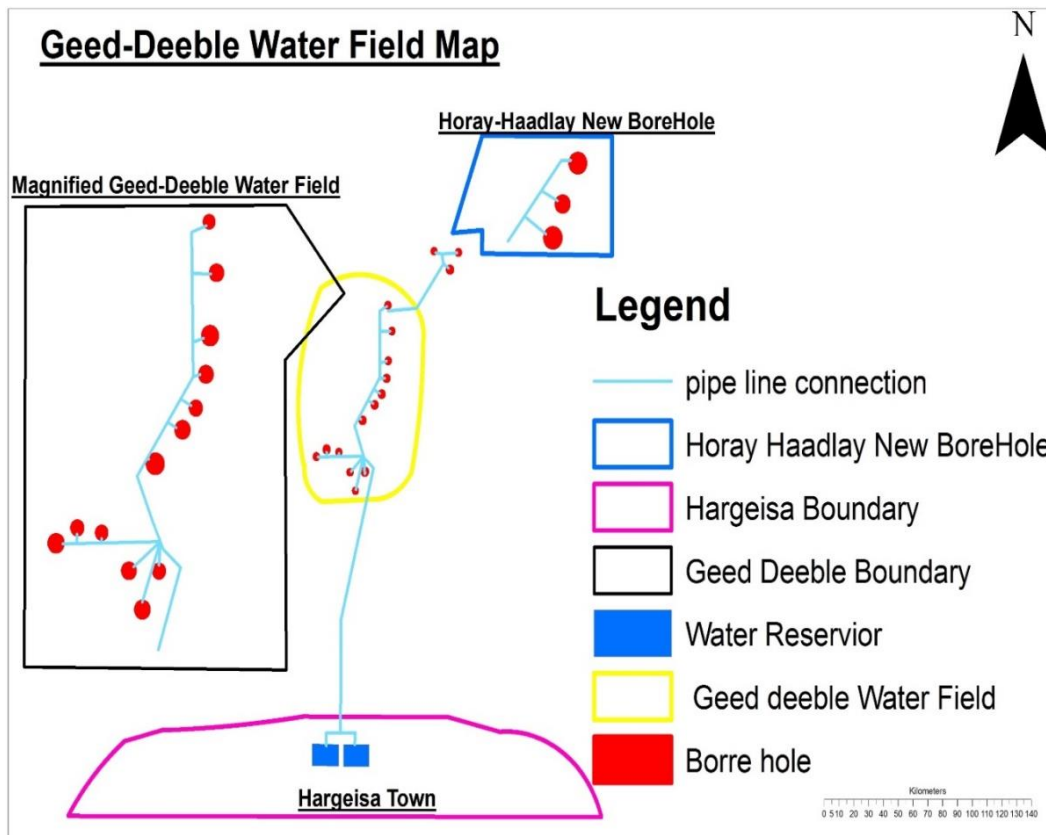
#### **2.3.3.2.1 Role of Stakeholder Participation:**

The Somaliland National Development Plan pillar on Infrastructure prioritizes support to the Hargeisa water Agency (HWA) to increase water production, pumping and transmission lines, and for the expansion of the distribution network, the plan was presented to International Organizations for funding International aid and investment involved in the Somaliland WASH sector has been primarily a humanitarian operation, however increasingly over the last 8 years focus has shifted towards long-term development projects. The current financial investment for improving Hargeisa water supply is about 53.2 million Euros, committed funds are from the European Union (16.5 million Euro) for the upgrading of water supply infrastructure, from the SDF 1,76 million dollars for the drilling of three new boreholes in and the expansion of the water supply work from Haraf to Ayah settlement, the Water Supply Plan (WSP) half a million dollars capacity building support to HWA and the World Banks urban development project for improving Hargeisa urban infrastructure including upgrading drainage and solid waste management facilities SDF, HWA, & HUWSUP,(2014).The German government-owned development bank (KfW/GIZ) recently announced 15 million Euros of funding for the urban water supply distribution networking of Hargeisa city. The (KfW/GIZ) and World Bank funds will support follow on phases of the Hargeisa Urban Water Supply Upgrading Project implemented by UN-Habitat, in partnership with the HWA the Somaliland Ministry of Water Resources. The project, which was launched January 2014, aimed to:

- Replace the pipeline system from the Geed-Deeble well fields to Hargeisa with a new high-capacity single transmission main, thus bringing more water into the municipal system,
- Construction of new and fuel efficient pumping station at Geed-Deeble to improve the regularity of pumped water to the city reservoirs in the north of Hargeisa.
- Replace old and damaged/ deteriorated boreholes and drill new ones to enhance water production from the Geed-Deeble well fields UN-Habitat & HUWSUP, (2014).

## 2.4 Source of Hargeisa water supply

Figure 2.8: Geed-Deeble Water Field Gis Digitizing Map



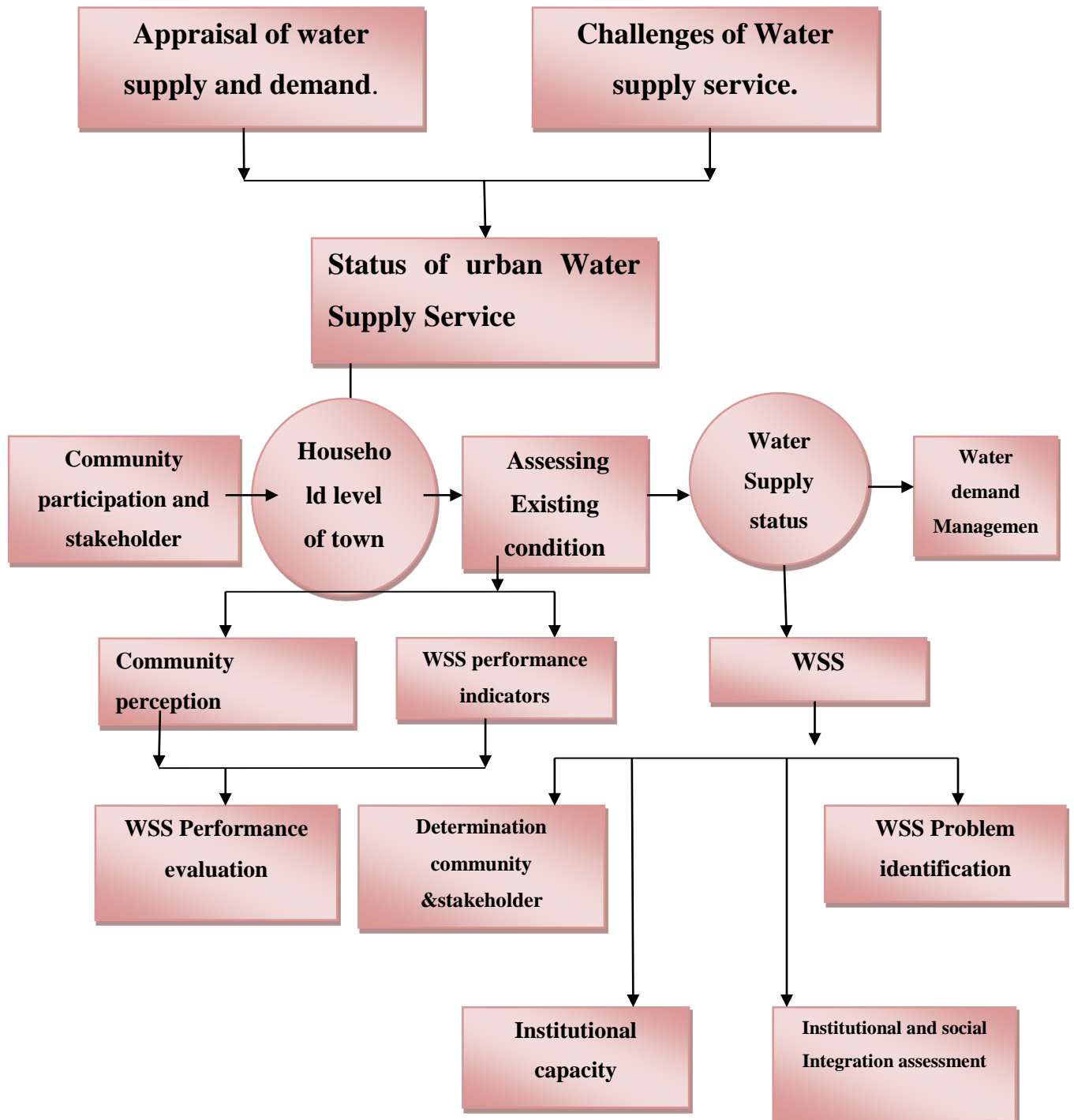
Researcher Developed (2019)

## 2.5 Research Gap

Even though some researchers have been conducted on different topic related with my research topic, their study didn't address the Appraisal of urban water supply in Hargeisa especially in scope of study in koodbuur district but they are mentioning other villages, but they are discover about the water status of the city and they reflect the most of the town is water stressed and they did not get enough water to use those needs in the daily live for both domestic and commercial water supply and also they agreed about the other alternatives of hargeisa water supply system and recommended the government to promoted the runoff water of the town and make a water harvesting dam of the near town to use agricultural purpose , for this study is filled the gap of infrastructure and community participation sector because of other study did not mention about the status of infrastructure and community role, and further information the study through both qualitative and quantitative means. But this research directly addressed the problem and picked out the challenges of water supply in Hargeisa. So the researcher took these problem and make research on it to give recommendation for the concerned body.

## 2.6 Conceptual Framework

**Figure 2.9:** Conceptual Model on Assessment and Interdependency of WSS As evident



## CHAPTER THREE: RESEARCH METHODOLOGY

### 3.1 Introduction.

The study methodology section deals with methods which are practically used in this study. Mixed methods of study in which quantitative and qualitative approaches were used.

### 3.2 Operational framework.

**Table 3.1 Operational framework:**

Research Objective	Variables	Method of Data Collection	Methods of Data Analysis
To assess the current status of water supply service	<ul style="list-style-type: none"> <li>✓ Primary source of drinking water</li> <li>✓ Water supply availability</li> </ul>	Questionnaire Interviews and field observation	Descriptive and inferential statistics
To analyze the demand and supply water service	<ul style="list-style-type: none"> <li>✓ Households daily water use &amp; demand</li> <li>✓ Water pipeline connected</li> <li>✓ Frequency of water supply from network</li> <li>✓</li> </ul>	Questionnaire Interviews and field observation	
To find out the major Challenges of water supply service	<ul style="list-style-type: none"> <li>✓ Water supply problems often exhibited</li> <li>✓ Identifying &amp; ranking major challenges</li> </ul>	Questionnaire Interviews and field observation	
roles of stakeholders and community participation	<ul style="list-style-type: none"> <li>✓ Role of water extension project of Hargeisa City</li> </ul>	Questionnaire Interviews and field observation	

**Developed by Researcher, 2019**

### 3.3. Research Design.

The study utilized the descriptive Research design, because the nature of problem in this study the researcher define the status of urban water supply, major challenges, and water supply and demand of Hargeisa Water supply service, seeking to appraise the urban water supply service. Time dimension Cross-sectional survey was carried out to collect the primary and secondary data due to time consideration in a simpler manner and as per the activity schedule set in the research.



### **3.4. Research Approach.**

The research adopted a mixed approach comparing of quantitative and, the qualitative approach was used to conduct narrative description of open questions as interview. The main reason conduct quantitative approach is use to open-ended questions which is known as questionnaire and this study the researcher used for both and mixed approach system.

### **3.5 Date Type and Source.**

Two types of data sources: were used primary and secondary data sources. Moreover, both qualitative and quantitative data type were used.

#### **3.5.1 Primary Data Sources:**

In basically, primary data sources were used for firsthand information to achieve the objective of the research. The primary data sources obtained through distributing of questionnaires for respondents in household, also visual observation and structured interview for responsible authorities and sample was conducting.

#### **3.5.2 Secondary Data Sources:**

The secondary data sources of this study were gathered from different documents mainly on water supply and demand, annual reports, assessments and manuals of the Agency.

### **3.6. Method of Data Collection**

#### **3.6.1 Questionnaire.**

Questionnaires is one of data collection instrument are preferred to get large amount of information from large number of people in a short period of time. The respondents of questionnaire had given sufficient time to give responses carefully to promote their freedom in giving response. A regular follow up of the questionnaires was maintaining to enhance the response rate and researcher used a questionnaire to collect information required for household sample as sample procedure of systematic random sampling and also questionnaire is more flexible due to collection of huge data in short time of period.

#### **3.6.2 Structured Interviews.**

Interview is a type data collection tool which is used to collect data about the high officials and managers and was conducted with the Municipality, Ministry of Water Resource Development and Hargeisa Water Supply Agency. The aim of the structured

interviews is to obtain in-depth information and limit the interviewees within the scope of the research.

### **3.6.3 Field Observation**

This method was type of data collection tools which is used the researcher to get data that cannot be addressed through the interview and questionnaire the. The researcher observed the existing water supply condition as well as reservoir, construction sites for Hargeisa urban water supply upgrading program.

### **3.7. Sample Design.**

The two main approaches in sample design are probability sampling and non-probability sampling approaches. In case of this study, the researcher used both probability and non-probability sampling due to nature of research and data collection tools. Particularly purposive sampling and simple random sampling were operative in the study to select key informant, compromising various households and Organizations those involve the urban water supply service. The reason for purposive and simple random is techniques was the judgment of the researcher based on who can provide the relevant data for the study specially the officials and household study.

#### **3.7.1. Population.**

The study delimited on one main sub city of Hargeisa, due to large and high population of city and also time and cost restrictions , the researcher decided to select one sub city or district in Hargeisa city, The Hargeisa city contains seven sub city and research focused on one main sub city and selected Koodbuur district , according to (Ministry, 2013) the selected target household of Koodbur district was 20,294 households and the district is clustered for four village **Guul Alle, Haji Farah, Lixle and Xero Awr** and this study is based on Two Village Of Koodbuur **Lixle and Xero Awr** Villages . These areas have more significant researcher to identify the main factors behind the shortage of water in the city and to observe the challenges of urban water supply in Hargeisa City.

**Table 3.2: Koodbuur district household estimate**

<b>Village Cluster</b>	<b>Households Estimate</b>
Guul Alle	<b>8602</b>
Xero-Awr	<b>4,081</b>
Lixle	<b>3,207</b>
Haji Farah	<b>4404</b>
Total	<b>20,294</b>

**Source: (Ministry, 2013)**

### **3.7.2. Sampling Procedure.**

The sampling procedure that the researcher selected and apply in different respondents from which a sample is drawn, particularly target areas where the researcher conducted the study to ensure the reliability of the study. Household's water supply is first one and second government officials which might have some data available.

**Table 3.3 sampling Procedure:**

<b>S/N</b>	<b>Respondents</b>	<b>Sampling</b>	<b>Method of selection</b>	<b>Data collection Method</b>
1	Governmental officials	Non-probability sampling	Purposive sampling	Structural Interview
2	From Households Respondent	Probability sampling	Simple/ Systematic Random sampling	Questionnaire

**Source: field survey (2019)**

### **3.7.3. Sample Unit.**

The sample units of this study the researcher selected respondents from the household and Government officials; such as of Local Governments, Ministry of Water Resource Development and Hargeisa Water Supply agency in order to find reliable data. The target population of the household is 20,294 in koodbuur district and some of governmental officials to appraise of urban water supply service in Hargeisa city.

**Table 3.4 Sampling frame:**

S/N	Respondents	Target population	Selected sample size	Required sample size	Data collection Method
1	Governmental officials	15	10	10	Structural Interview
2	From Households respondent	20,294	7288	196	Questionnaire

**Source: field survey (2019)**

### **3.7.4. Sampling Techniques.**

The researcher used both probability and non-probability sampling techniques in this study to select the respondents. The sampling techniques describe the population of interest, the sampling frame, methods of selecting the sample, and the sample itself. To obtain a representative sample of respondents in Hargeisa town, the researcher selected simple random sampling as well as the systematic random sampling.

- A. Identifying the Sample Frame: the list of households obtained from the koodbuur sub-city.
- B. Deciding the sample size: 196 ( by using sample size determined formula)
- C. Calculate the skip interval (k)=  $\frac{N}{n}$  in household lists. Therefore,  $k = \frac{7288}{196} = 37.1 \cong 37$
- D. Pulling the lists for the sample: starting the list by 39<sup>th</sup> list and continuing by selecting lists number 37, 74, ,111,148,185,222 and so on through the entire set of lists.
- E. The 196 lists are going to be selected to constitute the sample of the study.

In relation to non-probability sampling using purposive sampling method, the study respondents who were concerned individuals and water staff officers were selected.

### **3.7.5. Sample Size.**

The sample was determined through the following techniques, in order to calculate the sample size. Since the target population of koodbur district Hargeisa was 20,294 households according to (Ministry, 2013) and the researcher select 7288 household of Koodbuur Villages, according to Yamane formula if the target population is less than

10,000, the following formula is used in order to draw the required sample size from the target population:

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

Where

n= required sample size,

N=total number of households in koodbuur Villages

e=precision degree/ error (7%=0.07)

Hence, the researcher use 93% level of confidence where by

e= 7% (0.07)

N= 7288

$$n = \frac{7288}{1 + 7288(0.07)^2} =$$

$$n = \frac{7288}{1 + 36} = 196$$

n=196 household respondent

**Table 3.5 Sample size of Household's distribution of each village of koodbur district and the Governmental institutions**

S/N:	koodbuur district village	No; of Hhs	No;of sample HHs $Nk = (xk/N) n$	Interview	Total Sample
1	Lixle	3207	$(3207/7288)*196=86$		86
2	Xero Awr	4081	$(4081/7288)*196=110$		110
	<b>total</b>	<b>7288</b>			<b>196</b>
3	Water supply agency	7	$(7/15)*10$	5	
4	Ministry of water Resources	5	$(5/15)*10$	3	
5	Municipality	3	$(3/15)*10$	2	
	total			<b>10</b>	10
	<b>TOTAL</b>				<b>206</b>

**Source: field survey (2019)**

### **3.8. Data Analysis**

In analyzing the data, both qualitative and quantitative data analyses were employed depending on the nature of the research. The quantitative data was analyzed the descriptive statistics such as frequency and percentage. Whereas qualitative data was interpreted information obtain from interviews. After checking that data collected from the sampling households, governmental offices than were analyzed and prepared, coded and filled in to software of statistical package for social science (SPSS) Version 20 and analyzed using statistical measures such as percentages, mean, independent sample t-test, one way Anova, cross tabulation, and chi square test is used in our second objective of water supply and demand to examine whether there significant difference in mean amount of water consumption exhibited as a result of family size, this test was used to evaluate which groups of family size consume more water.

### **3.9 Data Presentation.**

The analyzed data was presented in the form of tables, pie charts, and bar graphs, maps and texts. The data used in qualitative approach was presented by using statement and discussion to elaborate the real condition for the existing households.

### **3.10 Limitation**

Financial and time constraints were the main challenges in the data collection time which can affect efficiency in this study. Next, during the time of data collection, the study faced challenge of getting interviewees and the some questionnaires because most of the time government officials were often busy on frequent meetings. The other limitation in this study was some respondents delayed to respond the questionnaire and to return back timely. There for, due efforts have been paid to finish the study properly but some of questionnaire does not return back to the researcher and also timely delay and is difficult to wait until the back and most of time researcher busy to collect the data as well and some of questionnaire poorly filled and some other not return back and researcher take as missing and losing data, also the other limitations There were limited studies on water supply for Hargeisa city and accessing relevant assessment works about challenges and perception of dwellers towards the current water supply and other reports; was difficult by the fact that the Hargeisa water agency does not have an effective mechanism of documenting past works except household connections, bill collection and rehabilitation works.

### **3.11 Ethical Consideration of Study.**

An ethical consideration refers to the ethical principles that are used when tackling a particular issue. The most common way of defining "ethics": norms for conduct that distinguish between acceptable and unacceptable behavior. Ethics are codes or rules which govern those practices of a profession. It dictates how information and client's relationships should be managed Ethical considerations occur when you are required to use these rules to better serve the clients. There are several reasons why it is important to adhere to ethical norms in research. First, norms promote the aims of research, such as knowledge, truth, and avoidance of error. For example, prohibitions against fabricating, falsifying, or misrepresenting research data promote the truth and avoid error. Second, researcher often involves a great deal of co-operation and co-ordination among many different people in different disciplines and institutions, ethical standards promote the values that are essential to collaborative work. Third, many of the ethical norms help to ensure that researchers can be held accountable to the public. Finally, many of the norms of research promote a variety of other important moral and social values.

So, ethical issues are an integral part of social research process. Indeed, a number of ethical considerations were taken into account throughout this study. All ethical issues are tried to follow in this social research. Respondents they have a right to privacy. It is up to them to decide when and to whom to disclose their personal information. A social researcher must uphold and defend this right. While collecting information, the respondents of this study shall inform clearly that the information they are providing during the survey would be kept in strict confidence. Only the researcher would have access to the questionnaires. Besides, participation of the respondents was voluntary. Respondents could agree to answer questions or refuse to participate any time. And to conduct this study all ethical issues like honesty, carefulness, respect for intellectual property, confidentiality, integrity, non-discrimination and the research was been strictly maintained to prevent any bias and unethical consideration.



## CHAPTER FOUR: RESULTS AND DISCUSSIONS

### 4.1 Socio-economic description and response rate of respondent

This chapter presents the results generated from the survey data result, based on the objectives of the study, the focus of the study is to assess the contemporary status of water supply in the study area as well as the gap between the supply and demand of water supply in the city, Furthermore, the challenges facing in the water supply and their root causes and also community and stakeholders discussed.

In this chapter organization, respondents' demographics are presented first, followed by a combined presentation and their interpretations of survey results for respondents' views about contemporary water supply and near future expectations.

Finally, the explored challenges, causes and supply and demand of the town for sustainable water supply for the study area all discussed.

#### 4.1.1 Socio-economic description & response rate of Respondent

**Table 4.1 response rate.**

No of Questionnaire distributed	Number of returned	Number of discarded	Number of not returned	Response Rate %
196	183	5	8	$183/196*100=93.4$

**Source: field survey (2019)**

During the survey data collection, all the planned instruments were carried out, a total of 196 questionnaires were distributed through proportional allocation survey method among the two selected villages. In short, of the total distributed questionnaire were not returned back to the researcher and other five (5) were (discarded).poorly fulfill. The above information of 196 as well as the not return back of 8 questionnaire is not much effect the data accuracy in this study is 93.4%, previously the level of confidence is 93% and now near the computation is above the confidence level. In the interviews, Executive Director at Hargeisa Water Agency was not interviewed; in substitution, his Deputy Executive was interviewed. Within this context, the other interviews were successfully conducted as planned. Since the data was collected from the households where there is no guarantee that every respondent has the ability to fluently understand the English language, some questionnaires have been translated to local language (Somali).

#### 4.1.2 Socio-economic and demographic Characteristics

The following Table 4.2 provides the demographic information of the respondents.

**Table 4.2: Demographic Information**

No	Description	Category	Frequency	Percent %
1	<b>Gender</b>	Male	114	62.3
		Female	69	37.7
		<b>Total</b>	<b>183</b>	<b>100%</b>
2	<b>Age</b>	18-25	65	35.5
		26-32	73	39.9
		33-40	35	19.1
		41+	10	5.5
		<b>Total</b>	<b>183</b>	<b>100%</b>
3	<b>Marital status</b>	Single	93	50.8
		Married	80	43.7
		Widow	10	5.5
		<b>Total</b>	<b>183</b>	<b>100%</b>
4	<b>Level of Education</b>	Primary/Secondary	34	18.6
		University degree	118	64.5
		Master's degree	31	16.9
		PhD	0	0
		<b>Total</b>	<b>183</b>	<b>100%</b>
5	<b>Family size</b>	2-4	18	9.8
		5-8	65	35.5
		9-12	60	32.8
		13+	40	21.9
		<b>Total</b>	<b>183</b>	<b>100%</b>
6	<b>Occupation</b>	Jobless	74	40.4
		Daily labor	109	59.6
		<b>Total</b>	<b>183</b>	<b>100%</b>
7	<b>Financial condition</b>	Higher class	27	14.8
		Middle class	121	66.1
		Low class	35	19.1
		<b>Total</b>	<b>183</b>	<b>100%</b>

*(Source: Field Survey, 2019)*

Although, females carry disproportionate burden of water activities at family level comparing their male counterparts, which made them knowledgeable about the water appraising as presented later sections of this chapter. However, both were contributed similarly in the survey with 62.3% and 37.7% for males and females respectively. Furthermore, the closer proportionality of both categories of gender was participated in

the survey shows that there is no bias in the survey instrument in relation to the gender of the respondents.

Similarly, age distribution of the survey respondents is more normal, where a large majority of respondent is about 39.9% were the ages between 26 and 32 years. In other words, 35.5% of the respondents were between the age group 18 – 25 years, where 19.1% were between 33 – 40 years, 5.5% of the respondents were 41 years old and above, It can therefore be concluded that the majority of the respondents are in the most productive age brackets of their life, the first quartile of 25 years of age showed that only 35.5% of the respondents were 25 years and below. Were the absolute majority of about 64.5% of them were above 25 years old and only 10 respondents were greater than 41 years old. All these descriptive statistical numbers are good indicators of that the majority of the respondents are mature enough to participate in the study.

In the marital status the large majority of about 50.8% of the respondent they are single (never got married) were the 43.7% of the respondent they are a married, were only 5.5% of the respondent is widow (earlier wedding).

The survey benefited a chance of selected households where at least one of its members completed the primary education. Details from the survey with regard to the level of education were; 18.6% only completed primary/Secondary education, where 64.5% of the respondents also completed the university degree level. Furthermore, 16.9% completed Master's degree education and no one got PhD and above education This means that the respondents are adequately qualified persons academically, which in turn can serve as value add to the data collection instruments for acquired reliable data elements, that give statistical power to any decision made by the study.

In the family size, the large majority of about 35.5% were between 5-8 household members, where households of 9 – 12 and 13 and above members were approximately equal with 32.8% and 21.9% respectively, while there was only household of 2-4 members which counts 9.8% of the households. Therefore, it is obvious that the majority of the households are large in family size, which in turn indicates how they are more vulnerable to water related problems. Moreover, the valid percentage of family size of selected households which is greater than the normal and national standard, the out of total of the respondent is 54.7% which are more than the national average household size of 7 members. The lower quartile was 7 which match the

national average family size. In other words, 100 of the households were families having more than 8 persons per household.

Regarding the source of income, almost about 59.6% of the respondents comprising 40.4% they are daily labor and jobless and the all families they are depend on the income of daily labor to cover their needs such as water the main source of revenue at national level is livestock and agricultural production of the country and last ten years the climate change has effect the production of agricultural farming and the level of jobless is increasing day to day this showed the respondents were representing different communities and neighborhoods and there is no strategic plan about the creativity of the jobs.

Using income classification as higher level, Lower level and Middle level, better off and Rich adopted by the Somaliland Food Security Assessment Unit (FSAU) in Hargeisa Urban Household Economy Assessment in 2003. Details from the survey with regard to the monthly income were; 19.1% both equally in the lower level or Poor households. Furthermore, 66.1% and 14.8% were Middle level and higher-income categories respectively. Therefore, the large majority of the households were from the middle class of either lower middle or upper middle, which in turn impacts both level of water consumption, affordability and their perceptions towards water service.

## **Results and Findings**

### **4.2: Status of Water Supply service in Hargeisa**

Since HWA was established in 1972, it has grown tremendously servicing the city. The Chinese built old water supply system (phase one in 1972— 74 ) Eight wells plus one transmission pipe line of 12” diameter was established and phase two in 1982 eight more wells & another transmission pipe line were extended the population was 350,000 maximum at that time that was destroyed by the civil war in 1988 has been rehabilitated. Out of the 16 original boreholes, thirteen are currently operational. The water production and boosting equipment were installed. A new water distribution network have been installed and extended to new settlements. At present, HWA serves over 1,500,000 persons living in and around Hargeisa (HWA, 2019).

12”-pipes take water from Geed-deeble to Biyo-shiinaha reservoir (the main water storage of Geed deeble). The water is then transferred to the next reservoirs in the Sheedaha area (a neighborhood in the North of Hargeisa), which in turn transmits water through small pipes to provide drinking water to the city, However, water distribution does not reach many parts of Hargeisa. Initially, when the water storage was built they were planned to provide water for approximately 350,000 persons, which at the time was equivalent to the number of people living in the city. Now the number of people exceeds more than 3 three times the intended. The demand for water is increasing as is the demand for land. People compete for houses that are closer to the areas reached by water resulting in very high land prices (Abdiladif, 2016).Humba-wayne is a first rain water harvesting dam in the study area of its size, funded by United Arab Emirates and implemented by Khalif Foundation. The dam was constructed at intersection point of four main streams in north-east of the city. The dam is to keep the running water from hills which used to go directly into the sea without the benefit of residents nearby. Now once the dam reserves the water then the farmers will benefit for irrigation and for other utilities (Biixi, 2017). Sadly, there was no water infrastructure yet built to connect the water in this dam to the city, and there is no even available fund to build, and motor tankers will probably fetch water and supply to the dwellers which in turn will increase water service coverage of motor tankers in the study area.



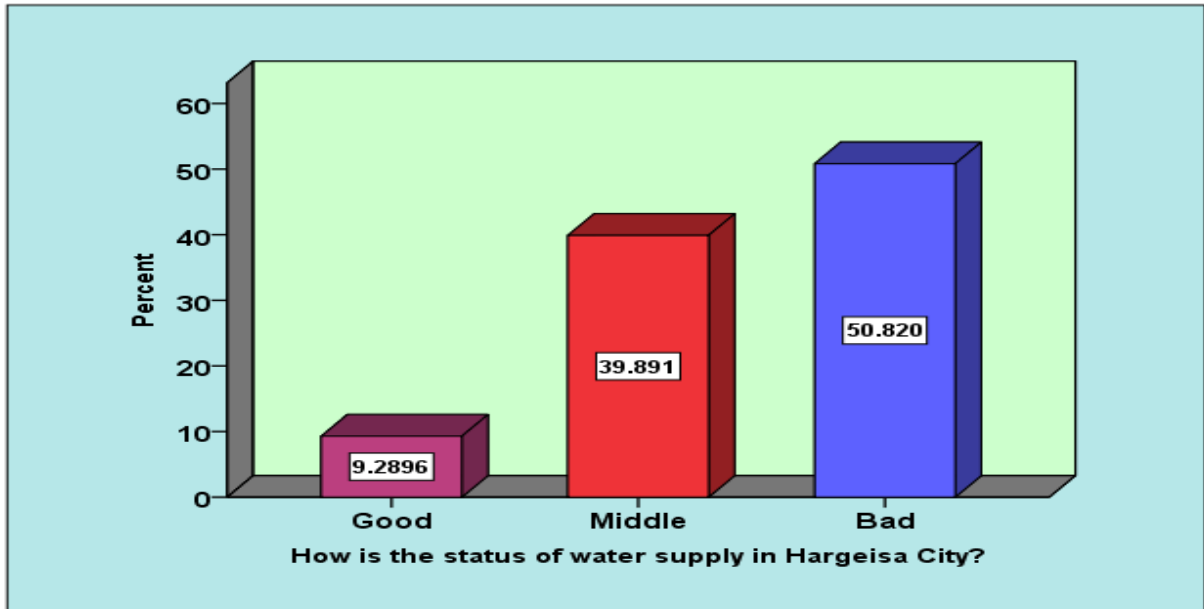
**Figure 4.1 Humba-Wayne Rain Water Irrigation Dam**  
(Source: Field Survey 2019)



**Figure 4.2 Water Supply Extension & Upgrading Project**  
(Source: Field Survey 2019)

#### 4.2.1 Status of water supply in Hargeisa City.

Figure 4.3: status of urban water supply



*Source: field survey, (2019)*

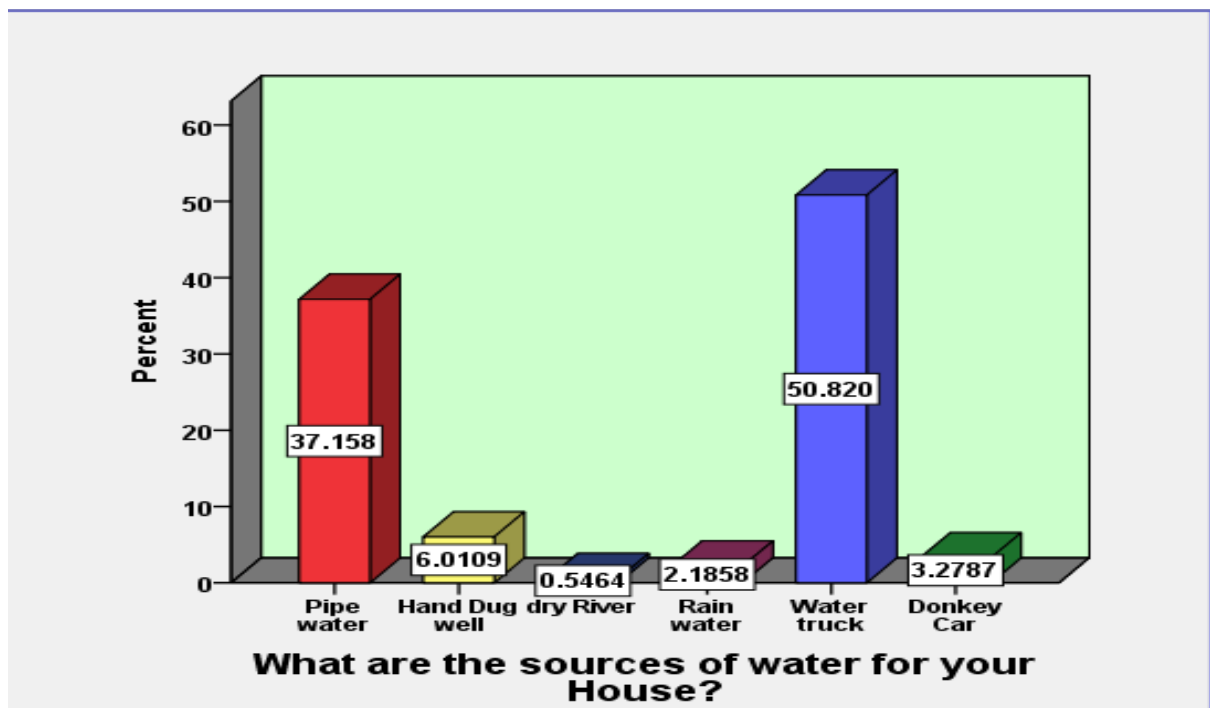
From figure 4.3 shows that, 9.2896% of the respondents said that, the status of Hargeisa water supply service is good while the 39.891% of the respondents told that the water situation of the city is middle. For Further information the majority of the respondents agreed the status of the city is bad situation as percentage of 50.820% of the respondent and for this situation the city status is below and national standard because the above data shows the decision and the real level of the city, while the majority of respondent they indicate the status of city is bad.

In the other hand the interviewees indicated that the system is very old and earlier constructed with chines government and previously is design 350,000 population before one decade and now the system does not except the amount of population living in the city, because of the amount of water supplies in the city is covered only the previous design and now the population of city increase as double and the city expanded large area and many immigrants is coming day to day and when we compare to the national standard for the above data shows the city is really water stressed and most of population is inadequate of water supply in the town.

#### 4.2.2 The Sources of water for the Households.

The source of water supply is very important for water appraisal and the evaluation of the city. The level of source is a part of production and development of water, the below data shows different sources of water in household level in the city, where the majority of the houses get their water services. Really the water of city is coming through piped water connection of geed-deeble water field to city reservoir after that the agency make distribution of water with different village, and others who are lack of piped they got water for car vendor and water tankers.

**Figure 4.4: source of water supply for your house**



*Source: Field Survey, (2019)*

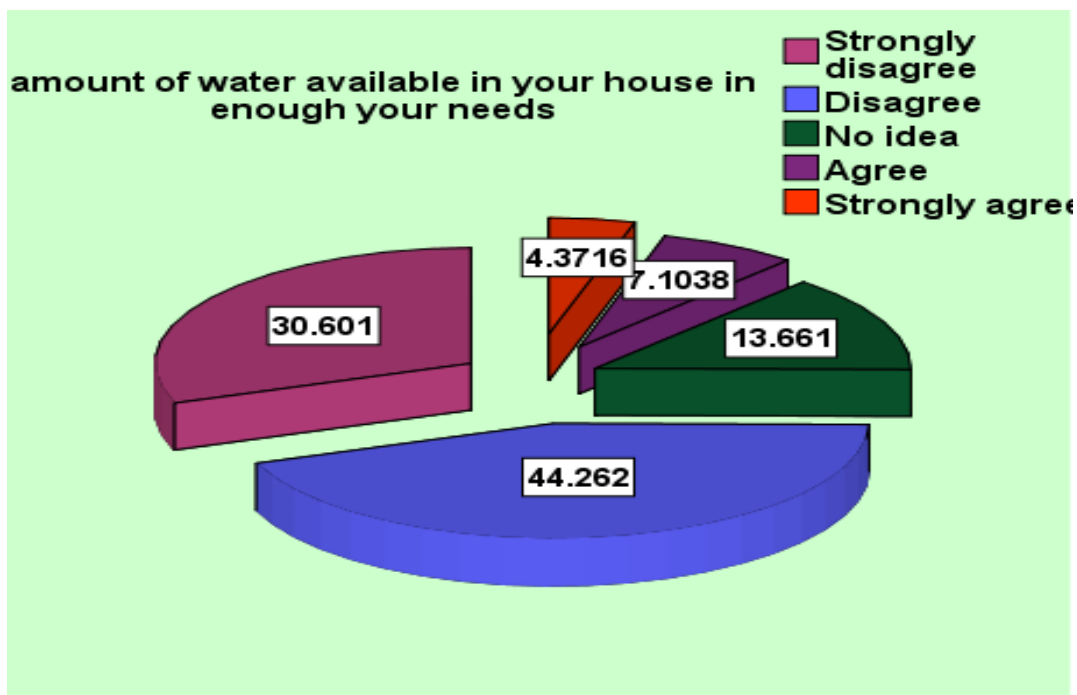
From figure 4.4 result of household in water supply is shows, 37.158% of the respondents primarily have a piped water source which directly connected to their houses from the main water system managed by public agency (Hargeisa Water Agency), while a total of 62.842% of them responded being obtained water from other water sources, 6.0109% from hand dug well, 0.546% from dry river, 2.1858% from rain water, 50.820% from water trucked, while 3.2787% from donkey car. Therefore, Piped water service coverage in the study area were lower than the city-wide service coverage of 62% of the respondent they got their water for different source of water specially water trucked system and pipe line is less ratio of the reflection of respondent in the study area.

On the other hand, Private vendors (Motor Tankers) are increasingly becoming primary water sources for many households, especially those in the new settlements in the city periphery as outlined in the figure 4.4 when we compare to the other sources of water.

The interviewees mentioned that the city have two main source of water supply of Geed-deeble water field and one is Humba-wayne Dam which is far away the city around 50km of north east of the city and no infrastructure connected dam to provide the water to the city and mostly the farmers benefit for irrigation purpose of the farming system and some of water trucked system they use to fetch a water for raining season to careful for water flooded and other hand the geed-deeble water field is primary source of the city and piped connection is transferred the water from geed-deeble to sheedaha near the edge of the town where the city reservoirs is settled and after the distribution network is done through the water supply agency.

#### 4.2.3 Water availability.

**Figure 4.5: amount of water available in your house is enough your needs?**



*Source: Field Survey, (2019)*

From figure 4.5 amount of water available in households show that 44.262% of the respondents disagreed whether the available water is enough to satisfy or not and 30.61% of the respondents strongly disagreed about that problem of water availability is enough to satisfy while, 13.66% of respondents told they did not have any idea about



the problem of water availability, for further information 7.10% and 4.37% of respondents agreed and strongly agreed about the water available is enough to satisfy their needs. And the majority of respondents disagreed about the water available for their houses is not fulfill the water needs of the population. And this evidence and imitation of the urban water supply status of the Hargeisa town is poor and below the standard majority of the people did not get their enough water to cover their needs of water and daily use of water consumption and the most households piped and others did not get enough water and the government and the water agency to see their situation of inadequacy of water supply system of the town and make strategic plan of water development and change of situation in the town.

Conversely, the interviews mentioned the water extension and upgrading project of water supply in Hargeisa is still function less and no productive the aim of this project is to upgrade and extend the amount of water supply system in the town and to add double a million liters of water in a daily water consumption where the previous is 9 million liters of water and extend up to 20 million a day and the respondent they finalize the project is not done as its and the last result of project was coming in few coming years.

#### **4.2.4 Information about the water supply Service of the town.**

**Table 4.3: information about water supply Service**

<b>You have any information about the water supply system of the town</b>			
	<b>Yes</b>	<b>No</b>	<b>Total</b>
<b>Frequency</b>	59	123	183
<b>Percentage</b>	32.2	67.2	100

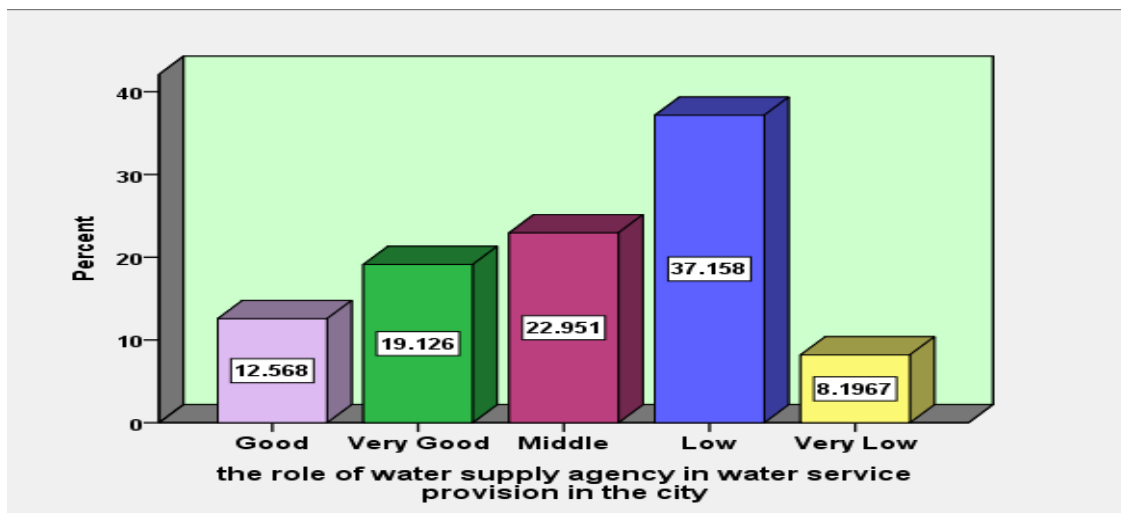
*Source: Field Survey, (2019)*

From table 4.3 information about the water supply service shows that, 67.2% of the respondents told that did not have any information or idea about water supply service of the town while the 32.2% they told that they have information about water supply service of the town and the majority of people did not understand the way of working the water agency of the town and their social responsibility of the water system and Further information the community participation is very good development about the water problem issue and this condition no role about the community and civil society , in this study population the most of respondent they are not illiteracy but they are not understand the water system of the town and also some of people they don't know

where the water is come from the first and some little of people they know the source of water and their system of work. In other hand those have information of water supply they indicate the researcher the system of water supply is poor and inadequate of the town and they mentioned the water agency is lack of water reservoir, technical expert, unfair distribution and expansion of water supply in the town and also management problem exist in the water supply service in the town. As the interviewees indicated the information and concept of water supply agency in the town is poor and lack of management system and they described this situation is not good about the water supply and system is very old and aged and it's not get the constant operation and maintenance of the agency. Finally the water supply agency interviewees mentioned no further information and base line data about the water system of the town and no further research related about what is the causes of this water service inadequacy of the city and no feasibility study done before the water extension project and previous study they lose during the civil war and the system of the water in the newly update and make a new route of water supply and distribution line, while the oldest in changed.

#### 4.2.5 The role of water supply agency.

**Figure 4.6: the role of water supply agency in water service provision in the city**



*Source: Field Survey, (2019)*

From figure 4.6 shows that the role of water supply agency in the city, 12.568% of the respondents said the role of Hargeisa water supply service is good while the 19.126% of the respondents told that the role of water supply situation of the city is very good. For Further information 22.951% of respondents reflected that the role of urban water

supply service is medium, while 37.158% of respondents said that the role of urban water supply is low and finally 8.1967% respondents repeated the water supply agency role is very low and the majority of the respondents agreed the role of urban water supply is low and very low status of the city as percentage of 45.3547% and the above data the majority of respondents mentioned the role of the agency in water supply in the city is not fine while less of respondent said good, middle and very good status of role of water supply agency.

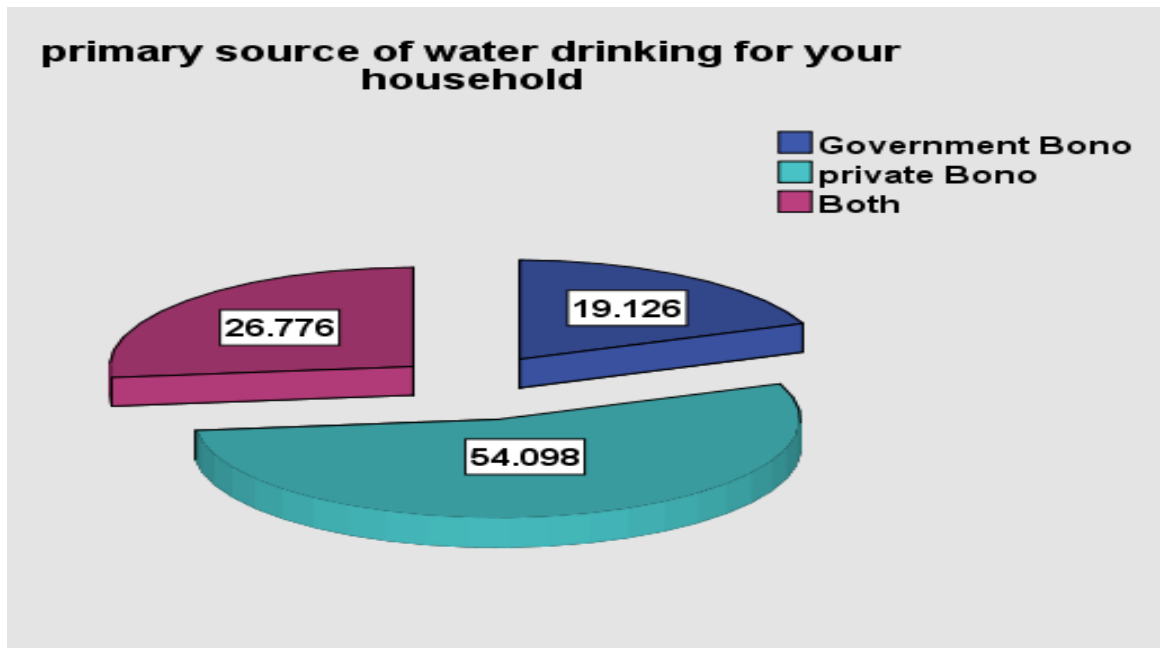
The role of community does not work probably and the agency does not make more struggle about the water development of the city and some they are underline no such more funding to upgrade the water project of the city and know the upgrading project is funding about the Somaliland Development Fund, European Union, Un habitat and Germany Government Fund (KFW)

#### **4.3 Water Supply and Demand at Household level**

The water is extracted from a network of 13 boreholes at Geed-deeble water field and pumped through two twin underground 12”inch diameter pipelines over a 20Km distance and at a 260m elevation to in-ground storage tanks overlooking the city the water supply infrastructure was badly changed during the civil war in the late 1980’s, and has gone through several rehabilitation works over the years, and mostly the pipeline layout still working but not rarely maintenance of infrastructure of network for the distribution and pumping lines and know is underway the Hargeisa urban water supply and upgrading project start from the 2013 and still under process and the plan is to finish this year and he is final stage of the time of implementation also the network distribution of the town is being processed from haraf to ayah and other they began as soon (HWA, 2019)

### 4.3.1 Primary source of water supply in household level.

Figure 4.7: primary source of water drinking for your household



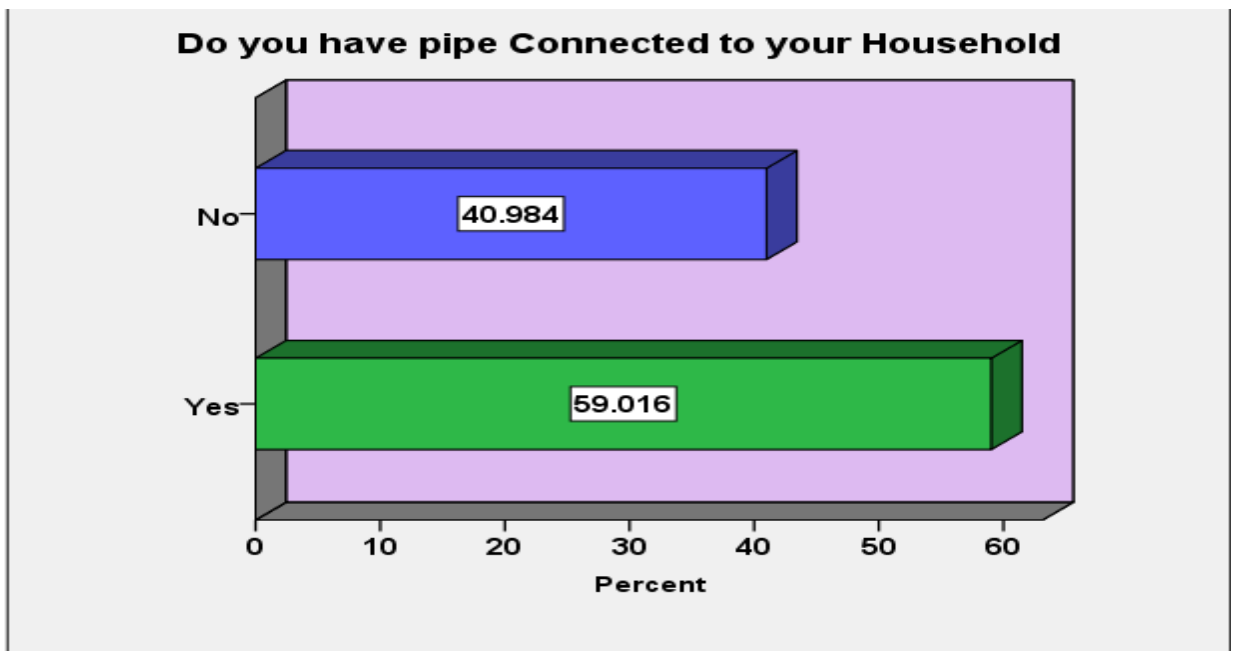
Source: Field Survey, (2019)

From figure 4.7 shows that the sources of drinking water supply in the town is not fulfill the requirement of the city, 54.098% of the respondents said that the primary water source of households is private bono or private service while the 19.126% of the respondents indicate the primary water source is governmental bono(water agency bono) or water agency piped water . For Further information 26.776% of respondents they reflect the source of water is both private and public service and we use for both piped and private owner.

And the above figure the majority of respondent said that unfortunately used our private water sector and the government water sector is not fulfill the needs of the society of the town and the study area.

### 4.3.2 Pipe connected in your home.

Figure 4.8: do you have a piped connected water in your house



Source: Field Survey, (2019)

From figure 4.8 shows that the pipeline connected in the households, 59.016% of the respondents said that we have a piped connected our houses while the 40.984% of the respondents indicated doesn't have a pipe connected in those houses and the more than half of the respondent of this study is not have a piped for their houses and this is another problem of the infrastructure and the most of pipe line is previous design and layout of the time of 1980 and the existing water pipeline is very old and does not get constant operation and maintenance of the infrastructure and no much such extension and upgrading of pipe line and the role of the water supply agency still undefined and their role is not fulfill the needs of society.

For the Figure 4.9 and Table 4.5 analysis below shows the days running of water in household for their water network piped is still bad and near 60% of the pipe line in the above 20% of it is no supply water system in the pipe means no really operation and maintenance of the infrastructure pipeline and this certification of the working less of the technical department of the water agency in the town.

The interviewees indicated that the role of water supply agency in operation and maintenance does not much clear and also the department head mentioned the water agency is responsible only the main water pipeline while the less diameter the village or society is responsible the operation and maintenance and this another factor of under

control of infrastructure and the agency does not consider the pipeline quality and also the water leakage which is effect the water supply and consumption of the town.

### 4.3.3 Water storage tank.

**Table 4.4: no of liters drinking of water storage tank in your house**

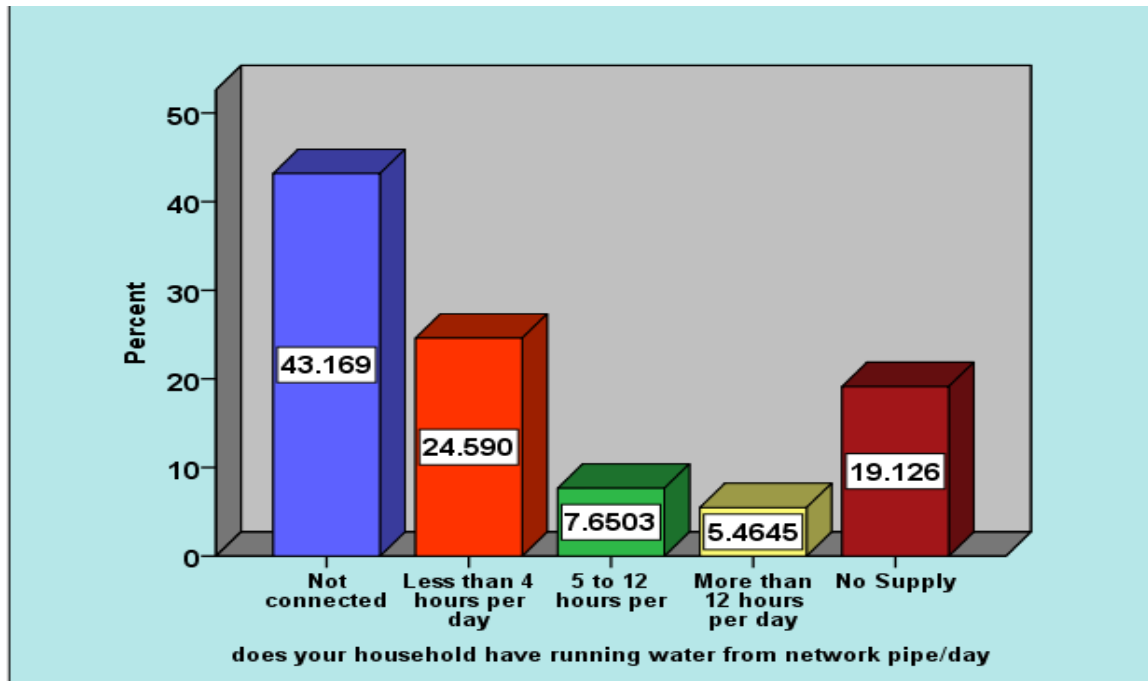
<b>How many liters of drink water storage tank do you have</b>						
<b>No in M<sup>3</sup></b>	5m <sup>3</sup>	10m <sup>3</sup>	20m <sup>3</sup>	25m <sup>3</sup>	above	Total
<b>Frequency</b>	42	60	47	22	12	183
<b>Percentage %</b>	23%	32.8%	25.7%	12%	6.5%	100%

*Source: Field Survey, (2019)*

From table 4.4 shows that the water storage tanks of households, 23% of the respondents have a water storage tank of 5m<sup>3</sup> of water storage and they are store their water to fill their need and the respondent they have piped and un piped water system ,while 25.7% of the respondent said that we have 20m<sup>3</sup> storage water tank ,for further information 12% of the respondent they have 25m<sup>3</sup> and also 6.5% of the respondent they have above 25m<sup>3</sup> of water storage tank finally the 32.8% of the respondent they have a 10m<sup>3</sup> water storage tank and they are 1/3 of our study population and this amount of water store verifies the level of water inadequacy of the village or the town and the 40% and above of the respondent have the higher level of water storage system. And the above data shows less responsibility of the water agency both piped and water trucked they have a high level of water storage system and they are very carefully about the water shortage system and the majority of the city respondent they are a inadequacy situation of water supply system.

#### 4.3.4 Household running water.

Figure 4.9 does your household have running water from network pipe/day



Source: Field Survey, (2019)

From figure 4.9 indicated that the running of water in households, 43.169% of the respondents said piped water is not connected to our household , while 24.59% of the respondent indicated as they received water less than four hour a day , and 7.65% of the respondent told that they receive water for 5-12 hour /day ,while 5.4645% of the respondent responded we receive the water more than 12 hour/day ,for further information the 19.126% of the respondent say we have a pipe network and the system is functionless that means no supply of water in our household and this above data shows about the 20% of the household connection does not work and no proper operation and maintenance of infrastructure and for figure 4.6 the 60% of the respondent said that we have pipe line network and now the 20% of that estimate is not work properly or no supply in yours and this analysis is real evident about the level of the operation and maintenance of the pipe line and the department of the technical issue is not good working system and remaining is near to 40% of the household have a piped water and 60% of the household still under private service and some of household they are not allow to pay or sell the water and most is a poor families and not allow to sell every day the water and water is back bound of human live.

#### 4.3.5 Household running water.

**Table 4.5: household have running water from network pipe/week**

	<b>Not connected</b>	<b>4-7 days per week</b>	<b>2-3 days per week</b>	<b>Once a week</b>	<b>Less than ones a week</b>	<b>No Supply</b>
<b>Frequency</b>	76	25	33	10	4	35
<b>Percent</b>	43.2%	13.1%	16.9%	5.5%	2.2%	19.1%

*Source: Field Survey, (2019)*

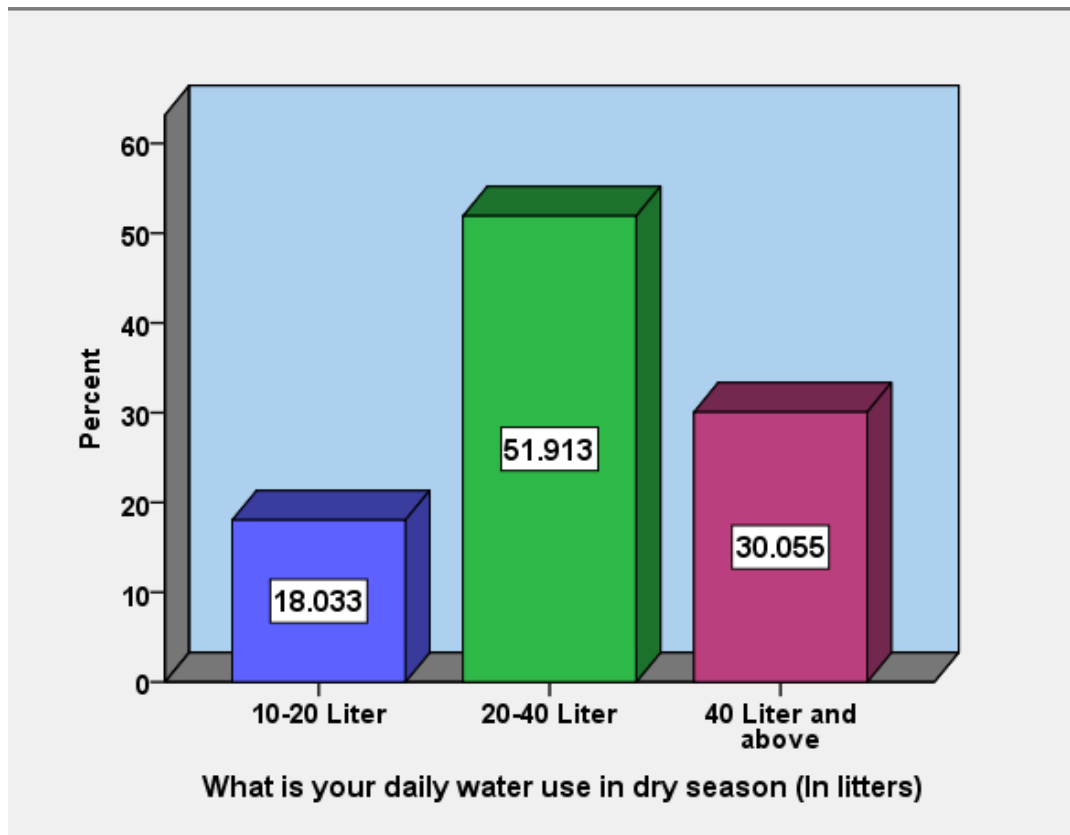
From table 4.5 indicated that the water running at households, 43.2% of the respondents said that the piped water is not connected our household , while 13.1% of the respondents replied received water 4-7days a week , and 16.9% of the respondent responded received water for 2-3 days a week ,while 5.5% of the respondents told that we receive the water at ones a week ,for further information the 2.2% of the respondents reacted we receive a water less than a ones a week, while 19.1% of the respondent returned we don't have a piped water that means no supply of our household as mentioned the above figure analyze is shown about the 20% of the household connection is not work and no proper operation and maintenance of infrastructure and for the above figure 4.8 the 60% of the respondent say we have pipe line network and now the 20% of that estimate is not work properly or no supply in their household and only 40% of the town have a system of water distribution and network layout who is working properly and next coming year may have not work all this infrastructure without replacement and constant maintenance.

The interviewees mentioned that the city have environmental challenges such as community awareness and some pipe does not developed with underground survey the department of the technical affairs does not work properly, when the pipeline is damaged and no operation and maintenance may such belligerent is coming between the agency and the society due to the lack of water available in such time the village they are lack of water long time due to lack of maintenance and this evident cause the conflict of the society and agency.



#### 4.3.6 Daily water use in dry season.

**Figure 4.10: daily water use in dry season in household**



*Source: Field Survey, (2019)*

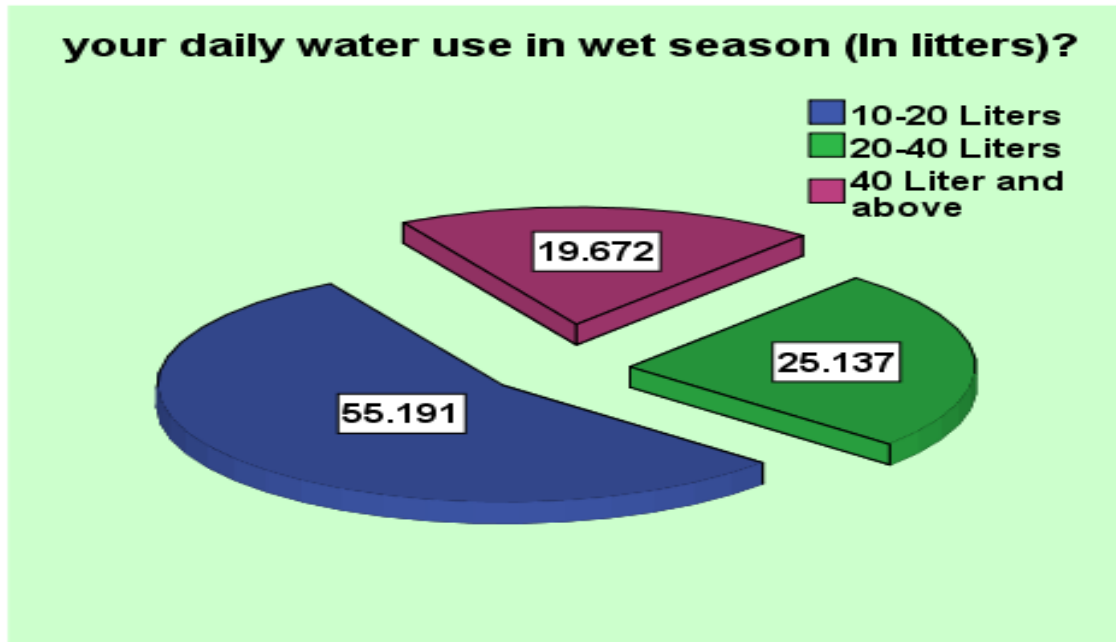
From figure 4.10 shows that the water daily use of dry season, 18.033% of the respondents said that we use water between 10-20 liters/day in dry season to provide drinking and domestic use, while 51.913% of respondents indicated use of water 20-40 liters/day in dry season to improve our daily use and growth up our live standard, for further information the 30.055% of the respondents replied that they need 40liters and above per day to use our needs of water service and the dry season is much more about the water use because of the climate change and water usage is very high about the dry season when we compare the wet season.

This evaluation used a crosschecking of households' daily water consumptions, expected amount of water that could be sufficient to their domestic use, and these values were compared the WHO standard of minimum urban water consumption rate of 35 liters per capita per day, and this study indicate the majority of the household they use the near and above the standard of who water standard and average of 35 liters/person, while the few of households is below the standard of the water per capita demand.

Finally the water usage is vary due to the time consideration, the climatic change dry and wet season have different water consumption and water usage as the above and the below data

#### 4.3.7 Daily water use in wet season

Figure 4.11: daily water use in dry season in household



Source: Field Survey, (2019)

From figure 4.11, shows that the water daily use in wet season, 55.191% of the respondents told that they use water between 10-20 liters/day in wet season to provide their drinking and domestic use, while 25.137% of respondent reflected we use 20-40 liters/day in wet season to improve and growth up our live standard, for further information the 19.672% of the respondents indicated that they need 40liters and above per day to use our needs of water service in wet season and the wet season is no much more about the water use because of the climate change and water usage is very low about the wet season when we compare the dry season.

For the above data the half and above of household in this study is below the standard and they use the water between 10-20 liters per day and the national standard indicate the average of water consumption per day is 35 liters per day and this seasonal variation and climate change effect and most of wet season no much evaporation and water usage is less.

#### 4.3.8 Comparison of seasonal variation.

**Table 4.6: Comparison of household with surplus, normal and deficit**

**Wet Season \* Dry Season Cross tabulation**

		Dry Season			Total
		deficit	normal	surplus	
Wet Season	deficit	21	72	7	<b>100</b>
	normal	11	10	25	<b>46</b>
	surplus	1	13	23	<b>37</b>
Total		<b>33</b>	<b>95</b>	<b>55</b>	<b>183</b>

*Source: Field Survey, (2019)*

From table 4.6, indicated that the comparison of two seasonal variation of dry and wet seasons due to measuring the deficit and surplus of water in household in dry season the 30.1% of household and their frequency is 55 have a water surplus, while 19.7% and frequency of 37 of household have a water surplus of wet season and this is evidence for the water surplus for the two season 10% of surplus exist and this surplus is used a water more than their normal water or standard and 30% of respondent and their family size use the 40 liters of water and above in a day and this rate is above the normal standard of 35 liters per day.

In the other hand the water deficit is between the household their water consumption is 10-20 liters per day are below the standard of 35 liter per day in dry season the 18% of respondents their frequency of 33 household size is below the normal water consumption and they are a deficit condition in dry season, while the 55.2% of respondent or 100 frequency of households are deficit and below standard in wet season, and when we compare for the two season the 30% is difference about the water consumption level and in wet season most of people they decrease the usage of water and that way they are deficit and below the standard level for the above data in wet season have a great deficit in the comparison of the two season .

For further information the normal level of the two season is 51.9% of 95 frequency and 25.1% of 46 frequency for the two season in dry and wet and the dry season is higher than in wet and as the above mentioned the dry season is more usable than wet season and the people usage of water is higher in dry season while less is wet season.

Finally the dry season is high significant level to wet season for the surplus type, while the wet season is high significant level to dry for the deficit type and this good indicator of seasonal measurement in dry and wet which one is highly water usable in the town.

**Table 4.7 Chi-square test Comparison**

			Wet Season	Dry Season
Chi-Square			38.066 <sup>a</sup>	32.393 <sup>a</sup>
df			2	2
Asymp. Sig.			.000	.000
Monte Carlo Sig.	93% Confidence Interval	Lower Bound	.000	.000
		Upper Bound	.000	.000

**Source: Field survey (2019)**

The Pearson Chi-Square statistic was used to determine whether there is a significant difference in dry and wet season. The Pearson Chi-Square value was found statistically significant, and value  $p < 0.001$ . This implies that the comparison among the two seasonal variation of water consumption differed significantly within the study area and also the wet season have high significantly season in study area because high value of chi-square test.

#### 4.3.9 Fetching of water per month.

**Table 4.8: how much time do you fetch water a month**

How much times do you fetch water a month					
No of Times	1	2	3	above	Total
Frequency	50	50	19	64	183
Percent	27.3%	27.3%	10.4%	35%	100%

**Source: Field Survey, (2019)**

From table 4.8, shows that the monthly fetching water in households, 27.3% of the respondents fetch a water one times a month with different source, while the 27.3% other fetch water two times a month and, 10.4% of respondent they fetch a water three times and finally 35% of respondent said that fetch the water above three times a month and the half of respondents they are same in water fetching who fetch in one or two

time in a month while the 35% expressed that they fetch a water three times and above in a month.

#### 4.3.10 daily water use per family size

**Table 4.9: water daily use per individuals**

Family size groups	N	Mean	Df	F	Sig.
2-4	18	2.000	3, 179	43.90	.000
5-8	65	2.0615			
9-12	60	2.2000			
13 above	40	2.1000			
Total	183	2.0903			

*Source: Field Survey, (2019)*

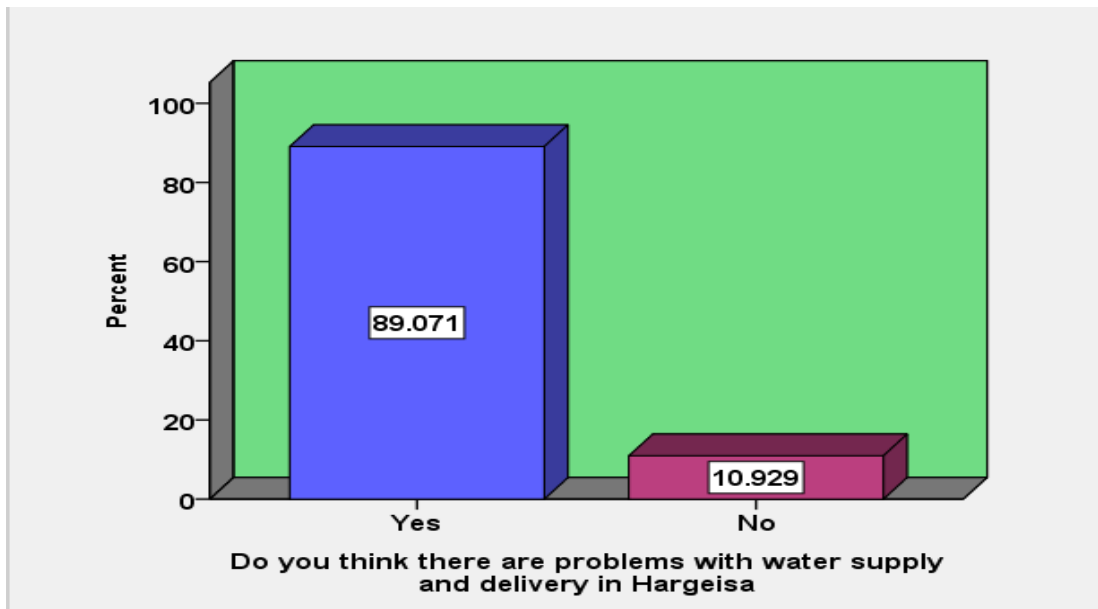
*DF= degree of freedom, M= mean, N=Sample, f=anova value, sig=signifance value*

The result from the one way ANOVA output indicated that amount of water consumption had a significant difference among the selected four household groups. The result indicates  $F(3, 179) = 43.90, p = .000$  and significant  $p < 0.07$  significance level. The mean values for the four groups indicated that as family size increases, the amount of water consumption per day also increases (2-4:  $M = 2.00$ ; 5-8:  $M = 2.0615$ ; 9-12:  $M = 2.2000$ ; 13 above=  $2.1000$ ). However, in the third group or households with a family size ranging from 9-12 had a diminishing return trend of water consumption i.e. increasing with a decreasing trend.

#### 4.4: Challenges Of water Supply in Hargeisa

##### 4.4.1 Problems of water supply in Hargeisa.

Figure 4.12: do you think there are problems in water supply



*Source: Field Survey, (2019)*

From Figure 4.12 shows that the water supply problem, 89.07% of the respondents strongly support the problem of Hargeisa water supply and they said yes, while the others of 10.929% of respondents marked the decision of problem of Hargeisa water supply service and they said no and the majority of respondents support that there is real problem have a Hargeisa water supply system while few people said no problem about the hargeisa water supply service and the decision is the town has a large problem about the water supply service in different sector of water system.

Conversely the interviewees mentioned that the most problem in the city is lack of community awareness and un-defined route of water supply pipe line in the town and also the managerial problem for those problem the interviewees indicate the during survey in the study.

**Table 4.10: the challenges of the water supply problem often exhibited on Hargeisa city.**

Challenges of water supply	Five point scale				
	SD	D	NI	A	SA
Lack technical expertise to handle the pumps	9.8%	16.9%	7.7%	29%	36.6%
Frequent broken down of pipe lines	5.5%	17.5%	29.5%	33.9%	13.7%
Few pipe lines cannot support fast expansion of township	7.7%	13.1%	22.4%	34.4%	22.4%
Management problems	14.8%	12.6%	13.1%	39.3%	20.2%
Topographic implications	7.7%	18%	20.2%	41.5%	12.6%
Limited budget and funds	18%	26.8%	21.3%	24%	9.8%
Unplanned town expansion	5.5%	6%	6.6%	27.9%	54.1%
Electricity power outage problems	14.8%	26.8%	38.3%	12%	8.2%
Population pressure	8.2%	13.1%	3.3%	39.3%	36.1%
Environmental degradation	14.8%	29%	29%	17.4%	9.8%
Unfair distribution of Water	25.1%	10.9%	8.7%	31.7%	23.5%

*Source: Field Survey, (2019)*

**(SA = Strongly Agree; A = Agree; NI = No Idea; D = Disagree; SD = Strongly Disagree)**

From table 4.10 shows that the different section of challenges of urban water supply system in the town is summarized below.

**I: is about the lack of technical expert;** from table 4.10 indicated that the 36.6% of the respondents strongly agree about the lack of technical experts and 29% of the respondents agreed about that problem while, 7.7% of respondents told they did not have any idea about the problem, for further information 16.9% and 9.8% of respondents disagreed and strongly disagreed about the water problem. And the majority of respondents they strongly agreed about the lack of technical problem of the town and this is one of main problem of the technical and the all infrastructure needs the expert to handle their daily work and this is very important about the improvement of the water agency performance of water service delivery system.

In other hand the water agency interview indicate the more technical challenge is there and some of pipe water is not underground system and they are outside and every think is easy to damage the pipe and no constant maintenance of water supply agency and also the pipe is less than 2” inch the village is maintained not our duty as he indicate the one interviewed in department of technical in the agency and other problem faced a technical department is no storage equipment and when some of machine or pipe is need maintenance is difficult to do as his time but he take a time to get a material and sometimes the equipment is import not in the market and he take a time to delivery and no strategy about the storage of material.

**II: frequently broken of pipe line of the city** ; is one of challenges of hargeisa water supply system and the above information shows the different ranking about the problem 13.7% and 33.9% of respondent they are replied strongly agree and agree about the broken pipeline of the town while 29.5% of respondents said that we don’t have any idea about the problem of broken pipeline of the city and for further information the 17.5% and 5.5% of the respondent they respond disagree and strongly disagree about the broken of pipeline and they are answering no problem about the frequently no broken pipeline in the town while the 1/3 of the respondent they said we don’t have any idea about the pipeline of the town and others or majority of the respondent they are agree and strongly agree about that problem of the town.

In the interview facts they are say about the operation and maintenance is difficult to do because of the agency is not have a storage system of equipment and some time we don’t get a material to maintain a pipeline or other equipment such as machine and this problem is highly arise in every day because the pipe line is very old and aged.

**III: Few pipe lines cannot support fast expansion of township of the city**; is one of challenges of hargeisa water supply system and the result above show the different measurement about the problem 34.4% and 22.4% of respondent they are forwarded strongly agree and agree about pipeline cannot support fast expansion of town while 22.4% of respondent said that we don’t have any idea about the problem of pipeline support of fast expansion of the town and for further information the 13.1% and 7.7% of the respondents they disagree and strongly disagree about the pipeline cannot support the fast expansion of the city and the ¼ of the respondent they reflect about the no idea of the pipe line expansion of the city and the society is very important about the water development sector.



As interviewed mention the three village of the town is not have pipeline design and layout and some of other village they not got the expansion of pipeline network in the town and the problem is after 1982 up to now no expansion of pipe line in the town and previous time is when they provide the last pipeline in the town and he mention they start now to set and design a new pipe line of water extension project in all villages in the town.

**IV : *management problem*** of the city; is one of the group of challenges regarded our data output of hargeisa water supply system and the result above show the different measurement about the problem 20.2% and 39.3% of respondents said that strongly agree and agree about the management problem of the town while 13.1% of respondents told that we don't have any idea about the problem of management system of the town and for further information the 12.6% and 14.8% of the respondent they respond disagree and strongly disagree about the management problem of the city and the majority of the respondent they are agree about the management problem of the town. As the above information the interviewees they mention about the managerial problem some of interview respondent they said the water agency have a management problem and the leaders isn't have a good experience of water supply management and they are missed the some of opportunity and managerial role of water supply agency.

**V : *topographic implication of the city*** ; is one of challenges of hargeisa water supply system and the result above show the different reflection about the problem 12.6% and 41.5% of respondents strongly agreed and agreed about the topographic implication of town while 20.2% of respondents does not have any idea about the problem of topographic implication of the town and for further information the 18% and 7.7% of the respondent they responded disagreed and strongly disagreed about the topographic system of the city and the near 1/2 of the respondent told that agreed and strongly support about the topographic implication of the town because the most part of the town is hilly area and the high elevation is there some of the village they are above the water storage tank of the town and this is a high problem related about the topographic system of the town.

In other hand the some of interviewees supported the previous information and said that the city have a some challenges of topographic problem and most of the city in between and near a hilly area and the topographic of town is different and some village have high elevation while some is low elevation and this is evident about the some part of the town they need the pump station to get a their water system.

**VI: *Limited budget and funds of hargeisa water supply system;*** the above data shows the result about the problem 9.8% and 24% of respondent they indicate strongly agree and agree about limited budget and fund of town while 21.3% of respondents didn't have any idea about the funding system of the town and other budget of the water agency for both governmental budget and international donors and for further information the 26.8% and 18% of the respondent they respond disagree and strongly disagree about the limited budget and fund of the city and the majority of the respondents they disagree the problem is not about limited budget but is other directions.

For further information the interviewees indicated the agency have a lack of fund to invest and support the water supply of the town and mostly they depend on the international donors and water sector development, in other hand the water agency produce its self their running cost and staff salary.

**VII: *unplanned town expansion of hargeisa water supply system;*** the above table show the measurement about the problem 54.1% and 27.9% of respondents told that strongly agree and agree about unplanned town expansion of town while 6.6% of respondent didn't have any idea about the plan and design as wells as the expansion of the town and for further information the 6% and 5.5% of the respondents they respond disagree and strongly disagree about the challenges of unplanned system and expansion of the city and the half of the respondent they are strongly agree about the unplanned of town expansion of the city and most of respondents they mentioned the expansion of unplanned system is a one of main challenges of Hargeisa water supply system.

For the facts the city is not have a plan for pipeline network and is difficult to demolish the some of huge building those are interconnecting the layout network of pipe and the municipality and the water agency they confuse the new pipeline of the city and still is function less and misunderstanding of water agency and municipality.

the interviewees they describe the situation is very difficult and the municipality don't have a land use plan of the city and some previous pipe is under the building and when they are damage no way to maintain or replacement and this is real problem of fast expansion of the city without considering the land use plan of the town.

**VIII : *Electricity power outage problems of hargeisa water supply system;*** the above data show the challenges about the water , 8.2% and 12% of respondents they indicate strongly agree and agree about Electricity power outage problems of water agency while 38.3% of respondents doesn't have any idea about the Electricity power outage

problems ,further information the 26.8% and 14.8% of the respondent they respond disagree and strongly disagree about the Electricity power outage problems of the agency and the majority of the respondents they responded about no idea of the problem of electricity and power outage of the Hargeisa water agency.

In evident the electricity power is not water challenging as interviewees mentioned about the water agency use as solar system specially a borehole is system connected a sun solar system and no required electric from other source such like a private electric or other and the previous time they use a machine produce electric as water pumped station and now they are grow up the solar system and no machine is working with fuel system.

**IX : population pressure of city hargeisa water supply system;** the result above show the problem of population pressure of city 36.1% and 39.3% of respondents told that strongly agree and agree about population pressure of town while 3.3% of respondents didn't have any idea about the population pressure and the population growth of the town and for further information the 13.1% and 8.2% of the respondents they mentioned disagree and strongly disagree about the population pressure of the city is not a problem of the water system and the 70% of the respondent they are strongly agree and agree about the population pressure of the city and most of respondent they mention the main challenge is population pressure of the city for both the residence and transit people of the city.

In other hand the interviewees respondents they indicate the city have a more challenging of population pressure the previous design of water supply In the town is 350,000 of people and they are increase  $\frac{2}{3}$  and now the last estimate of the town is around 750,000 of people living in hargeisa without transit and the summer time people come from abroad and country boundary, also the city is capital and governmental base and every day the people is immigrate for the town in rural and other urban center and as he mention the vice executive manager of water agency he said that we increase the water pumping at time of summer and we know the ratio of people is increase and water is very short about the resident and commercial place and in our plan is to double in amount of water has pumped a day because of this population pressure.

**X: environmental degradation of the city hargeisa water supply system;** the above output show the measurement is, 9.8% and 17.4% of respondents said that strongly agree and agree about environmental degradation of town while 29% of respondent say we don't have any idea about the environmental degradation and system of

environmental improvement of the town and for further information the 29% and 14.8% of the respondent they respond disagree and strongly disagree about the environmental degradation of the city and the 29% respondent of both they are disagree and no idea about the environmental degradation of the city.

The respond of interviewees mentioned that they have some environmental challenges and the one is community and lack of awareness and the agency is not have a good and enough space selection of layout distribution and also storage tank and the society isn't understand the important of the water system in villages or district, and another high problem is during a pipeline distribution the water agency need new route and line to set a pipeline to maintain a water quality and pressure and most of city is construct after early the design and some area is waste and not suitable for setting the water lines and the standard of main water line is far away minimum 1 meter for the waste and sewage area.

**XI : *unfair distribution of the city hargeisa water supply system***; the result above show the measurement about the challenges 23.5% and 31.7% of respondents they indicate strongly agreed and agreed about unfair distribution of water town while 8.7% of respondents didn't have any idea about the distribution water of the town and for further information the 10.9% and 25.1% of the respondents said that disagreed and strongly disagreed about the distribution system of water in the town and the 1/3 of the respondent they agreed about the distribution of water in the town is not fair and some residence they get over plus of water while other they are deficit of water system in the town and the above evident the water distribution is another challenges of water supply in the town.

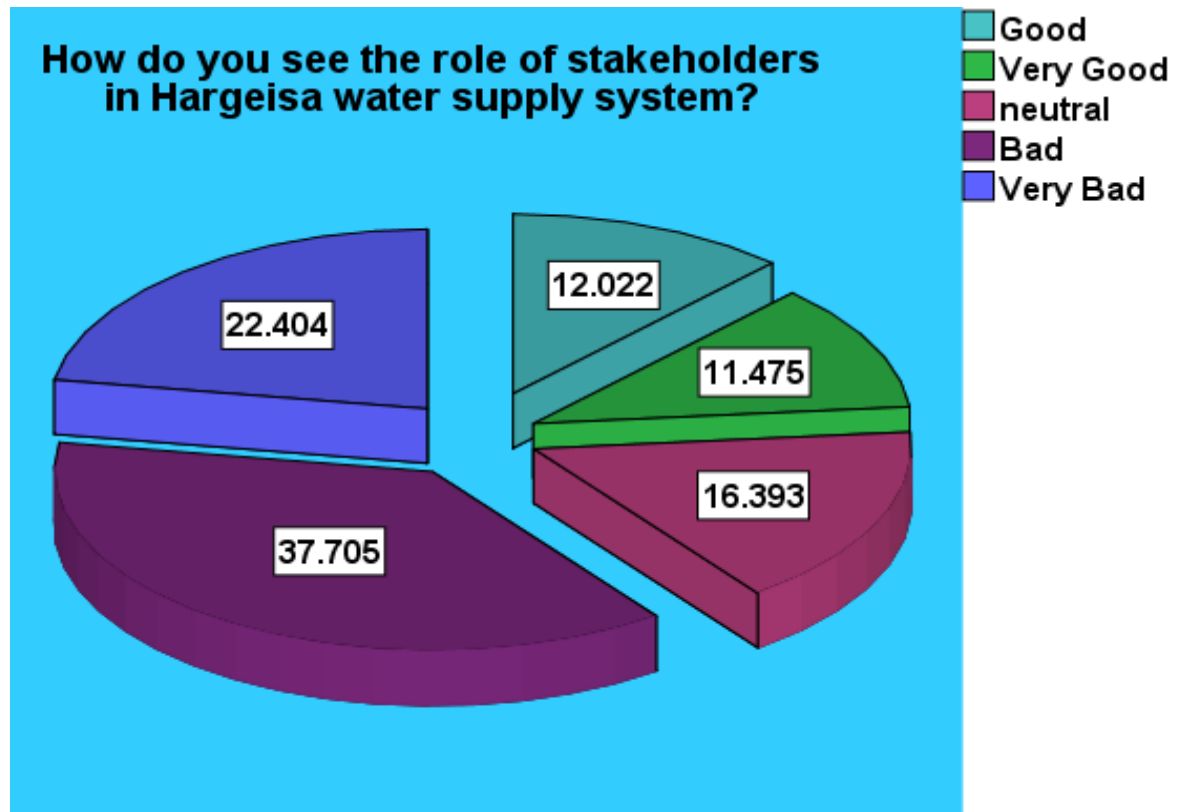
#### **4.5 Role of Stakeholder and Community Participation Involvement of Hargeisa Water Supply System:**

water supply is about 53.2 million Euros, committed funds are from the European Union (16.5 million Euro) for the upgrading of water supply infrastructure, from the SDF 1,76 million dollars for the drilling of three new boreholes in and the expansion of the water supply work from Haraf to Ayah settlement, the Water Supply Plan (WSP) half a million dollars capacity building support to HWA and the World Banks urban development project for improving Hargeisa urban infrastructure including upgrading drainage and solid waste management facilities, The German government-owned development bank (KfW/GIZ) recently

announced 15 million Euros of funding for the urban water supply distribution networking of Hargeisa city (SDF, HWA, & HUWSUP, 2014).

#### 4.5.1 Role of stakeholders

Figure 4.13: role of stakeholder in hargeisa water supply system



Source: Field Survey, (2019)

From Figure 4.13, indicated that the role of stakeholder in study area, 37.70% of the respondents said the role of stakeholder in hargeisa water supply is bad while the 22.40% of respondent told that the role of stakeholder is very bad and situation is not fine, for further information the 11.475% and 12.022% of the respondents they indicate the role is very good and good while 16.39% of respondents said that the role of stakeholders is neutral point and the most of the respondent they are mentioned the role of stakeholders is very bad and bad condition.

Conversely the hargeisa water supply extension and upgrading project is still underway and he is fail one to two times and this is a real measurement of the respondent they said bad and very bad situation in this study, the population they said the stakeholders they are not really implementing this project of water extension and the government they make a change management for the water supply agency and now he is final stage

as water supply report said in 2018 its is finish the end of this year 2019 and the all stakeholders have a different roles like pipeline making and also the distribution line of the different village.

The interviewees mentioned the role of stakeholder is big role about the water supply project and donors they took their parts of the project such as the World Bank, Kfw, EU, and UN-Habitat for hargeisa water supply upgrading project and they donate most of the budget in the project while the Somaliland government announced some of budget.

For further information the community participation is another stakeholder of water supply service in the town and this is one of backbone of the water supply agency, the community they took their part the water supply upgrading project as indicated the vice executive manager of water supply agency and the community elders and business managers they took their role of water expansion in the town and such of community they donate their land and houses to align the new route line of water supply in the town.

#### 4.5.2 Financial sources of water supply projects.

**Table 4.11: financial sources of water supply project in Hargeisa city.**

	<b>Government Budget</b>	<b>National Investors</b>	<b>NGO</b>	<b>Stakeholders</b>	<b>Total</b>
<b>Frequency</b>	85	11	23	64	183
<b>Percent</b>	46.4%	6%	12.6%	35%	100%

*Source: Field Survey, (2019)*

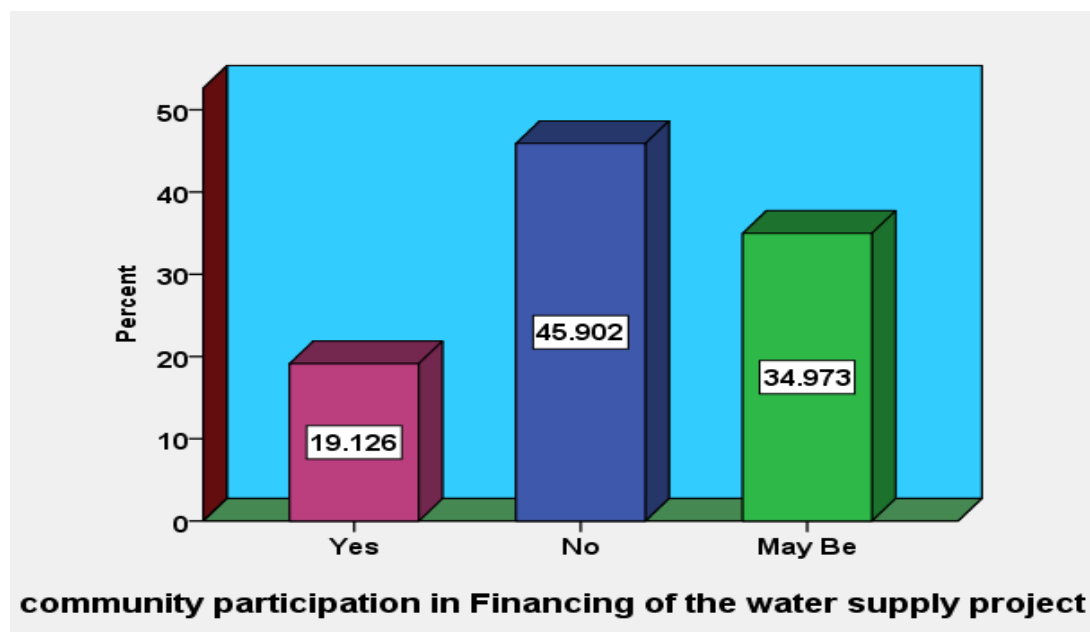
From Table 4.11, indicated that the financial sources of water supply project in study area, 46.5% of the respondents said the source of fund is governmental budget while, 35% of the respondents told that the source of finance is national stakeholders, for further information respondent said 12.6% and 6% is about NGO and national investors and this evidence about the government have a great role about the water supply fund of the town and also other stakeholders they took their roles of fund.

Conversely, the different information regarding the source of fund of the Hargeisa water supply agency interviewees said that no fund of other institution or central government to the water agency and it is produce a tax as it's self the finance is coming with water billing of the household and the agency they produce their running cost of

staff of agency and also tax submit to ministry of finance as yearly tax, but some of huge project the water supply interviewees they mentioned the agency is not able to carry this huge fund like a water extension and upgrading project most of fund is coming from international donors(EU) and Somaliland development fund and other national agency who is cooperation for hargeisa water agency such as Un- Habitat and Unicef for Somaliland water sector development.

#### 4.5.3 Community participation in water supply project.

**Figure 4.14: Community participation in financing of water supply project**



*Source: Field Survey, (2019)*

From Figure 4.14, shows that the community participation level, 45.902% of the respondents said no community participation of financing water supply project in the town while, 34.973% respondents told that may be is there a community participation in financing of water supply project, for further information 19.126% of respondents they indicate there is community participation of financing water supply infrastructure project.

For further information, the vice executive director of water supply agency he mention during interviewees the community elders have great role about the land use plan of the water supply project and he indicate the time of survey the elders they are working very good with resettlement of such household which those destination is used as water storage tank and other purpose and they are very good about the community awareness

of the town as well as the local government they took their role of water upgrading system of the town and they donate the sum of land to resettle the people those have original destination of water supply alignment.

For further information, the community is not much funding effect but they have role of donation those land and other resettlement and the above data indicate the community participation did not involve the financing of water infrastructure but they took the other roles of water extension and the university and other experts not much participation about the water supply project and no further study about the water supply program

#### 4.5.4 Level of community participation

**Table 4.12: level of community participation.**

	Level of community participation					
	high	Very high	neutral	low	Very low	Total
<b>Percent</b>	19.0	6.4	15	45.4	14.2	100%
<b>Frequency</b>	35	12	27	83	26	183

*Source: Field Survey, (2019)*

From table 4.12, indicated that the level of community participation in water sector, 19% of the respondents said that the level of community participation of water supply is high while, 6.4% of the respondents told that level of participation is very high, for further information respondents said 45.4% and 14.2% of community participation is low and very low level while, 15% of respondent said the level of community is neutral and this is evidence of the level of community participation is bad and there is no interconnection between the society and the management of the water supply agency of study area.

In facts the community elders have a great role about the water supply of the town and has a good relation about the management of the water agency but the civil and house society specially child and women they don't have a such great role of community participation of water supply system of the village or the town and they are not get a good awareness of the value of water supply in the town and those respondents forwarded this data they measure their ideas of water agency and community relationship.



## **4.6. Interpretation and Discussion**

This section focuses on the major findings of the study and their relation with the previous researcher findings. The contents focus on the status of water supply, the major challenges of water supply and factors behind, demand and supply of water in household and the stakeholder and community participation of water supply problem in hargeisa city

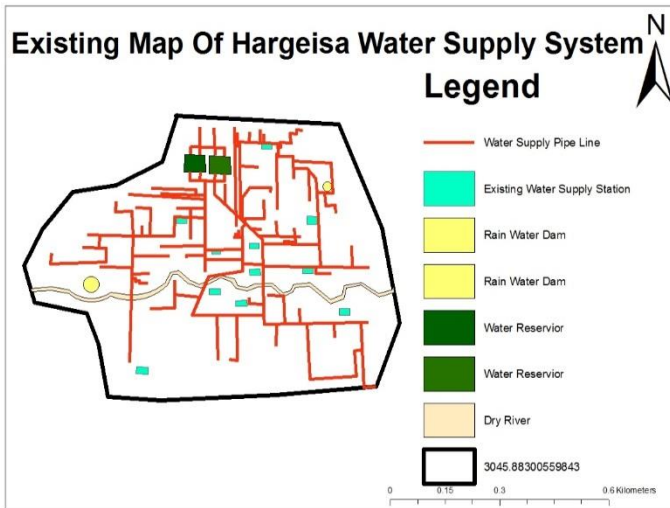
### **4.6.1. Status of water sources**

#### **4.6.1.1. The Mode of water supply.**

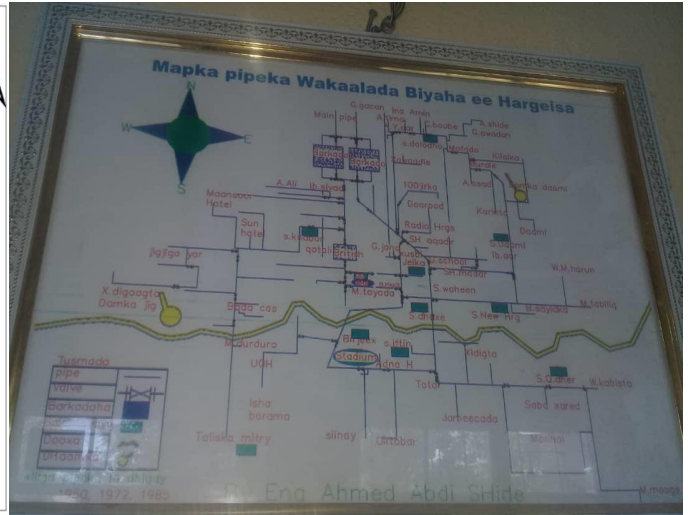
The result of the study indicated that, 37.158 % of the households, collect drinking water from a relatively safe sources such as pipeline, governmental bono while other near 63% of household collecting water from other sources such as water trucked, Donkey Car, rain water hand dug well and etc. However the major primary source of water is water trucked system, government and commercial bono water sources are very far away from the households and are often too congested especially in dry season. This finding was also consistent with the results of Biixi (2017) and k.Farah (2015). On the other hand, Private vendors (Motor Tankers and Donkey Carts) are increasingly becoming primary water sources for many households, especially those in the new settlements in the city periphery. (See Figure 4.4).

Moreover, all the identified water sources have their importance in the all studied areas, but some sources were predominant in one area comparing the other sources. In that regard, the predominant primary water source in xero-awr was Piped water, while Motor tankers were predominant primary water sources in lixle village.

The previous study of past time indicate the 35% of hargeisa respondent they have a piped water while 65% of respondent they are water trucked system as he mention SDF (2014) report and now in our findings of study area is not much difference and this evident that the city mostly water trucked system and in Koodbuur district is 37% have water piped system while the other is water trucked and private service.



**Figure 4.15: Existing Hargeisa water supply Gis Digitizing Map**  
(Source: Researcher Developed 2019)



**Figure 4.16: Existing Hargeisa water supply map**  
(Source: HWA Field Survey 2019)

Figure 4.15 shows the situation of water supply system in the town the most of the Village including the study area does not have a good water layout distribution as well as the pipe line network. All the system is poor only two water reservoir is there and they are near in each other and this is another problem of water inadequacy in the town also the existing layout is not design as well and they are very old and lack of operation and maintenance, also the water station not arranged as well and they are lack of survey design.

The other water sources, there was high seasonal dependency of which water source is an alternative, for example the hand dug well and dry river catchment was the predominant water source as such most of the studied households (see figure 4.4) were used for both as an alternative water sources in the rainy seasons and other season may un available and timely connected with rainy season. On the other hand, water trucked was a major water source in the dry seasons while the pipeline is small ratio about the source of water and the respondents they describe the water supply agency they are lack of water reservoir and the town is not have a enough water store to distribute the water system and this case is base and mother of water supply system and the town is not have a enough water storage.

#### **4.6.1.2 Water available in your house is enough your needs.**

The amount of water receiving in the town is part of status of water supply and the role about the assessment of the water supply and for the (figure 4.5) the a result shows that, 74.8% of the respondents they do not receive the amount of water they got a monthly of average consumption of water supply in the city and they mentioned disagreed and strongly disagreed and did not satisfy this service, and this evidence and imitation of the urban water supply status of the Hargeisa town is poor and below the standard majority of the people they are not got their enough water to cover their needs of water and daily use of water consumption.

the mostly household piped water is not satisfied this condition of water inadequacy and also others they do not get the enough water because their situation does not stable because they use different sources of water supply some time the households who use the water trucked they do not maintain the availability of water and the system also.

Finally the status of urban water supply in hargeisa is poor and below the national standard as they indicated the different respondents and interviewees most of them they are not satisfy about the system and also the service of the agency and the study area the most of water service delivery is water trucked system and the time of dry season the price of water is very high and difficult to pay the poor families that, the major of respondents agreed and strongly agreed a new institutional rearrangement is needed to enhance the management scheme in the water sector, above findings shows that the dwellers are not willing an improved water situation by this public institution only. To that end, finally large majority of these studied respondents they agreed the water available in the town is not enough the population and majority of household did not get enough water.

### **4.6.2 Water Supply and Demand in Household**

#### **4.6.2.1 Primary source of water for your household**

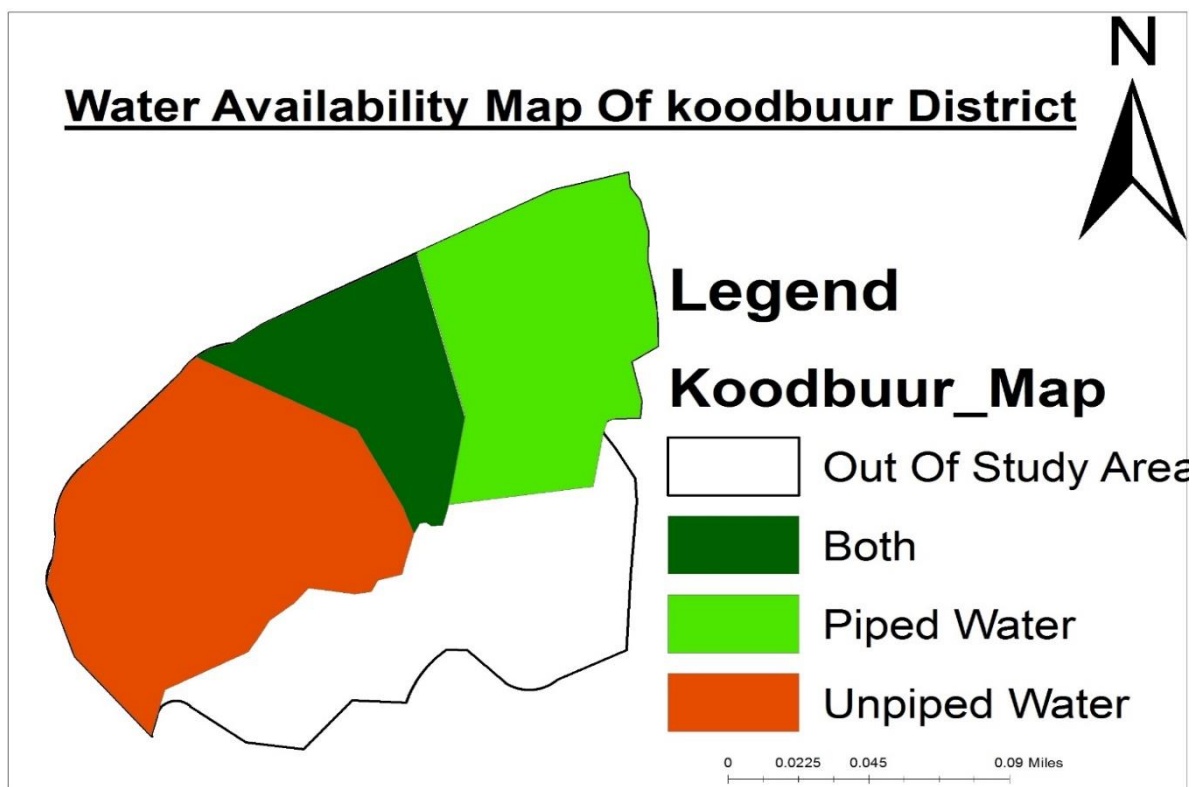
All the identified water sources have their importance in the all studied areas, but some sources were predominant in one area comparing the other sources. In that regard, the predominant primary water source in in study area was water trucked system, while the second predominant primary water sources in the areas is donkey car vendor.

From (figure 4.7) the above evident shows that, 54.098% of the respondents said that primary water source of our house is private bono or private service while the 26.776%

of respondents told that the source Of water is both private and public service and we use for both piped and private owner and this is very evident about the level of water supply of the town and the above 2/3 of the respondent they respond their primary water supply is under private and the agency is not responsible their water system and timely depend on the private sector.

On the other hand, the water storage capacity was also assessed. The result shows that, 100 percent of households rely on water storage materials; the most widely used water storage materials for both drinking and domestic water consumption were either tankers or jerry cans. The result of this study indicated that households have a mean of 20m<sup>3</sup> of water storage capacity for drinking and domestic water consumption respectively.

**Figure 4.17: water supply availability in Study Area GIS Digitizing Map**



**Researcher Developed, (2019)**

Figure 4.17. shows that the status of urban water supply in the study area or town and this digital map of water supply system in the koodbuur district an as the previous output the researcher only mention only the ratio of piped and un piped the Xero awr village its mostly they are piped water ,while lixle village majority they are under water stressed and they rely on water trucked system and the pipe line of the town is not normally distributed in the village and lixle is new village and its growing well in the

last decade while the xero awr is very oldest in the town and its geographically located near the water reservoir of the town.

#### **4.6.2.2 Households have a running water from network pipe/week**

The availability of water in the study area depends upon the regularity and the adequacy of supply. The survey results show that (43.2%) of the households in the area are connected to the pipeline water supply system. While other respondents (19.1%) do not have a supply but the pipes connected to their homes. The result also revealed that the percentage of piped water supply is so small when we compare the other respondent of study area. Thus, the above result indicates that, there are inequalities in the way various sections access water. Some access a little water where some of do not get even a drop. And also the people who get the water is 2-3 days a week highest one and others is ones a week and is very less time when we see the seven days a week, The result indicated, various sections of the town had problem of equal distribution some parts of the town had a frequent water supply while others had one or two within 10 days of the month. Finally , the above interpretation is really define the level of water consumption of the town specially the villages of this study when we see the household who have a piped water and one is not get a piped water their situation is same those have a piped water is not get enough water and mostly they are thinking with water availability as well as the other is water trucked system and privately owned, in other hand the literature studies define the Haregisa have a good water relative service for the table 2.2 in the chapter two and the 9<sup>th</sup> ranking or reliability and access of water but the situation is different as the output and the most of the household piped and un piped they not get enough water.

#### **4.6.2.3 Family size and water daily use in dry season**

From the above (figure 4.10) the output data indicate that majority of households consume water from 20 – 40 and 40 above liters per day. The result shows that, more respondent consume water from 2 – 4 jerry cans per day. However, the daily consumption of water differs from household to household depending on the family size of the household.

Water consumption is determined by the number of family size. The anova result indicated that as family size as family size increases, the amount of water consumption per day also increases. The mean consumption of water of households with a family size ranging from 9-12 had a diminishing return trend of water consumption i.e. increasing with a decreasing trend. The overall difference in amount of water

consumption between the fourth groups of households were significant because of the significantly greater amount of water consumption were observed by HHs with a family size ranging from 2-4 when we compare 13 and above their mean is much difference. This result is highly consistent with the results of Henry Wonder (2007). The result revealed that households with higher number of family size (from 8 – 11) in Ghana consumes little amount of water per day than households with a family size ranging from 3-7 (Henry, 2007). And also (asemeret, 2016) result indicate the family size of 4-7 is highly water consumption of the family size 7-9 in Gonder city.

Finally, the above data indicated that the level of water supply and demand in households is inequality about the distribution of water and available daily water, also the family size, those are factors behind the available demand of water, lastly the demand and supply of the town is not equal proportion and the city is poor demand and supply of water service.

#### **4.6.3 The major challenges of water supply**

As the findings of the study shows, there are a number of challenges that confront sustainable water supply in the study area. However, the major once are; population pressure, unplanned town expansion and technical experts.

Lack of technical expert factors were the major challenges of water supply service in the study area. This result was inconsistent with the result of the above analysis the respondent they indicate there was a problem of technical experts challenge of hargeisa city and they are support with the data of operation and maintenance level of the town. Conversely, they mentioned the population pressure is main challenges of hargeisa water supply system and day to day urban expansion is increase the challenges and inadequacy about the water supply system of the town, although the illegal immigration of rural to urban areas is causes of inadequacy of urban water supply and the previous design is not fulfill the needs of the residence and there is mismatch between the water demand and supply of the town and the problem is the people they are triple double when we compare the population design of water in the city .

For the above evidence the unplanned town expansion is real challenge of water supply in the town as they reflect the interview and also household questionnaire they are underline the previous design of the town and new system of settlement does not fill the system of water supply infrastructure of the smart cities and the hargeisa have a

late design standard about the 1970s and this design is not fill the needs of the society in the town and no expansion and system in the town after the late layout system of this time and now mostly it's aged infrastructure and it's need replacement and maintenance of infrastructure .

Finally, this results are consistent with the result of (asemeret, 2016) indicating that the major challenge of water supply in hargeisa town was near with a series of challenges of gonder town as those factors unplanned town expansion as a result of population pressure of Gondar town, However result unplanned town factors of this research was inconsistent with the result of (Yonis & Farah, 2015) The result indicated that city plan factors had large proportions in aggravating the problem of water supply and delivery system in hargeisa town.

For the above data the population pressure, unplanned town expansion and lack of technical expert is high average of water supply challenging in then town and other factor may affect the water suitability of the town, conclusively the city have more challenging factor of water supply system.

#### **4.6.4 Role of Stakeholder and Community Participation of Hargeisa Water Supply System.**

As the above data output the respondents they reflect the 74% of respondent they indicate the role of stakeholder and community participation is bad and very bad situation of the water supply role in the town and the civil society and households they are not measure the level of stakeholder but they are the visual respond and they are not now no more information about the stakeholders and national donation of different sector of the water development in the country.

For the further information the role of the government is not measurable and also the ministry of water resource he is mainly focused the way of upgrading the water sector of the country and the hargeisa is capital and they are of the strategy and policies of developing the water of the country.

The level of community participation is low and very low respond about the above analysis of the respondent and also the support some of the interviewees say the level of community is good and they are working very well with the water agency, and finally the role of government, stakeholders and also community participation is very good role and they are doing very well about the water supply development in hargeisa city and also less awareness of civil society is there specially the women and children.

Finally, the city have good stakeholder membership, less community participation of water supply financing ,low level of community participation and high governmental financing of water for this findings of this study the town have different challenges for community itself while the stakeholder and government take those responsible of water supply development.



## CHAPTER FIVE: CONCLUSION AND RECOMMENDATION

### 5.1. Conclusion

The status of water supply and service have a severe problem. Majority of households in study area (koodbuur district) collect drinking water from private service, government and commercial bono. However, government and commercial bono water sources were very far away from the households and were often too congested especially in dry season. In relation to this, domestic water consumption result reveals that more than two third of the respondents used water from unsafe sources such as water trucked, donkey cars, private wells and others, and the majority of the respondents disagreed the water availability and said that the water we receive did not enough our needs of living and domestic use of households, and majority of city is water stressed and finally the status of water supply in the town is poor and below the standard of water supply.

Majority of households consume water from 20–60 liter per day; the daily consumption of water significantly differs from household to household depending on the family size of the household. The study concluded that greater amount of water consumption were observed by HHs with a family size ranging from 9-12. Households with private pipeline connection consume less water or greater some times than without pipeline connection ; the findings state that the majority of respondent they respond the average of water consumption is between 20-60 liters as minimum and maximum consumption of water and which is near the standards of WHO (35 liter/ individual). The main water sources shared in the study area were the government, commercial bono and both. The frequency of piped water supply is intermittent and the daily water supply was not regular, the distribution was also at an awkward time and mostly they distribute a night time and at day time the distribution is less. Thus, severe water supply and delivery problems were occurred and there are inequalities in the way various sections access water. Some access a little water, some of access a normal whereas some do not get even a drop, in other hand the some household have a pipe system but unfortunately the system does not work and they are water trucked system.

In summary the water supply of the city was inadequate quantity and un-acceptable quality, the water is one of the basic needs of human beings, but the provision of potable water supply in Hargeisa city is inefficient. The situation is getting worse due to the

population growth and spatial expansion of the city which outstripped its ability to supply sufficient water for its inhabitants.

The study also steered the challenges exhibited to water supply service were topographic implications, management problem, unplanned town expansion, population pressure, few pipelines cannot support fast expansion of township and unfair distribution of water. The study indicated that water supply service problem would be severe for the now and future. Moreover, the output data model result revealed that topographic implications, management problem, unplanned town expansion, population pressure, few pipelines cannot support fast expansion of township and unfair distribution of water were among the major challenges that positively and significantly influence the severity of water supply and delivery problems. A unit increase in each of these factors will exacerbate the problem of water supply service in the coming future. The problem of water supply also had a significant impact in expenditure between households with and without pipeline connections in the area. Households without pipeline connections tend to expend significant costs for water per month and the amount of water fetching is very expensive during the dry season and some time they reach in one 100 liters (one foot) in 1.5\$ and above in Somaliland exchange rate is 1\$=9500 Somaliland shilling and this factor is very difficult to the poor family those are not allow to pay their water enough to survive their live. In general relation to this, the responsibility among boys and girls in fetching water differed significantly; the study concluded that girls took the major responsibility of fetching water. Implies that girls are exposed to different pressures like education. Moreover, a problem of water supply system had a significant association with the problem of health. The study concluded that, those whom use water from private wells and Dry River they tend to exposed to water born disease in the study area. Thus, as household's consumption of water from private wells increases, the health related water born diseases also increases in the study area.

Finally the major findings indicate the factors that water supply service is highly challenging and also the future they expand its effect, *unplanned town expansion, population pressure and lack of technical experts* they are factors have high ranking value in output data and they are high water challenging of the water supply in the town.

After years of water scarcity in Hargeisa, international development partners EU, World Bank/WSP, SDF and KFW/GIZ have invested range of projects to upgrade Hargeisa water supply system, through infrastructure development and

capacity building of HWA and key stakeholders. The main infrastructure project is HUWSUP, the project was replace the existing deteriorated twin-transmission main that runs from the principal well field at Geed-Deeble to Hargeisa with a high-capacity, single pipeline. Rehabilitating old damaged boreholes and drilling new 6 boreholes, will increase the water supply by a minimum of 3.5 million liters per day, and construction of new pumping and booster facilities will replace old and worn equipment with modern cost effective technology, and this for the support of stakeholder and national investor in HWA to fill the role of water supply and the needs of population in coming years , in other hand the community have their role of water supply project the findings indicate the community elders have high ranking of water development , while the other people did not have such effect of community participation of water supply project , and also the water financing the community is less role and their level is low, for those factors the water supply agency and the community relationship is low while have a good cooperation about the donors and stakeholders.

Finally, the study also observed an existed opportunities that the above challenges can be mitigated to enhance the contemporary water related problems and contribute to some extent for sustainable water supply system of the future in the study area.

## **5.2. Recommendations**

Based on the findings of the study, the following possible recommendations are forwarded:

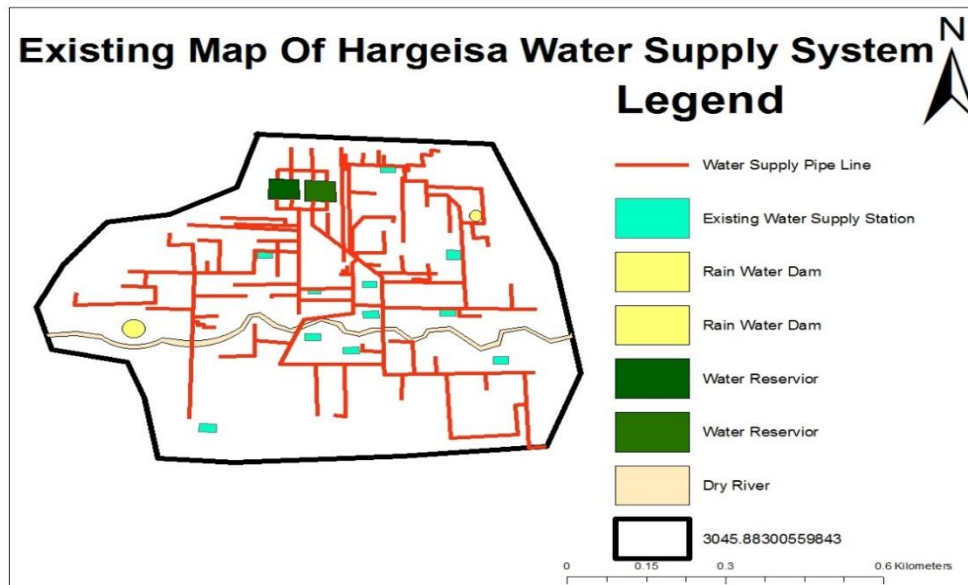
- ❖ The outcome of the study points towards the current potable water provision, demand, and supply in the town is low. For this reason, HWA should increase water production and expand the distribution lines to bring the system near to the dwellers in order to facilitate the people to get pipeline at close to their surroundings and get good water supply and demand in the town.
- ❖ The government should venture into the provision of water supply in the town to promote the strains that water service sector faces and regularly maintain the availability of water supply and demand in the town.
- ❖ Based on the poor status of the town, the water agency should make it fair distribution of water even water shortage is there, and increase Governmental bono in water sources as they are the main source of clean and safe and Providing the more water reservoir to get more water distribution in the town.

- ❖ The outcome of study towards the technical issue and lack of material store, the HWA should Provide training for technical experts to upgrade their technical experience, and should ensure the all pipeline is underground and far away the sewage and waste channel, also construct good store of material and equipment needed to replace and maintain the damage and non-worked machines and pipelines.
- ❖ Based on large family size with poor living standard of the studied households was not only a limiting factor in water service but also in many public services such as education and health. Thus, central government together with others should advocate effective family planning campaigns and raising public awareness and considered increasing decreasing trend of the family.
- ❖ Regarding the challenges of water supply the government and together with WSA should implement project management principles through lifecycle water projects, investing and creating strong sectoral and professional capacity buildings to avoid the future challenges, and government should provide the water sector plan of JPLG (Join program for local government) to develop the water sector in hargeisa and other regions.
- ❖ The expansion and unplanned system of the town the government should design the new water sources in the town and the WSA should develop the modern layout plan of water supply with national standard and update and should consider the population raising in the town.
- ❖ Donor organizations and institutions concerned should continue to support the developing countries like Somaliland, with funds, expertise, and other logistics to help meet the water supply needs of the increasing population.
- ❖ Based on the findings community participation level is bad, the water agency should conducted in public awareness for the society and households in fetching water in such sources of not clean and low quality.
- ❖ Community need assessments should be conducted by preparing different forums to understand their opinions on how to solve WSS problem because making oral discussion alone is not a guarantee for the community, they should be able to see practically the result of their contribution and service charge and this help to encourages their future participation to contribute the future water expansion.

### 5.2.1: For future Research

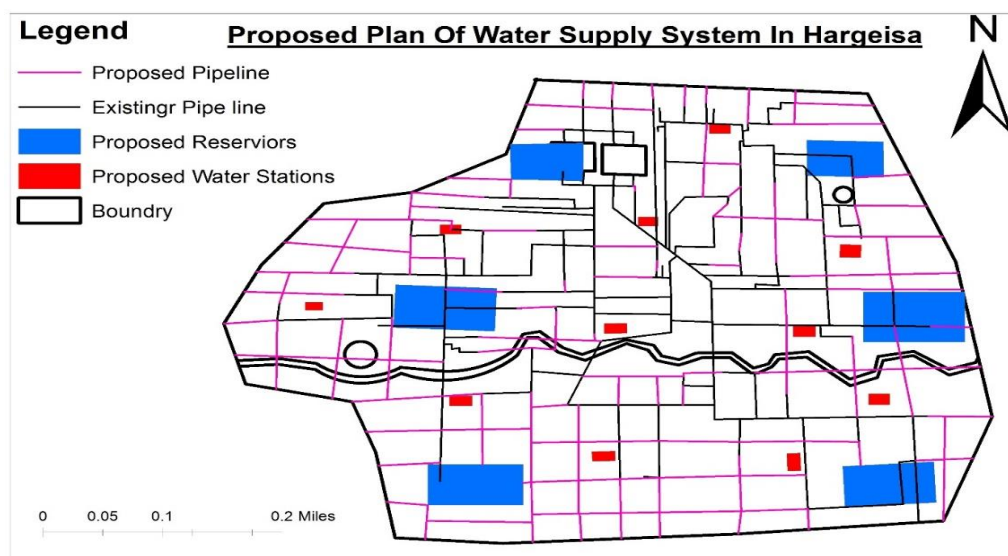
After the above findings, conclusion and recommendation the researcher developed to his effort the existing water supply map and also proposed 20 year plan of Hargeisa water supply system.

**Figure 5.1: Existing Water Supply System of Hargeisa**



**Source: Researcher Developed (2019)**

**Figure 5.2: Proposed Plan of Water Supply System in the Town**



**Researcher Developed, (2019)**

## REFERENCES

- A. k., & nalubega m. (2001). *guidelines for assessing the risk to groundwater from onsite. u k.*
- Abera, a. (2003). *the impact of water scarcity on economic development . northern west region of ethiopia.*
- African, d.b. (2016). *water infrastructure development for resilience in somaliland program. hargeisa: somaliland.*
- Aschalew, d. (2009). *determinant of house hold participation in water resource management. amhara region .*
- Asemet, y. (2016). *assessing challanges of water supply of gondor city administration. addis ababa ethiopia.*
- Asgedom, d. (2014). *assessing causes and challenges of urban water. international journal of science and research (ijsr), 1922.*
- Ayanie, b (2014). *an assessment on urban water supply infrastructure. addis ababa.*
- Boberg, j & csd, u. (2005). *liquid assets. in j. boberg, how demographic changes and water management policies affect freshwater resources (pp. 1-15). rand corporation.*
- Brockerhoff, m. p. (2000). *an urbanizing world and population bulletin,*
- Ch, eberhard et, al (2016). *providing water to poor people in african cities. washington, dc: the world bank, 1818 h street nw.,*
- Contributors,(2018). *hargeisa. retrieved 2018, from wikipedia, the free encyclopedia: "https://en.wikipedia.org/w/index.php?title=hargeisa&oldid=860440954*
- stolton, s. (2003). *running pure: the importance of forest protected areas to drinking water. world bank/wwf.*
- Fita, c. d. (2011). *an assessment of urban water supply and sanitation. addis ababa , ethiopia.*
- kabat, p. (2002). *impacts. in: appleton, b. (ed.), climate changes the water rules. in how water managers can cope with today's climate variability and. delft.*
- Haas, ( 2017). *an overview of municipal finance service. hargeisa,somaliland.*
- Hwa. (2019). *background. hargeisa: sagaljet.*
- k. e., jokiell,et al (2011). *big cities,big water,big challenges water in an urbanizing world. berlin: wwf germany, berlin.*
- chenoweth, j., & fife-schwa, c. (2006). *trend report on consumer trends, cross-cutting issues across europe. in trend repor (p. 46.).*

- khatri,(2007). *challenges for urban water supply and sanitation . delf,; netherlands.*
- Maina, k.(2014). *assessment of the challenges of water supply and sanitation in uncontrolled residential developments. nairobi: kenya.*
- Ministry of water, (2007). *water sector reform in kenya and the human right to water. nairobi kenya.*
- Ministry, n. (2013). *hargeisa household estimation press. hargeisa.*
- Moh.(2005). *health sector development plan iii, 2005/06-2009/10, planning and program. addis ababa,ethiopia.*
- collick & ayele, m. (2012). *assessment of water supply and sanitation. bahirdar ethiopia: water aid and learning and communication research report.*
- Sdf, et al (2014). *haregisa water supply upgrading and extension project. hargeisa.*
- T. s., jarmo et al (2018). *rehabilitation of aging urban water systems:. tampere, finland: tampere university of technology.*
- Water act. (2002). *laws of kenya:. in the water act, and government printer. nairobi,kenya.*
- Uhl& associates. (2012). *hydro-geological assessment of hargeisa city.*
- Unhabitat. (2003). *improving the lives of 100 million slums dwellers toward the millian development goals. nairobi kenya.*
- Un-habitat.(2006). *meeting development goal in small urban center, water and sanitation in the world cities. uk,earthscan.*
- Un-habitat, & huwsup. (2014). *haregisa water supply upgrading and extension project. hargeisa somaliland.*
- Unicef. (2012). *functional assessment with in education health and wash in somaliland.*
- Un-water. (2007). *coping with water scarcity. challenge of the twenty-first century. un-water, fao.*
- Usaid, (2008). *external program evaluation water, sanitation and hygiene (wash). addis ababa.*
- Wateraid, E. (2012). *assessment of water supply and sanitation. bahirdar ethiopia.*
- Wateraid,.(2010). *regional water supply and sanitation coverage ethiopia. addis ababa ethiopia.*
- Who/unicef. (2004). *joint monitoring programme for water supply and sanitation,.*
- Woldemariam, (2009). *water resource management. pietermaritzburg: university of kwazulu-natal.*
- World, b. (1955). *water resource management. washinton d.c: world bank.*

- yilma & donkor, (1997). *strategic issues of fresh water management in. journal of africa development, united nations economic commission for africa (uneca)*,.
- vairavamoothy, k. (2003). *fuzzy approach for the pipe condition. maryland, usa.*
- yonis, & farah. (2015). *challenges of sustaining urban water supply for rapidly growing post war. london: loughborough university uk.*
- Jerald, s., (2010). *Water sustainability in a changing world, fukuoka, japan: university of towa.*
- Mmewr, (2008). *Strategic ground water sources summary by Region in Somaliland*
- Swalim, (2012). *Climate Change Impacts on Water Resources of Somaliland and Puntland*
- Ministry.N.P (2011). *Somaliland food & water security strategy, Somaliland vision 2030*
- M, Biixi. (2017). *Assessment of Challenges and Opportunities of Sustainable Urban Water Supply in Somaliland.*
- Abdiladif, M. (2016). *The Somaliland Hargeisa Water Extension, High-quality Research Support programme (HQRS)*
- Henry Wonder (2007). *Assessing the Challenges of Sustainable Water Supply in Urban Ghana.* Stockholm, Sweden.
- Mmewr, (2002) *national water policy Hargeisa Somaliland*
- Boki, ayanie. (2014) *assessment on urban water supply infrastructure provision and management: the case of adama town, Addis Ababa, Ethiopia.*



**Appendix I**

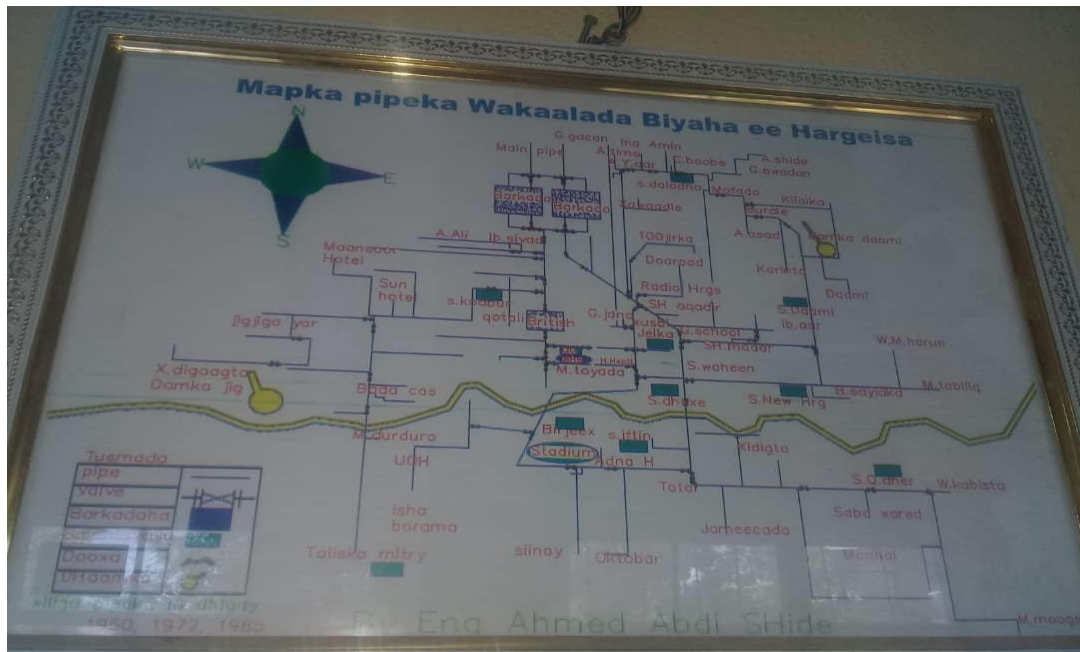


**Hargeisa Water Supply Extension project  
Source: Field Observation**



**Hargeisa Water Supply Extension project pipe line  
Source: Field Observation**

## Appendix II



## Appendix III: Questionnaire

### **Hargeisa Water Supply Existing Pipeline Network**

Dear

### **Source: Field Observation**

respondents,



### **Humba-Wayne Harvesting water Dam**

### **Source: Field Observation**

This questionnaire is geared up as a tool to carry out an academic research for the fulfillment of Master's degree of Science (MA) in Ethiopian Civil Service University College of Urban Development Study Department of Urban Infrastructure Provision and Management. The main objective of the research is to appraise the Water Supply service regarding in Hargeisa city. Therefore, the information you provide is very vital for the research work. Furthermore, the information you give used only for the academic research purpose.

**Thanks in advance for your cooperation.**

**1.1) Personal Profile of the Respondent (please tick on the dash space) (√)**

**1. Sex**

Male \_\_\_\_\_ Female \_\_\_\_\_

**2. Age**

(a) 18-25 \_\_\_\_\_ (b) 25-32 \_\_\_\_\_ (c) 32-40 \_\_\_\_\_ (d) 40 and above \_\_\_\_\_

**3. Marital Status**

(a) Single \_\_\_\_\_ (b) Marriage \_\_\_\_\_ (c) Widowed \_\_\_\_\_

**4. Level of Educational**

(a) Primary/ Secondary \_\_\_\_\_ (b) University degree \_\_\_\_\_ (c) Masters Degree \_\_\_\_\_  
(d)Phd \_\_\_\_\_

**5. Family size**

(a) 2-4 \_\_\_\_\_ (b) 4-8 \_\_\_\_\_ (C) 8-12 \_\_\_\_\_ (D) 12 and above \_\_\_\_\_

**6. Occupation**

a) Jobless \_\_\_\_\_ b) Daily labor \_\_\_\_\_

**7. Financial condition:**

a) Higher middle class \_\_\_\_\_ b) Middle class \_\_\_\_\_ c) Lower class \_\_\_\_\_

**I Assessment Of Status Of Water Supply Service**

. 1) What is the status of water supply in Hargeisa City?

A) Good \_\_\_\_\_ (B) Middle \_\_\_\_\_ (C) Bad \_\_\_\_\_

2) What are the sources of water for your House?

(A) Pipe water \_\_\_\_\_ (B) Hand Dug well \_\_\_\_\_ (C) Spring \_\_\_\_\_

(D) River \_\_\_\_\_ (E) Rain water \_\_\_\_\_ (F) Water truck \_\_\_\_\_

(G) Donkey Cars \_\_\_\_\_

3) Amount of water available in your house in enough your needs?

- A) Strongly disagree\_\_\_\_( B) disagree \_\_\_\_ (C) Neutral\_\_\_\_(D) Agree\_\_\_\_  
 B) (E) Strongly Agree\_\_\_\_

4) Do you have any information about the water supply system of the town?

- (A) Yes \_\_\_\_\_ (B) No \_\_\_\_\_

5) If yes about question 3 what is the concept do you have?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

6) How do you see the role of water supply agency in water service provision in the city?

- (A) Good\_\_\_\_ (B) Very Good\_\_\_\_ (C) Middle\_\_\_\_ (D) Low\_\_\_\_

(E) Very Low\_\_\_\_\_

## **II Assessment of Water Supply And Demand In Household**

1. What is the primary source of drinking water for your household?

- (1) Government, private Commercial Bono \_\_\_\_\_ (2) Private well and  
 Other\_\_\_\_\_

2. Do you have pipe connected to your home?

- (1) Yes \_\_\_\_\_ (2) No\_\_\_\_\_

3. How many liters of drinking water storage Tank do you have?

- (A) 5m<sup>3</sup>\_\_\_\_ (B) 10 m<sup>3</sup>\_\_\_\_ (C) 20 m<sup>3</sup>\_\_\_\_ (D) 25 m<sup>3</sup>\_\_\_\_ (E) above \_\_\_\_\_

4. How often does your household have running water from network pipe/day?

- (1) Not connected\_\_\_\_ (2) Less than 4 hours per day \_\_\_\_\_ (3) 5 to 12  
 hours per day\_\_\_\_\_ (4) More than 12 hours per day\_\_\_\_\_ (5)  
 No Supply\_\_\_\_\_

5 How often does your household have running water from network pipe/week?

- (1)Not connected \_\_\_\_\_ (2) 4-7 days per week\_\_\_\_\_ (3) 2-3 days per  
 week\_\_\_\_\_

(4) Once a week\_\_\_\_\_ (5) Less than ones a week\_\_\_\_\_

(6) No supply\_\_\_\_\_

6 What is your daily water use in dry season (In litters)?

- (1) 10-20 \_\_\_\_\_ (2) 20-40 \_\_\_\_\_ (3) 40 and above \_\_\_\_\_
- 7 What is your daily water use in wet season (In liters)?  
 (1) 10-20 \_\_\_\_\_ (2) 20-40 \_\_\_\_\_ (3) 40 and above \_\_\_\_\_
- 8 How many liters of water do you need for both drinking and domestic water per day? \_\_\_\_\_
- 9 How much times do you fetch water A Month?  
 1) 1 \_\_\_\_\_ 2) 2 \_\_\_\_\_ 3) >3 \_\_\_\_\_ 4) Other, Specify \_\_\_\_\_

**III Challenges Of water Supply:**

- 1) Do you think there are problems with water supply and delivery in Hargeisa?  
 (A) Yes \_\_\_\_\_ (B) No \_\_\_\_\_
- 2) Do you agree that the following issue is the challenges of the water supply problem often exhibited on Hargeisa city?

Challenges of water supply	Five point scale				
	Strongly disagree	Disagree	No idea	Agree	Strongly agree
Lack technical expertise to handle the pumps					
Frequent broken down of pipe lines					
Few pipe lines cannot support fast expansion of township					
Management problems					
Topographic implications					
Limited budget and funds					
Unplanned town expansion					
Electricity power outage problems					
Population pressure					
Environmental degradation					
Unfair distribution of Water					

**IV Role of Stakeholder and Community Participation Involvement of Hargeisa Water Supply System:**

- 1) How do you see the role of stakeholders in Hargeisa water supply system?
  - A) Good\_\_\_\_\_ B) Very Good\_\_\_\_ C) Neutral \_\_\_D) Bad \_\_\_\_\_ E) Very Bad\_\_\_\_\_
- 2) What are the financial sources of water supply projects in Hargeisa?
  - A) Government Budget\_\_\_\_\_ (B) National Investors\_\_\_\_ (C) NGO\_\_\_\_\_ (D) Other Stakeholder \_\_\_\_\_
- 3) Is there any community participation in Financing of the water supply project in your town?
  - A) Yes \_\_\_\_\_ (B) No \_\_\_\_\_ (C) May be \_\_\_\_\_
- 4) What level of community participation
  - A) high\_\_\_\_\_ B) Very high\_\_\_\_ C) neutral \_\_\_\_\_ D) Bad\_\_\_\_\_ E) very Bad

## **Appendix IV: Interview Guide for Officials**

### **2.3) Questions Answered by Hargeisa Water Supply Chief of Executive Manager**

This questionnaire is geared up as a tool to carry out an academic research for the fulfillment

of Master's Degree of urban science (MA) in Ethiopian Civil Service University College of Urban Development Study Department of Urban Infrastructure Provision and Management. The main objective of the research is to appraise the urban Water Supply Infrastructure service and regarding service delivery in Hargeisa town. Therefore, the information you provide is very vital for the research work. Furthermore, the information you give used only for the academic research purpose.

**Thanks in advance for your cooperation.**

#### **2.3.1) Personal Information**

1) Name \_\_\_\_\_ Age \_\_\_\_\_ sex \_\_\_\_\_ your position in the organization \_\_\_\_\_ educational Level \_\_\_\_\_ years of Experience in the office\_\_\_\_\_

#### **2.3.2) Detail Questions about Urban Water Supply Service**

- 1) What is the age and current status of water supply infrastructure service activities in Hargeisa town?
- 2) It there institutional capacity & integration on water project planning, designing, Financing, implementing and management approach and what's role in your Organization?

- 3) What is the trend of water supply infrastructure operation and maintenance service in Hargeisa town?
- 4) What are the major challenges and constraints encountered in the implementation of Providing improved water supply services to the urban dwellers?
- 5) What strategy is set by your office to overcome water supply service challenges as service provider?
- 6) What are the financial sources of water supply projects?  
\_\_\_\_\_
- 7) Finally, how do you see the role of stakeholders and of community participation in promoting inadequate water supply in Hargeisa town?  
\_\_\_\_\_

## **Annex IIV: Interview Guide for Officials.**

### **2.3) Questions Answered by Hargeisa Municipality Water Office And Ministry Water Resources Managers**

This questionnaire is geared up as a tool to carry out an academic research for the fulfillment of Master's degree of Science (MA) in Ethiopian Civil Service University Institute of Urban Development Study Department of Urban Infrastructure Provision and Management. The main objective of the research is to appraise the Water Supply service regarding in Hargeisa city. Therefore, the information you provide is very vital for the research work. Furthermore, the information you give used only for the academic research purpose.

**Thanks in advance for your cooperation.**

#### **2.3.1) Personal Information**

1) Name \_\_\_\_\_ Age \_\_\_\_\_ sex \_\_\_\_\_ your position in the organization \_\_\_\_\_ educational Level \_\_\_\_\_ years of Experience in the office \_\_\_\_\_

#### **2.3.2) Detail Questions about Urban Water Supply Service.**

- 1) What is the age and current status of water supply infrastructure service activities in Hargeisa town?
- 2) What's is the role of institutional capacity & integration on water project planning, designing, financing, implementing and management approach in your institution?

3) What is the trend of water supply infrastructure operation and maintenance service in Hargeisa town?

4) What are the major challenges and constraints encountered in the implementation of providing improved water supply services to the urban dwellers?

5) What strategy is set by your office to overcome water supply service challenges as service provider?

6) What are the financial sources of water supply projects in City?  
\_\_\_\_\_ 7) finally, how do you see the role of stakeholders and of community participation in promoting inadequate water supply in Hargeisa Town? \_\_\_\_\_