ADDIS ABABA UNIVERSITY

SCHOOL OF GRADUATE STUDIES

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CENTER FOR ENVIRONMENT AND DEVELOPMENT

Water Supply, Sanitation and Hygiene (WASH) in Jigjiga Town: Status and Trends, Associated Factors, and Opportunities

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A Thesis Submitted to
The Department of Water Resources Management

Presented In Partial Fulfillment of the Requirements for the Degree of Master of Science in Water Resources Management

Addis Ababa University
Addis Ababa, Ethiopia
June 2021

ADDIS ABABA UNIVERSITY

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DECLARATION

This thesis is my original work and has not been presented for MA/MSc degree in any other University and that all the sources and materials used for the thesis have been properly acknowledged.

Declared By: Mohamed Ismail

Signature:_____ **Date**: 28/06/2021

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ABSTRACT

Water, Sanitation, and Hygiene (WASH) are vital to human health and wellbeing. Many developing countries, like Ethiopia, face many challenges in achieving improved water supply, improved sanitation and proper hygiene practices. This study examined the associated factors and opportunities of Water Supply and Sanitation as well as the behavior of the people towards hygiene practices use in Jigjiga. The study design was mixed with using both quantitative and qualitative approaches. Questionnaire, key informant interview and observations were the main data collection tools. The data collected were analyzed through both descriptive and inferential analysis techniques; mean, standard deviation, multiple regressions, Pearson's correlation and so on. The study found that political factors are more significant than socio-economic factors in improved water supply and sanitation. To overcome the challenges of water supply and sanitation, results revealed that privatizing part of the operation and management would be a massive opportunity. Furthermore, the behavior of people towards hygiene practices use is associated with the attitude, perceived behavioral control and intention variables (r= .478, .551, .497 respectively, with p< 0.01*). Finally, the study recommends encouraging private sectors' involvement in water supply and sanitation, raising awareness programs on efficient use of water and the important of hygiene. It also suggests a further research about the importance of ecological and environmental factors in improved water supply and sanitation.*

Key words: Behavior, Hygiene, Sanitation, Water Supply,

DEDICATION

This is dedicated to my lovely parents; Ismail Muhumed and Khadra Nuh.

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ABBREVIATIONS

CSA – Central Statistics Agency

DSM-SWSR – Demand Side Management-Sustainable Water Resource

FGD – Focus Group Discussion

IBM-WASH – Integrated Behavioral Model for WASH

IMS – Integrated Management System

KMA – Kumasi Metropolitan Assembly

LCA – Life Cycle Assessment

MCM – Million Cubic Meters

MDG – Millennium Development Goals

MFA – Material Flow Analysis

OWNP – One WASH National Program

SSA – Sub-Saharan Africa

SNRS-WRDB – Somali National Regional State Water Resource Development Bureau

SSM-NRW – Supply Side Management Non-Revenue Water Reduction

TPB –Theory of Planned Behavior

TRA – Theory of Reasoned Action

UAP – Universal Access Plan

USAID – United States Agency for International Development

WASH – Water, Sanitation and Hygiene

WEAP – Water Evaluation and Planning System

WHO – World Health Organization

WSS – Water Supply and Sanitation

CHAPTER ONE

INTRODUCTION

1.1. Background

The use of improved water supply and sanitation is a basic need for human life. Globally, it is estimated that 1.1 billion people lack access to improved water supplies and 2.6 billion people lack adequate sanitation due to five major obstacles including; contamination of water in distribution systems, growing water scarcity and the potential for water reuse and conservation, implementing innovative low-cost sanitation systems, providing sustainable water supplies and sanitation for big cities, and reducing global and regional disparities in access to water and sanitation and developing financially sustainable water and sanitation services (Moe & Rheingans, 2006). In the developing world, 1.5 million children lose their lives every year, before the age of five, due to diarrhea and about 90% of this issue can be solved by a safe water supply, sanitation, and hygiene (Mosler, 2012).

According to (USAID, 2015), Ethiopia is one of the lowest in Africa in providing accessible water and sanitation services although it has untapped sufficient water resources. Some of the major challenges of managing water resources effectively and efficiently are due to financial and technical challenges. The situation of sanitation in the country is yet far from the targets; more than half of the population, mainly the poor, lack improved sanitation services and vulnerable to water and sanitation-related diseases. The major factors that affect the improvement of sanitation system in general and access to improved sanitation in particular are said to be inappropriate strategies, policies, and actions, weak stakeholders coordination, and very limited national budget allocations (Beyene et al., 2015).

In response to that, the government has launched the Universal Access Plan (UAP) – the plan was aimed to ensure access to safe water and sanitation by all by 2012 (Macdonald & Dochartaigh, 2009). The government has also made efforts to decentralize some of its responsibilities in water and sanitation, including the implementation of water and sanitation policies and strategies to the regional and local governments (Shanmugham et al., 2011). In addition, One WASH National

Program (OWNP), which is an integrated approach of harmonizing WASH plans, budgets, and actions, is one of the main national efforts to improve and achieve water, sanitation and hygiene results (Richard et al., 2018).

However, in Jigjiga, the current water supply system of the city was designed in 1975 by a German consultancy with the expectation of around 20,000 people to receive water from and generally, water is distributed through piped systems and on-site sources (Asfaw et al., 2016). It is obvious that the demand for water and sanitation is much higher due to rapid urban population growth and climate change effects. The city has one of the highest urban population growth rates in the country with 9.9% per annum (Gebregergis et al., 2016). Although demands for clean water are rapidly increasing, the only source of water for drinking and agricultural purpose throughout the Somali regional state is the underground water (Werkneh et al., 2015). In terms of accessibility, only 9% have access to piped water, while 4.5% and 9.5% get water from bore-holes and dug-wells, respectively. That made up only 24.2% of the water technologies used in the region is improved technologies and the remaining 75.8% of the technology used in the region employed for water supply is unimproved technology (Hundie & Abdisa, 2016).

1.2. Statement of the Problem

The provision of safe and affordable drinking water and adequate sanitation services has become unachievable for many countries and the situation is more worse for many countries in the developing world (Salami et al., 2014). Sub-Saharan Africa (SSA) has experienced difficulty in achieving the Millennium Development Goals (MDG) and targets towards water supply and sanitation. SSA countries accomplished coverage of 61 percent for improved water supply sources (WHO/UNICEF, 2012). Although it is understandable that the situation of water supply and sanitation varies through the regional states of Ethiopia, the country has generally met its MDG target of 57% access for water supply. In rural areas, 35 million people got access to piped and protected water sources between 1994 and 2015. In urban areas, an additional 10 million people gained access to piped water on premises including the benefits of convenience and time savings. But, MDG targets for sanitation have not been

achieved, although there was a significant progress made in reducing open defecation in rural areas (Jones et al., 2017). According to One WASH National Program (OWNP) review 2018, only 28 percent of people has access to improved sanitation and hygiene appears to be low as well.

However, in Ethiopia, 75 percent of health problems are resulted from communicable diseases (Asfaw et al., 2016) and 60–80 percent of the communicable diseases are due to unsafe and inadequate water supply and poor hygienic and sanitation practices (Soboksa et al., 2020). The Somali regional state of Ethiopia has its own challenges related to water supply and sanitation including that Somali region receives less rainfall than other regions, has more complex hydrogeology, has under-resourced regional and district technical expertise and capacity, and is sparsely populated by people practicing agro-pastoralism and pastoralism. The quantity and distribution across districts of water supply schemes are not sufficient to meet the demands of the population and their livestock (UNICEF, 2019).

Furthermore, it is estimated that the percent of households using improved drinking water sources is the lowest in Ethiopia with 42 percent of households use improved drinking water sources in Somali region. This is under the national average of 65 percent. While, for sanitation, 12 percent of rural households and 26 percent of urban households have access to improved sanitation facilities. 17 percent of households have an improved but shared toilet facility; this is relatively high compared to the other regions (CSA, 2017). According to the Ethiopian-Somali Regional Health Bureau, diarrhea is the first leading cause of morbidity and mortality in the region and it is found that lack of hand-washing practices, drinking water from unprotected sources and improper storage of water are the associated factors of such disease (Hashi et al., 2016).

Apart from that, several studies have been carried out about water supply and sanitation in the study area including; Water Supply Accessibility and Associated Factors Chekol et al. (2020), where it is found that fifth of households in Jigjiga have the access in water supply that meet standard and that water accessibility is associated with education status and having a private pipe water supply; Physico-chemical

Analysis of Drinking Water Quality (Werkneh et al., 2015); Households' Willingness To Pay For Improved Water Supply (Hundie et al., 2016), where it is discovered that age, monthly income of the household, family size and source of water are significant variables that explain willingness to pay for improved water service; and Solid Waste Management Practices and the Role of Public Participation (Birhanu et al., 2019). However, there is no any study about the associated factors of Water Supply, Sanitation and Hygiene (WASH) in the study area, which has attempted to figure out its status, associated factors, and opportunities. Therefore, this study was intended to get answer for the question of what are the associated factors of WASH.

1.3. Objective of the Study

4.3.1. General Objective

The main aim of this study is to assess the status, associated factors and opportunities of Water Supply, Sanitation and Hygiene (WASH) in Jigjiga town.

4.3.2. Specific Objectives

- To assess the status and trends of Water Supply and Sanitation (WSS)
- To examine factors associated with improved water supply and sanitation
- To explore the current opportunities for improving water supply and sanitation
- To examine the behavior of the people towards hygiene practices use

1.4. Research Questions

- What are the status and trends of Water Supply and Sanitation?
- Is political factor very important in affecting water supply and sanitation in jigjiga as compared with social and economic factors?
- What are the current opportunities for improving of water supply and sanitation?
- What is the behavior of the people towards hygiene practices?

1.5. Significance of the Study

The study aims at assessing status, associated factors, and opportunities of WASH in Jigjiga town. It will be benefited by different people including decision-makers, academicians, etc.

- *From policy implication point of view,* information is always an issue and many times decision has to be made with knowing less about the current situation of a certain issue and the result of this research will help decision-makers develop policies, plans, strategies and take appropriate actions on Water Supply, Sanitation and Hygiene (WASH) improvements.

- *From academic point of view***,** based on the findings of this study, recommendations about the future possible studies that could be conducted are shared and this will support other researchers and academicians who are willing to write about Water, Sanitation and Hygiene (WASH) to find research topics easily.

As a result, the usage of the information of this study will improve the overall situation WASH of the city.

1.6. Scope the Study

Geographical Scope; the research concentrated and confined to the geographical boundaries of Jigjiga town to assess WASH.

Content Scope; the research focused on investigating the status, associated factors, and opportunities of WASH in Jigjiga town.

Time Scope; the research carried out for a period of 4 months, as from March 2021 to June 2021, concentrating on the status, associated factors, and opportunities WASH in Jigjiga town.

1.7. Limitations of the Study

Financial issue; research task requires multiple resources to be fully, accurately, and reliably conducted. One of the main resources is having the finance to have done daily activities through the time of setting up the objectives up-to presenting and reporting the final findings. For this research, finance was one of the major

problems, because you sometimes have to go back to one office more than ten times to get certain data from, or to have an interview with an expert as everyone is doing their duties or following up an unreturned questionnaire form, but with the help of friends as data collectors and connecting dots with familiar faces made possible to overcome more financial need.

Covid-19 effect; as the second consecutive year of dealing with coronavirus, things are still have to come back normal, where physical contact, people gathering and normal meetings are yet to be avoided, this research had to compromise some data collection tools including Focus Group Discussions (FGD) which could add an additional and detailed information to get answers for the research questions.

Access to data; as there is no proper documentation uniformly in the region, getting some of the data was another issue. In some cases, it had to be waited for that one employee who is on their annual leave to comeback to office to get data or simply the permission, which again made *time resources* an issue to be considered.

1.8. Organization of the Study

This thesis will be organized into five chapters. The first part is an introductory part. The second chapter deals with the review of related literature obtained from various published and unpublished reference materials. The third part of the thesis describes the methodology of the research. The fourth chapter is the results and discussions to present the analysis and its interpretation of the data, which is about the water supply; sanitation and hygiene (WASH) of Jigjiga town. The last part of this study is chapter five which is the conclusion and recommendation. And finally, Bibliographies, pictures, and appendices will also be attached at the end of the paper.

CHAPTER TWO

LITERATURE REVIEW

2.1. Conceptual Definitions

Sanitation: the definition of 'sanitation' varies through different disciplines and organizations and linked to public health, engineering and to a lesser extent, to environmental sustainability (Feris, 2015). But according to Centers for Disease Control and Prevention, 2017; Basic sanitation is described as having access to facilities for the safe disposal of human waste (feces and urine), as well as having the ability to maintain hygienic conditions, through services such as garbage collection, industrial/hazardous waste management, and wastewater treatment and disposal.

It is also defined as the use of improved facilities that are not shared with other households." Improved facilities include "flush/pour flush to piped sewer systems, septic tanks or pit latrines; ventilated improved pit latrines, composting toilets or pit latrines with slabs (Capone et al., 2020).

WASH (or Watsan, WaSH): is an acronym that stands for "water, sanitation and hygiene"

Improved Water Supply: the term 'improved water supply' refers water supplies with piped water into dwelling, plot or yard; public tap; tube-well or borehole; protected dug well or spring; and collected rainwater. To be classified as improved, the water supply must provide at least 20 litres per capita per day from a protected source within 1 km of the user's dwelling (WHO, 2008).

2.2. Theories and Models of water supply and sanitation

2.2.1. Theory of Planned Behavior

The Theory of Planned Behavior (TPB), previously known as the Theory of Reasoned Action (TRA), was developed by Ajzen and Fishbein in 1980. TPB predicts a person's desire to behave in a certain way or to engage in a behavior at specific moment and location (Icek, 1991). The theory aimed to explain the ability of individuals to perform or do not perform a behavior and factors that influence them.

The theory has three major factors that influence a person's intention to engage in a behavior; attitude of the person towards a behavior, subjective norms or a person's peer evaluation about their concern over a certain behavior, and the perceived behavioral control, which is a person's believe about their ability to performing a behavior (Madden et al., 1992).

2.2.2. The RANAS Model of Behavior Change for Water and Sanitation

RANAS Model was created for water and sanitation practices. The model contains of five blocks of factors; **risk factors** (including all factors that related to individual's understanding and awareness of health risks), **attitudinal factors** (all factors those shape an individual's mindset towards the positivity and negativity of engaging a behavior), **normative factors** (social related factors about the behavior), **ability factors** (individual believes about the ability to perform a behavior) and **self-regulations factors** (factors that influence the continuance and maintenance of the behavior) (Mosler, 2012).

The aim of this model is to develop a methodological approach that should enable intended behavior change by presenting: (1) a conceptual behavioral model based on sound psychological evidence and theory, (2) the behavior change techniques corresponding to the factors to be changed, and (3) an analytical tool for deriving the factors to be changed on the basis of quantitative data (Mosler, 2012).

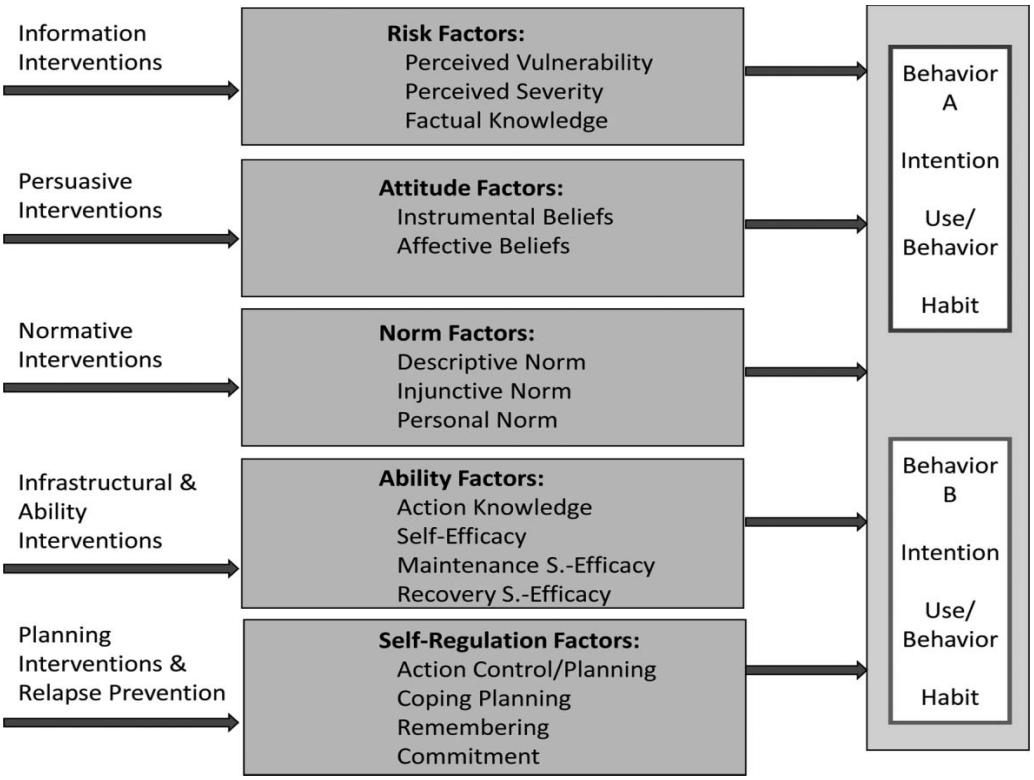

Figure 2.1: the RANAS model for behavior change for WASH

Source: (Mosler, 2012).

2.2.3. The Integrated Behavioral Model for Water, Sanitation and Hygiene (IBM-WASH)

The Integrated Behavioral Model for WASH (IBM-WASH) is a synthesized some of the existing behavioral models. IBM-WASH is built as a matrix, three dimensions to be the columns of the matric and five levels to be the rows of the matrix (Dreibelbis et al., 2013).

The three dimensions that influence WASH behaviors are the Contextual Dimension includes determinants related to the individual, setting, and/or environment that can influence behavior change and adoption of new technologies. The Psychosocial Dimension comprises the behavioral, social, or psychological determinants that influence behavioral outcomes and technology adoption. The Technological Dimension consists of the attributes of a technology, product or device that influence

its adoption and sustained use. Those, aforementioned, interacting dimensions reflect the concept of reciprocal determinism in Social Cognitive Theory, which describes mutual interactions between the individual, the behavior, and the environment in which the behavior is practiced (Dreibelbis et al., 2013).

The five levels of the IBM-WASH model including the Societal / Structural Level of the model refers to the broad organizational, institutional, or cultural factors that influence behaviors in each of our three dimensions. This includes factors such as laws, policies, climate, geography, geology, and manufacturing and commercial distribution of products. The Community Level includes the physical and social environment in which individuals are nested, as well as the formal and informal institutions that shape individual experiences. It is analogous to both the Institutional and the Community factors. The Interpersonal/Household Level represents interactions between individuals and the people they intimately associate with, including household members, close friends and neighbors. At this level, factors include roles and responsibilities in the household, household wealth, injunctive and descriptive norms, aspirations, shame, sharing access to a product, and behavioral modeling. The Individual Level includes socio-demographic factors – such as age and gender, individual cognitive factors, and attitudes toward the product, hardware, or behavior. The final level of the model is the Habitual Level which reflects the fact that the opportunity and necessity for WASH-related behaviors are repeated over the course of the day, and the multiple processes or events that can result in the specific behavioral outcomes (Dreibelbis et al., 2013).

Table 2.1: The IBM-WASH framework

Levels	Contextual factors	Psychosocial factors	Technology factors
Societal/Structural	Policy and regulations, climate and Geography	Leadership/advocacy, cultural identity	Manufacturing, financing, and distribution of the product; current and past national policies and promotion of products
Community	Access to markets, access to resources, built and physical environment	Shared values, collective efficacy, social integration, stigma	Location, access, availability, individual vs. collective ownership/access, and maintenance of the product
Interpersonal/Household	Roles and responsibilities, household	Injunctive norms,	Sharing of access to product, modelling/

	structure, division of labour, available Space	descriptive norms, aspirations, shame, nurture	demonstration of use of product
Individual	Wealth, age, education, gender, livelihoods/employment	Self-efficacy, knowledge, disgust, perceived threat	Perceived cost, value, convenience, and other strengths and weaknesses of the product
Habitual	Favourable environment for habit formation, opportunity for and barriers to repetition of behavior	Existing water and sanitation habits, outcome expectations	Ease/Effectiveness of routine use of product
Levels	Contextual factors	Psychosocial factors	Technology factors
Societal/Structural	Policy and regulations, climate and Geography	Leadership/advocacy, cultural identity	Manufacturing, financing, and distribution of the product; current and past national policies and promotion of products
Community	Access to markets, access to resources, built and physical environment	Shared values, collective efficacy, social integration, stigma	Location, access, availability, individual vs. collective ownership/access, and maintenance of the product
Interpersonal/Household	Roles and responsibilities, household structure, division of labour, available Space	Injunctive norms, descriptive norms, aspirations, shame, nurture	Sharing of access to product, modelling/ demonstration of use of product
Individual	Wealth, age, education, gender, livelihoods/employment	Self-efficacy, knowledge, disgust, perceived threat	Perceived cost, value, convenience, and other strengths and weaknesses of the product
Habitual	Favourable environment for habit formation, opportunity for and barriers to repetition of behavior	Existing water and sanitation habits, outcome Expectations	Ease/Effectiveness of routine use of product

Source: (Dreibelbis et al., 2013)

2.3. Global WASH

According to UN-Water (2021) report on Sustainable Development Goal 6 (SDG-6), it is depicted that 26% (2 billion) of the world's population lack safely managed drinking water services in 2020, while 46% (3.6 billion) of the world's population lacked safely managed sanitation services and 494 million people practiced open defecation in 2020. Also, 29% (2.3 billion) of world's population lacked a based hand-washing facility with soap and water at home in 2020.

In the developing countries, rapid population growth and urbanization impacts an increase in improper settlements, poor infrastructure networks and planning systems.

That contributes to the lack of access to safe drinking water, basic sanitation and hand-washing facilities (Bishoge, 2021).

2.4. Water supply and sanitation in Ethiopia

Ethiopia is one of the lowest in Africa for water supply due to the factors of topography, sources of water reserve, distribution systems, treatment plants, and community health centers (Shanmugham et al., 2011). Lots of attempts to improve Water and Sanitation has been made and there is a significant progress made in access to improved water and basic sanitation, but the actual condition of sanitation varies through the country (Seyoum et al., 2016).

2.4.1. Trends of access to improved water supply and sanitation

In 2005, the proportion of the population using improved water was 61.4% and it went down to 53.6% in 2011. The proportion of urban households that use improved water supplies has reached up to 94.3% in 2011, while more than half of the rural population (58.3%) consumed water from unimproved sources (Seyoum & Graham, 2016). In 2004, majority of the Ethiopian population used unimproved sanitation services, most of the population was practicing open defecation method, and this made Ethiopia to be far away from the MDG target for sanitation. In the trends of access to sanitation coverage, the country had made a huge progress in the period of 1990-2014, from 4% up to 47.9%, unfortunately, it could not achieve the MDG sanitation target of 56% (Beyene et al., 2015).

Table 2.2: Proportion of households with access to improved drinking water and sanitation by regions in Ethiopia, 2016.

Region	Access to improved drinking water	Access to improved sanitation	Numbers of enumeration areas
National	49.6 (48.4–50.7)	6.3 (5.8–6.8)	643
Addis Ababa	95.3 (94.1–96.2)	22.7 (20.5–24.9)	56
Afar	41.0 (37.8–44.4)	4.1 (3.0–5.7)	53
Amhara	45.9 (43.5–48.2)	1.7 (1.2–2.5)	71
Benishangul	62.0 (59.1–64.7)	1.8 (1.2–2.8)	50
Dire Dawa	75.9 (73.1–78.5)	24.0 (21.5–26.8)	44
Gambela	74.5 (71.8–77.1)	8.2 (6.6–10.2)	50
Harari	73.7 (70.9–76.2)	17.1 (15.0–19.5)	44
Oromia	51.5 (49.2–53.8)	5.6 (4.7–6.8)	74
SNNPR	39.3 (37.1–41.6)	8.0 (6.8–9.3)	71

Somali	28.5 (25.9–31.3)	12.3 (10.3–14.6)	67
Tigray	57.3 (55.0–60.0)	7.7 (6.5–9.1)	63

Source: (Azage et al., 2020)

2.5. Challenges of water supply and sanitation in Ethiopia

Providing enough and safe drinking water is going to be more difficult in the world. Although fresh water is finite and only amounts 2.5% of the water on the earth, what makes the situation more worse is global warming and climate change, changes in distribution, and the increasing pollution (Ahmadi et al., 2020). Globally, 2.6 billion people lack access to improved sanitation and it results both health and environmental issues (Dahlman, 2009).

Furthermore, the hugeness of the challenge of securing fresh water and basic sanitation for human differs through different contexts. Most probably, it depends on the geographical location and socio-economic status of a certain country (Proskuryakova et al., 2017).

2.5.1. Water Supply

Water supply, in Ethiopia, has challenged by many issues including the rapid population growth per unit area, water scarcity, polluted surface water and water which is not found at the right place where people reside in (Reimann et al., 2003). According to Taye et al. (2018), water resources in general and Awash basin water resources in particular, has impacted by the highly growing demands caused by the inevitable urban population growth and urbanization, industries and the growing demands of agriculture sector for water. It is also predicted that capital city of Addis Ababa will face water shortage because of the combination of factors of climate change and urbanization (Kifle et al., 2017).

2.5.2. Sanitation

The limitation of using basic sanitation is associated with cultural practices and socio-economic factors (UNICEF & WHO, 2017). The rapid urban population growth has also impacted the Sub-Saharan countries, like Ethiopia, to make progress in access to basic sanitation (Hopewell & Graham, 2014).

2.6. Best Practices of Water Supply and Sanitation

2.6.1. Addis Ababa, Ethiopia

Alemu et al. (2020) have made scenario analysis to predict future water supply and demand of Addis Ababa, Ethiopia by using Water Evaluation and Planning system (WEAP) model. These scenarios are classified into four groups; Reference, External Driven Factor, Water Management, and Future Predicted scenarios.

Reference scenario, which is also known as *the business-as-usual scenario*, keeps all key assumptions and other factors constant, but socio-economic and demographic factors goes up at the projected rates. It also becomes a benchmark for comparing the results of the other scenarios. *External driven factor scenarios*, few assumptions have been taken to anticipate the influence of external factors on water demand; from the dimension of population, three assumptions have been taken, high population growth with 4.5% increase annually, medium population growth with about 2.5% increase annually, and low population growth with 1.5% increase annually. While, for high living of standard, only the factor of water use rate is employed as 150 LPD. For *water management scenario*, the authors were more optimistic. For both of the strategies employed in this scenario (Demand side management-sustainable water resource and reuse (DSM-SWSR) and Supply side management and non-revenue water reduction (SSM-NRW)), it is assumed both consumers and suppliers apply good water management strategies, technologies and made significant changes. Integrated management strategies (IMS), here, it is assumed government starts to minimize the nonrevenue water and incorporates the practice of demand side management strategies by creating awareness programs. Lastly, *Future predicted scenarios* were made of the combination of the external factors and water management strategies into three future scenarios to predict the future water demand of the city. Three possible combinations were formed based on 'What if' condition; (1) *Pessimistic future (PF),* for this case, it is firstly assumed 50% of NRW and there is no any measure taken to reduce the NRW, secondly, there is 2% sustainable water sources including reuse rate, and thirdly, 4.5% of population growth rate, (2) *Moderate future (MS),* in this moderate prediction, it is assumed sustainable water use

and reuse as well as as supply side measure like NRW practices in such a way that the percentage change is medium; it is above the reference scenario and below the assumptions of the optimistic future. *Optimistic future (OF),* the case is designed by considering different strategies such as supply and demand side measures and population growth control. With 10% of NRW and 30% of the nonrevenue water reduction takes place by the supply management strategies, 15% sustainable water sources including reuse rate and the demand side management strategies are applied, and 1.5% population growth rate estimation.

The results show the predictions of unmet water demand for external driven factor scenario and the projected population of the city using low population growth rate (1.5%) and high population growth rate (4.5%) will be about 4.57 and 7.07 million people respectively by 2030. The total unmet water demand by 2030 for the HPGR + HLS scenarios would grow to 583 MCM; this represents about 90% increase in comparison to the Ref case. However, considering only living standard; as incomes grow and the household water requirements increase, the unmet water demand of Addis Ababa in HLS scenario is expected to grow to around 410 MCM by 2030; indicating about 34% increase when compared with the Ref scenario.

The results for water management scenario, analysis of DSM-SWSR scenario indicates that with the effective implementation of different management strategies at the demand side, unmet water demand will grow to 262 MCM by 2030. This value is about 15% decrease when compared with the Ref scenario. In the SSM-NRW scenario, it was assumed that measures were taken at the supply side to improve the efficiency of water supply system in the city. Consequently, analysis of this scenario shows that unmet water demand will reach 227 MCM by 2030, which represents about 26% reduction in unmet water demand with respect to the Ref case.

For future predicted scenario results, with the three possible combinations; (i.e. Optimistic, Moderate, and Pessimistic futures), the findings depict future predicted scenario analysis and their comparative analysis with the reference scenario indicates that unmet water demand in the PF scenario will reach 728 MCM by 2030—over

130% increase compared to the Ref scenario. But, in the MF scenario, unmet water demand is expected to reach 283 MCM by 2030; about 8% reduction in comparison to the Ref scenario. On the other hand, the unmet water demand for the OF scenario grows to 164 MCM or 47% reduction in unmet water demand relative to the Ref case.

2.6.2. Kumasi, Ghana

For handling liquid household waste in Kumasi city, three sanitation scenarios were developed by Dahlman (2009), including the *Urine diversion, the Biogas*, and *the Waterborne scenario.* The model was built based on material flow analysis (MFA) and life cycle assessment (LCA) to analyze the environmental performance of the scenarios. The residential areas in the city has been categorized into five residential categories same to those used in Kumasi Metropolitan Assembly (KMA), in the Sanitation Strategic Plan; *the Indigenous, the Tenement, the Government, the High cost sectors and the newly developing sector*.

The Indigenous residential area is the older part of the city and the major house form is the single storey compound, the traditional Ghanaian housing. It is a building surrounding a common courtyard (where most household activities are performed) with direct entrance to 10-15 rooms, rented out one by one. Almost two-third of the households live only in one room and these areas are highly dense with 80-250 p/ha, 25% connected to yard tap, while 75% buy from neighbors. For sanitation technologies majority of them (60%) use public latrine and 25% use pit latrines. *The tenement sector* consists mainly of multi-storey compounds, but also of up to four-storey apartment houses. Also this sector is very crowded (with 200-300 p/ha), while for water, 90% house connections, of which 25% have multiple fixtures. For sanitation, 45% use septic tanks, 40% public latrine, 10% simplified sewers and standards are generally higher than in the indigenous sector. *The government sector* is government's housing for people to be rented or bought. The house type is bungalows and tenants usually rent one or two rooms. The area is less dense with 50 p/ha and for sanitation, 100% use septic tanks – partial drain fields. The high cost sector consists of villas in spacious lots. The residential areas developed as suburbs, initially around

the dwellings of the colonial officers, but are today partly integrated in the urban area and the population density is 10-15 p/ha, while for sanitation, 100% of the people use septic tanks, partial drain fields, all houses full internal plumbing. *The newly developing sector* is typically in detached single family houses on 30x30m plots. 15% of the population lives in this area. The population dense for this area is 5-10% and they use 100% septic tanks without drain field. Again, the city is grouped into dense areas (the indigenous and the tenement sector) and spatial areas (the government and the high cost sector).

For scenario one – *The urine diverting scenario;* for dense areas, where reuse practices are not that much feasible, dehydration toilets are chosen as they do require a little commitment from the user result in a product of less weight than faeces and compost, which simplifies transport. Simply urine is stored under the toilet in a small container and both dehydrated faeces and urine are transported to treatment station. Compost and treated urine is collected and used by any of the urban farmers in the vicinity. The remains must be transported to peri-urban/rural farmers, or be disposed of in a different manner. For spatial areas, Urine diverting compost toilets have been chosen. About 60% - 70% of the people in this area practice backyard-farming and compost and urine can be utilized as fertilizer. 60% of the total food consumption is from urban and peri-urban agriculture. Greywater is either discharged into the open gutter system, or locally infiltrated in vertical flow filters. Water that has gone through the filter can either be collected and used for irrigation, or be infiltrated.

For scenario two – *The biogas scenario;* for dense areas, biogas plants are placed at a local level with a simple design, without energy demand. For the simulations, a settling tank and a sand filter were chosen. UV light does not affect the simulation variables nitrogen and phosphorus, but is in some cases necessary to obtain a pathogen count low enough, depending on the destination of the effluent (release to surface water/ restricted/unrestricted irrigation, cleaning water etc). Nutrients and organic material in the effluent contribute to eutrophication if released into surface waters, while they add fertilizing value to irrigation water. For spatial areas, a similar system was chosen also for the spatial areas. The difference between the two lies in

the local reuse potential and the handling of greywater (the latter the same as in the spatial areas in the urine diversion scenario).

For scenario three – *The waterborne scenario;* for existing septic tanks, the already today existing WC-septic tank systems in the high cost, the government and the newly developing sectors will remain. Drain fields have been repaired. A grease trap placed after the septic tank prevents clogging in the drain field. For other areas and all new development, Simplified sewerage and treatment in waste stabilization ponds have been chosen for all other areas, as well as for future growth within the high cost, the government and the newly developing sectors. A grease trap prevents clogging in the sewers and a rock filter following the WSP lowers the amount of suspended solids usually associated with WSP effluents.

2.7. Conceptual Framework

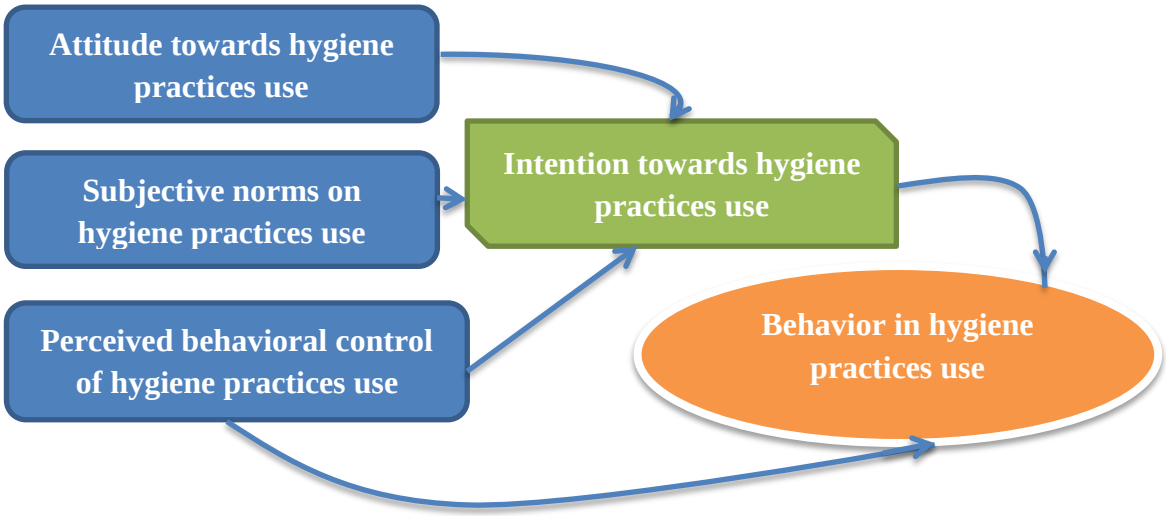

Figure-2.4: Conceptual framework

Source: (Madden et al., 1992).

The conceptual framework was drawn from the literature. It assumes that attitude, subjective norms and perceived behavioral control predict the intention of the people on behavior.

CHAPTER THREE

MATERIALS AND METHODS

3.1. Description of the Study Area

Jigjiga, the capital city of Somali National Regional State of East Ethiopia, is about 630km East from Addis Ababa City and 105km from Harar city of East Hararge Zone of Oromia and Harari Region. The city is geographically located between 9° 16' 30" to 9° 24' 30" N Latitude and 42° 44' 0" to 42° 51' 0" E Longitude. It has an elevation of 1609 meters above sea level. Based on figures from the central statistical agency in 2005, Jigjiga has an estimated total population of 98,076 of whom 50,355 are men and 47,721 are women. The climate of Jigjiga is a subtropical highland climate with the influence of mountain climate, with hot and dry summers and cold winters. This is attributed to the fact that Jigjiga is located on a plain surrounded by mountains and to its distance to the sea and its effects. The annual average temperature and annual rainfall range are between 25 to 31 °C and 11 to 712 mm respectively. The % humidity was in the range of 45 to 70%.

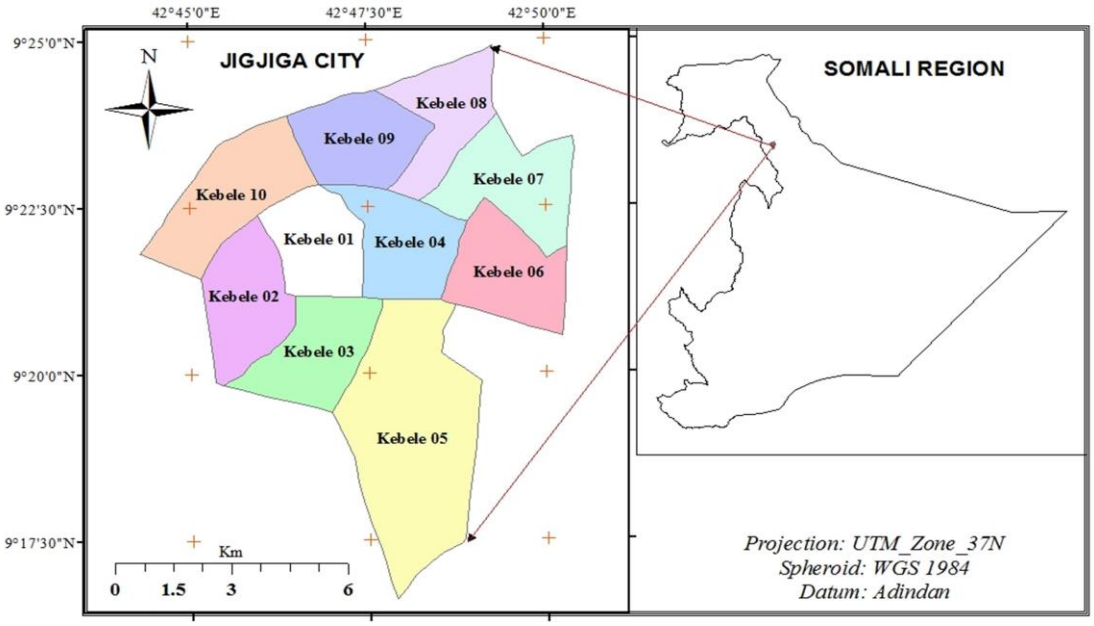

Figure-3.1: Location map of the study area

Source: (Birhanu & Berisa, 2019)

3.2. Research Design

This research employed mixed research design as it has intended to look for the associated factors and opportunities of water supply and sanitation. The research used both quantitative and qualitative approaches to look at the issue from different angles and substantiate information collected through both of the approaches.

3.3. Sampling Technique and Size

As aforementioned, Jigjiga is the capital city of Somali regional state as well as one of the woredas of Fafan Zone (sometimes called Jigjiga zone). According to the population projection at woreda level by Ethiopian Central Statistical Agency (CSA 2017), Jigjiga city has a population of 125,876 (CSA, 2007). The city has 10 kebeles. Then, a simple random sampling technique was employed to select 4 kebeles in the town. Kebele 3, Kebele 6, Kebele 8 and Kebele 10 were selected. Again, a simple random sampling was used to select respondents within the Kebeles. This kind of selection provides and ensures representation of the total population and results in more reliable and wide-detailed information.

According to Azage et al. (2020), in Ethiopia, Somali region has the lowest rate in access to improved water 28.5% with confidence interval (CI) of 95%. To determine the sample size, studies employ different formulas based on their research approach and/or desired objective. For this study, the sample size was computed by the sample size proportion formula ($n= Z_{\alpha/2}^2 *p*(1-p) / MOE^2$) with 95% of confidence level (Z=1.96) and Margin of Error (MOE) of 0.80, as illustrated below.

$n= Z_{\alpha/2}^2 *p*(1-p) / MOE^2$ **{where n= sample size; Z= Z score; p= proportion; MOE= Margin of Error}**

$n= (1.96)^2*0.285*(1-0.285) / (0.080)^2$

n= 0.8120448 / 0.0064 **n= 126.8; n= 127**

3.4. Tools and Techniques of Data Collection

3.4.1. Primary Data

To obtain detailed information about the issue, this research employed questionnaire survey, KIIs and field observation for primary data collection.

Questionnaire Survey

Questionnaire is a research instrument consisting of a set of questions (items) intended to capture responses from respondents in a standardized manner. Structured questions were asked for households of the city to select an answer from a given set of choices. It was designed and preferred with the intention to get a wide and large amount of information (including the socio-demographic characters of the respondents) from the sampled 127 persons within short period of time (less than 30 days). The respondents of the questionnaire were given enough time to give responses carefully and the response rate was maintained by a regular follow up. Based on the number of households in the selected Kebeles, proportion of sample size for each Kebele was calculated. The table below summarizes it.

Table 3.1: Sample size distribution

No.	Kebele	Population (HH)	Sample distribution
1.	Kebele 3	678	14
2.	Kebele 6	2,824	57
3.	Kebele 8	1,745	35
4.	Kebele 10	1,011	21

Source: Researcher's own survey, 2021

Key Informant Interview (KII)

Key Informant Interview (KII) was also used with the intention of obtaining in-depth information and to limit the discussions with the research scope. Seven people were interviewed. 2 persons from the Somali Regional Water Resources Development bureau, 2 persons from the Sanitation and Beautification Agency, 1 expert from Jigjiga University and 2 community elders were purposively selected and interviewed about opportunities and factors affecting Water Supply and Sanitation. KII has been done in a face-to-face way.

Field Observation

In addition to the above data collection methods, a field visit were executed by the researcher to substantiate and augment the information obtained through other primary and secondary data collection tools. The researcher observed the situation of water supply and sanitation in the city.

3.4.2. Secondary Data Sources

Besides the aforementioned data collection techniques and procedures, intensive desk review of published and unpublished literatures such as books, journals, articles, reports and e-resources were carried out as well as documents from relevant regional bureaus including, Water Resources Management bureau and 'Sanitation and Beautification Agency' and other internet sources.

3.5. Techniques of Data Analysis

3.5.1. Quantitative

Quantitative data that was collected from questionnaire survey were analyzed using SPSS software in order to describing key findings, conditions, states and circumstances disclosed from the data. Different statistical analysis techniques were used; both descriptive statistics and inferential statistics.

Descriptive statistical analysis

Descriptive statistics are procedures used to summarize, organize and make sense of set of scores called data. Some of the descriptive statistical techniques used are measure of central tendencies (mean), measures of dispersion (standard deviation) and correlation measurement (Pearson's correlation). In describing the socio-demographic variables (e.g. sex, educational level, occupation etc.) and opportunities for improving Water Supply and Sanitation, frequency, percentage, mean, and standard deviation were statistical techniques used in the study. While, pearson's correlation coefficient has been computed to analyze the association between the Planned Behavioral Theory variables.

Inferential statistical analysis

Inferential statistics are procedures used to infer or generalize observations made with samples to the larger population from which they were selected. One of the inferential statistical technique used in this study is standard multiple regression analysis. According to Pallant (2005), the main of research questions that multiple regression can be used to get answer for are: 1) How well a *set of variables* is able to predict a particular outcome? 2) *Which variable* in a set of variables is the best predictor of an outcome? 3) Whether a particular predictor variable is still able to predict an outcome when the effects of another variable are *controlled* for?

In this study, standard multiple regression was computed to measure the importance of associated factors on improved Water Supply and Sanitation – socio-economic factors and political factors.

3.5.2. Qualitative

Qualitative data that were collected through in-depth key informants' interviews as well as the observations were analyzed by both thematic and keywords-in-context analyses. It was thematically analyzed; the prominent themes in the data were identified, organized and interpreted. Also, keyword-in-context analyses were used to detect the fundamental relationships of participants' infers through their verbal explanation.

3.6. Definition of Variables

The main study variables are including the socio-economic factors - sex, age, marital status, education status, occupation, household income, and household size - political factors and so on. The table below summarizes the study variables and their description.

Table 3.2: Description of the study variables

Variables	Description
Dependent Variables	
Improved Water Supply and Sanitation	Here it meant WSS are improved when it's available, affordable and the quality is good.
Behavior	It means performing or doing the actual

	behavior, in this context, the existence of hygiene practices use by the people
Independent Variables	
Sex of the respondent	Male or female
Age of the respondent	Age is set to be selected from five ranges; 18-25, 26-33, 34-41, 42-49, 50 and above.
Education level of the respondent	It means the level of education reached
Marital status of the respondent	Whether marital status has a significant relationship with improved WSS
Occupation	Type of work to get a living
Income of the household	The income of the family per month
Household size	The number of persons whom live in one house
Political factors	To measure whether political factors influence more for improving WSS
Attitude	Attitude toward the behavior is a person's overall evaluation of the behavior.
Subjective norms	Subjective norms are a person's own estimate of the social pressure to perform or not perform the target behavior.
Perceived behavioral control	Perceived behavioral control is the extent to which a person feels able to enact the target behavior.
Intention	The readiness of a person to perform the target behavior

3.7. Reliability and Validity

3.7.1. Reliability

To make sure the reliability of the scale, internal consistency indicator was used. A minimum of Cronbach's alpha value of 0.7 is usually recommended (when items are ten), but it depends on the number of items in the scale; the smaller the number of items, the smaller the Cronbach alpha values (Pallant, 2005). In the cases where the

items of a scale are fewer than ten, the mean of inter-item correlation is advised to be calculated and reported.

As the items of most of the scales in this study were five, the Cronbach alpha values of the different scales varied, with some of them indicating high reliability (>0.7) and some of them indicating low reliability (<0.7). Consequently, the mean of inter-item correlation is opted to be calculated. The mean of inter-item correlation of the scales is 0.229 and it was optimal.

3.7.2. Validity

The two main validity parts, in research, are credibility (internal) and transferability (external) (Mohajan, 2017). To make sure *the internal and external validity* of the study, researcher's bias was avoided, appropriate strategies were developed (e.g. Random sampling technique), interviewing different people of societal-leaders (e.g. academic leaders, community leaders). In terms of validity type, content validity has been made. The questions in the instrument were carefully checked whether it is measuring well about the issues. The questionnaire form had been translated into the local language 'Somali' and then piloted in order to make sure the validity. The questionnaire was improved and modified based on the feedbacks from the pilot phase.

3.8. Ethical Considerations

Research should be designed, planned, conducted and then, results be disseminated with the consideration of research ethics (Kaewkungwal et al., 2019). One of the constraints that students always miss to take into account is to not get a written permission from the institution that the research being under-taken or in which the data is being collected (Polonsky et al., 2004). Thus, written permission letters were got from Addis Ababa University (especially from the Collage of Development Studies) as well as the concerned government bureaus in Jigjiga town to avoid any suspicion over the purpose of the study. Since participating a research is a voluntary task, informed consent is sought from the respondents and they would have the right to stop their contribution into the study at any stage or time. The study also made sure

the confidentiality and anonymous of the respondents, so there would be no harm at all to them.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1. Introduction

This is a chapter where the detail discussion of the results found, sorted and analyzed is provided. The data collected through all of the data sources described previously were analyzed in the way they can support and explain each other. Statistical Package in Social Sciences (SPSS) software version 21 was computed to come up with the quantitative results. The findings entailed response rate, socio-economic and demographic characteristics, associated factors of improved Water Supply and Sanitation, opportunities for improving Water Supply and Sanitation, improved Water Supply and Sanitation, and behavior of the people towards hygiene practices use.

4.2. Response Rate

For gathering quantitative data, 127 questionnaire forms were distributed and 109 questionnaire forms (85.8%) were filled correctly and returned. While for the qualitative data, 7 interviewees were sampled and as it was expected they all participated with a response rate of 100%.

Table 4.1: Response rate

Method	Instrument	Distributed	Responded	Response (%)
Quantitative	Questionnaire	127	109	85.8

Source: Researcher's own survey, 2021

4.3. Socio-economic and demographic characteristics

4.3.3. Demographic characteristics of the respondents

This section discusses the socio-economic and demographic characteristics of sampled households such as sex, age, marital status, education level, occupation, household income, and household size. Factors that are more important in deciding the status of Water Supply and Sanitation in the study area are unknown. The significance of those socio-economic and demographics characteristics are compared with the one political factors have on Water Supply and Sanitation.

Table 4.2: Socio-economic and demographic characteristics

No.	Variables		Frequency (percent)
1.	**Sex**	Male	57(52.3)
		Female	52(47.7)
2.	**Age**	18-25	40(36.7)
		26-33	41(37.6)
		34-41	17(15.6)
		42-49	7(6.4)
		50 and above	4(3.7)
3.	**Marital status**	Single	48(44.0)
		Married	53(48.6)
		Divorced	7(6.4)
		Widowed	1(0.9)
4.	**Education Level**	Literate	16(14.7)
		Primary school	12(11.0)
		Secondary school	29(26.6)
		College/university	52(47.7)
5.	**Occupation**	Unemployed	39(35.8)
		Self-employed	24(22.0)
		Public employee	22(20.2)
		Private employee	24(22.0)
6.	**Household income (in Birr)**	Below 4000	21(19.3)
		4000-8000	43(39.4)
		8100-15000	20(18.3)
		15000 and above	25(22.9)
7.	**Household size**	Less than 5	29(26.6)
		5	26(23.9)
		More than 5	54(49.5)

Source: Researcher's own survey, 2021

Sex

From the total of 109 respondents of this study, 52.3% were males, while the remaining 47.7% were females. It has been realized that there are no differences made by the age on whether to have improved Water Supply and Sanitation.

Age

In the study, age was categorized into five ranges (18-25, 26-33, 34-41, 42-49, and above 50). 36.7% of the respondents were the age of 18-25, 37.6% were the age between 26 and 33, and the rest 25.7% were older than 41 years old. Age is found to have no significant relationship in getting improved Water Supply and Sanitation services.

Marital status

Almost have of the respondents were married (48.6%), while a large number were single (44.0%). 6.4% of them were divorced and 0.9% were widowed.

Education level

Majority of the people that participated in the study (47.7%) were reached college/university level, while the second majority of the respondents (26.6%) were reached secondary school. The remaining percent (25.7%) were reached primary school or learned reading and writing (literate). Unlike the conclusions drawn by (Chekol et al., 2020) regarding to the associated factors of water supply accessibility, education is found not to be associated with improved Water Supply and Sanitation in general and availability and affordability of water and sanitation facilities in particular.

Occupation

As the results show, 35.7% of the respondents are unemployed, while 44% are self-employed or privately employed. The remaining 20.2% of the respondents are government employees. It’s quite understandable that unemployment has a negative impact on people’s living standard.

Household income

Household income is a main factor in the study as well as an independent variable for the analysis of the significance of socio-economic and political factors in improved Water Supply and Sanitation.

As the above table shows, the majority of households' incomes are between 4000 to 8000 Birr (39.4%), while 22.9% of the households receive an income above 15000 Birr and 18% of them have a monthly income of 8100 to 15000 Birr. The remaining 19.3% receives an income below 4000 Birr. It's found that household income plays key role on deciding the status of Water Supply and Sanitation in the households. This is consistent with the findings of Yohannes (2014) that has confirmed the association between household income and the availability of improved sanitation. The more income a family receives the better situation of their Water Supply and Sanitation. Also, Tuyet-Hanh et al. (2016) found that wealthy families are more accessible in improved water supply and sanitation by 11 times.

Household size

The above table depicts that majority of the households (49.5%) are more than five people, and 26.6% of them are less than five people, while 23.9% of them are five people. Household size is one of the socio-economic factors used in the study. According to Kayser (2013), *"per capita water use decreases as household size increases, because an additional person has little effect on the overall household quantity used for domestic activities such as dishwashing, house cleaning and laundry."* But it is still arguable that small household size might ease the issue of Water Supply and Sanitation. Majority of the households in Jigjiga are more than 5 people, but those who are less than five people might have a privilege of not being under such pressure in terms of quantity of water.

4.3.4. Demographic characteristics of the interviewees

Similar to the respondents, here below are the demographic characteristics of the interviewees.

Table 4.4: Demographic characteristics of the interviewees

No.	Variables		Frequency(Percent)
1.	**Sex**	Male	5(71.42)
		Female	2(28.57)
2.	**Age**	26-33	-
		34-41	4(57.14)
		42-49	2(28.57)
		50 and above	1(14.28)
3.	**Marital Status**	Single	2(28.57)
		Married	5(71.42)
		Divorced	-
		Widowed	-
4.	**Education Level**	Literate	1(14.28)
		Primary school	1(14.28)
		Secondary school	-
		College/university	5(71.42)
5.	**Occupation**	Unemployed	2(28.57)
		Self-employed	1(14.28)
		Public employee	4(57.14)
		Private employee	-
6.	**Household Income**	Below 4000	1(14.28)
		4000-8000	1(14.28)
		8100-15000	2(28.57)
		15000 and above	3(42.85)
7.	**Household Size**	Less than 5	-
		5	1(14.28)
		More than 5	6(85.71)

Source: Researcher's own survey, 2021

4.4. The status and trends of Water Supply and Sanitation

4.4.1. Status of Water Supply and Sanitation

Water supply status can be evaluated and assessed through different approaches; like assessing water supply coverage, quantity, quality, availability, affordability, reliability, equity, production, and/or consumption (Liu et al., 2017; Kayser et al., 2013). Here, water supply status is meant to measure based on the quantity - deficiency in available water to water demand is used as an indicator. As *table 4.5* depicts, the available amount of water in 2008 - *water production subtracted by the percent of loss (28% of average loss)* is calculated to be 1,212,041 m^3 per year, while the deficient amount of water based on the domestic demand of the city (showed in *table 4.5*) is 315,484 m^3 per year, which means there was 20% deficit in domestic water demand in 2008. Since then, rapid population growth in the city and also the rural-urban migration caused an increase in the demand. With the rapid growth of the demand, it is concluded that there is a domestic water shortage in Jigjiga by at least 20%. In addition, this domestic demand deficiency is just a portion of the overall demand for water in the city.

Table 4.5: Projected water domestic demand and available water

Year	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Available Water (after loss)(m^3/year)	656,934	651,560	733,542	868,121	979,664	1,262,542
Year	**2008**	**2010**	**2015**	**2020**	**2025**	**2030**
Projected domestic demand (m^3/year)		1,527,525	2,276,870	3,121,845	4,268,675	5,889,275

Source: (SNRS-WRDB, 2011)

Table 4.6: Water sources and daily water usage

Item		**Frequency(percent)**
Major source of water	Pipe	42(38.5)
	Shared pipe	20(18.3)
	Vendors	35(32.1)
	Both pipe and vendors	12(11.0)

Water use per day	20-40 litres	13(11.9)
	40-60 litres	22(20.2)
	60-80 litres	38(34.9)
	80-100 litres	17(15.6)
	100 litres and above	19(17.4)

Source: Researcher's own survey, 2021

Table 4.6 shows the status of water supply is low based on the portion of the population that does use piped water within their yard (only 38.5%). Here it can be inferred that more than half of the households in Jigjiga (61.5%) struggle to get water. Again, it shows that 82.6% of the households use not more than 100 littres per day, while the majority of the households in Jigjiga are more than 5 (look at *table 4.2*). According to WHO, a person should get an amount of water between 50 to 100 liters per day to ensure that the most basic needs are met (Kayser et al., 2013). It is also observed that, specifically during dry season, water price gets higher (about 15 Birr per Jerrycan). From all the results above, the study found the existence of a huge water shortage and that of the water supply status in the town is low. Chekol et al. (2020); Deyessa (2011) similarly confirmed that water consumption rate per person per day is less than 20 liters.

One interviewee mentioned that;

> *'Some people hardly get enough water to meet basic needs, they might sometimes might not have taking shower for three or four days or leave other domestic uses to just keep drinking and cooking water safe and available in their homes, but some families might have enough water to meet their basic needs. I don't exactly know about the reason but they might be very rich to make things possible for themselves'*

Table 4.7: Waste collection service status

Item		**Frequency(percent)**
Number of HH receive waste collection	Yes	68(62.4)
	No	41(37.6)

The frequency of waste collection services	Once in the week	21(19.3)
	Twice in the week	16(14.7)
	Once in the month	18(16.5)
	Twice in the month	13(11.9)

***HH stands for Household**

Source: Researcher's own survey, 2021

For sanitation, only 68% of the town receives waste collection services and out of them, 19.3% receive the waste collection services once in the week, 14.7% get water collection service twice in the week, 16.5% get waste collection services once in the month and lastly 11.9% of them receive waste collection services twice in the month. The results of this study are inconsistent with the findings of Birhanu et al. (2019), where he concluded that majority of the households in Jigjiga (87.5%) receive waste collection services weekly.

Interviewees stated about the status of the waste disposal system;

> '*Generally, solid waste is collected both by the municipal truck & other Private waste collectors transferred to newly prepared dump site in a place locally called Diniti by the bank of major streams. The problem is that it can easily be carried far away from the site by wind and river stream and pollute wider environment.'*
>
> *'The former dump site, that is still not properly closed, has caused families live near it a high health crisis, during dry season the trucks go off road some hundreds of meters, whereas; during rainy season the trucks hardly go off roads; they rather prefer to dump their load along the road left and right. It is also reported that some farmers request for wastes to be dumped on their farmland as fertilizer and soil enhancement.'*

4.4.2. Trends of Water Supply and Sanitation

Here, the trend of water supply is analyzed based on the population growth, water availability, and water consumption. The trend of population is calculated from

Central Statistics population baseline of 1997, which was 65,795, with a population growth rate of 4.11 (SNRS-WRDB, 2011).

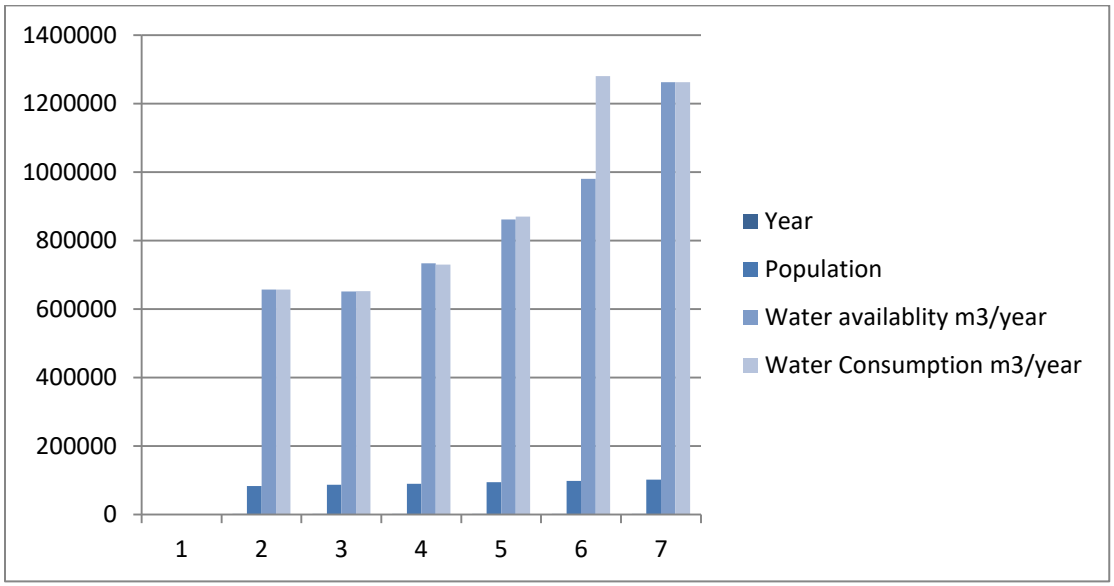

Figure-4.1: Water Supply trend analysis

According to the figure above, water consumption steadily increases and the increase in water consumption is always higher than available water (water supplied by the government). Continues population growth has made the water available more scarce to match the water consumption in the city.

Interviewees similarly stated that;

> *'One of the main challenges on covering the demand of Jigjiga city for improved water supply and sanitation is the fast-growing population of the city; rural-urban immigration and the urban population growth within the city.'*

Key informant interviewees also stated that;

> *"Generally, sanitation is very poor in Jigjiga; solid waste management is being done significant progress, but liquid waste management has not been progressed significantly. There is no sewerage system in the city at all, there is a temporary disposal site and it is not environmental friendly.*

We are now in the process of designing appropriate integrated sanitation system and feasibility studies have been done so far."

4.5. Associated factors of improved Water Supply and Sanitation

Different factors are assumed to be associated with improved Water Supply and Sanitation including seven socio-economic factors as well as a political factor *(Table 4.3)*. The socio-economic factors are sex, age, marital status, education, occupation, household income and household size. To find out which factors are associated with improved Water Supply and Sanitation, multiple regression model was computed. The model results have shown that the independent or predictor variables account 32.1% (R square = .321) for the variance in the dependent variable - improved Water Supply and Sanitation and the remaining percentage is explained by other factors. The overall regression model was significant, $F(8,100)=5.910$, $p<.001$, $R^2=32.1\%$.

Table 4.8: Associated factors of improved Water Supply and Sanitation

Variables	**B(S.E)**	T	**P-Values**
SEX	.571(1.330)	.429	.669
AGE	-1.077(.643)	-1.567	.120
MARITAL STATUS	1.174(1.032)	1.137	.258
EDUCATION LEVEL	.219(.640)	.342	.733
OCCUPATION	.530(.539)	.984	.328
HOUSEHOLD INCOME	3.291(.606)	5.434	.000
HOUSEHOLD SIZE	.188(.754)	.249	.804
POLITICAL FACTOR	.368(.156)	2.357	.020

Source: Researcher's own survey, 2021

The study results have shown the household income has statistically significant relationship with improved Water Supply and Sanitation at $p<0.01$. Therefore, an increase of one unit in the income of the household results better improved Water Supply and Sanitation by 3.291 times.

One of the key informants interviewed have also confirmed this,

"…to be honest, the shortage of water in the city is very high, the supply and demand are highly unmatched. I believe that the income of the family makes a huge difference on the water and sanitation services that families get. Families with high income would be in a better position. Even if they are receiving water from water-trucks, they are able to buy and store a lot of water in their yard, so particularly water availability in their house would be high"

As the above table depicts, political factors are found to have an influence on the Water Supply and Sanitation. It has significant relationship with the dependent variable at $p<0.05$. The dependent variable varies .368 times when political factor changes by one unit.

The study also reveals that the remained six independent variables have no significant relationship with the dependent variable (improved Water Supply and Sanitation) (sex, $p= .669$) (age, $p=.120$) (marital status, $p=.258$) (education level, $p=.733$) (occupation, $p=.328$) (household size, $p=.804$).

Community elder stated that,

'Adeer (uncle/nephew), I am old enough to not lie to you. We all know who is responsible for providing water and sanitation services to the people. The situation of the water supply and sanitation in Jigjiga town is related with political issues and particularly low commitment by the authorities.'

4.6. Opportunities for improving Water Supply and Sanitation

To figure out the existing opportunities for improving Water Supply and Sanitation, the researcher have come up with five items as the current opportunities. Respondents were asked to select one of the five options, strongly dis-agree (1)…… strongly agree (5).

Table 4.9: Opportunities for improving Water Supply and Sanitation

No.	Items	N	Min	Max	Mean	Std. Deviation

1.	The newly established sub-city administrative system (four sub-cities) will improve the Water Supply and Sanitation system in the city	109	1	5	4.16	.964
2.	Privatizing some of the operation and management of Water Supply and Sanitation for the city	109	1	5	4.11	1.074
3.	Increasing the service charges for water and sanitation services will let the city authority provide the demanded services	109	1	5	3.27	1.470
4.	To improve the economic status of the community	109	1	5	3.96	1.097
5.	The on-going government efforts of building new water source in Fafan would be another opportunity	109	1	5	4.15	1.026
	Overall Mean	109	1.00	5.00	3.9284	.77341

Source: Researcher's own survey, 2021

Descriptive statistics of the items of the opportunities for improving Water Supply and Sanitation reveal an overall mean score of 3.92 (SD=0.773). This shows an agreement on the opportunities for improving Water Supply and Sanitation.

Three of the five items (item-1, item-2 and item-5) have the highest mean scores (4.16, 4.11 and 4.15 respectively), indicating those three opportunities currently exist to improve the Water Supply and Sanitation in Jigjiga town.

Key informant interviewees from the government stated that,

> *'The most important opportunity that exists to improve water situation in the city is the on-going project of expanding the city's water supply system. The design has successfully been done; the construction phase has to be started soon.'*

> *'The city has zero sewerage system, but now the feasibility studies of the project of improved sanitation system is recently conducted and that can be a big opportunity for creating a better sanitation in the city.'*

4.7. Improved Water Supply and Sanitation

The results of this section are about people's agreement on the existing situation of water supply and sanitation services in the study area, through likert scale from strongly disagreed (1) to strongly agreed (5). Five items were constructed based on the themes of availability, affordability, and quality. The mean scores below 2.6 is considered as low, the mean score between 2.6 up to 3.4 was considered as moderate and the mean score above 3.5 was considered as high.

Table 4.10: Improved Water Supply and Sanitation

No.	Items	N	Min	Max	Mean	Std. Deviation
1.	I am satisfied with the current water supply and sanitation services	109	1	5	3.01	1.601
2.	The city waste collection services are good	109	1	5	3.32	1.545
3.	The water services in the city are affordable	109	1	5	3.32	1.484
4.	I am satisfied with the quality of the drinking-water	109	1	5	3.35	1.518

5.	Water is available in our house every time	109	1	5	3.37	1.519
	Overall Mean	109	1.00	5.00	3.2734	1.39461

Source: Researcher's own survey, 2021

The results of table 4.5 shows a moderate agreement on all the items of improved Water Supply and Sanitation with an overall mean score of 3.27 (SD=1.39). Respondents moderately agreed on the availability of water in every time, with mean score of 3.37 (SD=1.5), it also shows an agreement on the affordability of water services in the city, with mean score of 3.32 (SD=1.4).

It is found that people are not fully satisfied with the current water supply and sanitation services, with a mean score of 3.01(SD=1.6).

4.8. Behavior of the people towards the use of hygiene practices

This section is aimed to answer the predictors or factors that influence people's behavior towards hygiene practices use, using the Theory of Planned Behavior (TPB). The behavior of a person to do a certain action is said to be decided mostly by their intention to do that certain thing. Three elements are initially vital to know for predicting whether a person intends to do a certain thing or action – the attitude, subjective norms, and perceived behavioral control (Francis et al., 2004). Many studies have agreed on the efficiency and effectiveness of the theory planned behavior for explaining intentions and predicting behaviors (Godin et al., 1996).

In addition, the determinants of hygiene practices behavior (particularly, household hygiene) is indirectly found to be related with the attitude of people of using the practices (e.g. the attitude of people in living in unhealthy environment), perceived behavioral control of the people; whether a person feels busy, tired, or cannot perform the behavior and subjective norms of people around the person about doing the behavior (Aunger et al., 2016).

As a result, it is noticed that TPB best fits to research about the behavior of people towards the use of hygiene practices. It has been initially analyzed the intention of the people to know about their behavior towards the hygiene practice use as well as the

attitude, subjective norms, and perceived behavioral control of the people in using hygiene practices. The next table shows the associations between the three mentioned elements of TPB and the intention variable.

Table 4.11: Pearson correlations between constructs of TPB with intention

Variable	Intention
Attitude	.571**
Subjective Norms	.248**
Perceived Behavioral Control	.468**

**. Correlation is significant at the 0.01 level (2-tailed).
Source: Researcher's own survey, 2021

As *table 4.5* reveals, there is statistically significant, strong positive correlation between attitude and intention $r(107) = .571$, = .000, with attitude explaining 32.6% of the variation in the intention.

Subjective norms and intention shows statistically significant, low positive correlation $r(107) = .248$, = .05, with subjective norms explaining 6% of the variation in intention.

There is also statistically significant, moderate positive correlation between perceived behavioral control and intention $r(107) = .468$, = .000, with perceived behavioral control explaining 21.9% of the variation in intention.

Table 4.12: Pearson correlations between constructs of TPB with behavior

Variable	Behavior
Attitude	.478**
Subjective norms	.094
Perceived Behavioral Control	.551**
Intention	.497**

**. Correlation is significant at the 0.01 level (2-tailed).
Source: Researcher's own survey, 2021

The above table (*table 4.6*) shows statistically significant, moderate positive correlation between attitude and behavior *r(107)*= .478, = .000, with attitude explaining 22.8% of the variation in behavior.

There was also statistically significant, strong positive correlation between perceived behavioral control and behavior *r(107)*= .551, = .000, with perceived behavioral control explaining 30.3% of the variation in behavior. The results again reveals statistically significant, moderate positive correlation between intention and behavior *r*(107)= .497, = .000, with intention explaining 24.7% of the variation in behavior.

While it shows no statistically significant, positive correlation between subjective norms and behavior *r*(107)= .094, = 0.329.

Table 4.13: Pearson correlations between constructs of the TPB

Variable	**Attitude**	**Subjective Norms**	**PBC**
Attitude		.186	.431**
Subjective Norms	.186		.186
Perceived Behavioral Control	.431**	.186	

**. Correlation is significant at the 0.01 level (2-tailed).
Source: Researcher's own survey, 2021

The results were statistically significant, moderate positive correlation between attitude and perceived behavioral control *r*(107)= .431, = .000 with attitude explaining 18.5% of the variation in the perceived behavioral control.

It also shows no statistically significant, low positive correlation between attitude and subjective norms *r*(107)= .186, with no enough evidence to infer correlation exists in sampled population.

Sudjana et al. (2016); and Afzal at al. (2018) similarly confirmed the existence of significance correlation between attitude and personal hygiene practices *'the actual behavior'*. In addition, O'Boyle et al., (2001) has come up with the conclusion that

there is association between the variables of TPB and intention to hygiene practices use ‘hand-wash particularly’, where TPB variables predict intention to hygiene practices use. Again, Shapiro et al., (2011) has found almost the same results as this study in terms of which variable that predicts the intention most; perceived behavioral control and attitude variables explains changes in the intention variable.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1. Conclusion

This study aimed to examine the existing situation of Water, Sanitation, and Hygiene (WASH) in Jigjiga town. It focuses on the associated factors and opportunities of improved Water Supply and Sanitation. In addition to that, a huge part of the study examined the behavior of the people towards hygiene practices use. To find out answers for the research questions, the study has chosen appropriate research design – mixed research design. It has been more appropriate to use both quantitative and qualitative approaches to cover those issues widely and detailed.

Out of the 127 questionnaire forms distributed for collecting the quantitative data in the study, 109 questionnaire forms have successfully been retuned. In addition, in-depth key informant interviews of seven interviewees and personal observations were complemented to receive enough and detailed information about the issue.

The analysis and interpretation of the data collected have been vital for the study to come up with results and infer conclusions from it to be part of the improvements on Water, Sanitation and Hygiene (WASH) in Jigjiga city. Several techniques and tools of analysis have been used including; descriptive statistics for socio-economic and demographic characteristics as well as the opportunities for improving Water Supply and Sanitation, multiple regression analysis were also computed to figure out the significance between socio-economic factors and political factors against improved Water Supply and Sanitation, and lastly, Pearson correlation analysis were conducted for the constructs of the Planned Behavioral Theory (PBT) in order to understand the behavior of the people towards hygiene practices use.

The socio-economic and demographic results show that 52.3% of the respondents of the study were males and 47.7% were females, which avoids much domination by one sex group in the participation of the study, which made the study more inclusive. As the demographic results in *chapter four* presents, almost 74% of the respondents' ages were 34, while the other 26% were older than 34. It can be inferred that most of

the people living in Jigjiga are youth. Like the sex of the respondents, the percentage of single and married were quite similar, 44% and 48.6% respectively, but the absolute majority of the respondents were educated with 47% reached college/university level, 27% reached secondary school level, and 11% reached primary school level. While a small portion of the respondents were 14% were literate – who only know how to read and write.

In terms of occupation, 64% were employed through the different sectors of works such as private sector, public sector etc. While 36% were unemployed. All of those results show no significant with the improved Water Supply and Sanitation or do not affect the water supply and sanitation services people receives in Jigjiga, but household income contributes to the water supply and sanitation services. The majority of the households' incomes were in the ranges between 4000 and 8000 Birr (39.4%), 19% of them were ranged below 4000 Birr and 18.3% were ranged between 8100 and 15000 Birr. While the remaining portion (23%) were having an income greater than 15000 Birr.

The study found that, in terms of water quantity, a huge deficit and water shortage exists in the city. Results show about 20% of deficits in water availability to match the town's demand for water supply. Also the trend analysis in this study show water production is way much lower than water demand. It is understood that the rapid population growth of the city is a big issue to solve the problems of water shortage and unreliable sanitation services.

The responsibility of providing enough and reliable Water Supply and Sanitation services normally lies on public sector. The study found that political factors are more important than socio-economic factors in getting improved water supply sanitation services. Only household income appears to be significant contributor, out of the seven factors in the socio-economic factors. Political factors are found to be more associated in improved Water Supply and Sanitation at $p<0.01$.

The study reveals that privatizing some of the operation and management of Water Supply and Sanitation can improve the service with a mean score of 4.11 (SD=1.07).

It is also found that the on-going efforts of the government of building new water sources at Fafan would be another opportunity to improve the Water Supply and Sanitation situation in the city with mean score of 4.15 (SD= 1.02). The last but not least, the newly established sub-city administrative system (four sub-cities) will improve the management of Water Supply and Sanitation system in the city with a mean score of 4.16 (SD=0.96).

There is a huge water shortage in the city (Hussein, 2021). The results of the study shows that current water supply and sanitation services are not satisfied by the people in the city, with a mean score of 3.01(SD=1.6).

In understanding the behavior of the people towards the use of hygiene practices, a questionnaire for the main five constructs of the Theory of Planned Behavior were created with each of them having at least five items; attitude (7 items), subjective norms (5 items), perceived behavioral control (5 items), intention (6 items) and behavior (6 items). The results of the comparison and correlations between attitude, subjective norms, and perceived behavioral control with the intention of the people towards use of hygiene practices shows statistically significant, positive correlation among all the three construct with intention. Attitude with intention (r= .571, $p<0$.01), subjective norms with intention (r= .248, p= 0.05), and perceived behavioral control with intentions (r= .468, p<0.01).

It also depicts there is statistically significant positive correlation between Attitude, perceived behavioral control and intention with the behavior of the people towards the use of hygiene practices. Attitude have statistically significant, moderate positive correlation with behavior (r= .478, p=0.01). This means that attitude variable predicts 22.8% the variations in behavior variable. It also found that perceived behavioral control statistically has a positive, strong correlation with behavior (r= .551, p< 0.01) and it explains people's behavior towards hygiene practices use by 30.3%. While intention of the people moderately associated with the behavior of the people (r= .497, p< 0.01) with intention explaining 24.7% of the variation in behavior of the people. But, subjective norms around the people have shown no significant correlation with their behavior of using hygiene practices (r= .094, p= 0.32).

Furthermore, it is also found a statistically significant, moderate correlation between attitude of the people about the use of hygiene practices and their perceived behavioral control (r= .431, p< 0.01), while it shows no statistically significant positive correlation between attitude of the people and the subjective norms around them r= .186, p= 0.05).

5.2. Recommendations

Based on the findings, recommendations for the improvement of the Water supply and sanitation, and Hygiene (WASH) are forwarded.

- Private sector involvement; It is globally understood that privatizing some of the public responsibilities is a relief and more efficient to provide a good service. Therefore, it is advisable for the Somali Regional State Government to encourage more of private sector's involvement in the operation and management of the Water Supply and Sanitation.
- Strengthening the coordination and collaboration of stakeholders; it is recommended to strengthen the coordination and collaboration among the stakeholders of Water Supply and Sanitation.
- Awareness programs for efficient use of water**;** the demand of water can be reduced by a proper and efficient use of the water by the consumers, so responsible offices should raise awareness on an efficient use of available water at household level.
- Awareness programs for hygiene practices use; attitude, intention and perceived behavioral control, which are found to be more significant in hygiene practices use for the people in Jigjiga town, can be improved with regular awareness programs aiming the importance of hygiene.
- Effective Monitoring and Evaluation (M&E); Policies, plans and strategies are always well written, but forgotten in shelves. A good tool for accomplishing regional goals and objectives is effective monitoring and evaluation, so I would recommend for a separate M&E office for the Somali Regional State, this will help plans and strategies to be implemented properly.

- Household water storage improvement; families that have a larger water storage capacity would be more able to reduce the pressure of water shortage in the household; once affordability is not an issue (Mattos et al., 2021).

Further Recommendations

- The study focused more on the significance of socio-economic and political factors on improved Water Supply and Sanitation by excluding other factors like environment and ecological factors. Therefore, another research can be conducted to cover about the other factors.
- As the geographical scope of the study was limited only to Jigjiga town, other future studies can be concentrated on other towns in the region.
- The issue of Water Supply, Sanitation and Hygiene (WASH) is a more problematic and challenging in rural areas, so a research entitled 'the associated factors of WASH' is recommended to conduct in rural areas.
- The study was thematically limited to mostly hand hygiene practices. A feminine hygiene practice is also as important as a hand hygiene practice and future researchers can study about the issue of feminine hygiene practices and how water shortage affects it.

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Appendixes

Appendix 1: Household Questionnaire

HOUSEHOLD QUESTIONNAIRE

Dear respondent, the purpose of this questionnaire is to study the associated factors and opportunities of Water Supply, Sanitation and Hygiene (WASH). The following questions are aimed at obtaining information about the status of Water Supply and Sanitation, opportunities for improving Water Supply and Sanitation as well as the behavior of the people towards the use of hygiene practices. This study is conducted as a requirement for the degree of Masters of Science in Water Resources Management, and any findings from the research will serve as a valuable resource for further studies on the issue at the same time revealing the existing reality. Furthermore, your identity and the information you provide in this questionnaire will remain confidential, hence I request you to be honest and forthcoming in your response. Thank you in advance for your collaboration!

PART-1: PERSONAL INFORMATION **Date: .....**

Form no: ……

Sex of respondent: □ Male □ Female

Age: 18-25 □ 26-33 □ 34-41 □ 42-49 □ 50 and above □

Marital status: Single□ Married□ Divorced□ Widow□

Level of education: Literate□ Primary school□ Secondary school□ College/University□

Occupation: Unemployed□ Self-employed□ Public employee□ Private employee

Household income (Birr): Below 4000□ 4000-8000□ 8100-15000□ above 15000□

Household size: Less than 5□ 5□ More than 5□

1. **What is the major source of water?**

   Pipe□ Shared pipe□ Vendors□ both pipe and vendors □

2. **Usage of water per day per household**
   20 - 40 litres of water□ 40 - 60 litres of water□ 60 - 80 litres of water□
   80 - 100 litres of water□ 100 litres and above□
3. **Does your household get waste collection services?**
   YES { } NO { **}**
4. **If YES, how frequent do you get waste collection services?**
   Once in the week { } Twice in the week { } Once in the month { } Twice in the month

Associated factors of improved Water Supply and Sanitation

No.	Political factors	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	Improper budget allocation					
2	Lack of government commitment					
3	Corruption is a major issue					
4	Conflict of interest					
5	Limited coordination and cooperation between government bureaus					

Opportunities for improving water supply and sanitation

No.	Items	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1.	The newly established sub-city administrative system (four sub-cities) will improve the Water Supply and Sanitation system in the					

	city					
2.	Privatizing some of the operation and management of Water Supply and Sanitation for the city					
3.	Increasing the service charges for water and sanitation services will let the city authority provide the demanded services					
4.	To improve the economic status of the community					
5.	The on-going government efforts of building new water source in Fafan would be another opportunity					

Improved Water Supply and Sanitation

No.	Items	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	Water is available in our house every time					
2	The water services in the city are affordable					

3	I am satisfied with the quality of the drinking-water					
4	The city waste collection services are good					
5	I am satisfied with the current water supply and sanitation services					

PART-2:

People's Behavior towards Hygiene Practices

i. Attitudes

No.	Item	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1.	Hands should be washed after defecating					
2.	Hands should be washed after cleaning child's bottom					
3.	Hands should be washed before preparing food					
4.	Hands should be washed before eating					
5.	Hands should be washed before feeding a child					
6.	Body should be washed everyday					
7.	cleaned clothes should be worn everyday					

ii. Subjective norms

No.	Item	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1.	My family does not allow exploitation of water and soap.					
2.	My friends and relatives rarely practice handwash at critical times.					
3.	Households do not prepare handwash site/equipment in the house.					
4.	Government does not usually promote handwashing practices at critical times.					
5.	Our community does not consider handwash with soap as important.					

iii. Perceived behavioral control (PBC)

No.	Item	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1.	I can buy and use soap for handwash					
2.	I can wash my hands at critical times					
3.	I can change my clothes everyday					
4.	I can get handwash facilities (e.g. water, soap etc.)					
1.	I can wash my body every day					

iv. Intention

No.	Item	Definitely	Probably	Possibly	Probably NOT	Definitely NOT
1.	I want to practice handwash at critical times					
2.	I want to use soap for handwash					
3.	I want handwash facilities (e.g. water, soap etc.) to be available in our house					
4.	I want people in our house to practice handwash at critical times					
5.	I want to change my clothes everyday					
6.	I want to wash my body everyday					

v. Behavior

No.	Item	Always	Often	Sometimes	Rarely	Never
1.	I wash my hands after defecating					
2.	I wash my hands before preparing food					

3.	I wash my hands before eating					
4.	I wash my hands before feeding a child					
5.	I wash my body everyday					
6.	I change my clothes everyday					

Appendix 2: Interview Questions

Key informant interview questions

1. What is the status of Water Supply and Sanitation?
2. What are the improvements and changes made for improving water supply and sanitation?
3. What do you think it is a challenge to providing improved Water Supply and Sanitation?
4. What are the current opportunities for improving Water Supply and Sanitation?
5. What would you recommend to improve WASH in general?