# A MODEL FOR SUSTAINABLE POTABLE WATER PROVISION IN LOCAL GOVERNMENT: A CASE STUDY OF NORTON TOWN COUNCIL IN ZIMBABWE

BY

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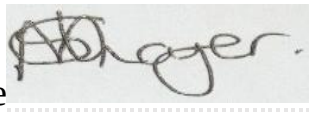
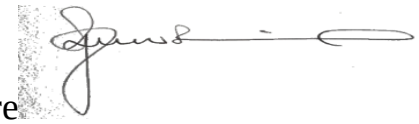
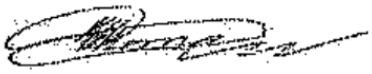
## DECLARATION

I Shayamano Melody (18022936) hereby declare that the dissertation for the Master of Administration degree at the University of Venda, hereby submitted by me, has not been submitted previously for a degree at this or any other university, that it is my own work in design and in execution, and that all reference material contained therein has been duly acknowledged.

Student : Ms. M Shayamano Signature 

Supervisor : Dr J. Zuwarimwe Signature 

Co-Supervisor : Mr M. Silima Signature 

## DEDICATION

I also dedicate this dissertation to my loving mother and my sisters for their support and encouragements throughout this entire journey.

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## ABSTRACT

Urban population is growing worldwide and most especially in developing states and the demand for water is increasing surpassing the capacity of urban councils to supply. Access to water is a fundamental human right and as such should be available to all. The local government has initiated a number of strategies aimed at balancing water demand and supply capacity but no solid solutions have been implemented. Potable water provision in the Norton Town Council has proven to be erratic and unsustainable depriving the residents of their rights. Several limitations have resulted in the Council to fail drastically in supplying potable water as mandated by the government. The study adopted a pragmatic research paradigm through the utilisation of both the quantitative as well as qualitative research approaches. The researcher used questionnaires and key informant interviews to collect primary data. The findings of the study showed that population growth and changing consumption patterns are the major challenges leading to increased demand against dwindling supply. The deteriorating supply capacity is due to several reasons such as financial constraints, poor management systems, political interference and absolute infrastructure system. The findings also suggested that the population is further increasing and as such, the challenges mentioned needs to be addressed to boost the potable water supply infrastructure system. The challenges can be addressed through effective management of the physical infrastructure system, capacity development, improved financial capacity, responsive regulatory environment and efficient institutional governance system. Based on the findings, the study proposes a sustainable potable water provision model for the Norton Town Council which aims to strike a balance between potable water demand and supply as well as financial resources towards a more effective and efficient water supply system.

**Key words: Sustainability, Governance, Potable Water, Water Supply, Local Government.**

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## LIST OF ABBREVIATIONS AND ACRONYMS

DID : Department for International Development

GWP : Global Water Partnership

HCC : Harare City Council

IUWM : Integrated Urban Water Management

MDGs : Millennium Development Goals

NTC : Norton Town Council

SDGs : Sustainable Development Goals

SPSS : Statistical Package for Social Science

UN : United Nations

UNDP : United Nations Development Programme

UNESCO : United Nations Educational, Scientific and Cultural Organization

UNGA : United Nations General Assembly

UNICEF : United Nations International Children's Emergency Fund

UNPF : United Nations Population Fund

WHO : World Health Organisation

WSS : Water Supply System

WWAP : World Water Development Report

WWDR : World Water Development Report

ZHPF : Zimbabwe Homeless People's Federation

ZIMSTAT : Zimbabwe Statistics

ZINWA : Zimbabwe National Water Authority

# CHAPTER 1

# INTRODUCTION AND BACKGROUND OF THE STUDY

## 1.1 Introduction

Access to potable water has gained much attention globally and has increasingly been articulated as a drive to transform the world through sustainable water supply management in urban municipalities (UN, 2018; World Health Organisation 2017; Chigonda and Chazireni, 2017; Guppy and Anderson, 2017; Kusena, 2016). Potable water has become a spotlight because of massive water shortages that has led to under development and recurring outbreaks of water borne diseases (Chigonda and Chazereni, 2017). Local authorities have a responsibility to provide access to potable water (Chigonda and Chazireni, 2017; Department for International Development (DID), 2015). Water has been recognised as a human right and governments are responsible for ensuring that the right to water is realised (UN, 2018). The Zimbabwean constitution as the supreme law of the land also recognise water as a human right as enshrined in chapter 4 section 77 (a) "every person has the right to safe, clean and potable water" as such the state has a prerogative responsibility to ensure the full realisation of this right. To help achieve equitable water supply services in Zimbabwe, the government formed the Zimbabwe National Water Authority (ZINWA) in 1998 with the mandate of advising government on policy formulation, planning, management and development related to water resources (ZINWA Act chapter 20:05).

Furthermore, the constitution of Zimbabwe amendment number 20 of 2013 Chapter 14 part 3 and the Urban Council's Act [Chapter 29: 15] lays the foundation of the powers and duties of local government amongst them is the responsibility for water provision in Zimbabwe. Amongst the various duties and responsibilities of the local government, provision of water related services are an obligation (Chigwata and de Visser, 2018). The urban local government in Zimbabwe is structured hierarchically based on size and administrative function (Chakaipa, 2010). Urban Councils Act Chapter 29:15 (1996) categorised urban local government into four levels namely the cities, municipalities, town councils and town boards from the highest to the lowest respectively (Muyambo and Klaassen, 2015; Chakaipa, 2010). The study seeks to formulate a model for sustainable potable water provision management in local government particularly focusing on Norton, a small urban town in the Mashonaland West province, which is categorised as a town council. The study focuses on the planning and management of the

water supply system paying particular attention towards population growth and water supply in-terms of potable water demand and supply as the basis towards improved water delivery and subsequently leading to human rights realisation and development.

### 1.2 Background of the study

Potable water is essential for life sustenance and must be available to all without any form of discrimination (World Health Organisation, 2017). Access to potable water is therefore a fundamental human right and it is critical for the achievement of the set Sustainable Development Goals by 2030 (United Nations, General Assembly, 2015). In line with the above, there is general recognition that effective potable water provision contributes to improved public health, economic growth and the upholding of human rights subsequently forming a base towards global, regional as well as national development (Kayser *et al*, 2013). Despite the commitment to improve access to potable water, a huge proportion of the global population is still failing to enjoy this right in all aspects of sufficient quantity, quality, regularity and accessibility.

WHO (2017) defined potable water as water that is free from anything that can cause health risks when consumed over a lifetime. Therefore, potable water is safe and suitable for drinking and in the preparation of food as well as for purposes of personal hygiene. The availability and affordability of potable water can attribute towards development in all life aspects namely social, economic and environmental (UN, 2018). 89 percent of the global population have at least a single source of potable water service whereas the remaining still lack basic service to water and 2.1 billion people do not have access to potable water on their homes (UN, 2018). United Nations International Children's Emergency Fund (UNICEF), (2014) report highlights that an estimated 748 million people still lack access to safe water and billions more lack safe drinking water (WHO, 2014).

The importance of access to potable water, is substantiated by the world Sustainable Development Goals (SDG) 2030. The UN reflects water and sanitation as a global issue due to rising inequalities, climate change, depletion of natural resources and environmental degradation hence water was placed in the global political agenda (UN, 2018). Water provision is a fundamental aspect that subsequently contribute towards social and economic development of nations through sustainable management of water resources. Goal number 6 is on water and sanitation and specifically focuses on providing clean and safe drinking water, sanitation and

waste removal which seeks to "ensure availability and sustainable management of water and sanitation for all" (UN, 2018:178). The goal emphases on "achieving universal and equitable access to safe and affordable drinking water for all". The goal recognises that the sustainable management of water resources results in economic prosperity and social development. In this light, the goal includes 8 global targets covering the entire water supply and management. The study speaks precisely to target 6.1 aimed at achieving safe and affordable drinking water, 6.4 ensuring increased water use efficiency and ensuring fresh water supplies, target 6.5 that is aimed at integrated water resources management and target 6.b which emphasises stakeholder participation in water related management issues (UN, 2018). The goal seeks to ensure availability of water and sustainable planning and management of water and sanitation for all. To facilitate the acceleration of the goal there is need for commitment from the government and relevant stakeholders, implementation of robust governance systems, capacity building as well as effectual financing mechanisms to sustain water supply management.

Population growth, changing consumption patterns and urbanisation are among the major reasons for changing water demand in the world (UNESCO, UN-Water, 2020; Connor *et al.*, 2015). Global population is rapidly growing and developing countries are accounting for 93% of urbanisation, 40% of which are urban slumps and it is estimated that by 2030 the urban population will double (Connor *et al*, 2015). The UN-Habitat report showed a 4.3% increase in urban population per annum in developing countries and thus overwhelming the capacity of urban local councils to cater for increased urban population (National Report for Habitat {iii} 2015). The expansion leads to the mushrooming of urban slums where citizens will be lacking one or more basic service from the local government most especially access to safe water (UN Habitat, 2010).

Most developing nations are faced with high population growth and rapid urbanisation constituting to an increased demand which cannot be met by the current capacity of the urban councils to provide (Chigonda and Chazireni, 2017; Shekede, 2016; Makwara and Tavuyanago, 2012; Chigonda, 2011). Zimbabwe is also faced with the same predicament and as such, water services are rapidly deteriorating that subsequently resulted in health disaster that claimed approximately 4000 lives and more than 100 000 people infected with cholera epidemic in 2008 (Coutinho 2010 cited in De Visser *et al.*, 2010). The water borne diseases have been recurring almost each year claiming many lives in Zimbabwean major urban areas.

Due to serious economic meltdown in Zimbabwe since early 2000, urban local government have been deprived financially to implement drafted programs for their respective councils which led to the collapse of water supply systems (Manzungu 2012; Chigonda 2011). According to the National Water and Sanitation Inventory (2009) cited in Mangizvo and Kapungu (2010) and Chirisa (2013) reveals that urban water supply coverage dropped from 100% to 81% of people with access to potable water from 1980 to 1999 and further dropped to 51% by 2009 which is a significant decline. The MDGs like most developing countries yielded limited progress towards access and provision of water and in Zimbabwe access to potable water further declined leaving more people without a reliable source of potable water (UNECA, 2015). Adding on, water supply system or infrastructure have become absolute with some equipment having outstretched their existence hence urban councils incur huge amounts of money for maintenance hindering the efficiency of urban councils to supply water to urban population (Chigonda and Chazireni, 2017).

Similarly, Norton town council is also experiencing potable water provision challenges like any other urban local municipality. The challenges are implicated mostly by rapid population growth that do not meet with the water supply, the demand exceeds far beyond the capacity of the town council to provide (Chigonda and Chazireni, 2017; Makwara and Tavuyanago, 2012; Chigonda, 2011). In addition, the Norton town council only manages to cater for 45% of the residents with relatively regular access to potable water and currently, the trends still exist (Norton Town Council Report, 2018; Chigonda, 2011). The council sorely depends on buying water from Harare city council that is already failing as it produces 60% pumping capacity supplying other satellite urban areas of Chitungwiza, Ruwa and Epworth (Chigonda, 2011). The town is expanding in terms of housing and population, but these new expansion areas do not receive water since the council have no capacity to supply. The citizens have resorted to rely on boreholes and digging of shallow wells with contaminated water that do not meet the global standard and expectations (World Bank, 2014; Chigonda, 2011). The old areas that used to receive water now suffer the same predicament as they receive short supply hours at a very low pressure (Chigonda, 2011) which contradicts with WHO (2010) regulations. Bates-Eamer *et al.*, (2012) and WHO (2010) reiterates that a person is entitled to between 50 and 100 litres of potable water per day and must be continuous and sufficient without interruptions in supply requiring not more than 10 minutes to collect. Therefore, it is significant to conduct a research that focuses on potable water provision issues in urban local government to determine the root

causes to unsustainable water provision. It is also important to analyse these issues and bring about a sustainable solution.

### 1.3 Research Problem

The Norton town council is mandated by the Urban Councils Act to provide potable water to all its residents but less than 50% of the households have regular access to potable water (Norton Town Council Report, 2018). Although the town has put in place strategic and master plans, the implementation is questionable as evidenced by weaknesses in the governance and sustainability of water supply within the town. This becomes a serious challenge given that Norton's population that was 44 397 in 2002 rose to 67 591 in 2012 (ZIMSTAT, 2012). The council is only managing to supply potable water to less than half of the total population (NTC report, 2018). The issue is further exacerbated by expanding urban housing projects against dilapidated water supply infrastructure system. Considering the estimated rate at which Norton urban population is increasing, there is need to put in place a sustainable and robust water supply management system. Thus, it is imperative to conduct a study to have an understanding and in-depth analysis on the planning and management of potable water provision to achieve supply sustainability.

### 1.4 Aim and objectives of the research

The aim of the study is to formulate a model for sustainable potable water provision in local government with specific reference to Norton Town Council in Zimbabwe. The following objectives guides the research;

- To characterise the Norton urban population water demand and supply situation. (Water demand and supply scenario).
- Analyse the water supply system against infrastructure needs scenario in terms of anticipated urban growth.
- To suggest a model for sustainable potable water provision by Norton town council.

### 1.5 Research questions

- What characterises Norton urban population water demand and supply situation?
- What is the current water supply system against infrastructure needs scenario in terms of anticipated growth?

- What model can the Norton Town Council put in place for sustainable potable water provision?

### 1.6 Significance of the Study

This research is of great significance as it provides much insight on potable water supply sustainability in the small town of Norton since most researches focused on larger urban areas such as Harare, Gweru and Mutare. The study is also significant in analysisng the sustainability issues that govern the water supply system and identify areas requiring interventions in the perspective of small urban areas. The study aligns with the United Nations SDGs agenda (2015-2030) specifically goal number 6 which seeks to "ensure availability and sustainable management of water and sanitation for all" (UN, 2016). The findings and recommendations of the study provides great in-sights to a wide array of audiences such as the local government through providing policy makers an opportunity to draft and undertake programmes that will positively contribute to improved potable water provision signifying good governance. The study fills the gap between policy formulation and implementation regarding water provision in urban areas.

The study will asssist the Norton Town Council to realise various factors that are hampering sustainable potable water provision hence the study will redefine and readdress the potable water supply issues. This affords an opportunity to the town council authorities to restructure their strategic and master plans to suit the area within which they operate. The study affords an opportunity for the consumers to air out their views in a participatory way and influence decisions at the local sphere of government ensuring social justice, equality and democracy. Their contributions will be valuable towards sustainable and effective service provision. The study is also significant in the public administration domain as the core principles of public administration are articulated namely efficiency, equality, effectiveness, equity and economy. Lastly, the study is also significant in that it contributes to the dearth of literature on potable water supply system management in small urban areas of developing countries therefore adding new knowledge towards the topic under investigation.

### 1.7 Delimitations of the study

The study formulated a model for sustainable potable water supply management in local government. The study focused on Norton Town Council as a case area because it is a growing and developing small urban area within Mashonaland West province due to the proximity of

water resources such as Lake Chivero. About 346 questionnaires were distributed to the household within Norton. The researcher interviewed four Norton Town Council top officials. The systems approach, demand management approach and the integrated urban water management model were utilised to guide the research study.

### 1.8 Demarcation of the study

The Norton town council is located in Zimbabwe in the Mashonaland west province approximately 40 km from Harare. The town has a total population of 67 591 people (ZIMSTATS, 2012). The town has 13 wards that are each represented by an elected councillor. The town consist of 27 017 households (Norton Town Council, 2018). Figure 1.1 shows the location of Norton Town in Mashonaland West Province, Zimbabwe.

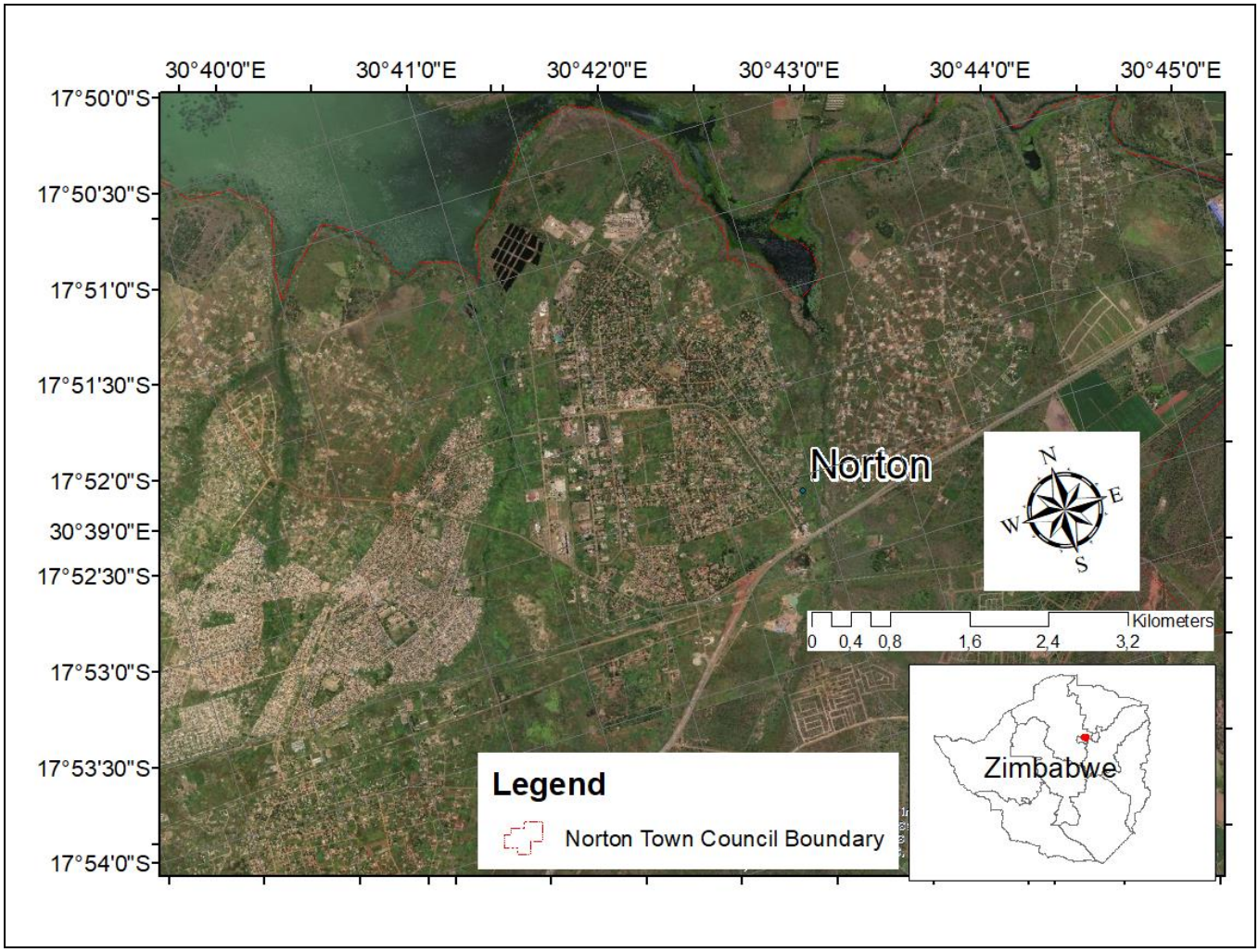


*Figure 1.1: Location of study area, Mashonaland West Province*
*Source: Author, 2020)*

### 1.9 Definition of key concepts

**Potable water-** Potable water is water that is safe and suitable for drinking and in the preparation of food and water used for personal hygiene that is free from anything that can cause health risk when consumed over a life-time (WHO 2017). For the purpose of this study, potable water refers to clean consumable water for consumption and personal needs free from any forms of bacteria that have the potential to cause health risks.

**Sustainability-** Sustainability is the "development that meets the needs of the present without compromising the ability of the future generations to meet their own needs (UN World commission of environment and development, 2015). The operational definition for water sustainability is to comprehensively manage the available water resources in the most efficient manner for present and future generational needs.

**Governance-** The concept of governance in water provision entails different political, technical, economic, social and administrative systems in place at different societal levels that are aimed at planning, developing and managing the delivery of water and water resources (Cowater International, 2008). Good governance of potable water encourages societal development and improved health that is characterised with effective planning and management of the water supply system (Musingafi, 2015). Based on that, the study adopted a conscious definition of governance as the management and development of water supply system by the responsible institutions and various stakeholders for effective supply considering both internal and external factors.

**Water demand-** Water demand can be defined as the total volume of water requested by users to satisfy their basic needs (Department for International Development, 2003). For the purpose of the study, water demand entails the amount of water that meets the needs of a society at any given time.

**Water supply-** Water supply entails a system which provide reliable water that is of potable quality and adequate quantity to address the primary water needs of households for uses such as drinking, cooking and personal hygiene purposes (Cook, 2017). Water supply entails the adequate provision of clean and reliable water for household consumption that meets the guidelines of international organisations.

## 1.10 Chapter outline

### Chapter 1: Introduction and Background

This chapter introduces the topic and background of the study. It discusses the problem statement, aim of the study, objectives, research questions, and the significance of the study.

### Chapter 2: Literature review

This chapter reviews literature interrelated to the topic under study. It presents the conceptual framework, literature on the concepts that underpins to the research in relation to the study objectives, the theoretical framework and models used to analyse the sustainability of water supply.

### Chapter 3: Methodology and research design

This chapter illustrated the process adopted by the researcher in conducting the research and the methods that were used to accomplish the aim and objectives of the study. This chapter outlines the research design, sampling techniques, data collection methods, data analysis techniques and ethical considerations.

### Chapter 4: Results presentation, interpretation and discussion

This chapter focuses on data presentation and interpretation of results.

### Chapter 5: Summary, conclusion and Recommendations

This is the final chapter of the research consisting of recommendations, solutions and conclusions of the study.

# CHAPTER 2

# LITERATURE REVIEW

## 2.1 Introduction

This chapter presents reviewed data relevant for the study from different secondary sources such as journals, books, articles, policies and council documents related to the topic. The literature was reviewed in relation to the research objectives. The peculiar issues that were reviewed includes characteristics of water demand and supply situation, the analysis of the water supply system, the infrastructure needs, sustainable solutions that were adopted by various institutions to meet with the growing urban potable water demand and the regulatory framework for equitable water supply in urban areas of Zimbabwe. The chapter started by framing the conceptual framework that guided the study and defining the concepts used in the study. The chapter also deliberates on the theoretical approach and model guiding the research study.

## 2.2 Conceptual framework

Conceptual framework is a tool to structure an inquiry that connects the research problem and possible solutions showing steps that were taken to reach a conclusion (Kumar and Antoneko, 2014). The conceptual framework shows the linkage between the key elements of the study namely the mandate of the local government to provide potable water, the systems approach, demand management approach and the IUWM model, study variables and the research objectives that underpins the study. The key steps that were taken to achieve the objectives of the study are graphically represented. Fig 2.1 depicts the conceptual framework that was followed by the researcher in conducting this study.

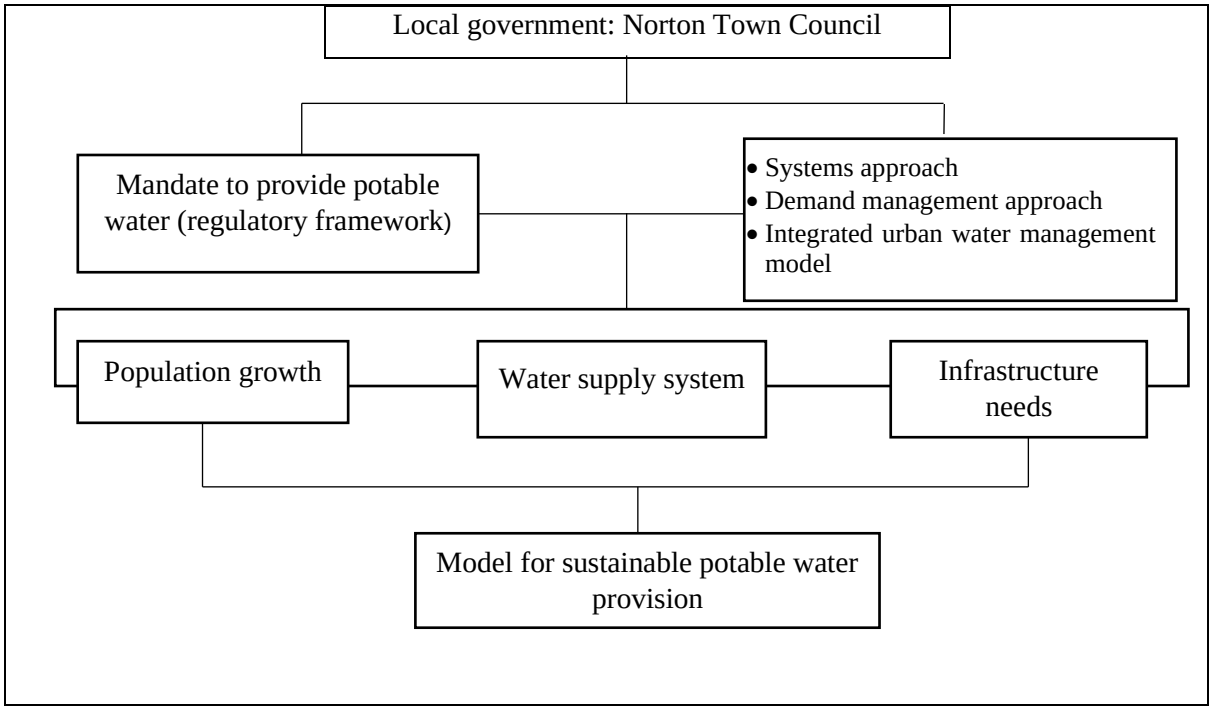


*Figure 2.1: Research conceptual framework*
*Source: Author, 2020*

The conceptual framework aided the researcher to review relevant literature on potable water as a concept to understand its importance in facilitating development and for sustainable resilient urban areas. The researcher critically reviewed literature on the urban population growth, the water supply system inclusive of varied factors that affect the system and the infrastructure needs to understand how these issues hinders the sustainability of the water supply. The systems approach, demand management approach and the IUWM model aided the researcher in comprehending strategies that propel sustainable supply of potable water in this small urban town. The regulatory mandate for water provision provided insights on how various pieces of legislation and policies help in facilitating continuous and effective water supply.

### 2.3 The concept of potable water supply

Potable water is a universal concept that is aimed at sustaining life through the provision of clean water and as such has been recognised as a fundamental human right as well as for sustainable development (UN, 2018). According to the WHO (2017), potable water is water that is free from anything that can cause health risks when consumed over a life-time. Thus, potable water is an essential component for life sustenance and must be available to all without discrimination for the realisation of the right to life and dignity (UN, 2015; UNGA 2010). Satisfactory quality of potable water is a fundamental indicator for the health and well-being

of a community (WHO, 2017; UN, 2015). Literature shows that the availability of potable water for all will curb water related diseases like cholera and diarrhoea and provides an opportunity for improved health (Mangizvo and Kapungu, 2012; WHO, 2010). Therefore, potable water concept in this study is used to refer to water that is free from anything that can potentially cause harm when consumed. The provision of potable water that can be effectively realised through effective planning and management of the water supply system as the study espouses.

The Millennium Development Goals (MDGs) 2015 to halve the proportion of people without access drinking water that is safe yielded less results in most of African countries due to increase in population, political instability and financial problems to invest in existing and new water infrastructure (UNECA, 2015). Some critics states that the MDGs mainly focused much on the outcomes with insignificant attention given to the resources that are fundamental towards achieving the intended goals (U.N, 2018). Therefore, the success of the MDGs are controversial hence national governments agreed to SDGs targets from 2015 to 2030 in order to redress the failures of the previous international goals. Water was recognised as one of the top priorities that ultimately led to an independent goal number six that focuses on "water and sanitation for all" Satterthwaite (2016). The realisation of the goal rests upon effective, robust and sustainable planning and management of water resources for human development, economic, social and environmental development. The goal has five target areas focusing on WASH, water governance, water quality and waste-water management, water resources and combating water related disasters (WWAP, 2015). The concept also aligns with SDG no. 11 that aims to 'make cities and human settlements inclusive, safe, resilient and sustainable.' In this case, equitable supply of potable piped water results in sustainability of communities, safe environment free from health related illnesses, resilient through provision of accessible physical sources and subsequently results in all forms of development such as human, economic and social development.

### 2.4 Access to potable water as a human right

Potable water is now acknowledged as a fundamental human right since 2010 when the United Nations General Assembly recognised its importance towards achieving other broad social and economic rights (Hall, Koppen and Houwelling, 2014). According to UN (2015) "the human right to potable water entitles everyone to access to a sufficient, safe, physically accessible and affordable amount of safe drinking water for personal and domestic uses." Additionally, WHO

(2010) reiterates principles that connote the human right to water as graphically illustrated with table 2.1.

| | |
|---|---|
| **Sufficient** | Each individual is entitled to have access to water that is sufficient and continuous to satisfy both domestic and personal hygiene uses. The water must be between 50-100 litres per day to ensure few health concerns (WHO, 2010). |
| **Safe** | The water must be safe for domestic and personal uses free from chemical substances, radiological hazard and macro-organisms that threaten human health. |
| **Acceptable** | Water should be of an acceptable colour, odour and taste for personal or domestic use. [...] All water facilities and services must be culturally appropriate and sensitive to gender, lifecycle and privacy requirements. |
| **Affordable** | Water, and water facilities and services, must be affordable for all. The United Nations Development Programme (UNDP) suggests that water costs should not exceed 3 per cent of household income. |
| **Physically accessible** | Everyone has the right to a water and sanitation service that is physically accessible within, or in the immediate vicinity of the household, educational institution, workplace or health institution. According to WHO, the water source has to be within 1,000 metres of the home and collection time should not exceed 30 minutes |

*Table 2.1 Principles of potable water as a human right*

*Source: WHO (2010)*

In Zimbabwe, the right to water is also acknowledged, with three key issues namely in terms of availability, quality and accessibility with overlapping dimensions that are physical accessibility, economic accessibility and non-discrimination (Crisis in Zimbabwe Coalition, 2010). Be that as it may, the right to water for the citizens also comes with responsibilities that the citizens are obliged to observe in order to realise this right. The UN development report, (2006) provided clarifications on various misconceptions that arise in conceptualising potable water as a human right as depicted by the table 2.2.

| Misconceptions | Clarification |
|---|---|
| The right entitles people to free water | Water and sanitation services need to be affordable for all. People are expected to contribute financially or otherwise to the extent that they can do so. |
| The right allows for unlimited use of water | The right entitles everyone to sufficient water for personal and domestic uses and is to be realised in a sustainable manner for present and future generations. |
| The right entitles everyone to household connection | Water and sanitation facilities need to be within, or in the immediate vicinity of the household, and can comprise facilities such as wells and pit latrines |
| The right to water entitles people to water resources in other countries | People cannot claim water from other countries. However, international customary law on transboundary watercourses stipulates that such watercourses should be shared in an equitable and reasonable manner, with priority given to vital human needs. |
| A country is in violation of the right if not all its people have access to water and sanitation | The right requires that a State take steps to the maximum of available resources to progressively realise the right. |

*Table 2.2: Human rights to water common misconceptions and clarifications.*
*Source: UN Human Development Report, (2006).*

Analysing the misconceptions and the clarifications as highlighted above indicates the applicability of the demand management approach as well as the systems approach to water delivery. The citizens and the water supply institutions have a role to play towards sustainable supply of water and the government is also responsible for achieving this right through the provision of regulatory frameworks, alternative strategies to water supply and effective governance (Olagunju, 2019; Chatiza, 2016; Machingauta, 2010). Thus from this perspective, the citizens and the government have an active role to play towards sustainable water supply in urban areas and most especially in Norton.

## 2.5 Potable water supply in Zimbabwe

The period after independence, from 1980 to late 1990s water supply in Zimbabwe was relatively reliable and efficient for the urban dwellers (Makwara, 2011). The country was highly rated when it comes to access to potable water in Sub-Saharan Africa (Nhapi, 2009). Zimbabwe is a semi-arid country receiving annual rainfall from November to April. Murungweni, (2013) further supports the assertion and also indicted that every citizen had

access to water supply services in each household as a result of efficient planning and management of water supply infrastructure system as well as tracking the growth and development of unban settlement in relation to available resources and the capacity of the urban local government to provide. Thus, the Zimbabwean government was able to uphold the right to access potable water for each individual as enshrined in the constitution (2013). Muzondi (2014) asserts that water supply was confined to the colonial urban planning and water infrastructure system and the local government during that time had the capacity to absorb increase in population due to in-migration from the rural areas to urban areas and most especially in Harare.

At the beginning of the new millennium from 2000 to 2008; the period saw a drop in water supply resulting from unprecedented urbanisation which overwhelmed the water supply infrastructure capacity. Around 85% of the population had access to potable water and around 2008, the statistics of people with access to potable water further decreased to less than 74% (Nhema and Zinyama, 2016; Mangizvo and Kapungu, 2010; Nhapi, 2009). The decrease in access to water implied that the number of households without direct connection to municipal water increased and the quality of water supplied deteriorated. During the same time, population in Zimbabwe was growing yet the water supply infrastructure system was not growing at the same pace thus resulted in further decline in water service provision. The failure to balance potable water demand and supply was due to a number of issues such as lack of revenue, obsolete infrastructure, incoherent water supply policies, lack of financial and structural investments (Chigonda and Chazireni, 2017; Shekede, 2016; Manzungu *et al.*, 2016; Kusena, 2016; Matsa and Tapfuma; 2015; Muzondi, 2014; Murungweni, 2013; Makwara and Tavuyanago, 2012).

Erratic water supply being experienced in Zimbabwe is as a result of obsolete water supply infrastructure system. The Harare City Council has been operational without adequate maintenance of the water supply system which resulted in the malfunctioning of the entire water supply system and have been failing to adequately supply water in Harare evidenced with high revenue water (Chigonda and Chazireni, 2017; Manzungu *et al.*, 2016; Shekede, 2016). Unfortunately, the Harare City Council (HCC) is also mandated to provide water to the small satellite urban areas of Chitungwiza, Ruwa, Epworth and Norton, that on its own is a worsened burden since the HCC is failing to provide efficient water supply services within their area of jurisdiction. The satellite urban areas buy water from the HCC and redistribute the

water to their respective areas of jurisdiction. With the current water supply set up, much of the treated water is being lost in the distribution system hence the satellite urban areas receive less water in relation to the amount paid for (Muzondi, 2014; Chigonda, 2011). The demand for potable water is growing putting pressure on the already failing water infrastructure thus overwhelming the capacity of municipalities to deliver (Kusena and Beckedah, 2016; Mapfumo and Madesha, 2014).

Revenue in public institutions is essential towards the planning, management and sustaining public service delivery thus the lack of revenue in urban local government in Zimbabwe led to further dilapidation of the already existing potable water infrastructure system. The collapse in revenue was due to non-payment of rates by urban dwellers and the withdrawal of government grands citing economic collapse (Mabika, 2015; Mapfumo and Madesha, 2014). The residence thus developed a culture of non-payment for water services in urban areas under the misconception that access to water is their right disregarding their responsibility to pay rates hence the citizens were deprived of their right to water (Majuru, Suhrcke and Hunter, 2016; Manzungu *et al.,* 2016). It not only affected the water supply institutions but also the citizens in general as evidenced by water borne related disasters such as the outbreaks of cholera and diarrhoea claiming more than 4000 lives and leaving 100 000 people infected with cholera epidemic in 2008 (Coutinho, 2010). Since then, water borne diseases have been recurring almost each year further claiming lives in Zimbabwe (Muzondi, 2014). This therefore shows the necessity of a model for sustainable water provision in Norton Town Council to enhance human development and socio-economic development for the town.

### 2.6 Local government financing in Zimbabwe

Public service sustainability in local government is hinged upon financial resources management and mobilisation (Zhou and Chilunjika, 2013; Besley and Persson, 2013). The local government is obligated by law to provide for services in their areas of jurisdiction and also constructing as well as maintaining the infrastructure sustainably. The services and goods provided for by the local municipalities are based on payments on the services received. World Bank (2007) asserts that the local government has ultimate power to manage their own revenue and expenditures which was made possible through fiscal decentralisation aimed at reduce central government control and interference. Thus to achieve sustainability in service provision, it is essential for local government entities to effectively plan, mobilise and manage financial resources to realize service delivery objectives.

Resultantly, Oosthuizen and Thornhill (2017:436) asserts that a municipality must ensure that its customers are billed; that it collects all money due and payable to it; and that it adopts, maintains and implements a credit control and debt collection policy. The bulk of revenue generation for urban local government are derived from internal sources through billing for services, taxes, licencing, health and educational facilities (Zhou and Chilunjika, 2013). Authors such as Mabika (2015) confirms that the local authorities heavily depend upon user payments and taxes to generate much of the revenue constituting more than half of the revenue collection for public services in the urban areas. Externally, local municipalities also generate revenue through government grants, loans and transfers (Oosthuizen and Thornhill, 2017; Mabika, 2015; Cautinho, 2010). However, in developing nations, the local government has been struggling to provide basic services due to revenue challenges as evidenced by their failure to expand, replace and maintain infrastructure that has over lived its existence (Eneh and Nnaji, 2016; Kusena, 2016).

In the Zimbabwean local government context, the Urban Councils Act [chapter 29:15] authorises the local councils to mobilize financial resources independently through levying rates and charging service user fees. Nevertheless, the local authorities still lean on the decreasing financial support from the central government in form of loans, government transfers and grants, that has further worsened the delivery of public services within the country (Mabika, 2015; Zhou and Chilunjika, 2013; Cautinho, 2010). The central government financial support is neither stable nor sustainable and in most cases, the government withdrew financial support to these urban municipalities. The situation is further worsened by the socio-economic meltdown that hit Zimbabwe in the 2000s; the revenue base of the local authorities as the channels for accrueling revenue is dwindling due to lack of user payments that form the backbone of revenue for the councils hence crippling their service supply sustainability.

A study conducted by Matabvu (2016) revealed that the local authorities have adopted new revenue collection strategies but however, despite these efforts the councils fall into budget deficit as a result of the obsolete infrastructure that constantly require service maintenance. The infrastructure dilapidation further affects the revenue generation through unbilled potable water loss expressed as non-revenue water lost in the distribution system and also from estimated billing system financially crippling the local authorities most especially the case of Harare City Council. The study thus argues that water supply sustainability in the Norton Town Council is

hinged upon user payments accrued from delivering potable water, as enough revenue will be available for infrastructure maintenance and expansion.

### 2.7 Urban population water demand

Generally, water demand refers to the total volume of water needed to satisfy users' basic needs (Department for International Development, 2003). Water demand is largely influenced by population growth and globally by 2050, water demand is projected to increase by 55 % (WWDR, 2015). WHO (2015) points out that officially, 663 million people currently do not have access to an improved drinking water source hence their demand for water is basically not being met thus widening gap between demand and supply. Adding on, global demographic changes are anticipated to raise to a total population of 9.7 billion people and double the number of people living in urban areas, 40% of which will be living in water scarce areas (Guppy and Anderson, 2017). Population growth is therefore accelerating strain on water resource which subsequently increases the number of people without access to potable water (Guppy and Anderson 2017; UN WWDR, 2015; Khatri, Vairavamoorthy, 2007). Historically, water scarcity was largely pronounced in the rural areas however, recent trends point out to worsening unavailability of potable water in urban areas due to an increase in demand as a result of population growth, urbanisation and lack of water treatment facilities (Kusena, 2016; Muller, 2016; Romero-Lankao and Gnatz, 2016).

In developing nations, urban population growth rate stands at 3.9% annually and it is the highest in the whole world according to the UNPF (2007). Due to the increase in population, urban centres are unable to manage their domestic water efficiently consequently leading the municipal government to struggle to reconcile available water supply capacity to meet with the ever-growing demand (Watson, 2009; Makwara and Tavuyanago, 2012; Clifford-Holmes *et al*., 2014; Muzondi, 2014; Matsa and Tapfuma, 2015). The population growth is also exacerbated by rapid urbanisation that does not match government's capacity to provide equitable potable water (Nhema and Zinyama, 2016; Khatri and Vairavamoorthy, 2007). In Ethiopia, a study conducted by Desalegn (2014) showed that water demand is increasing at a pace that that do not equate with water supply. The increase in water demand is as a result of urban development, expansion and new urban dwellers stressing the water supply infrastructure that is not expanding ultimately leading to water supply shortages. Similarly, Chigonda (2011) asserts that the mushrooming of illegal settlement and urban slums are exerting pressure for water demand in urban areas thus hindering the local government's capacity to supply potable

water to the new settlement areas. Gondo and Kalowole (2019) reiterates that gender is also a significant variable in understanding the demand and management of potable water within communities. Females tend to conserve more water as compared to males because they spend more time queuing for water as a gender role unlike the male counterparts.

### 2.7.1 Characterising urban population water demand

Potable water demand differs in relation to different areas across the globe therefore it is essential to understand the aspects that characterise these urban demands to come up with unique solutions peculiar to the demand challenges being faced (Morote *et al.,* 2016; Zeneli, 2016; Desalegn, 2014, Chigonda, 2011; Marela, 1992). Understanding these complex aspects afforded this research to find insights in literature and determine the major characteristics of urban population water demand in Norton town. The potable water demand characteristics differ in relation to different urban areas and location signifying the need for an investigation that is aimed at understanding these characteristics in relation to Norton town.

Emerging trends from different scholars indicate that demographic factors are among the major contributions towards water demand (Gondo and Kalowole, 2019; Dos Santos *et al.,* 2017; Magombo and Kosamu, 2016; Panganai and Mangizvo, 2016). The demand for water in the urban areas is largely influenced by population growth dynamics that stresses water resources to meet with population increase (Eneh and Nnaji, 2016). The water governing institutions thus fails to adequately provide sufficient potable water to the ever increasing population in the urban areas. The growth in population is compromising the delivery of basic services since the growth is not proportionate to the capacity of the institutions to supply. Moreover, deteriorating water quality has been experienced by the urban dwellers receiving water that has odour, that can be attributed to heavily populated water sources (Matsa and Tapfuma, 2015; Mudzingwa, 2015). In the case of Harare, one of the major raw sources of water such as lack Chivero is heavily polluted due to increased human activities around the area thus resulting in expensive water treatment processes. The sustainability and efficiency of supply in such cases is undermined, as the council is not financially viable to purchase adequate water treatment chemicals. Due to this reason, most urban municipalities are failing to plan and manage their domestic water supply efficiently posing a challenge to the sustainability of water supply in urban areas.

Changing water consumption patterns and changing lifestyle is also another issue confronting local government in urban areas leading to increased potable water demand (UNESCO, UN-Water, 2020; Chigonda and Chazireni, 2017; Dos Santos *et al*., 2017; Connor *et al.,* 2015). In developing countries, the water demand is a serious concern due to inefficient use of available potable water resources most especially in urban areas (Shabbir, Saleem and Usman, 2016). The tariffs for water are relatively cheap and uneconomic in respect to the revenue against expenditure hence people tend to be wasteful when using the water (Chigonda, 2011). This therefore shows the relevance of the demand management model since it shows the importance of water pricing as a demand management mechanism in ensuring efficient utilisation of water resources. According to Shabbir *et al.,* (2016:2) water pricing is an important economic instrument that not only supports improved infrastructure development (through increased revenues) but also helpful in demand management policies to conserve and make efficient use of water resource. This therefore shows that the pricing for potable water must be in line with the income of the household and also act as a conservation technique to guarantee efficient use of water and grey water towards the realisation of water supply sustainability.

Adding on, urbanisation and economic activities are also important factors that contributes to increased water demand in urban areas. Saraswat, Mishra and Kumar (2017) reiterates that urbanisation leads urban sprawl and the mushrooming of informal urban settlement most especially in large urban areas that will not be covered by the water supply infrastructure system hence the demand for potable water is unmet in such areas. The gap between demand and supply thus further widens and the UN Habitat (2010) posits that the citizens in these informal settlements lacks one or more basic services most especially access to potable water resulting in outbreak of water borne diseases. A study conducted by Asoka *et al.,* (2013) showed that more than half of the Kenyan population lives in informal settlements with no direct and intermittent water supply facilities. Therefore, it can be noted that most of the population in the developing nations lives in the informal settlements and the impact of inadequate potable water access is disastrous consequently contributing towards unsustainable water supply management and underdevelopment (Dos Santos *et al.*, 2017).

According to Asoka *et al.*, (2013), growth of urban areas is inevitable and the solution to urban problems depends heavily on effective urban planning, infrastructure development and management. Urban expansion is inevitable where population is increasing to absorb new urban dwellers. Nevertheless, the planning and expansion of urban housing settlements is not

in tandem with supply as newly allocated location are not connected to the water supply system and residents rely on other sources of water such as boreholes, wells and water harvesting as alluded by Chigonda (2011). This shows failure of urban planners in meeting the needs of the people through the provision of bulk services as stressed by the IUWM model which emphasises the need for an integrated approach to water planning and management in urban areas (Bahri, 2012).

### 2.8 Water supply in urban areas

Water supply entails the availability of potable water in terms of quantity and quality at the place where the user needs it and must be reliable (WHO, 2010). Water scarcity in urban areas of developing states is increasingly becoming a major issue in terms of the quantity and quality (Adams *et al*, 2018, Dos Santos *et al*, 2017; Matsa, 2012, Gray, 2010). The water quality is highly questionable as the water will be contaminated characterised with odour, colour and foul taste (UN, 2015). Potable water supply in most developing states in urban areas is not continuous and reliable. There are myriad issues hampering sustainable and efficient water supply in urban areas hence water supply has taken an extreme negative turn. Ineffective institutional governance, insufficient stakeholder engagement, financial constraints, political interference and ecological issues are the major contributors towards unsustainable potable water supply in urban areas (Chatiza, 2016; Panganai and Mangizvo, 2016; Chigonda, 2011).

The National Water and Sanitation Inventory, 2009 cited in Mangizvo and Kapungu (2010) asserts that there was a major decline in potable water provision and sanitation in urban Harare from 81% in 1999 to 51% a decade later instead of improving, the water supply services deteriorated. Chiriseri (2014) and Chatiza (2016) opined the water supply by the Harare City Council is contaminated mostly with corroded supply system as the infrastructure system has become obsolete thus the water is not fit for human consumption.

Adding on, there is a general consensus that water crisis in many areas have been as a result of poor water supply governance (Togarepi and Tsiko, 2012; Manzungu, 2012; Hukka *et al.*, 2010). Asoka *et al., (*2013) is of the opinion that proper planning and management of water supply infrastructure is the core factor towards the realisation of quality water and efficient quantity. Adding on, understanding water demand of customers is an essential start-off point in the realisation of equitable water supply in urban areas (Zimbabwe Water Forum, 2012). Water supply must be continuous and uninterrupted with a 24/7 service provision (UN World Water Development, 2015). As has been mentioned, water supply crisis in most urban areas

is as a result of old and dilapidated water infrastructure that do not equate with demand as the water infrastructure system is being overwhelmed (Makwara and Tavuyango, 2012; Mangizvo and Kapungu, 2010. The poor water infrastructure system is also responsible for non-revenue water lost through leaks that costing councils a fortune financially crippling the revenue base as more water is treated and distributed to the consumers at a loss as most of the water is lost in the distribution phase (Mangizvo *et al.*, 2016). Therefore, ineffective management of the water supply system in urban areas has dire consequences in limiting potable water supply to the consumers.

Eneh and Nnaji (2016) postulate that ineffective governance also manifests in managerial issues that hinder the capacity of potable water institutions to supply water to different consumers. According to their study, poor governance issues are the major draw-back towards water supply in Nigeria, Enugu. The poor governance apparently manifests inform of corrupt tendencies by the officials, late payment of staff that leads to demotivated employees and operational constrains all leading to poor potable water supply. These conclusions are supported with the study conducted by Mapfumo and Madhesha (2014) who established that poor governance issues are an obstacle towards efficient water delivery in Masvingo, Zimbabwe. This therefore implies that effective institutional management contributes towards sustainable supply of potable water.

Sustainable water supply is not a sole responsibility of a single entity and as such stakeholder participation is vital for successful water supply system (Bahri, 2012). The involvement and consultation of consumers, policy makers and urban planners' inputs results in successful management and design of water supply systems and also encouraging the principles of accountability and transparency that will improve revenue generation for financing water infrastructure needs (Hack, 2013; Hamlat, 2013). Not only does stakeholder involvement contribute towards efficient management of water supply system but also contributes towards the realisation of human rights to democracy through effective participation. However, the water supply is characterised with lack of key stakeholder engagement that has contributed to the failure of local government institutions to provide efficient supply and manage the water supply resources (Dos Santos *et al.*, 2017; Panganai and Mangizvo, 2016; Eneh and Nnaji, 2016).

This engagement of stakeholders can be evidenced by partnerships of water utilities and external actors. In Malawi, the participation of the stakeholders was through community public

partnerships that resulted in improved water supply in informal settlement that was previously an impossible mission due to mismanagement of funds, community exclusion and also vandalism of water infrastructure (Adams and Zulu, 2015). The commencement of the partnerships in 2006 was coupled with improvements in the water supply to informal settlements at community level as the supply was mainly managed by private operators and all operations were accounted for (Adams *et al.*, 2018). Significantly, the engagement of stakeholders leads to improved technical and financial management essential for maintenance and procuring new water supply infrastructure system (Adams and Zulu, 2015).

Majuru *et al.*, (2016) highlighted that the provision and management of water supply in urban areas has been collapsing gradually owing to the economic challenges confronting the public service. Local authorities have two major sources of finance as argued earlier; internal and external sources (Cautinho 2010). Internally, the councils generate own finance through revenue collection that includes user fees, taxes and licencing fees and external revenue sources comprising government grants, loans and transfers (Mabika, 2015; Cautinho, 2010). Adding on, Mabika (2015) argue that the economic meltdown that hit the country in the early 2000s negatively affected local authority's revenue base reaching unprecedented levels as government and the internal strategies to improve revenue have since collapsed. Government failure to provide financial resources for water infrastructure development plans have been the major draw back towards the realisation of improved water supply since the existing infrastructure is old and dilapidated thus unable to meet with increasing demand (Manzungu *et al*, 2016; World Bank, 2014). Capital investment is therefore essential in managing complex urban water systems (Sally *et al.*, 2014).

Literature shows that financial constrains are a major hindrance to water supply in urban areas (Chigonda and Chazireni, 2017; Manzungu *et al.*, 2016; Mabika, 2015; Sally *et al.*, 2014). For instance, a study conducted by Ajibade *et al.*, (2015) in Nigerian urban water institutions showed that financial issues are an obstacle to the realisation of sustainable supply of water. These financial issues manifest due to funding challenges, over dependency on government and lack of reliable sources of finance for urban water institutions. In the case of Zimbabwe, financial constrains led to the failure of councils to replace and maintain the water supply system due to non-payment of rates and bills by the consumers and government parastatals (Mangizvo *et al.*, 2016). Therefore, this implies that the availability of finance has a positive bearing towards sustainable water supply.

Sustainable potable water supply is also hinged upon user payments to ensure equitable and efficient water provision (Mabika, 2015). This is in line with the human rights perspective on water supply echoing the need for citizens to pay for supplied water as citizens are not entitled to free water (WHO, 2010). More so, the government also have a prerogative responsibility to fund these local authorities since service delivery is inclined with the availability of financial resources (Musingafi, 2012). In Zimbabwe however, the government has failed to fund councils, rate payers are the main revenue source yet the citizens have become sceptical about paying (Sithole, 2013). This unwillingness to pay by residents have negatively affected water delivery system as the revenue base was reduced (Mangizvo *et al.*, 2016; Muzondi, 2014). Therefore, revenue collection strategies have to be put in place to encourage service payment and it is important to engage different stakeholders for the realisation of water supply efficiency as postulated by the systems approach.

In order to meet growing urban water demand, local authorities have to embrace new technologies that will increase water supply (Makwara 2012). However, Sharma and Vairavamoorthy, (2009) asserts that most developing countries do not have access to improved infrastructure technologies for supplying potable water and also lack skilled manpower to implement the existing technologies. A study by Nhapi (2015) on the challenges of water supply and sanitation in developing countries concluded that inappropriate technologies is an issue that is faced by local authorities in providing water. Consumers end up being billed less than the actual volume of water consumed due to poor water metering systems that are sub-standard, costing councils more money for water treatment and distribution for less cost recovery. Thus, attention must be paid more on embracing new technologies to effective water management and conversation techniques (Mangizvo *et al.*, 2016: Sharma and Vairavamoorthy, 2009).

Political interference is yet another factor that hinder urban water supply. Efficiency, transparency and effectiveness of water supply in most urban areas in Zimbabwe is eroded as a result of political interference (Mapfumo and Madhesha, 2014). Efforts made by the urban authorities have resulted in limited success due to political meddling with administrative governance hence the autonomy of these institutions are side-lined. An example of such meddling can be evidenced by the government directive by the then Minister of Local Government to write-off debts owed by residents from 2009 to 2013 just a week before the harmonised elections (Muperi, 2013). Nyikadzino and Nhema (2015) indicated that the decision affected urban councils' capacity to provide water services as the revenue base was

crippled. Recently, the government in partnership with some local authorities decided to reduce debts by 50% upon each payment made by customers. This implies that political interference not only disregard the independence of these institutions but also affect the revenue base having grave effects towards water supply.

Adding on, there is high centralisation of water supply in Zimbabwe. An example can be drawn from a number of government reforms that are detrimental towards efficient service provision most especially the creation of Zimbabwe National Water Authority (ZINWA) in 1998 with the mandate of advising the government on policy formulation, planning, management and development related to water resources (ZINWA Act chapter 20:05). In 2005, the government directed all local authorities to transfer water and sanitation services to ZINWA with no proper planning and implementation plans that inevitably failed (Muchadenyika and Williams, 2018; Chigonda, 2011). In 2009, the government reversed the directive and the mandate for water provision was transferred back to local authorities in the wink of cholera outbreaks hence the local authorities were not in any position to deliver the water services (Muchadenyika, 2014). This therefore shows that water supply in Zimbabwe is highly characterised with massive political interference as most policies that are implemented are politically motivated and managed with inexperienced personnel.

Moreover, the interference also increases the magnitude of space to be covered by these local councils with less financial capacity to sustain these new resettlement areas (Zimbabwe Homeless People's Federation, 2015). The government executes water related plans without proper consultation, planning, designing and implementation of the plans (Chigonda, 2011). An example can be highlighted with the establishment of Hopley settlement area that came into existence in 2005 after the infamous operation restore order *(Murambatsvina).* Since then, water services in the peri-urban area have been a challenge, NGOs have intervened to ameliorate the situation through drilling of boreholes that yielded less success as the boreholes dry up constantly during dry spells (ZHPF, 2015).

Adding on, the boreholes prove to be unsustainable due to malfunctioning as they are not being effectively maintained. The Department of Water Affairs (2013) delineates that sufficient availability of water supports development, eliminates poverty and fight against inequality. Therefore, the notion of water as a social good is thwarted upon evidenced with recurring water disease outbreaks, social injustice and worsened poverty. In countries like Botswana, political interference also affects the autonomy of local government at the expense of service delivery

(Dipholo and Gumede, 2013). The study they conducted illustrated that the local authorities are a mere extension of the central government stripping the local government management powers which had devastating effects on water supply. Therefore, independency of urban local authorities from the central government provides a platform for improved water supply services.

Ecological factors also contribute towards efficient supply of water through planning and management of the water supply system focusing on rainfall patterns and climate change thereby informing authorities about alleviation measures to reduce the impact of climate change on water supply**.** Climate change is one of the major areas focused by researchers in assessing the challenges of potable water provision in urban areas since the hydrological cycle is affected by climate change (UNESCO, UN-Water, 2020; Dos Santos *et al.*, 2017; Macdonald *et al.*, 2011). Khatri and Vairavamoorthy (2007) conducted a study on the challenges for urban water supply and sanitation in developing countries. The results highlighted that climatic changes affect water availability to equate with the ever-increasing water demand. Also, changes in climate have different impacts in relation to different urban areas as some experience intense storms and others will experience severe shortages. Thus, it is important for water supply institutions to have expert knowledge and understanding on the climatic conditions in which they operate to reduce the urban areas' vulnerability to climate change that threatens development socially, economically and environmentally that translate in strategic planning and management (Dos Santos *et al.*, 2017; Khatri and Vairavamoorthy, 2007).

A study conducted by Howard *et al.*, (2016) showed the same results indicating that climate change poses as a serious threat to water supply due to reduction in precipitation leading to loss of water sources and destruction of water infrastructure as a result of flooding affecting the quality and quantity of water supply. The study also highlights actions to reduce the impact of climate change that includes measures of climate resilience plans into water safety, improved management and accounting of water resources as risk management plans. An example of the action can be attributed to Ethiopia, the country has been exposed to climate change that resulted in flooding contaminating water sources deterring potable water supply (WHO, 2017). As a solution to ensure sustainable supply, the Meskan district after climate resistance planning concluded that farming activities close to water sources was the significant hazard and as such the farmers had to be relocated. This implies that climate change is a significant hindrance

towards potable water supply and as such, mitigating measures have to be put in place to reduce the impact thereof.

### 2.9 Urban water supply system and infrastructure needs

Urban water supply system is influenced by planning, designing and management that results in meeting demand for potable water (Loucks and Beek, 2017). Kayser (2013) and (WHO 2016) reiterated that efficient water supply is an integral aspect that leads to sustainable development through improved social health, economic growth and the subsequent realisation of the right to water and sanitation. To achieve this, there is need for commitment from governments all over the world through investment that is aimed at enhancing the water sector (WHO, 2016). Moreover, growth of areas around the world most especially in Africa is inevitable creating urban burdens therefore the solutions largely depend on effective urban planning for infrastructure development and management (Asoka *et al.*, 2013). Therefore, understanding the water supply system is significant in making vital decisions towards water supply as well as the formulation of strategies that can be implemented towards improvement of water supply system in urban areas. The study therefore reviewed literature to get knowledge on water supply system to understand the water infrastructure needs across the Norton town.

The water supply system is an interconnected network of engineered hydrologic and hydraulic components which provide water to consumers. The system comprises of four major aspects as alluded by Maharashtra (2012) showing a typical piped water supply system as illustrated on the figure 2.2 starting from a water source, treatment, storage and distribution phases:

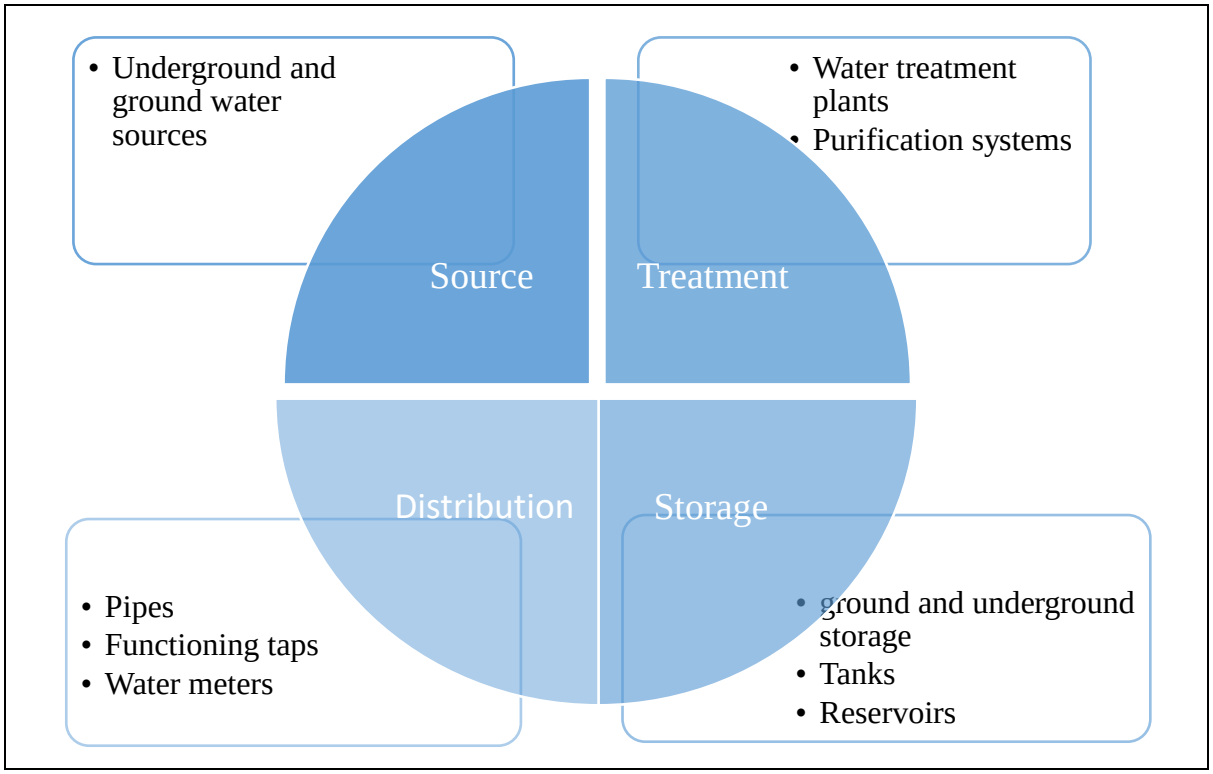


*Figure 2.2: Water supply system*
*Source: Maharashtra, (2012).*

The major purpose of the water supply system is basically to supply water with the appropriate quality, quantity and pressure to the consumers thus jointly defining the facilities necessary to deliver water from the source to the consumers (Maharashta, 2012). There are basic necessities required in the distribution of water to retain the potability of the water in the distribution pipes, the water should be sufficient enough to be distributed to all intended locations under the right pressure with minimum losses associated with leakages. Thus, the system is basically a physical structure necessary for water transportation from one point to the other. Be that as it may, the system does not effectively function in isolation of the other external aspects necessary for the supply system to be fully functional inclusive of human, administration, regulations and financial aspects to also be addressed (Dos Santos *et al.*, 2017, Chigonda and Chazireni 2017; Eneh and Nnaji, 2016; Asoka *et al.*, 2013).

A review of literature from both the global north and the global south indicate that infrastructure needs differ across different urban areas influenced by social, economic, demographics, technical and political governance factors (Chigonda and Chazireni 2017; Eneh and Nnaji, 2016; Panganai and Mangizvo, 2016; Manzungu *et al.*, 2016). As deliberated earlier, the urban local authorities are being overwhelmed by population increase subsequently resulting in poor water supply services a major concern that calls for an overhaul intervention

in water supply management. The study reflected on the physical water supply infrastructure needs, financial, governance, legislative, personnel and regulatory issues.

### 2.9.1 Technical water supply infrastructure system

Water infrastructure operation and maintenance are often neglected leading to damages of the equipment and machinery, water loss in the distribution system and water unreliability hence affecting the quality and quantity of the water supplied (UN, 2015). It is against this backdrop that many water infrastructure projects tend to fail as these factors are intertwined and operate as a system that literature does not emphasise (UN, 2015). Understanding how the factors interact as a system will help planners, the institution, stakeholders, the government, consumers and policy makers to come up with solutions to sustain water delivery infrastructure system. The technical water system infrastructure can be categorised into four major technical types corresponding with the water supply system namely potable water source, treatment, storage and distribution. Each infrastructure category plays an integral function towards the realisation of potable water supply to the customers.

Potable water source comes from the surface and ground water for example rivers, dams, water reservoirs and drilled wells. The water source plays a crucial role in the realisation of adequate supply to the system to meet with demand (U.S Congress report, 2015). UN (2018) reiterates that the availability of water resources is critical for the availability of sustainable supply services thus on the other hand, insufficient water sources translates to inadequate and insufficient potable water services. The water systems that utilises local sources require less built infrastructure as the transportation is relatively shorter and more sustainable than external sources (Vanbriesen *et al.*, 2013). Water sources is critical for water quality and quantity that will be provided into the distribution system and this varies with spatial locations. In Zimbabwe, most urban centres draw their water from reservoirs, dams and rivers but their use is no longer significant as they are highly polluted and silted implying not only higher water treatment costs but also reduced volumes of stored water (Panganai and Mangizvo, 2016). The major obstacle that hindered effective water supply can be attributed towards untracked water pollution that has ultimately led to serious water crisis from the major water source for example Lake Chivero as water treatment becomes very expensive (Manzungu *et al.*, 2016).

WHO (2010) posits that water supply must be safe for human consumption free from contamination and pathogens that discredit the potability of water. This manifests in the

construction, expansion and rehabilitation of facilities such as water treatment plants to reduce or eliminate contaminations through the process of water treatment (UN, 2015). The contaminations that should be eliminated includes pathogens that affect water taste, colour and odour driven by customer, state and global expectations.

Concurrently, the UN (2015) articulates that potable water storage infrastructure system can be conveyed through the construction and rehabilitation of covered and protected storage tanks and reservoirs. Sufficient storage facilities are crucial for the provision of adequate supply of treated water to customers to meet with peak demand period and maintain the required pressure in the distribution system (UN, 2015).

A water distribution system is the physical works purposely intended to deliver potable water from the source to the customers with the right pressure, quality and quantity (Oyedele, 2014). The distribution system needs are concerned with the maintenance of existing infrastructure and the replacement of the water distribution mains, installation of new pipes and installation of new water mains to the new settlement areas including water meters to record water consumption per household (U.S Congress report, 2015). More so, the infrastructure need category also translates to the need for replacing aging and deteriorating water distribution mains (UN, 2015). The water distribution infrastructure maintains the water quantity and quality as per international standards hence leads to significant economic and social benefits (UN, 2015). In relation to urban population growth and development, this will inevitably lead to increase in households that manifests in the creation of new settlement. The increase relatively indicates the need for new water infrastructure development to cater for the new locations.

Most urban areas of Zimbabwe have obsolete water supply infrastructure and as such, urban councils are failing to provide water services as a result of urging and dilapidated infrastructure (Panganai and Mangizvo, 2016; Mangizvo and Kapungu, 2010). The water supply systems were constructed before independence and no proper maintenance were conducted over the years and urban councils do not have the financial capacity to replace the infrastructure (Mangizvo and Kapungu, 2010; Kwindini, 2007). The old and dilapidated water infrastructure compromises supply to new urban formal locations as well as developing slums and greater Harare namely Chitungwiza, Norton and Ruwa (World Bank, 2014). Adding on, the projects that are aimed at rehabilitating the infrastructure depends on the central government to provide for funding that has consequently left the most municipality crippled in their quest to construct

reservoir tanks, purchasing of new pipes amongst other infrastructure projects as alluded by Magizvo and Kapungu, (2010).

Furthermore, the infrastructure is also characterised with water leaks that account for most of non-revenue water in urban councils. Chigonda and Chazireni (2017:29) defined non-revenue water as the difference between the amount of treated water put into the distribution system and the amount of water billed to consumers. In an attempt to meet with the ever-increasing water demand, the urban councils face a challenge of high-water loss levels in the transportation and distribution of water making it difficult to meet with the consumer demands as well as keeping up water tariffs at reasonable prices (Chigonda and Chazireni, 2017). In Zimbabwean urban councils, non-revenue water loss is occurring at intolerable rates as evidenced by 52% of treated water loss in Mutare in 2001 and 30% water loss for Kwekwe city council in 1992 (Gumbo and Van der Zaag 2001; Goldlatt *et al.*, 2000). Thus threatening water supply viability, hampering efforts for water provision to different consumers. This also aligns with a study conducted by Eneh and Nnaji (2016) in Enugu, Nigeria showed that obsolete water infrastructure is the major problem resulting in inefficient water supply consisting of weak pipelines frequently bursting resulting in leaks hence the institution incurs huge costs for maintenance. Therefore, proper planning, designing and maintenance of the water distribution system will have tremendous positive results in providing potable water to consumers in a more efficient and sustainable way.

### 2.9.2 Effective financial capacity and management

Sustainability in potable water supply is depended upon robust financial management within public service since water supply is a system to ensure efficiency in service provision. The human right to water alluded the need for user payments as a sustainable measure towards realising efficient supply (WHO, 2010). According to Eberhard (2019), financial sustainability of service providers can be measured by the ability of the providers to generate cash surpluses after taking into account operating costs. This shows the necessity of adequate financing to cover for operating costs, investments in the infrastructure system, monitoring and evaluation as well as other key institutional activities to cover for effective potable water supply.

Lockwood *et al*., (2018) substantiates that there is lack of clarity on those expected to fund the water supply maintenance and operational costs in most developing nations and hence there is

a supply gap due to inadequate planning, budgets and technical faults. Therefore, effective planning in financial investments is key towards the success of all piped water schemes bearing in mind all sources of finance for local government to meet with the supply expenditure in a sustainable way. However, in Zimbabwe, the beginning of the 2000 era brought a phase of economic challenges that resulted in dwindling financial grands from the central government towards the local municipalities (Kusena, 2016). Despite the dwindling revenue, new potable water needs in urban areas are emerging further complicating the already complex water supply situation. Of all these sources of finance, the revenue base that contribute much towards the overall revenue for the local government is mainly derived from tariffs by the service users as compared to grands and transfers (Matabvu, 2016; Nhema and Zinyama, 2016; Mabika, 2015). This therefore calls for robust systems in place to maximise service payments from the users to archive sustainable water supply by the local government through effective billing system and strategies that ensure service payment by the citizens.

Water billing system ensures that the consumers pay for the services that are being rendered to them. Effective water provision depends upon effective, timeous and efficient water billing system that properly records bills and taxes that are due to consumers. Poor billing system, unmetered consumption and illegal consumption are the major hindrance towards revenue collection by councils (Liemberger and Wyatt 2019; Brasuell, 2015). Urban councils must make it a priority that their billing system is efficient enough for cost recovery. A study conducted by Brasuell (2015) concluded that poor billing system is an obstacle towards revenue collection and as such, leads to budget deficit for service providers. This also concurs with a study conducted by Moffat (2014) which highlighted that the poor billing system also manifests in consumers tempering with water meters, incorrect billing system, incorrect meter readings, and some consumers do not receive invoice notifications that they should pay as invoices will be sent to a wrong address hence consumers retaliates from paying inflated rates. Therefore, revenue collection strategies must be tightened to ensure effective revenue collection through proper billing and metering system thus reducing non-revenue water and operational losses.

### 2.9.3 Competitive personnel capacity

Water supply services do not operate in a vacuum hence the attention also needs to be placed on the personnel within the institutions due to the dynamic changes within the sector that needs constant upgrading. When the personnel needs are met positive results are inevitable as the

needs of the service users will be constantly addressed which is core towards effectiveness in the water supply sector (Chigonda and Chazireni, 2017; Panganai and Mangizvo, 2017). There is therefore, the need to constantly monitor and evaluate the capacity of the expertise and general employees to ensure that they keep up with changing consumption trends and growing population through innovative thinking, constant training and development. UN (2018) reiterates that capacity development is a fundamental aspect towards contributing to sustainable potable water provision as enshrined in the SDGs agenda 2030 precisely goal number 6.

Literature also portray human resources gaps in the water sector as a hindrance towards sustainable water supply (Eneh and Nnaji, 2016; Muller, 2016; IWA, 2014). *UN (2018)* substantiates that acute lack of capacity is constraining water resources development and management in all its facets, across most developing countries, particularly in sub-Saharan Africa. This is because the human capacity is responsible for the management of the entire water supply system as well as implementing all relevant policies aimed at managing and sustaining the water sector. SDG number 6 target 6 (a) provides an opportunity to assess personnel needs through capacity building in improving water provision most especially in developing countries (UNGA, 2015). Efficiency and effectiveness of employees are core towards the overall output of an organisation realised through training and development programs (Eneh and Eneh, 2016; Armstrong, 2010).

There is need for adequate funding aimed at capacity building that will lead to innovative learning enhancing employee competence and generally improving the capacity of the water sectors as employees will be able to cope with changing demand and new technologies (UNWWDR, 2016). To strengthen the capacity of institutions, it also requires long term support and commitment by the responsible authorities to support capacity development to have experienced technicians and effective professionals to translate their knowledge to practical solutions.

### 2.9.4 Governance efficiency

The concept of governance according to literature shows that there is a challenge in defining and understanding what governance is. Furthermore, combining governance issues to water sustainability further complicates the process. However, to understand the concept better, the governance of water can be differentiated into two levels that is at the macro level i.e national level and micro level at an institutional level. The study focused on governance at a micro level

defined by the UNDP (2004:66) as "…the range of political, social, economic and administrative systems that are in place to develop and manage water resources and the delivery of water services, at different levels of society." From the definition, it is essential to note that governance of water must be dynamic with transformative capacity to manage and cope with changes within societies due to population growth, which is inevitable in most urban areas of most Sub Saharan Africa (Kusena, 2016). Robust implementation of water governance eliminates inequality, ill health, poverty and underdevelopment (UN, 2018). Hence Adams *et al.,* (2018) opined that for sustainable urban water supply in Sub-Sharan Africa to be realised, it requires innovative governance coupled with robust institutional arrangements among the key stakeholders to incorporate their strengths towards improving potable water provision.

Robust governance and management of urban areas is fundamental towards better living conditions and development (UNPF, 2007). Governance speaks on how governing institutions should run with some set principles that encourages good governance (Ekundayo, 2017). The principles include accountability, control, responsiveness, transparency, efficiency, economy and public participation. UN (2018) notes that good governance is a critical pillar for the implementation of SDGs especially goal 6 that focuses on water management. Lockwood *et al.,* (2018:10) reiterates that "effective service delivery 'on the ground' starts with strong institutional arrangements and clearly defined and implemented policies, strategies and the effective demarcation of roles and functions." However, the strategies and arrangements for the protection of water resources are still inadequate to address the challenges that results from increased water demand leading to insufficient supply most especially in Zimbabwe and other African countries in general (Eneh and Nnaji, 2016; Kusena, 2016). UN (2018) posits that weak governance is an issue in the management of water resources hence it is essential to tackle these issues to achieve sustainability and development.

Mapfumo and Madhesha (2014) and Mudzingwa, (2015) asserts that there is poor governance and disjointed policy structures as a result of lack of accountability, inefficiency and ineffectiveness hence spells the water crisis in Zimbabwe. These challenges contribute to bad attitude of consumers against the water governing institutions resulting in a culture of distrust and non-payments as well as negative attitude on the utilisation of the supplied water services (Eneh and Nnaji, 2016; Magombo and Kosamu, 2016). Consequently, these attitudes cripple the revenue base of local authorities leading to financial incapacitation, as more water is used without being paid for hence further deteriorating the infrastructure system due to maintenance negligence thus unsustainably managing the water supply system in urban areas.

Public participation is also an important aspect in ensuring robust governance system in local government service delivery. UN (2018) stress the importance of good governance principally including the provision of all stakeholders with information and providing the citizens as well as communities a voice in the decision making process. Adding on, participatory approach and stakeholder engagement are essential in the formulation of water related policies in a transparent and an inclusive manner for resource mobilisation to ensure sustainable water service management essential for supporting the local government. Nevertheless, a top-down approach to water service management is a chief constituent of bad governance that the city of Harare, in Zimbabwe have been implementing leading to deteriorated service provision over the years (Maramura, 2017). The findings of his study showed that the sustainability of potable water provision is in turmoil in Zimbabwe due to governance crisis. The crisis can only be addressed by designing a new water supply tool inclusive of pro-poor approaches and an inclusive stakeholder engagement.

### 2.9.5 Responsive regulatory frameworks

To ensure sustainable supply of potable water, regulatory needs must also be considered as a critical factor essential in ensuring that the interests of all relevant stakeholders are met and protected (Lockwood *et al*., 2018). These needs manifest in legal and legislative frameworks that are aimed at sustaining the water sector. Water and Sanitation Rotarian Action Group Report (2012) posits that regulations impose standards for potable water to ensure that the citizens can be assured of safe, reliable and sustainable drinking water. The regulatory and policy needs must reflect the ethos of the international community, the national government as well as the water governing institutions to provide a form of precise policies that reflects the needs of a particular community bearing in mind the national as well as international perspectives.

The global community adopted MDGs that were aimed at halving the number of people without access to water by 2015. The goal yielded less results especially in developing countries and were succeeded by SDGs with specific target 6 that focuses on water and national governments have been mandated to providing water through drafting water policies and amending existing ones to meet this global initiative (Majuru *et al.*, 2016). WHO, (2015) further affirms that the governments should achieve universal and equitable access to potable water that is safe, sufficient, affordable and reliable by the year 2030. Beside qualifying access to potable water as a human right, this also emphasises the need for government and other relevant stakeholders to partner and ensure the attainment of equal access to water for all (Coutinho, 2010). Despite

the presence of these international policies, the water services being rendered are not sustainable due to lack of political will in diverting resources from the right angle that has led to a massive gap between water policies and the water supply services (Folifac, 2007).

The water supply system legislative framework in Zimbabwe is characterised by serious fragmentation and lack of uniformity in areas of responsibility hence there is overlap of mandates between different institutions (Tom and Munemo, 2015; Musingafi, 2013). The fragmentation does not only interrupt potable water supply but also cripples economic development due to a plethora of legislation pieces, numerous administrative institutions and ministries (Musingafi, 2013). A comparison with the developed countries such as Australia, shows that the regulatory framework had positive results tracking back from 2004 with the National water initiative to govern the water sector. The initiative was mainly aimed at improving urban water management through efficiency in planning and over-allocated water system that ensured enough financial resources. Furthermore, an independent body was established to govern water systems through the National Water Commission Act of 2004 (National Water Commission, 2011). This not only implies that proper designing and implementation of these regulatory frameworks will lead to more sustainable water provision at present and in future but will also lead to the realisation of human right to water as well as socio-economic development.

## 2.10 Sustainable potable water provision in urban areas.

The major rationale for this research is the need to suggest a sustainable potable water model to help the Norton Town Council in planning, managing and implementing sustainable water infrastructure system. Most urban areas do not monitor water demand and supply situations that ultimately lead to the failure of the water sector. For sustainable water provision to be achieved there is need for institutional, social, financial, technical and environmental dimensions to be met. The study analyses an integrated urban water management model to provide insights about potable water issues and opportunities that translates to sustainable urban water supply.

### 2.10.1 Theoretical framework

The research was informed by the systems approach and the integrated urban water management (IUWM) model. The key themes of these approaches echo on the importance of strategic planning and management of the water supply system, which will result in improved

potable water supply in urban councils. The theories aided the researcher in the analysis of data that was collected through key informant interviews and questionnaires.

### 2.10.1 The systems approach

This research was guided by the systems approach as propounded by Ludwig in the 1950s and was advanced by Ashby in the late 1960s. The theory is multi-disciplinary and can be applied to different fields to respond to different situations or problems (Norton, 2017; Jackson and Eisner, 2010) with the major rationale of studying relationships that exists between phenomena. A system is defined as "a set of interconnected components forming a whole." The approach acknowledges that the failure of a single item can affect and distort the entire system. A systems model to water supply system acknowledges that a single glitch in one subsystem it can have ripple effects towards the entire system.

It also emphasises that the potable water supply system function as an overall interconnected system to achieve the overall objective of local government to provide basic services and meet their constitutional obligation. An operational definition of a system was given by Hall *et al.*, (2016) alluding it as a coordinated way of providing services through the interconnection of both physical facilities and the human aspects. The systems approach to potable water supply planning and management will effectively combine systems thinking towards a sustainable and resilient urban water provision system. Figure 2.3 shows the linkage between the theory and potable water supply.

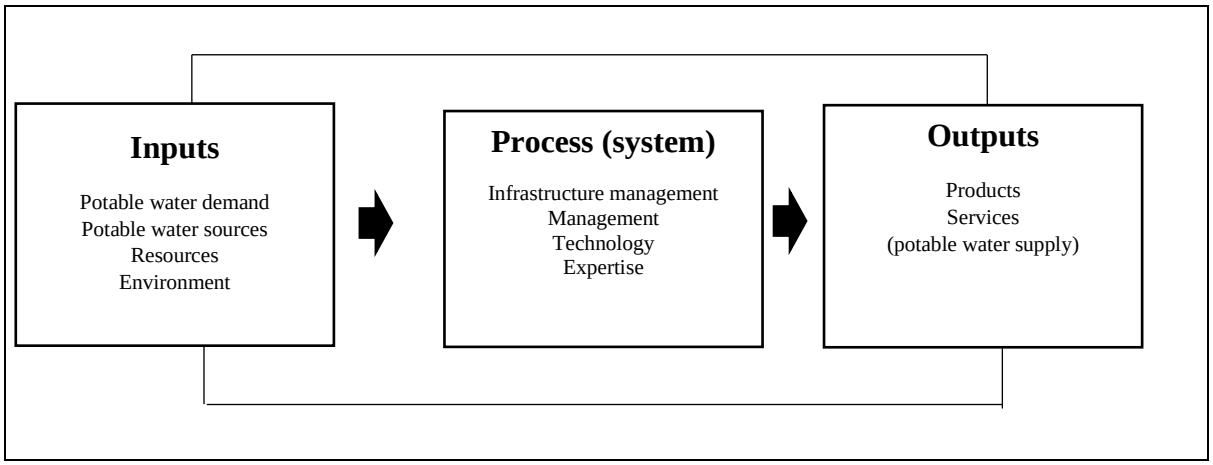


*Figure 2.3 Components of systems approach*
Source: Author, (2019).

The approach postulate that organisations are shaped and nurtured by the environment they operate in (Pettinger, 1996; Giddens, 2005). Urban councils do not exist in isolation to the

external environment employing an open system to management affecting the environment and the environment in turn also have a tremendous effect towards the institution. The approach effectively combines systems linking to infrastructure needs for sustainable and resilient urban water infrastructure. Kuhn (1974) asserts that the understanding of a single part of a system enables understanding other parts that interact as a system. Bhagwan (2009) stresses the need to identify and address serious constrains affecting the water supply system as a whole.

The systems approach was used to analyse the water supply system as a tool for sustainable water supply in urban areas as a tool for planning, organising and management of the water supply system. The environment according to the approach includes the social, economic, political as well as the ecological aspects as influencing the operation of an entity (Pettinger, 1996). The problems of water supply management are complex constituting different interdependent components hence there is need to understand potable water issues in a system-based phenomenon. Thus, the approach served as a lens that urban local authorities can utilise to understand and offer recommendations to address potable water issues that cripple the service capacity of urban councils in Zimbabwe. Nevertheless, the theory also has a number of weaknesses; the most prominent one is the failure to emphasise the need for collective action from the consumers through effective use of the available water before maximising the outputs. The demand management approach was used to overcome this limitation.

### 2.10.2 Demand management approach

Water demand management is any actions that are adopted with the aim of efficiently using available water and reducing the amount of water used (Global Water Partnership, 2012; Brooks, 2006). The approach is aimed at water conservation through the protection of available water resources (Kusena, 2016; Gray, 2010; Brandes, 2006). The approach is designed to reduce water usage by water supply institutions with the implementation of water policies and initiatives to meet with water supply sustainability, social development and equity, economic efficiency, political acceptability and environmental protection (Department of Water Affairs and Forestry, 2004). Mckenzie (2014) posits that demand management approach can improve water supply capacity that also translates to improved water supply coverage. This can be effected through the adoption of tools such as conversation methods, metering, education and through the use of legislations that encourage effective use of available water (Gray, 2010; Brandes, 2006). Therefore, there is the need to understand water demand and supply in the

current urban areas to enable policy makers and water supply authorities to archive sustainable water supply.

The effective control of water usage can be achieved by incorporating the supplier or the consumer. The supplier can use physical or economic methods to limit supply, and the consumer can adjust his way of living either voluntarily or under pressure by the supplier (Stephenson, 1999). The approach seeks to encourage efficient use of existing water supply through economic and effective management prior to increasing the water supply (Global Water Partnership, 2012). The efficiency can be achieved through factors such as the reduction in non-revenue water. The approach comprises of various interventions towards the water systems with the agenda of increasing technical, social, economic, environmental, and institutional efficiencies in the various uses of water (GWP, 2011).

The major obstacle that affects most areas in developing countries is the adoption of supply-oriented approaches to water management with little emphasis focusing on the conservative side which can ultimately improve the water supply capacity (Kusena, 2016; Gumbo and van der Zaag, 2002). To achieve desired results, it is crucial to engage all stakeholders to come up with solutions that are unique to a particular water institution. This engagement requires the stakeholders to work together equally rather than following a distinct hierarchy thus curbing conflicts (Aapaoja *et al.,* 2013, Nkondo. 2013). Integrating stakeholders and most especially the consumers encourages the principles of social justice and democracy (Manzungu *et al.,* 2016). In essence, the involvement of consumers in WDM aligns with target 6b of the SDG goal number 6 that aims at ensuring availability and sustainability of water management through citizen participation (Griggs, 2013). Therefore, WDM can be implemented in a bid to achieve water sustainability in urban areas. The theory assisted the researcher to come up with a model that can be employed by the Norton Town Council in improving potable water provision in their town of jurisdiction.

### 2.10.3 Integrated urban water management model

Most developing urban areas do not have sustainable models that are aimed at improving water supply and this has led to the failure of most water delivery institutions to keep up with growing urban population trends as well as to identify, analyse and address water infrastructure needs. The study analysed an integrated urban water management model to provide insights about potable water provision issues and opportunities that translates to sustainable urban water supply integrating planning, designing and management of the water supply system. Integrated

urban water management model incorporates urban water demand, supply, the physical system, institutional, financial and regulatory facets to ensure sustainable water supply system (Bahri *et al.*, 2016; Mitchell 2006). The model focuses on economic, political, environmental, social and technical water management aspects thus ensuring sustainable development through effective water supply (GWP, 2013). The model is graphically illustrated in figure 2.4.

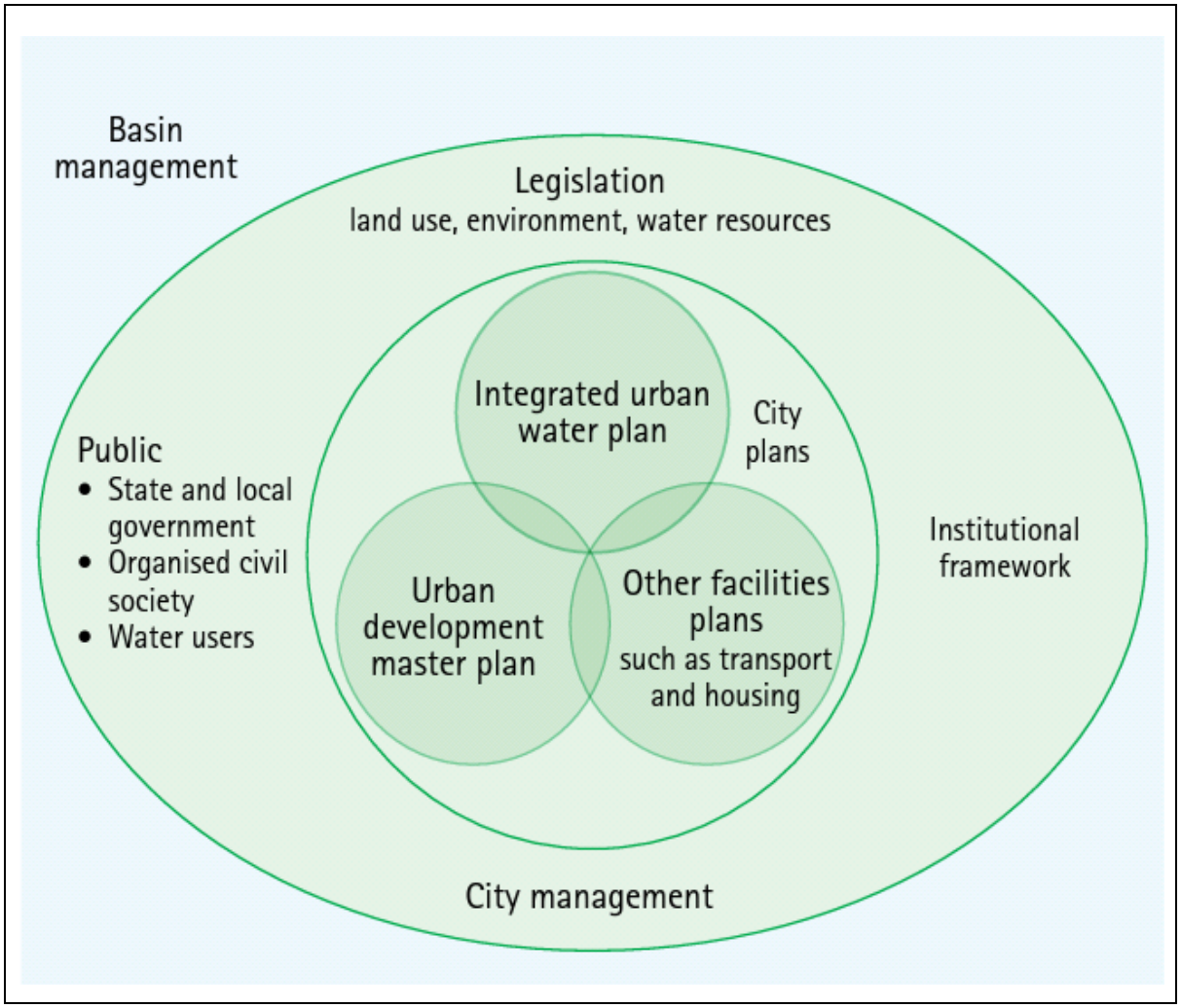


*Figure 2.4: Integrated urban water management framework*
*Source: Tucci et al., (2010).*

The framework is essential for planners to collaborate with the government to overcome public policies that are fragmented and help in decision making by linking planning with infrastructure development and management (Buhri, 2012). Due to rapid population growth in urban areas, that ultimately leads to urban expansion that is not commensurate to urban water system to cover new residential areas and increased costs of water delivery (UN-Habitat, 2008) results in worsening water provision. Therefore, it is essential to include urban planners in the water sector since planning is inclined with infrastructure development.

Furthermore, successful IUWM requires significant amount of funds to cover for capital, operations and maintenance costs (Bahri, 2012). As such, the water governing institutions should embark on programs and projects that are aimed at improving revenue generation needed for sustainable water supply. An example can be the implementation of a sound water pricing policy complemented by revenue collection strategies that influences the adoption of new technologies aimed at improving the water supply system with reduced costs and reduced risks of system failure (Bahri, 2012).

Also, the framework aids in facilitating the adoption of collective approaches that involves different stakeholders to determine action, priorities and responsibilities of water sectors to solve water scarcity problems (GWP, 2013). Stakeholder participation requires genuine involvement of the stakeholders in planning and decision making rather than merely being informed on already made decisions (Bahri, 2012). Nonetheless, the duties and responsibilities of each stakeholder or player must be clearly defined to avoid overlapping of duties that might limit the success of IUWM (GWP, 2013). In addition, the involvement of the government and the private sector is also a sustainable way to ensure efficiency in water delivery management in terms of finance and coverage through performance-based leases and contracts thus, delivering positive results (Kingdom *et al.,* 2006).

Water utility personnel capacity building is also equally important as conveyed with the framework as it also forms an essential aspect to the realisation of successful implementation of IUWM. Capacity building entails learning and nurturing of skills, knowledge and abilities aimed at developing individuals to deliver what is expected of them in an efficient and sustainable way (Chakunda and Chakaipa, 2015). According to Bahri (2012:53), "institutional capacity building is crucial for updating and integrating knowledge in the natural sciences, engineering, environmental biology, economics, finance, and sociology." This however depends on effective implementation of policies that are aimed at the management of water in urban areas (Bahri, 2012).

Furthermore, GWP, (2013) and Bahri, (2012) indicates that to achieve sustainable water supply encompassing both quality and quantity requires the involvement of various actors. The challenge therefore is the adherence of the needs of the multiple actors and balancing their needs and interests towards sustainability in the water sector. It can be argued that there is a knowledge gap between potable water demand and supply in small urban areas and solutions on how to close this ever-increasing gap to achieve equitable development in the towns is a

necessity. Nevertheless, there can never be sustainable reforms without robust leadership, proper planning, implementation, political will and stakeholder commitments.

The model is essential for planners and policy makers to collaborate with the government to overcome public policies that are fragmented and help in decision making by linking planning with infrastructure development and management (Bahri, 2012). Therefore, it is essential to include all relevant stakeholders in the water sector since planning is inclined with infrastructure development. Thus, analysing the model also aided the researcher to come up with a sustainable water supply model within Norton.

### 2.10.2 Case studies on sustainable potable water in small urban areas

It is essential to engage the experiences of other countries in assessing sustainability of water supply management to offer practical recommendations that the NTC can implement. The study selected case studies from developed and developing nations in order to draw lessons from initiatives that were adopted by water governing institutions with the aim of achieving sustainable potable water supply in urban areas. Countries like Senegal, Ghana and Canada were used to have an overview of the experiences from both regional and international cases.

#### 2.10.2.1 Case study of Senegal water sector

The government of Senegal recognised the urgent need for water reforms in the early years of 1990s as a result of a huge number of urban population without access to potable water (Tsitsifli and Kanakoudis, 2008). The challenges they experienced pointed the need for the involvement of private institutions for financial viability to improve efficiency and effectiveness in-terms of infrastructure development, the quality of water and quantity of water. The country adopted the 3Ps (Public-Private Partnerships) as a sustainable way to supply water to the urban areas. Public-private partnerships can be defined as contractual agreement between the government and private organisations that will be aimed at designing, financing, operating and implementing infrastructure facilities that were previously provided by the government leading to long-term water supply and management sustainability (Ehrhardt et al., 2015).

The 3Ps have an advantage of value for money and are founded on outcome or results oriented with a public need being met and a profit being made (UN, 2005). The major rationale for PPPs is to provide households with uninterrupted water supply 24/7 according to Ehrhardt *et al.*, (2015). To roll the ball into action, the government in 1994 created a state asset holding company that was aimed at retaining state assets and an operating company that would be

responsible for producing and delivering potable water with 51%-49% shareholding for the government and the operating company respectively. This consequently resulted in the alleviation of direct and indirect financial support from the state. The operating company managed to improve billing procedures, revenue collection enhancement and reducing non-revenue water that became successful as a result of strong political will, good management and leadership from these two agencies.

Resultantly, it can be argued that for sustainability of water supply management to be successful like in the case of Senegal, there is need for the strategic agreement to be designed specifically to meet with the needs of the community. Furthermore, a culture of trust must be implemented and maintained between the government and other private actors to ensure sustainable solutions to the water sector. The government is the key actor in ensuring full realisation to the success of these models and must be committed to ensure the implementation of water related projects timeously. There can never be sustainable reforms without robust leadership, political will and stakeholder commitments. Thus, the argument of this study maintain that sustainability in the supply of water calls for a complex system approach and inclusive responsibilities of various stakeholders to enhance financial viability and functionality of the small urban local government to fulfil their obligated mandate in this case effective supply of piped potable water to communities.

#### 2.10.2.2 Case study of Bawku West District, Ghana

The Bawku West District (BWD) has seven town councils and the capital of the District is Zebulla Area Council according to the new local government systems of 1988. The council constitutes a population of around 73,968 further subdivided into 15 communities and it is considered the most populous area within the district (Abanyie, Ampadu, Amuah, Douti and Owusu, 2019). The BWD Water and Sanitation Team is a department responsible for water provision under the BWD assembly providing services and technical assistance to the water and sanitation management teams (WSMTs). The residents within the area are said to have access to both piped water connection and boreholes (Abanyie *et al.,* 2019). Due to these availability of improved water sources the occurrence of water borne diseases are rarely prevalent. Nevertheless, due to ecological issues causing prolonged dryness and minimal rainfall the improved water sources dry up and people resort to the use of unsafe water sources for personal hygiene and domestic uses resulting in water-borne diseases (UNDP, 2011).

New water supply systems were constructed to ensure sustainability in water supply within the communities (UNDP, 2011). The initiatives were not an overnight solution; the success was hinged upon a number of issues which made it possible to have prolonged supply services. The communities with positive supply results were the communities with active WSMTs because they also depended on the same facilities for regular supply hence they ensured that the facilities are always in good conditions. The facilities are regularly maintained to ensure prolonged functionality and sustainability; that is made possible due to revenue collection from the community members hence there is a quick response to a breakdown because funds will be available for the maintenance and repairs of the water supply facilities coupled with effective monitoring and evaluation systems in place. Therefore, the study argues that sustainable potable water supply is multi-faceted and dynamic and hence requires a systems perspective to collaborate all relevant stakeholders to efficiently and sustainably contribute towards achieving the ultimate goal.

On the other hand, some communities still struggle to successfully attain a reliable piped potable water supply within their respective communities due to lack of effective training of the WSMT (Abanyie *et al.,* 2019). Lane (2018) substantiates that training WSMTs is a crucial component that sustains the water supply systems in terms of durability. It is further argued that, the trained WSMTs are knowledgeable in financial management, technical capacity, managerial aspects and external support mobilisation hence better services as compared to untrained WSMTs (Lane, 2018). Other challenges confronting the WSMTs includes low motivation since they are not being paid for the services they provide and obsolete water supply infrastructure system hence periodically causing system failure difficult to repair (Lane, 2018. In light of the discussion, sustainability in piped potable water supply essentially rests upon fundamental aspects such as effective capacity training, effective financial management, stakeholder engagement and public participation.

### 2.10.2.3 Case study of Canada

Potable water supply in Canada is said to be almost universal and most Canadians are served with piped municipal water (Human rights Watch, 2016). The country is rich in water resources and said to be one of the wealthiest and as such access to safe, affordable and sufficient drinking water is quite easy for most Canadians (Klasing, 2016; Human rights Watch, 2016). Despite the abundant water resources, communities within ‘land reserves’ for example Ontorio are still faced with a challenge in accessing potable water. The Canadian government regulates the

quality of water supplied in the country except for these reserve communities. According to (Human rights Watch, 2016), the water supplied to the reserve communities is "contaminated, hard to access, or at risk due to faulty treatment systems." The water crisis in these areas has resulted in skin related illnesses, water borne diseases, increased cost of living as people now use bottled water for drinking and personal hygiene, increased risks of cancer and gastrointestinal disorders. Over the years, the people relied on water advisories to warn them from using tap water due to high risk of contamination. No prominent improvements have been recorded so far. Both long and short-term government initiatives are put in place to ensure easy access to water for all through for instance, injecting funds for the maintenance and repair of water related infrastructure within these community reserves.

Nevertheless, financial commitment alone will never be able to resolve the water crisis within the reserves. Although financial resources are important for infrastructure investment the government also needs to provide long lasting solutions to the water crisis through the identification of contributory problems (Klasing, 2016). Binding water related regulations, protection of the water sources to curb persistent contamination, effective capacity and supporting water operations are equally important in ensuring that all Canadians are enjoying their rights equally. This however implies that, for sustainable potable water provision for every individual, it is imperative for collaborative action from both the public and private sectors towards supporting water related operations in the reserve communities. The water supply function as an interconnected system with all aspects given equal importance.

### 2.11 Regulatory frameworks in Zimbabwe

The formulation and implementation of legislative frameworks is core towards ensuring sustainable and quality delivery of services. In Zimbabwe however, the sections of legislation that guides potable water provision are fragmented and uncoordinated thus the major challenge resulting in water crisis in Zimbabwe (Mudzingwa, 2015: Chinamora, 2002). Adding on, the study thus argue that the Norton Town Council lacks a comprehensive potable water provision model due to incoherent legislative frameworks. Nonetheless, the following Acts are critical in the supply and management of water in Zimbabwean local government. Effective implementation of these acts will enable sustainable development of communities through equitable water provision.

### 2.11.1 Constitution of Zimbabwe (2013)

The constitution act as the highest form of law in any country and as such the constitution supersede other laws and guide the individuals against the state and vice versa (Peters, 2006). In this regard, the constitution thus the highest law within the country and all other legislative frameworks should align to the ethos of the constitution. Water is recognised as a human right under the fundamental human rights chapter 4-part 2 subsection 77 (Constitution of Zimbabwe, 2013). The constitution highlights that;

(a) *"every person has the right to safe, clean and potable water… and the State must take reasonable legislative and other measures, within the limits of the resources available to it, to achieve the progressive realisation of this right."*

This implies that, the government has an active role to play in ensuring that all citizens enjoy this right in terms of quality and quantity without any form of discrimination as it is a civil right (Chatiza, 2016; Manzungu *et al.*, 2016; Mudzingwa, 2015). To uphold the right to water however, the citizens also need to pay for the water services, as it is a misconception to just assert water as an obligation of the state (Majuru, *et al.*, 2016; Manzungu *et al.*, 2016; Makwara, 2011). For this right to be realised, potable water in urban councils should be financially affordable for all since the government is obligated to also contribute towards financial viability of the urban councils to ensure sustainable potable water provision.

### 2.11.2 Urban Councils Act [Chapter 29:15] of 1996

Urban areas in Zimbabwe are governed under the Urban Councils Act [Chapter 29:15] and provides a mandate for water provision services (Muchadenyika and Williams, 2018). The Act came into effect in 2015 after various amendments were enacted since post 1980 with an agenda of incorporating the previously marginalised black communities (Urban Councils Act, 2015). The act was set to achieve equality in terms of service delivery and ensuring democratisation of local government through stakeholder engagement and public participation (Maramura, 2017; Manzungu *et al.*, 2016). In line with the Act, water supply provisions are contained in part xiii section 183 of the Urban Councils Act (Chapter 29:15) highlighting that;

(1) "*A council may provide and maintain a supply of water within or outside the council area and for that purpose the council may—*

*(a) in accordance with the Water Act [Chapter 20:22] take such measures and construct such works, whether inside or outside the council area, as it considers necessary for the purpose of providing and maintaining a supply of water;*

*(b) enter into agreements for the purchase and sale of water and for any other thing necessary in connection with the maintenance and supply of water.*

*(2) It shall be lawful for a council to add fluoride to water intended to be supplied for consumption by the public."*

However, assessing the act in terms of water provision and management in the urban areas, a number of weaknesses are evident. According to Muzondi, (2014:2914) the Urban Councils Act does not provide ample regulations on the management of urban water supply service; instead, it is just a large document without authentic contextual coverage on the management of water supply systems. Thus, an indication that the act does not provide for the detailed responsibilities and effective management systems of the water supply system most especially in terms of water tariffs hence owing to the further dilapidation of the water supply infrastructure system in Zimbabwe (Muzondi, 2014; Chigonda, 2011). Adding on, the administration of public service delivery in urban areas have not been participatory due to the top-down approach the government thus against the sentiments of the act itself (Zhou, 2013). Subsequently, the partial application of the act has had a plethora of challenges in terms of potable water supply inclusive of the water supply infrastructure owing to the unsustainability of supply and worsened human and community underdevelopment.

### 2.11.3 Water Act [Chapter 20: 24] Act No. 31 of 1998

The Water act was passed in 1998 as a significant framework that was set out to govern water resources growth and management and the water governing institutions in Zimbabwe. The act was also established to redress the racial potable water delivery which limited the blacks from accessing potable water and participating in water related decision making. According to the act, every Zimbabwean citizen is entitled to use potable water for domestic and personal hygiene uses and non-domestic water uses attracted commercial charges as charged by the water service provider. The act therefore provided for the right to water for every citizen as echoed by this study. Furthermore, the principles of public administration were addressed by

the Act such as effectiveness, equity, efficiency and economic value of water hence ensuring sustainable water resources.

This indicates that the government is responsible for the management of water resources since they retain the right to ground water and surface water. In line with surveyed literature, the effective implementation of the water act as a legislative framework failed to effectively perform what they were intended to due to issue of financial constrains as the policy was donor driven (Musingafi, 2012; Makurira and Magomo, 2009). Due to political instability that was present in Zimbabwe, stakeholders lost confidence and financial donors began to withdrew from funding the water sector. Without financial support, the water infrastructure system further deteriorated as the urban local councils are not self-sufficient. The water act also saw the formation of Zimbabwe National Water Authority (ZINWA) that basically focused on catchment management of water resources.

### 2.11.4 Zimbabwe National Water Authority Act (ZINWA) of 1998

ZINWA was established to govern and manage water allocation, management and consumption (Nhapi, 2009). Thus, the organisation is responsible for the planning, development and management of water resource in urban areas (ZINWA Act, 1998). Nhapi (2009:25) further reiterates that ZINWA was formed "to improve national and regional planning, and to reduce government expenditure in the water sector through the levying and sale of water". According to the Act section 5;

> "*... the functions of the Authority shall be—*
> *(a) to advise the Minister on the formulation of national policies and standards on—*
> *(i) water resources planning, management and development; and (...)*
> *(v) water pricing; and*
> *(b) subject to the Water Act [Chapter 20:24], to assist and participate in or advise on any matter pertaining to the planning of the development, exploitation, protection and conservation of water resources; and*
> *(c) to exploit, conserve and manage the water resources of Zimbabwe with the object of—*
> *(i) securing equitable accessibility and efficient allocation, distribution, use and development;*

*(ii) providing, in both the short and the long term, adequate water on a cost effective basis;*

*(iii) taking appropriate measures to minimise the impacts of droughts, floods or other hazards;*

*(d) to promote an equitable, efficient and sustainable allocation and distribution of water resources."*

Given the functions of the parastatal, it is clear indication that the act fails to address the management of urban water as it emphasises on catchment management (Chigonda, 2011). Consequently, potable water supply infrastructure system from this perspective was state owned owing to rather massive dilapidation, as there is no other organisation to oversee the operations of ZINWA (Muzondi, 2014). This gave room to corruption and mismanagement of public funds at the hands of the government (Chigonda, 2011). More so, the government in 2004 drafted a water policy that was never implemented leading to worsened water supply in Zimbabwean urban areas and also the existing frameworks are outdated due to dynamics in water demand and the level of urban development (Tom and Munemo, 2015; Chigonda, 2011; Zimbabwe in Crisis Coalition, 2010; Nhapi, 2009). Hence, the justification for this study that potable water provision in urban areas is a system that requires the regulation and legislative provisions for effective and sustainable water supply management in local government.

## 2.12 Chapter summary

The chapter explored literature relevant towards urban potable water demand, supply and the water infrastructure situation. Different water supply systems were analysed form an international, African and Zimbabwean context. The chapter also discussed the approaches guiding the study, the characteristics of urban water demand and supply, water infrastructure needs and sustainable potable water model.

# CHAPTER 3

# RESEARCH METHODOLOGY

## 3.1 Introduction

The chapter discusses the research methods that were employed by the researcher to achieve the research objectives. The chapter discusses the research paradigm, research design, sampling procedures and data collection methods. Data analysis, ethical considerations and the study limitations were also discussed in this chapter

## 3.2 Research paradigm

This study was guided by pragmatic research paradigm. It is an all-encompassing worldview with a strong philosophical foundation in mixing both qualitative and quantitative methods without loyalty to one single paradigm. In addition, this paradigm emphasises that the choice of methods, techniques and procedures for data collection and analysis is central to the research problem or research questions (Creswell, 2014). One of the paradigms that guided this research is positivist/scientific methodology as recommended by Mefalopulos, (2008). Research located in this paradigm relies on testing hypotheses, calculations, to provide explanations and derive conclusions (Kivunja and Kuyini, 2017). This paradigm was used to address the study objectives. Another paradigm that guided this study is the constructivist which "does not generalize, but explore meanings that participants place on the social situation under study" (Phothongsunan, 2015:35). This paradigm aligns with objective number one and two that intended to investigate the water supply infrastructure needs and sustainability of the water supply system in local government with particular attention towards Norton Town Council.

## 3.3 Research design

A research design is a contextual structure of how a research is conducted, a blue-print that the researcher adopts for data collection, measurement and analysis of data (Kothari and Garg, 2014). The research design facilitates smooth conduct of a research in an efficient way yielding more data. The study adopted a survey research design.

### 3.3.1 A survey research design and justification.

A survey design affords a researcher to administer a survey to a specific sample of a population in order to describe and understand the characteristics, opinions and attitudes of the population

(Glawson, 2005). The design was opted for because it helped the researcher to answer the objectives of the research and incorporates various methods in collecting data exploring new avenues of water supply in a relatively smaller urban area. In this case, a survey was selected as the best design for this study because it relatively described the water demand and supply characteristics within Norton (quantitative) and the behaviour, attitudes and opinions of the population were also explored using qualitative approach hence justifying the use of a mixed method.

### 3.4 Research approach

The study employed a mixed method research approach. A mixed method research approach is defined as a method of enquiry that involves the collection of both qualitative and quantitative data and integrating the two data forms (Creswell, 2014: 4). Data was collected concurrently. Mixed method approach provides a deep understanding of a research problem and provide meaningful answers to the research questions than the use of either approach alone (Creswell and Creswell, 2017). It was very significant to conduct a mixed method approach in the study as the use of both approaches helped in answering the overall objective of the study and the addressing the research problem inhibiting the short comings of either approach. Quantitative data was collected through the use of questionnaires. The questionnaires contained closed ended questions (quantitative) and open-ended questions (qualitative). Qualitative data was also collected through key informant interviews. Therefore, a mixed method approach is justifiable and is the most appropriate approach for the study.

### 3.5 Study population

Kothari (2014) defined a study population as “all items in a field of inquiry.” The study population comprised of total households in Norton constituting 27 017 (NTC, 2018) and four purposively selected directors of the Norton Town Council. The population selected was utilised to understand the water demand and supply scenario as well as overall water supply system in the town for sustainable water provision. The study population consisted of 27 017 households within the town.

#### 3.5.1 Study Sample

The sample for the study comprised of four NTC directors that included the housing director, finance director, engineering director and the health director. From the total households of 27 017, about 379 households were selected to fill in the questionnaires. The population sample

was calculated using Raosoft sample size calculator from the total number of households of 27 017 accessed from http://www.raosoft.com/samplesize.html. The sample size was derived with 95% confidence level, 5% margin error and 50 % response distribution accessed on 24 February 2019. The sample size was justifiable since a survey design requires a substantively larger sample to get a clear description of the entire population. Adding on, a larger sample avoided response bias and also minimized response errors.

### 3.6 Sampling

Sampling is a plan used for obtaining samples from an entire population used by a researcher (Kothari and Garg, 2014). The method of obtaining samples is fundamental depending on the type of research study. The study adopted both probability and non-probability sampling to achieve the objectives of the research. Probability sampling meant that all the samples had an equal chance of being selected to take part in the research (Kothari and Garg, 2014) whereas non-probability sampling was used to select a portion of finite sample of a population being studied (Battaglia, 2011).

#### 3.6.1 Sample selection

According to Edmonds and Kennedy (2017), sample selection is the procedure used to identify individuals whom the researcher intends to collect data from. Four types of probability sampling can be identified namely, simple random sampling, stratified sampling, cluster sampling and systematic sampling. To meet the objective of the study, stratified random sampling was selected as the most appropriate method to have an overall overview of water demand and supply scenario from the different suburbs. Non-probability sampling also has different sub-types namely purposive or judgemental sampling, quota sampling, convenience sampling and snowball sampling (Henry, 1990 cited in Babbie, 2007). The researcher adopted purposive sampling to select key informants.

#### 3.6.2 Stratified random sampling and justification

Stratified random sampling is the identification of different types of people that make up the target population and works out the proportions needed for the sample to be representative hence each sample was representative of the entire population (McLeod, 2014). In this case, the researcher stratified the households in relation to two categories namely high density and low density suburbs that were selected randomly through proportional representation. The 379

households selected for the study filled in the questionnaires acknowledging that the water supply issue affected the suburbs differently. Table 3.1 shows how the researcher calculated the household samples.

| | High density | Low density | Total |
|---|---|---|---|
| Total households | 17 189 | 9 828 | 27 017 |
| Samples | 243 | 136 | 379 |

*Proportional area sample size = area population x 379*
*total study population*

*Table 3.1: Households sample selection*

Source: Author, 2019

### 3.6.2 Purposive or judgemental sampling and justification

The purposive or judgemental sampling enabled the researcher to select individuals to participate in the research study. The selection of this type of non-probability sampling is based on expert knowledge or specific needs according to Edmonds and Kennedy (2017). Four key informants were purposively selected from the Norton Town Council departments namely the housing director, finance director, engineering director and the health director. These individuals were selected under the assumption that they had expert knowledge and understanding about sustainable water provision in Norton. This choice was also influenced by the timeous application and cost-effective way in implementing this method.

## 3.7 Data collection

Data collection is a systematic approach to gathering and measuring of information from a range of sources to obtain a complete and accurate picture of an area of interest (McLaughlin, 2016). Data was obtained from both primary and secondary sources. Primary data collection was discussed first then the secondary data collection was discussed in the second section.

### 3.7.1 Primary data collection

Kothari (2014) regards primary data as original and fresh data collected for the first time by a researcher. Household questionnaires (refer to Appendix 2) and key informant interviews (refer to Appendix 3) were used to collect primary data for this study. These sources were significant in collecting valuable primary data from the residents and Norton Town Council directors

respectively which helped in answering the research questions and archiving the aim of the study.

The data collected was essential in investigating the sustainability of potable water supply system in Norton. The Norton Town Council directors were purposively selected as they are experts in the water supply system and are technocrats in the management of the town council. The key informants who were selected included the engineering director, finance director, housing director and health director. The finance director was selected to get insights on the financial aspects that hinders sustainability of water supply in the council that emanates from non-payments. The engineering director was interviewed to understand the current water supply infrastructure system and the supply system against the potable water demands. The housing director was selected to deliberate on the potable water demand for households and the current supply system. Lastly, the health director was interviewed to provide information required to attain equitable potable water to achieve free water borne diseases in the town. All the directors deliberated on the water supply needs affecting all the departments that helped in coming up with a sustainable model for potable water supply in Norton Town Council.

The researcher with the help of one research assistant distributed 379 questionnaires to Norton residents. The questionnaires were distributed randomly to the high and low-density suburbs in Norton town. The questionnaires contained open and closed ended questions that was deliberately done to provide intuition on the concept of sustainability of potable water within the town and closed questions encouraged easy response from the residence respectively. The respondents were given time to respond and fill in the questionnaires at the time most convenient for them and the researcher and the assistant did a follow up to collect the questionnaires.

### 3.7.2 Secondary data collection

Secondary data can be defined as data that is readily already available having been collected and analysed (Kothari, 2004). Secondary data for this study was collected from published and unpublished sources. The researcher only utilised reliable data sources to answer the aims and objectives of the study. Published data sources used for this study comprised of government documents, books, articles, journals, publications, conference papers and reports. Sources of unpublished data includes dissertations, government documents and reports.

Various government policies and legislations were used in this study as sources of secondary data and how they affect water service delivery in Zimbabwe also including international strategic vision towards equality in access to water. These documents included the constitution of Zimbabwe of 2013, the Water Act, the Norton Town Council reports, the SDGs providing essential information about water provision in local government. These documents provided key challenges faced by the council in sustaining water provision and also helped in assessing water supply in relation to urban population growth thus contributing towards the realization of sustainable water delivery.

Studies that were conducted by various researchers were reviewed to get insights on the water supply system and how it helps in ensuring socio-economic development in local communities. The studies conducted by Chigonda (2011), Matsa and Tapfuma (2015), Eneh and Nnaji (2016) and Chigonda and Chazireni (2017) provided insights on the water demand and supply scenario and how it helps in facilitating development and the adherence of human right to water. The importance of addressing the water delivery infrastructure needs were also stressed by scholars like Dos Santos *et al.,* (2017) and Panganayi and Mangizvo (2016) hence emphasising its importance in facilitating sustainable water delivery with the objective of filling literature gaps.

A survey of available literature aided the researcher to obtain in depth understanding of sustainable potable water provision in an attempt to come up with a sustainable model for potable water provision for Norton Town Council. Valuable information was obtained from literature to help answering the research questions and reaching the overall objectives of the study. The researcher also reviewed approaches linked to the sustainability of potable water provision and the management of the institutions and drew lessons from various case studies. The theories that were utilised in this study include the systems approach, demand management approach and the integrated urban water management model. The theories enabled the researcher to analyse data qualitatively through the identification of various factors that are significant in the sustainability of potable water provision and also helped in in recommending solutions to the problem that influenced the researcher to undertake this research. Table 3.2 provides the research questions linked to the research method.

| Research objectives | Research question | Data sources and methods | Data analysis and data presentation | Research outcome or contribution to knowledge |
|---|---|---|---|---|
| To characterise the Norton urban population water demand and supply situation. (Water demand and supply scenario) | What characterises urban population in Norton in relation to water infrastructure? | Questionnaires<br>Interviews<br>Secondary sources | Thematic analysis (qualitative)<br>Trend analysis<br>Factor analysis | Major characteristics of urban water demand and supply.<br><br>An understanding of the extent to which Norton Town Council is managing to meet its water demand and supply scenario |
| 2. Analyse the water supply system against infrastructure needs scenario in terms of anticipated urban growth. | What are the current water supply system and infrastructure? | Questionnaires<br>Interviews<br>Secondary sources | SPSS package presented in form of text, graphs and tables.<br>Thematic content analysis | An understanding of the NTC water supply system and the infrastructure needs |
| 3. To suggest a model for sustainable potable water provision by Norton town council. | What model can the Norton Town Council put in place for sustainable potable water provision? | Interviews<br>Literature review<br>Questionnaire | Factor analysis | A model that guides water provision by Norton Town Council for sustainable development. |

*Table 3.2 Research methods linked to research questions*
*Source: Author, 2019*

The table 3.2 highlights the research objectives, research questions, data collection tools, data analysis and the study outcome.

### 3.8 Data analysis and presentation

Data analysis is a means of systematically organising, integrating and examining data in search of relationships and patterns that exist among the collected data (Neuman, 2011). The collected data was analysed in relation to the objectives of the study and the theoretical framework which underpinned the research. The qualitative primary data collected in the research was analysed using thematic analysis technique whereas quantitative data was analysed using descriptive and

inferential statistics with the use of IBM SPSS version 25 presented in form of graphs and tables.

### 3.8.1 Qualitative data analysis

Thematic analysis is a process involving a number of stages aimed at the identification of ideas that are most frequent or recurring in the documented data (Jason and Glenwick 2016). Thematic analysis technique aided the researcher to identify recurring patterns and themes from the interviews and open-ended questions that was essential in analysing the water supply system and identifying infrastructure needs for sustainable water supply. The technique provides detailed and explained themes as alluded by Braun and Clarke (2006,11).

Braun and Clarke (2006) asserts that thematic analysis is a six-phased approach that guided the researcher to analyse qualitative data. The first phase was for the researcher to immerse in the data and familiarised the content. The researcher started with transcribing the recorded data that was collected through the use of key informant interviews with the directors of different departments from the Norton Town Council. The transcribed data was constantly checked which enhanced familiarity of the data by the researcher. The transcriptions were constantly read by the researcher to draw themes and patterns from the interview transcriptions and the same procedure was done for the open-ended questions contained in the questionnaires. The researcher was familiar with the data that was being analysed.

On the following phase, the researcher jotted down brief notes and highlighted potential codes from the transcripts and questionnaires and organised the data to meaningful groups. Codes that the researcher believed contained the same meaning were quoted and organised to form meaningful categories.

The next step, the researcher explored the themes and coded them into potential themes that helped in meeting with the objectives of the research. Some of the codes formed main themes whereas other codes formed subthemes. This was done through the use of mind maps and tables to find relationship between the themes. Upon the completion of this stage, the researcher formed a thematic map with relevant and valid themes that related to the study objectives were selected.

The fourth stage, the researcher reviewed and refined the themes scrutinizing the drafted thematic map and further coding creating a suitable map to suit with answering the research

questions. A list of themes was drawn from the gathered data to basically capture the major characteristics through the identification of what each particular theme was about and relating them to the objectives of the study. At the end of the stage, the researcher also analysed how different themes relates and identified whether the themes can be used for creating subthemes.

The themes were named and prepared for presentation at the fifth stage and at the final stage; the researcher produced a detailed report of the themes that answered the study objectives in a manner that is analytical.

### 3.8.2 Quantitative data analysis

The primary data collected using questionnaires was analysed quantitatively in line with the objectives of the study. The analysis was facilitated with the use of a computer software known as IBM Statistical Package for Social Sciences (SPSS)which helped the researcher in the management of data. The data management includes entering, saving and editing data from the self-administered questionnaires and analysing the data statistically and the findings presented in form of tables and graphs in relation to the objectives of the study. Reliability and validity tests, normality tests, regression and factor analysis were performed by the researcher

The descriptive analysis was conducted by the researcher as postulated by Boone and Boone (2012) such as measuring the central tendency and measuring variability through standard deviation on responses on the instrument such as the Likert scale. Since the questionnaires for the study adopted a Likert scale, the central tendency and variability was measured. This was adopted to determine views of respondents on the measurement constructs in relation to the characteristics of potable water demand and supply and the infrastructure needs in relation to population growth in Norton Town Council in Zimbabwe.

Normality tests were performed because of the general assumption that data follows normal distribution that was measured using of Kurtosis and Skewness. For Lee (2008:63), “Skewness characterizes the degree of asymmetry of a distribution around its mean. Kurtosis characterises the relative peakedness or flatness of a distribution compare to the normal distribution. As a rule of thumb, if the skewness is within range of +/-2 and kurtosis is within range of +/-3, the data is assumed to be normal”. Park, (2008) cited in Lee (2008) asserts that there are two ways checking normality namely numerical and graphical. The study adopted numerical method presented in the form of a table and data was presumed to be suitable for further analysis

statistically as it was within the recommended range of +/-2 skewness and +/-3 kurtosis as shown by table 3.3.

| Targeted research objectives | Study constructs measuring research objectives | N | Minimum | Maximum | Mean | Std. Deviation | Skewness | | Kurtosis | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Statistic | Statistic | Statistic | Statistic | Statistic | Statistic | Std. Error | Statistic | Std. Error |
| To characterise the Norton urban population water demand and supply situation. (Water demand and supply scenario) | Characteristics of demand | 345 | 1 | 5 | 3.67 | 1.090 | -0.606 | .131 | -.330 | .262 |
| | Characteristics of supply | 341 | 1 | 5 | 3.63 | 1.017 | -.624 | .132 | -.102 | .263 |
| 2. Analyse the water supply system against infrastructure needs scenario in terms of anticipated urban growth. | Sources of water | 342 | 1 | 4 | 3.89 | 1.019 | -1.341 | 1.31 | -.270 | .261 |
| | Frequency of supply | 340 | 1 | 5 | 2.33 | 1.111 | .403 | .132 | -.669 | .263 |
| | Human needs | 342 | 1 | 5 | 3.92 | 1.031 | -1.266 | 1.32 | 1075 | .263 |
| | Physical WSS | 341 | 1 | 5 | 3.62 | 1.057 | -.620 | .132 | -.291 | .263 |
| 3.. To suggest a model for sustainable potable water provision by Norton Town Council. | Ways of achieving supply sustainability | 341 | 1 | 5 | 3.56 | 1.045 | -.552 | .132 | -.278 | .264 |

*Table 3.3: Normality tests for study constructs*
*Source: Author, 2020*

The results as shown on the table shows that the data was assumed to be fit for further statistical analysis.

Factor analysis according to Young and Pearce (2013) relates to a notion that observable and measurable variables can be reduced to fewer variables that share the same variance. In the case of this study, the researcher used exploratory factor analysis (EFA). EFA was adopted because the researcher wanted to discover and understand factors that influence variables and then analysed these factor variables which facilitated the researcher to discover variables that are related and draw research conclusions. This research was suitable for conducting factor analysis since the respondents that took part in the study were at least 300 participants and also the variable items under each variable construct were at least 5 as postulated by Comrey and Lee (1992).

### 3.9 Validity and reliability

Validity and reliability tests were conducted to ensure that the research instrument in this case the questionnaire had internal consistency and stability as alluded by (Al-Sheheri, 2012). Reliability and validity was performed using Cronbach's Alpha (Cronbach, 1951). The measurement scales that were used to measure the objectives of the study included characteristics of potable water demand, characteristics of potable water supply in Norton and the water infrastructure needs by the council for effective water supply; these were tested for reliability using a four-point-likert scale. A four-point-likert scale is used to measure reliability of the study constructs as suggested by Hair *et al.*, (2014). Reliability that is 0.50 and below is considered as low reliability, 0.50 and below 0.70 is high moderate reliability which is acceptable, reliability that ranges from 0.70 and below 0.90 is high-reliability and 0.90 and below 1.0 is considered as excellent-reliability (Hair *et al.*, 2014). Nadi, *et al.*, (2012) asserts that Cronbach Alpha with a reliability score above 0.50 is acceptable. The Cronbach Alpha for the constructs ranged between 0.644 and 0.880 hence the constructs of the study were considered to be reliable. The values are above the recommended degree of reliability as presented in table 3.4.

| Study objective | | Variable construct | Items | Cronbach Alpha | Comment based on Hair et.al. (2014) four degrees of reliability |
|---|---|---|---|---|---|
| 1. To characterise the Norton urban population water demand and supply situation. | Demand characteristics | Demography | 8 | 0.742 | High-Reliability |
| | | Social | 6 | 0.792 | High-Reliability |
| | | Economic | 5 | 0.724 | High-Reliability |
| | Supply characteristics | Water supply system | 10 | 0.805 | High-Reliability |
| | | Economic | 10 | 0.820 | High-Reliability |
| | | Institutional | 11 | 0.873 | High-Reliability |
| | | Political | 5 | 0.880 | High-Reliability |
| 2. Analyse the water supply system against infrastructure needs scenario in terms of anticipated urban growth | | Infrastructure needs | 6 | 0.745 | High reliability |
| To suggest a model for sustainable potable water provision by Norton Town Council. | | Sustainability issues | 14 | 0.840 | High reliability |

*Table 3.4 Cronbach Alpha Reliability results for study variable constructs*

*Source: Author 2020*

Descriptive analysis was used in this study to establish the water demand and supply characteristics of the Norton town. Factor analysis was also performed in this study for variable reduction into fewer factors to facilitate further analysis and reach objective conclusions from the data collected. The researcher also performed trend analysis to analyse data collected from 2012 to 2019.

### 3.10 Response rate for the study

Table 3.5 show the response rate of the self-administered questionnaire distributed.

| | **Frequency** | **Percentage (%)** | **Total** |
|---|---|---|---|
| Number of questionnaires distributed | 379 | 100% | 379 |
| Number of questionnaires returned | 346 | 91% | 346 |
| Number of questionnaires used for analysis | 346 | 91% | 346 |
| **Total response rate** | **346** | **91%** | **346** |

*Table 3.5: Response rate of the self-administered questionnaire distributed.*
*Source: Author 2020*

A total number of 379 questionnaires were distributed for this study as shown in table 3.5 and a response rate of 91% (346) was recorded. Welman, Mitchell and Kruger (2011) assert that a survey should have at least 60% response rate for the results to be regarded as accurate, useful and truly representing the entire population. Basing on this assertion, the response rate of 91% is regarded as useful and accurate for representing an entire population of Norton town with regards to sustainable potable water provision.

### 3.11 Ethical considerations

Ethics are the norms or rules of conduct that sets out what is acceptable and unacceptable behaviour (Resnik, 2011). The researcher requested and obtained an Ethical clearance letter certificate from UNIVEN ethics committee before commencing the data collection process (refer to appendix 6). A letter to request permission from the Norton Town Council to conduct the research was also drawn (refer to appendix 7) and the researcher was granted permission (refer to appendix 8). The researcher has an obligation to protect and uphold the rights of individuals and in this case the participants' during the conduct of the research (Burns and Grove 2003). The ethical standards that were upheld in the study are as follows:

### 3.11.1 Confidentiality/ Anonymity

It is an important ethical consideration where a researcher does not publicly identify people's responses (Babbie, 2017). The researcher ensured confidentiality and anonymity by not including respondents' names during data presentation and during data publication. The information was kept as confidential as possible. The data collected was not be disclosed to any third parties.

### 3.11.2 Voluntary participation

Babbie (2017) accentuates that social research often entails intruding into people's lives; hence some individuals will not be comfortable discussing their lives with strangers. In this instance, voluntary participation was considered; the researcher did not coerce people to participate in the research.

### 3.11.3 Consent

Adams (2013) asserts that in research participants must consent to participate voluntarily. In order to uphold this ethic, the researcher sought respondents' signatures on the questionnaire before filling in the data. In the case of interviews, the interviewer explained to the interviewees that it was voluntary and also requested to record the interviews before-hand.

### 3.11.4 Trust

To gain the trust of respondents, the researcher presented an ethical clearance letter as well as research approval letter from both the Norton Town Council to participants as part of gaining their consent. This enabled the researcher to gain trust from the respondents and they in turn provided truthful answers on the questionnaires and from the interviewees hence giving objective responses freely.

### 3.11.5 Language

The researcher and the research assistants are well versed with dominant vernacular of the respondents in Norton community which are Shona and English.

### 3.11.6 Sensitive information

Some of the items on the questionnaires require responses which some participants may regard as sensitive information such as age and educational qualification. The researcher however provided open-ended categorical responses to avoid the uncomfortable situation that result from filling in the specific individual exact information.

## 3.12 Limitations of the study

Study limitations basically allows the assessment of research findings and derive further research gaps (Creswell, 2014). There were few limitations to this research study. The first limitation was financial resources to conduct the study since the research was a self-funded project. Another limitation that the researcher experienced was of data collection, due to the sensitivity nature of the study reaching the intended participants was a challenge most especially for the interviews.

## 3.13 Chapter summary

This chapter discussed the research methods achieve aim and objectives of the study. The research paradigm, design, approach, methods of data collection, methods of data analysis, ethical considerations and limitations of the study were also deliberated upon.

# CHAPTER 4

# RESULTS PRESENTATION, INTERPRETATION AND DISCUSSION

## 4.1. Introduction

The chapter focuses on data analysis, presentation and interpretation towards the conceptualization of a model for sustainable potable water provision in local governments with specific reference to Norton Town Council. Norton urban water demand and supply situation, water supply system versus infrastructure needs scenario in relationship to anticipated urban growth and factors to be considered for sustainable potable water provision by Norton Town Council were presented and discussed in this chapter. The results were then used to formulate a model for sustainable water provision in Norton Town Council in Zimbabwe.

## 4.2 Quantitative and qualitative results

### 4.2.1 Demographic characteristics of respondents

The demographic characteristics of the respondents will be analysed in this section

#### 4.2.1.1 Gender

To understand the proportion of males and females from the respondents, gender of the respondents was analysed. The respondents' gender is presented in figure 4.1

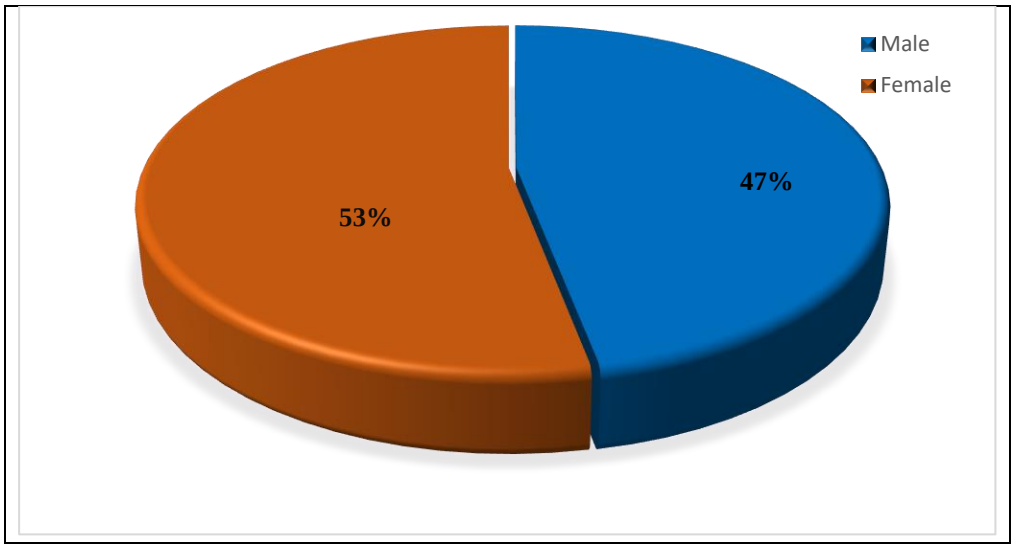


*Figure 4.1: Gender of respondents*
*Source: Author,2020*

There are more females in Zimbabwe compared to males according to population statistics (ZIMSTAT, 2018; ZIMSTAT, 2012). Relatively, the statistics of Norton population depicts

that there are more females compared to males in the population (ZIMSTAT, 2012). The study also shows the same statistics as the female participants (53%) were more than the male participants (47%). Analysing gender in this study was important in determining Gondo and Kalowole (2019)'s assertion that gender plays a significant role in the demand and management of water hence influencing household potable water consumptions.

#### 4.2.1.2 Age group of respondents

Age of respondents within Norton Town was analysed to understand the different age groups in order to determine if age influences views of respondents' perception on the characteristics of potable water demand and supply within Norton. Figure 4.2 shows the different age groups of the respondents who took part in the study.

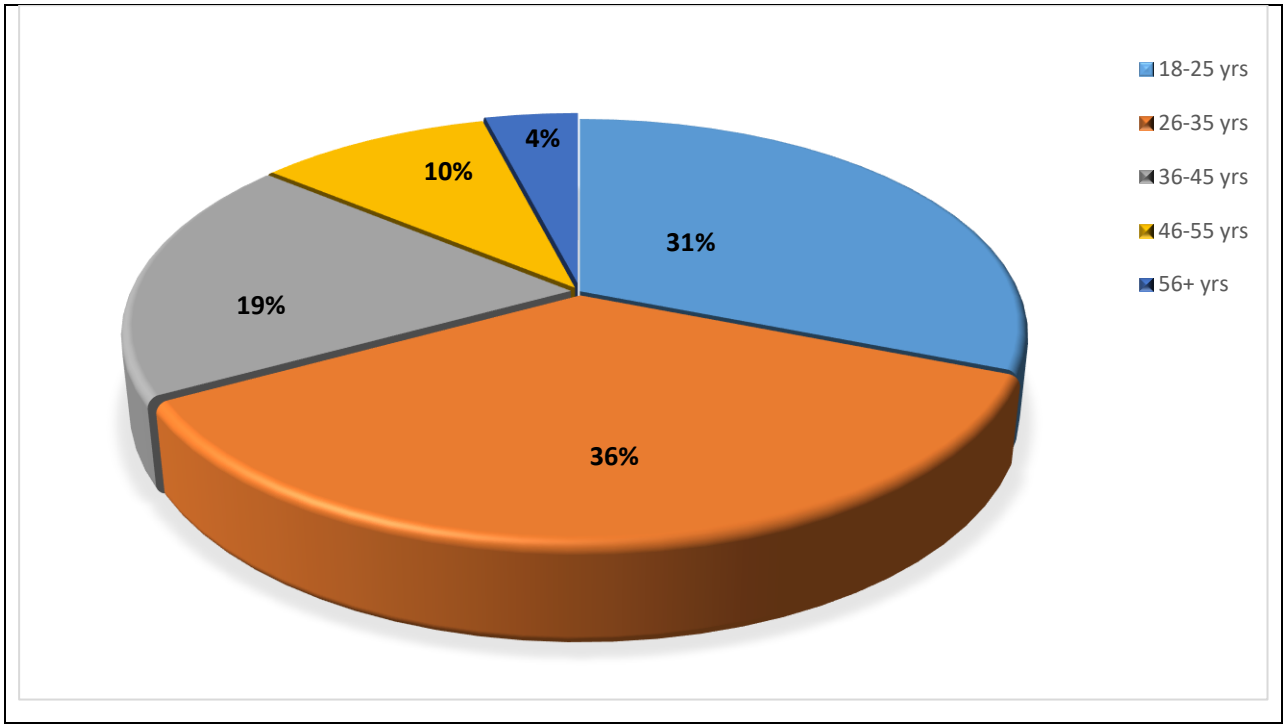


*Figure 4.2: Age group of respondents*
*Source: Author, 2020*

Figure 4.2 presents the age distribution showing that 31% of the respondents were aged between 18-25 years, 36% of the respondents were between the age range of 26-35, 19% were between 36-45, 10% aged between 46-55 and 4% respondents aged 56 and above years. The findings show that a larger age group of the population is comprised of the youths. The findings are in line with the national statistics revealing that there are more youth aged between 18-35 years within the country (ZIMSTAT, 2012). These results are in tandem with the fact that water demand and consumption is relatively high for the youth as compared to the elderly within the

society (Ogunbode and Ifabiyi, 2014). Furthermore, the youth generally have the responsibility for queuing and fetching water (Chigonda and Chazereni, 2017).

#### 4.2.1.3 Educational qualifications of respondents

Figure 4.3 shows educational qualifications of respondents. Formal education was analysed to determine if any relationship exists between potable water demand, supply and conservation techniques to achieve sustainable water supply within the town hence the respondents were asked to provide their educational qualifications.

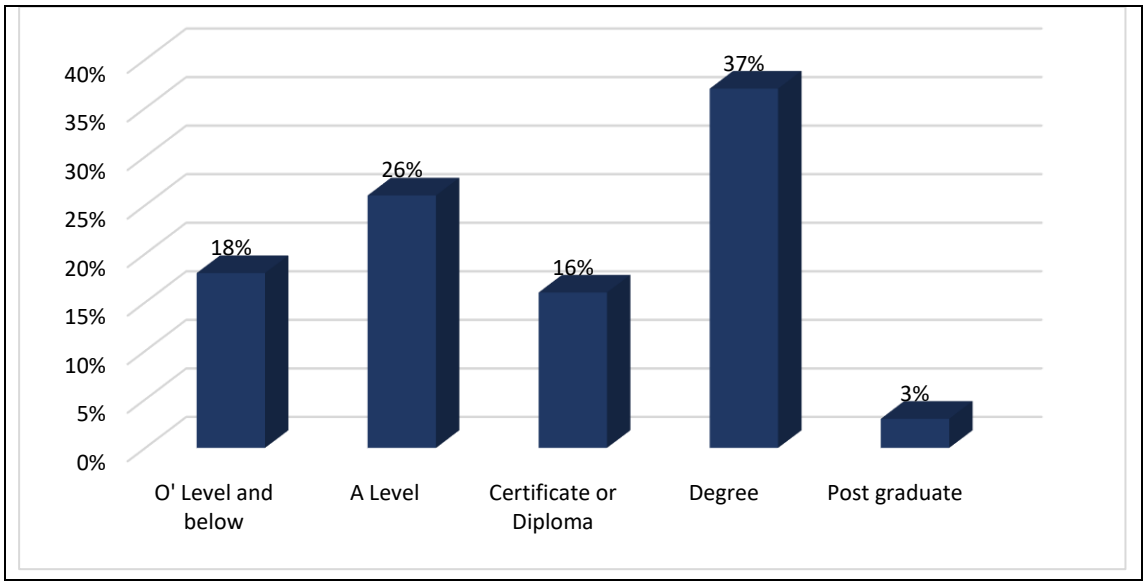


*Figure 4.3: Educational qualifications of respondents*
*Source: Author, 2020*

Respondents with qualifications such as Ordinary level and below constituted 18% of the population in comparison with 26% with an Advanced level qualification, 16% with a certificate or diploma, 37% with a degree and 3% with a postgraduate qualification. These statistical results show that a larger population of Norton residents has a degree in comparison with other educational qualifications as presented above.

#### 4.2.1.4 Place of stay

To understand the demand and supply characteristics from the high and low-density suburbs, place of stay was analysed from the respondents. Figure 4.4 highlights the statistical numbers in relation to place of stay.

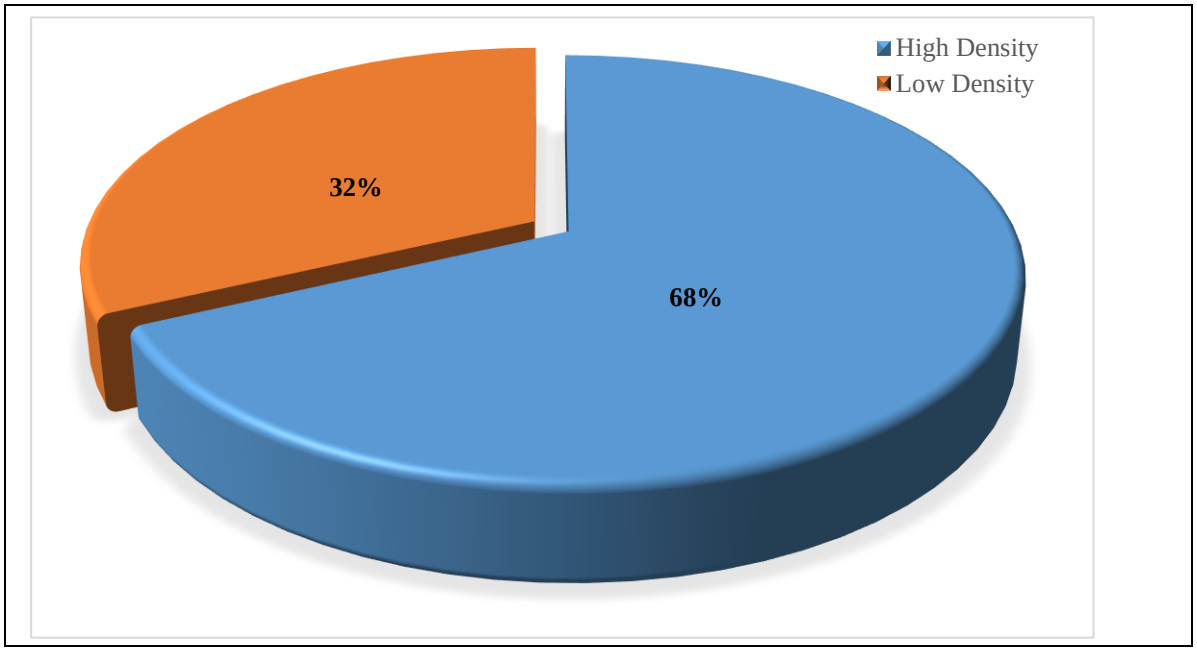


*Figure 4.4: Place of stay*
*Source: Author, 2020*

From the above figure, it is indicated that 68% of the respondents live in high-density suburbs, and 32% live in the low-density suburbs within Norton. This is substantiated by the fact that there are relatively more high-density residential areas as compared to low density households in Norton. The figure also depicts that a larger sampled population are form the low income families and as a result affects the financial base of the NTC as they fail to pay for services provided resulting in poor management of the water supply infrastructure system as a result of financial constraints.

#### 4.2.1.5 Period of stay

Figure 4.5 shows respondents' period of stay in Norton. Period of stay was analysed to determine if the respondents lived within the town relatively longer period to understand the water provision challenges within the town. The study perceived that the period of stay has effect on the knowledge of water issues faced by the residents within the town.

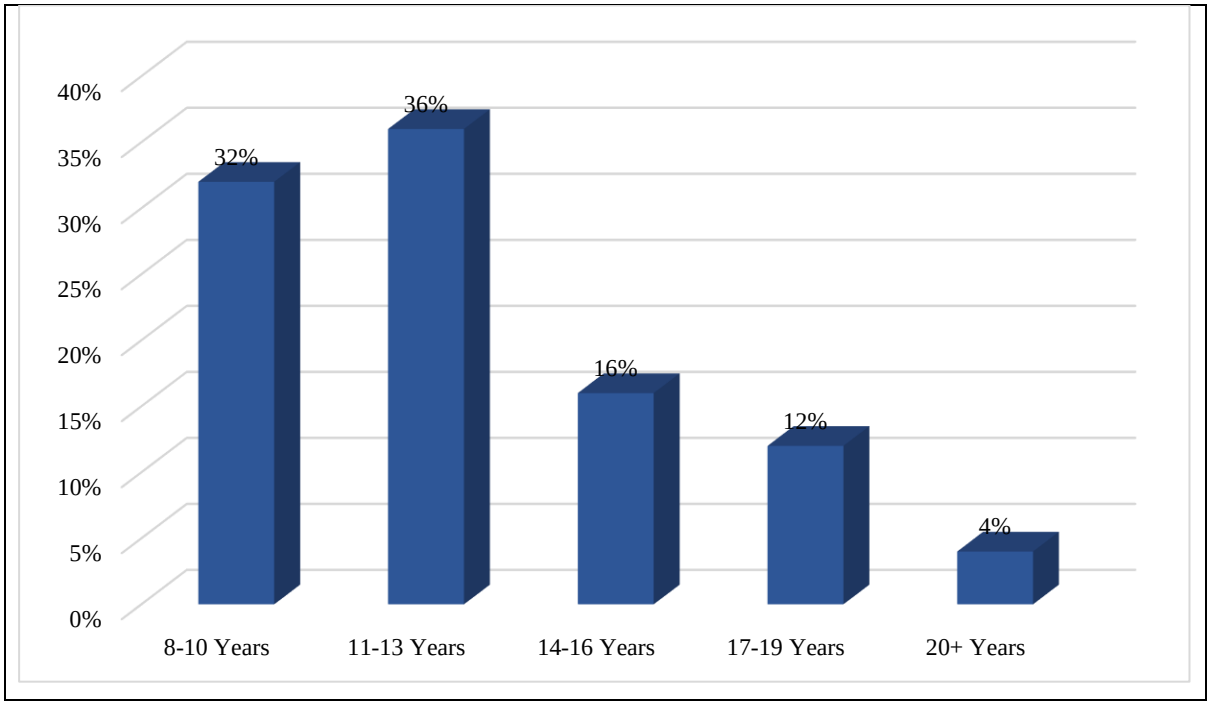


*Figure 4.5: Period of stay*
*Source*: *Author*, 2020

The results indicate that 32% of the respondents lived in the town for 8-10 years, 36% lived for 11- 13 years, 16% lived for 14-16 years, 12% lived for 17-20 years and 4% indicated that they lived for more than 26 years. The period of stay assisted the researcher to select and collect data from respondents who lived in the town since 2012 and cognisant of the potable water supply issues facing the town.

### 4.3 Potable water demand and supply in Norton Town Council

Population growth in Norton from 2012 to 2019 was analysed as shown on Figure 4.6. To understand per capita water demand, individual water demand was calculated using the cut-off water volume of 50 litres per day as mandated by WHO and the Zimbabwe water regulating authorities that must be continuous and sufficient without interruptions in supply. The demand basically covers domestic water uses such as for drinking and for personal hygiene. The assumption is that as population grows, the water consumption also increases in relation to increase in population. The study was based on domestic water demand and supply hence justifying population increase as influencing water demand in Norton. Figure 4.6 shows the population growth in Norton from 2012 to 2019.

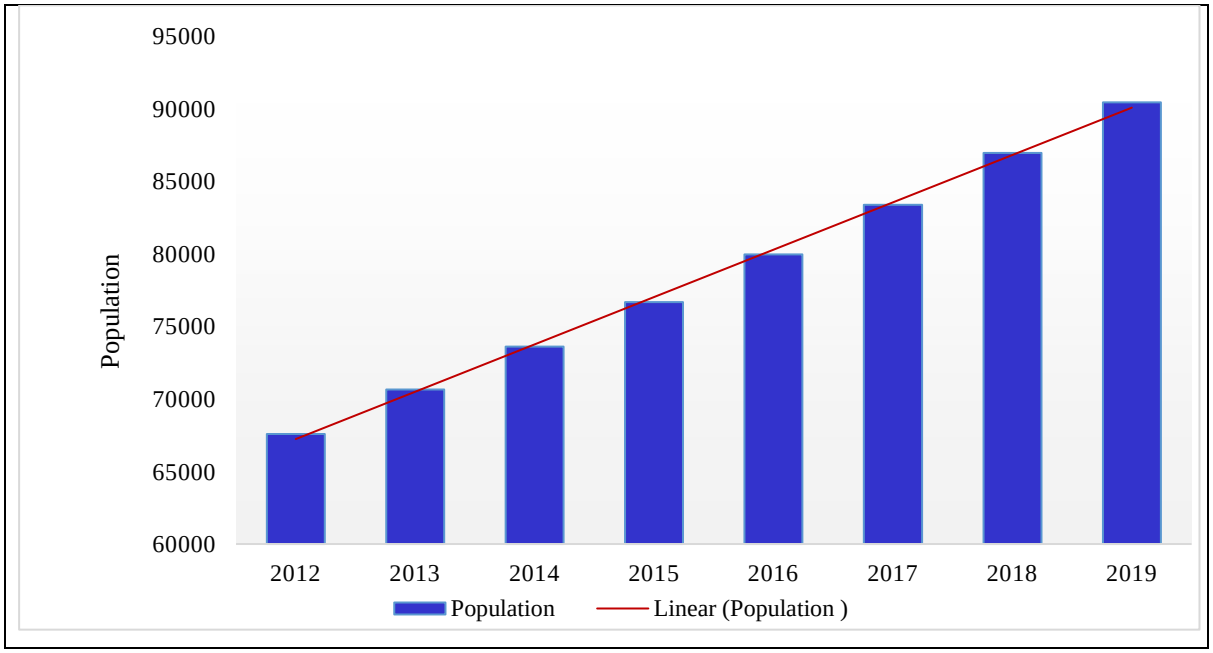


*Figure 4.6: Population growth in Norton*
*Source*: *Author, 2020*

The findings as depicted on figure 4.6 established that the Council is faced with rapid population increase annually. The lowest recorded population was in the year, 2012 and has been growing at an average of 4 percent per annum. The more the population, the more the demand for potable water. The population growth has placed the NTC under intense pressure to effectively supply potable water against escalating demand coupled with other unprecedented problems such as financial constraints, urbanisation and urban expansion to mention a few that led the council to be overwhelmed. The failure of balancing population growth and robust infrastructural system has drastically led to the collapse of equitable water service provision in Norton. The findings concur with the literature surveyed indicating that increase in population is placing strain on the capacity of local government to meet with the demand for water leaving a huge number of people without access to potable water (UNESCO, UN-Water, 2020; Guppy and Anderson 2017; Kusena, 2016; Muller, 2016; Nhema and Zinyama, 2016; UN WWDR, 2015). The study hence cites that population increase in the town is the major driver for increased potable water demand hence management strategies by the Council needs to be effected as well as alternative potable water sources to ensure sustainable access to potable water for all. To further understand the potable water demand versus supply dynamics within Norton, figure 4.7 depicts the trends from 2012 to 2019.

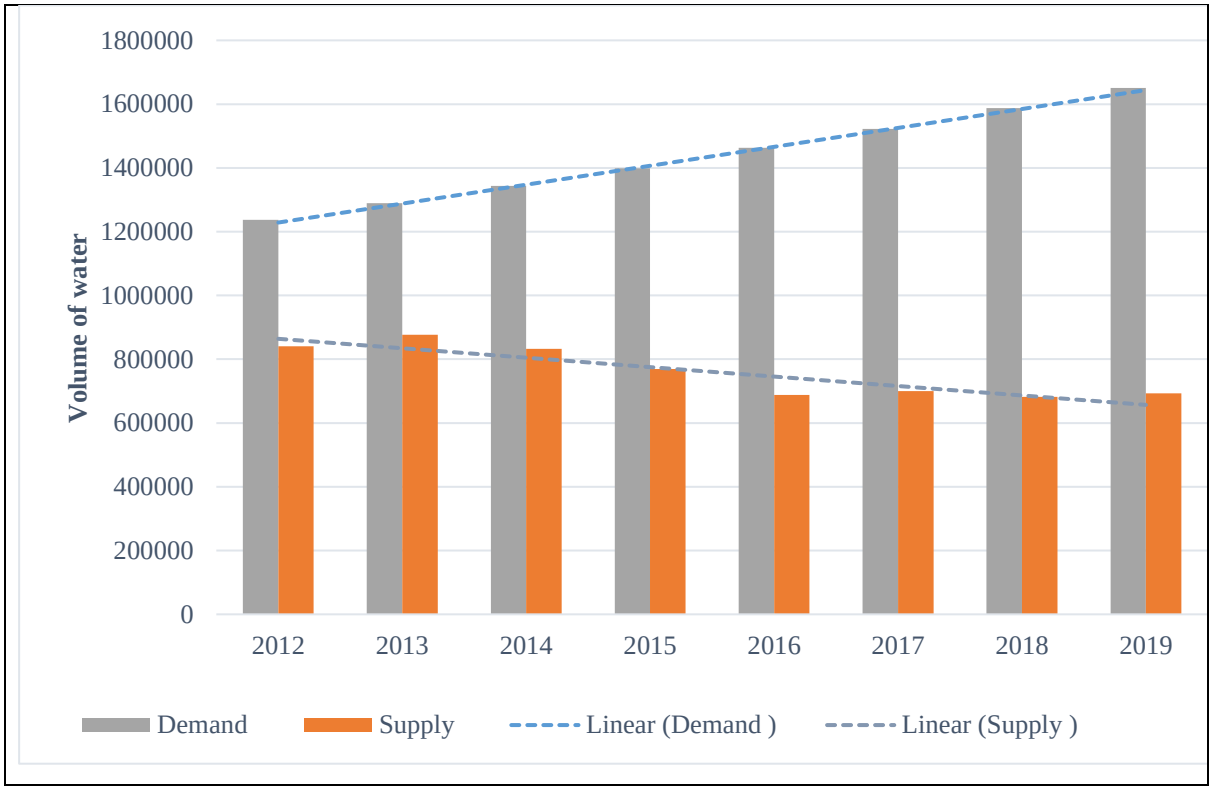


*Figure 4.7: Potable water demand and supply situation in NTC from 2012-2019.*
*Source: Author, 2020*

The results show that the demand for potable water has been increasing over the years against degreasing supply. In 2012, there was a narrow gap between the water demand and supply as compared to the other years. The gap between the demand for water and the supply has been further widening and the largest difference is shown on figure 4.7; in 2019 more than half of the entire population had no access to piped potable water from the NTC. The capacity of the council to supply is continuously deteriorating against a peaking demand. A significant number of people within the town considerably lack access to piped potable water from the council as the system is currently being overwhelmed by increase in population. The reasons for the above figure can be attributed to basically growth in population due to demographic factors, economic and social factors. Adding on, since 2012, the results indicate that Norton have been failing to provide the entire population with potable water and their mandate of water provision has further worsened instead of improving as the years progressed.

In addition, a survey of literature indicates that domestic demand of water is multi-fold most especially in the urban areas (Dos Santos, 2017; Mangizvo *et al.*, 2017; Dos Santos *et al*., 2016; Kusena, 2016; Magombo and Kosamu, 2016; Panganai and Mangizvo, 2016; Muller, 2016). The demand for water is highly influenced by varying water uses between the low and high

density suburbs. According to the study findings, the most prominent potable water uses in the town includes the water for drinking, personal hygiene, sanitation and for food preparation, which is higher in high-density suburbs as compared to low density areas. Most of the low density residential areas have other water source alternatives and the population living in low density areas is less than the population in high density hence the demand for piped water from the council is lower in the low density.

The respondents were asked to indicate their sources of water supply in Norton. The results are presented in figure 4.8.

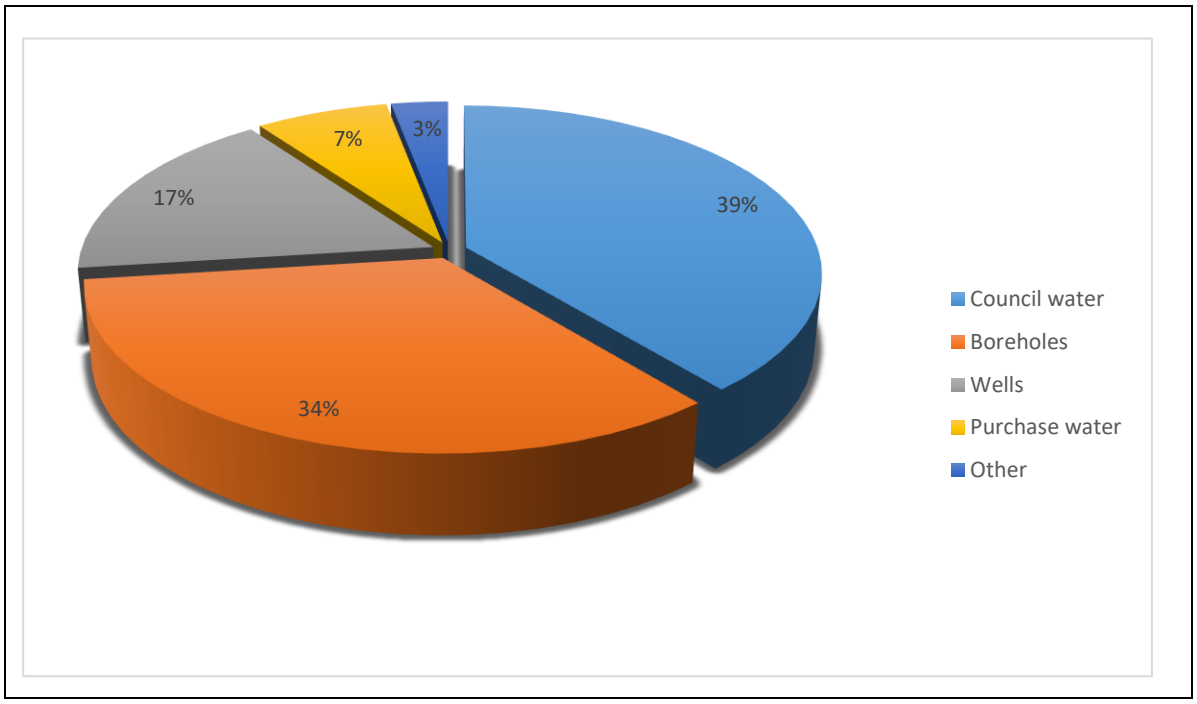


*Figure 4.8 Water sources in Norton*

Source: *Author, 2020*

Figure 4.8 shows that 39% of the respondents use piped water from the Norton Town Council for their water needs, 32% use boreholes, 19% uses shallow wells, while 7% rely on purchasing water mainly for drinking and 3% indicated other sources of supply. The findings suggest that the respondents who were surveyed presented that the NTC only manages to supply 39% with piped water, which is neither reliable nor clean enough for safe consumption. The residents have resorted to other sources of water such as the use of boreholes and shallow wells on their household premises raising concerns of contamination and unsuitable for consumption whilst other indicated that they purchase water mainly for drinking. Boreholes are increasingly being recognised as the second best water source, this is also supported by the NTC officials who

cited a number of boreholes being sunk in the town and indicated the existence of private (owned by individual households) and public boreholes.

However, the NTC is failing to maintain the borehole infrastructure resulting in the malfunctioning of the boreholes further resulting in lack of access to potable water for the residents. The results of this study concur with the findings of Matsa and Tapfuma (2015) who indicated that the users of water from the local authorities are declining especially in developing states due to unreliability of the source hence people are opting for other water supply alternatives to ease the water challenges in the urban areas. In the case of Norton however, some of the borehole water is contaminated and have been closed down and the few that are still functioning are overused risking breakdown at any time due to pressure. The study therefore seeks to suggest a model for improved water supply by the NTC in a sustainable manner to increase the number of people who use Council water as an ultimate and reliable source of potable water supply for the Norton dwellers and sustainable alternative sources for potable water.

From the trends shown, there is clear indication that there is a gap between domestic potable water demand and the actual water supply in Norton since demand is surpassing the capacity of the Norton City Council to supply. The reasons for the above figure can be attributed to the increase in population due to demographic changes, economic factors and social factors. A number of variables form each sub-category were used to determine the characteristics of potable water demand in Norton. The variables used explain about 60% of the demographic characteristics of potable water demand in Norton. With 2 (two) factor loadings namely population dynamics and water use dynamics as shown in table 4.1. Social and economic characteristics influencing potable water demand viz population growth were also analysed and the results are presented in this section. The results indicate that the variables used are significant in determining the causes of increasing demand for water in the town. These conclusions were made basing on the factor analysis conducted under each category.

*Table 4.1: Rotated Factor Matrix for demographic characteristics of water demand*

| | Factor | |
|---|---|---|
| | 1 | 2 |
| Household size | .888 | |
| total number of family renting per household | .671 | |
| Spatial distribution of people within the town | .650 | |
| Total number of households | .519 | |
| Population increase | | .773 |

| | | |
|---|---|---|
| Gender | | .650 |
| changing water consumption patterns | | .529 |
| Family size within each household | | .495 |
| Eigenvalues | 3.322 | 1.497 |
| % Variance | 41.53 | 18.70 |
| Cumulative % | 41.53 | 60.24 |

Extraction Method: Principal Axis Factoring. Rotation Method: Varimax with Kaiser Normalization.
*Source: Author, 2020*

Table 4.2 presents 2 factors that were retained and had an eigenvalue greater than 1, factor 1 (3.322) and factor 2 (1.497). These factors had a cumulative variance of 60.24%, leaving a total value of 39.76% as other characteristics of demographic potable water demand. Table 4.2 shows extracted factors named and described.

| **Factor No.** | **Name of factor** | **% of variance** | **Factor description** |
|---|---|---|---|
| 1 | Water use dynamics | 41.53% | Factor 1 consisted of household size, total number of family renting per household, spatial distribution of people within the town and total number of households with factor loadings ranging from 0.519 to 0.888. |
| 2 | Population demand | 18.70% | Factor 2 comprised of population increase, gender, changing water consumption patterns and family size within each household with factor loadings of 0.495 to 0.773 |

*Table 4.2: Factor description for demographic characteristics of water* demand*: Source: Author, 2020*

Yong and Pearce, (2013) asserts that the factors should be named, there are no rules pertaining to factor naming hence the researcher should give names that best represents the variables within factors. The extracted factors as shown in table 4.9 were named as follows, factor 1 (potable water use dynamics) and factor 2 (population demand). Therefore, this shows that water use dynamics and population characterise potable water demand in Norton.

Adding on, the characteristics that were used to determine economic factors influencing population growth and increasing potable water demand within Norton were also analysed. Factor analysis was performed on 5 variables used to measure the economic influence on population growth and potable water demand. The results are presented on table 4.3.

*Table 4.3: Rotated Factor Matrix for the economic characteristics of potable water demand in Norton*

| | Factor | |
|---|---|---|
| | 1 | 2 |
| Cheaper housing rentals | .923 | |
| Availability of employment opportunities | .839 | . |
| Level of economic development | .408 | |
| Number of operating industrial institutions | | .831 |
| Availability of vacant lands | | .408 |
| Eigenvalues | 2.564 | 1.052 |
| % Variance | 51.273 | 24.035 |
| Cumulative % | 51.273 | 75.308 |

Extraction Method: Principal Axis Factoring. Rotation Method: Varimax with Kaiser Normalization.
*Source: Author, 2020*

These variables had a cumulating percentage of 75% in explaining economic influence on population increase within the town. The eigenvalues for factor 1 (2.564) and factor 2 (1.052); all variables had factor loadings above 0.4 in explaining economic characteristics on water demand in Norton. Table 4.4 shows the factor descriptions named and described.

*Table 4.4: Factor description for the economic characteristics of potable water demand in Norton*

| **Factor No.** | **Name of factor** | **% of variance** | **Factor description** |
|---|---|---|---|
| 1 | Availability of economic opportunities | 51 % | Factor 1 consisted of items such as the availability of employment opportunities and level of economic development with factor loadings of 0.839 and 0.408. |
| 2 | Availability of land for development | 24% | Factor 2 comprised of the number of available industrial institutions and vacant lands hence people also move from other areas to Norton to utilise such opportunities. The factor loadings recorded 0.408 and 0.813. |

*Source: Author, 2020*

Two factor loadings were deduced that are; *availability of economic opportunities* leading people to use piped potable water to perform a number of economic activities such as farming and other human activities leading to pollution of water sources such as the Lake Chivero. The second factor was named *availability of land for development* hence people tend to move from other areas to the town to utilise these economic opportunities. The results are significant as they are essential in formulating a sustainable water provision and management system within Norton Town.

To determine social characteristics influencing potable water demand within the town was also analysed as significant in influencing population growth. The findings are presented in table 4.5

*Table 4.5: Rotated Factor Matrix for social characteristics of population growth in Norton*

| | Factor | |
|---|---|---|
| | 1 | 2 |
| The town is located in a good environment (preferred by most people) | .765 | .311 |
| Safe place for dwelling as compared to other small town | .735 | .558 |
| New residential areas | .715 | |
| availability of social amenities such as churches | | |
| availability of institutions such as schools and health facilities | | .753 |
| Residential location of households | | .744 |
| Eigenvalues | 3.032 | 1.116 |
| % Variance | 50.536 | 18.592 |
| Cumulative % | 50.536 | 69.128 |

Extraction Method: Principal Axis Factoring. Rotation Method: Varimax with Kaiser Normalization.
*Source: Author, 2020*

Two factors that were retained and had an eigenvalue greater than 1, factor 1 (3.032) and factor 2 (1.116). These factors had a cumulative variance of 69%. Table 4.6 shows extracted factors named and described.

*Table 4.6: Factor description*

| **Factor No.** | **Name of factor** | **% of variance** | **Factor description** |
|---|---|---|---|
| 1 | Types of residential areas | 50.54% | Factor 1 consisted of items such as that the town is located in a good environment (preferred by most people), safe place for dwelling as compared to other small town and new residential areas with factor loadings ranging from 0.715 to 0.765. |
| 2 | Residential expansion exerting pressure on social institution | 18.60% | Factor 2 comprised of availability of institutions such as schools and health facilities and residential location of households within each household with factor loadings of 0.753 and 0.744 respectively. |

*Source: Author, 2020*

Residential expansion and the type of residential area were the social aspects influencing the demand for potable water within Norton that were named and described after performing factor analysis. These factors explain 69% of social characterisation of increase in potable water demand due to increase in population within Norton. To further support this, the researcher

analysed the household growth dynamics within the low and high density areas of the town from 2012 to 2019 and the results are presented in figure 4.9

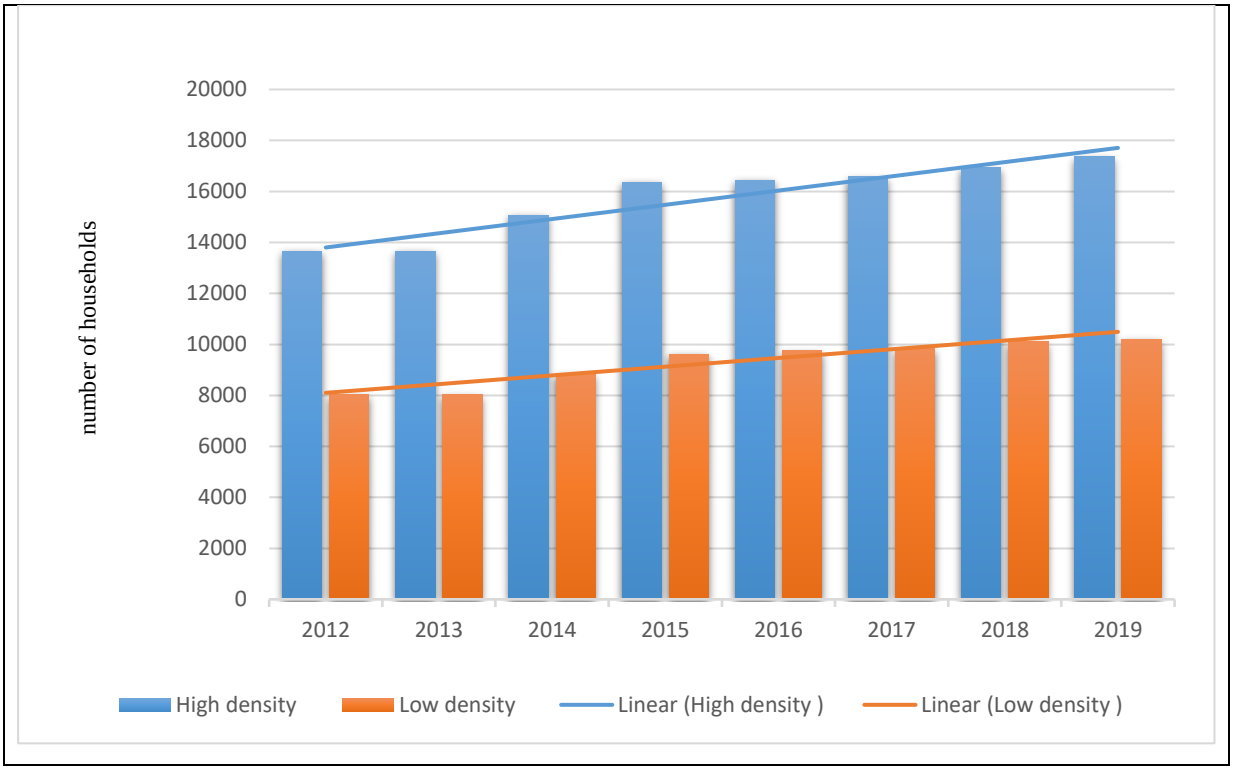


*Figure 4.9: Household growth dynamics in Norton (high versus low density)*
*Source: Author, 2020*

The results show that the town expanded in terms of residential locations and the number of households increased in numbers for both the low density and the high density areas. Furthermore, the number of high density households surpasses the low densities thus indicating more demand for piped potable water in the high density areas. This also implies that there is more population density in the high density locations in Norton. The total households in Norton have been increasing over the years corresponding with increased population. The high density areas are growing faster than the low density locations. This indicates that water demand is relatively higher in the high density as compared to the low density areas according to the SLB reports (2019).

The findings are significant in formulating a sustainable water provision and management model within Norton Town since the factors that characterise potable water demand have been identified. This is further supported with literature surveyed, indicating that the characteristics for potable water demand are multi-fold hence the need to narrow down these factors and assess their impacts towards influencing the demand for potable water within communities (Dos Santos *et al.*, 2017; Magombo and Kosamu, 2016; Panganai and Mangizvo, 2016).

### 4.4 Characterising potable water supply in Norton

The study analysed the characteristics of potable water within Norton and the findings suggest that here is poor potable water supply in Norton. The findings also show that access to potable water is limited which goes against the guidelines of WHO (2010) on the amount of water that an individual is entitled to receive per day in terms of availability, quality and accessibility (Chigonda and Chazereni, 2017; Dos Santos *et al.*, 2017; Eneh and Nnaji ,2016; Bates-Eamer *et al.*, 2012). The citizens receive water with low pressure and for relatively very few hours about 3-6 hours and some of the suburbs do not receive water completely. To explain the widening demand and supply gap in water provision (as shown in figure 4.7), a number of variables were used to explain the deteriorating potable water supply over the years. Therefore, the respondents were asked to indicate what influences the supply of potable water in Norton using various variables from the physical water supply system, economic, governance and political issues. The findings are presented below.

#### 4.4.1 Obsolete physical water supply infrastructure system

The major hindrance to effective water supply in Norton is due to the dilapidated and neglected water supply infrastructure management. Correlation coefficient matrix for 10 variables used to measure the physical water supply system as a characteristic for potable water supply calculated using exploratory factor analysis. 5 items were eliminated because the correlation coefficient values were less than the cut-off value of 0.30. The results were evaluated with the remaining 5 items with correlation coefficient value greater than 0.30 as shown in table 4.3 that were suitable for factor analysis. The determinant score had a value 0.036 which is above the cut-off value of 0.00001 as recommended by Lin and Wu (2016) and Samuels (2016). The data was regarded as suitable for factor analysis. The KMO test was also performed and the statistic value of 0.870 was recorded thus the data was suitable for factor analysis. Table 4.7 indicates factor analysis for the variables used to examine the potable water supply scenario in Norton.

*Table 4.7: Factor Loading Matrix for the WSS*

| | Factor |
|---|---|
| | 1 |
| Lack of water storage facilities | .885 |
| Unsustainability of water source | .862 |
| Poor water quality | .848 |
| Dilapidated distribution networks | .748 |
| Insufficient potable water access | .714 |

Extraction Method: Principal Axis Factoring.

*Source: Author, 2020*

The results as shown from the table 4.7 indicate that the variables used for the analysis have a practical significance with high factor loading of more than the cut-off value of 0.40 hence, significantly contributing towards the factor being measured with an Eigenvalues value of 3.721 and a cumulative value of 62% in explaining the poor physical water supply system as hindering effective supply.

The results concur with the data collected from the interviews conducted. The researcher interviewed participant 1 and 2 to understand the current water supply characteristics in Norton. Participant 2 said that,

> *"we do not have a water treatment plant, we depend on water from the City of Harare and the water is not enough they give us 5 to 6 mega liters per day and it is not enough. Even when we distribute the water, it is not for more than 6 hours,"* (Participant 2).

Therefore, this implies that the current potable water supply in Norton is characterized by poor water supply system, unreliability of supply, as the water is only available to a maximum of six hours per day and poor water supply infrastructure system. Effective supply is being hindered by the current water supply system resulting in more people without access to equitable and continuous piped potable supply of water. The Norton SLB report (2019) recorded 64.7% of households served with municipal water in 2016 and 2017. The percentage dropped in 2018 to 62.4% meaning that the total number of people without access to water increased with a total percentage of 2.3%. In 2019, the number of people without access to potable water increased in the town to 43% of the total households.

Adding on, participant 1 further indicated that,

> *"we already have a shortage of water supply not all areas receive water. Maridale and Johannesburg do not receive water from the Norton Town Council completely,"* (Participant 1).

This clearly shows that the council is drastically failing to provide the stipulated water entitlements per capita of clean water that is continuous and sufficient without interruptions in supply (WHO, 2010; Bates-Eamer *et al.*, 2012). In 2017, a total population of 83 388 was receiving water at a rate less than the stipulated amount (Norton SLB Report, 2019). This not only results in unsustainability of the water supply and leads to pipe corrosion during the

rationing period further deteriorating the distribution system but also leads to water contamination due to low pressure in the network.

Upon further probing, participant 4 said that water supply challenges affect the high and low density suburbs differently with supply problem more severe in the high density suburbs in comparison with the low density areas. The quotation below is supports this assertion.

> *"you find out that with the current set up, water reaches the low-density suburbs first with high pressure and when it reaches the low density the pressure will be low ..."* (Participant 4).

This implies that piped potable water supply in Norton is not uniformly distributed as the low density relatively receives more water and the high density mentioned above that is Maridale and Johannesburg are in dire water shortages and the citizens have resorted to digging shallow wells with contaminated water unsuitable for drinking.

### 4.4.2 Financial constraints

EFA was performed on 10 items that were used to measure the economic characteristics of potable water supply in Norton. Correlation coefficients matrix was calculated, and 2 items were eliminated because the correlation coefficient as recommended by Lin and Wu (2016) was less than 0.30. Therefore, 8 items were used to measure the characteristics as shown in table 4.23 and a significant value of 0.87 which is way beyond the cut-off value of 0.00001 (Yong and Pearce, 2013). The KMO statistic value was calculated and had a value of is 0.824 and the Bartlett's test of sphericity was 806.197 demonstrating sampling adequacy. Factor analysis was performed and the results are presented in table 4.8.

| | Factor |
|---|---|
| | 1 |
| Customer unwillingness to pay for water bills | .671 |
| Unreliable sources of finance | .670 |
| Failing to embracing new technologies | .624 |
| Economic value of water | .598 |
| Mismanagement of resource | .598 |
| Financial constrains | .591 |
| Low income of the consumers | .578 |
| Low level of industrial performance | .545 |

Extraction Method: Principal Axis Factoring.

*Table 4.8 Factor Matrix for economic characteristics of water supply in Norton Source: Author, 2020*

The results indicated 1 factor loading with a cumulative value of 55%. The factor indicates financial constraints as a major draw back towards effectively providing potable water in Norton.

A survey of literature indicates that, sustainable water management in urban areas is hinged upon payment of rates for the water supplied according to reviewed literature (Mabika, 2015; Ajibade *et al.,* 2015; Matsa and Tapfuma, 2015). Sound economic planning and management of finances positively contributes towards sustainable potable water supply. Participant 1 pointed out that the Council is faced with a challenge of financial constraints due to the economic hardship facing the country, the cost of chemicals for treating the water and also the issue of non-payment by the customers.

> *"The cost of water and the cost of chemicals and also the cost of maintaining the water infrastructure affects the water supply…so, there is the cost of treating the water and the cost of maintaining the infrastructure, the cost of repairing the infrastructure and the cost of staff who work on the infrastructure they affect the water supply," (Participant 1)*

This shows that sufficient financial resources result in sustainable water supply system as the financial resources will be readily available for footing the costs associated with supply issues in urban areas. Nevertheless, in the case of Norton, the supply is characterised with insufficient resources to cater for the sustainability in supply. Participant 3 indicated that,

> "*Norton Town Council struggles to pay for the right amount of water. We are supposed to do regular water quality monitoring, regular upgrading of the water reticulation system but we find ourselves being strained financially so we won't be able to provide the water," (Participant 3).*

This reveals that the Norton Town Council is hindered by economic constraints in supplying water to the citizens. The economic factors hindering sustainable supply includes but not limited to the culture of non-payment by citizens, financial mismanagement and lack of financial support from the government and other relevant stakeholders. Therefore, financial issues affects supply capacity and sustainability due to the absence of revenue collection channels for infrastructure maintenance and replacements.

### 4.4.3 Political

EFA was performed on 5 items used to measure the political aspects characterising potable water supply in Norton. The correlation coefficients matrix was calculated for the variables as shown in table 4.22. Yong and Pearce (2013) recommends that the correlation should be above 0.30 hence the variables had a positive value from the cut-off point qualifying the data for factor analysis. The correlation ranged from 0.369 and 1. The significant value was 0.010 qualifying for factor analysis. Adding on, the KMO and Bartlett's test were performed to measure sampling adequacy and the results showed the value of 0.732 for the KMO and 1526.387 for the Bartlett's test with a significance of 0.0001.

Factor analysis was performed as presented in table 4.9 and recorded 2 factors that had an eigenvalue greater than 1 with factor 1 having a value of 3.387 and factor 2 a value of 1.150. The factors had a cumulative value of 91%.

| | Factor | |
|---|---|---|
| | 1 | 2 |
| Poor governance | .901 | |
| Poor policy frameworks | .889 | |
| Ineffective legislative frameworks | .812 | |
| Political interference | | .927 |
| Lack of decentralisation | | .920 |
| Eigenvalues | 3.387 | 1.150 |
| % Variance | 67.749 | 22.998 |
| Cumulative % | 67.749 | 90.748 |

*Table 4.9 Rotated Factor Matrix: Source: Author, 2020*

Table 4.10 shows extracted factors named and described.

| Factor No. | Name of factor | % of variance | Factor description |
|---|---|---|---|
| 1 | Lack of political will | 67.75 | Factor 1 comprised of items such as poor governance, poor policy frameworks and ineffective legislative frameworks with factor loadings of 0.901,0.889 and 0.812. |
| 2 | Lack of administrative independence | 23% | Factor 2 consisted of 2 variables namely political interference and lack of decentralisation in potable water supply with factor loadings 0.927 and 0.920 respectively. |

*Table 4.10: Factor description: Source: Author, 2020*

The factors indicate that potable water supply in Norton is characterised with lack of political or policy will and lack of administrative independence as the significant factors leading the NTC to fail to effectively and sustainably supply water in Norton.

Interviewed participants were asked to elaborate on how politics influences water supply in Norton. Political interference was indicated as a major obstacle towards attaining sustainable supply of water. Participant 1 stated that,

> *"Political interference affects the operations of the council. At one time we had to cancel debts and at the same time we had incurred costs in supplying water … and this had a negative impact on us."* (Participant 1).

Participant 2 also added that the issue of political interference as an obstacle in the supply management of portable water in Norton.

> *"And another thing is the issue of political interference in the billing system of the Council."* (Participant 2).

Participant 3 further reiterated that there are poor policy frameworks and lack of political will from the government and also indicated the issue of poor governance as affecting the sustainability of the water supply in urban areas. Participant 3 highlighted that,

> *"The government is supposed to provide expertise on establishing water works right, finance if possible for water works through the central bank, coordinate and demand revenue from residents to solve their problems, come up with integrated water supply systems that should come from the government. (Participant 3)*

It is evident that politics hinder sustainable water supply planning and management in urban areas through high meddling in the administrative governance of the Norton Town Council thus limiting decentralisation and side-lining the autonomy of the local authorities. In this case, the local government is a mere extension of the central government. Literature also support the contention that politics hinder effective management of water supply by the responsible water governing institutions as they try to put forward their political agendas at the expense of sustaining water provision as a basic human right and as such contributing to human development which subsequently leads to socio-economic development (Adams *et al.*, 2018; Eneh and Eneh, 2016; Matsa and Tapfuma, 2015; Desalegn 2014; Dipholo and Gumede, 2013; Chigonda, 2011).

### 4.4.4 Institutional or Governance Issues

Correlation coefficient matrix for the 11 items was calculated to measure institutional or governance characteristics of potable water supply in Norton the determinant score was above the cut-off value of 0.30 thus factor analysis was performed. KMO and Bartlett's test were performed, the results indicated a patterned relationship between the variables ($p < 0.001$) and KMO value of measuring sampling adequacy (0.798) which is above the recommended cut-off value of 0.5 hence suitable for performing EFA.

EFA was performed and the results are presented in table 4.11. 3 factors were extracted from the data with factor loadings above 0.40 and had a cumulative value of 68% in explaining the institutional factors influencing water supply in Norton with an eigenvalue greater than 1 (4.861; 1.590 and 1.026).

| | Factor | | |
|---|---|---|---|
| | 1 | 2 | 3 |
| Corruption | .734 | | |
| Bureaucracy | .725 | | |
| Lack of expertise knowledge | .686 | | |
| Exclusion in planning | .648 | | |
| Ineffective management | .626 | | |
| Lack of public participation | .530 | | |
| Lack of infrastructure maintenance and replacements | | .872 | |
| Lack of transparency | | .826 | |
| Lack of efficiency | | .462 | |
| Social exclusion | | | .837 |
| lack of stakeholder involvement | | | .836 |
| Eigenvalues | 4.861 | 1.590 | 1.026 |
| % Variance | 44.194 | 14.458 | 9.329 |
| Cumulative % | 44.194 | 58.652 | 67.981 |

*Extraction Method: Principal Axis Factoring. Rotation Method: Varimax with Kaiser Normalization.*

*Table 4.11 Rotated Factor Matrix for institutional aspects influencing potable water supply in Norton: Source: Author, 2020*

The proposed names of the factors and the description of each factor is presented in Table 4.12. The remaining 32% is left unaccounted for as other factors affecting the institutional capacity of effective water supply in Norton.

| Factor No. | Name of factor | % of variance | Factor description |
|---|---|---|---|
| 1 | Poor planning and management | 44.20% | Factor 1 consisted of items such as exclusion in planning, ineffective management and lack of public participation with factor loadings ranging from 0.530 to 0.648. |
| 2 | Ineffective personnel capacity | 14.46% | Factor 2 comprised of lack of infrastructure maintenance and replacements, lack of transparency and lack of efficiency in water supply with factor loadings 0.872, 0.826 and 0.462 respectively. |
| 3 | Lack of stakeholder engagement | 9.33% | Factor 3 consisted of items such as social exclusion and lack of stakeholder involvement with factor loadings of 0.837 and 8.36. |

*Table 4.12: Factor description: Source: Author, 2020*

The institutional characteristics of potable water supply generally interlinks with issues related to effective water governance. Water governance has increasingly caught research attention due to the important role the concept plays towards the formulation and implementation of solutions that are aimed at sustaining urban water supply system (Chigonda and Chazireni, 2017; Megdal *et al.*, 2017, Eneh and Nnaji, 2016, Butler, *et al.*, 2016; Kusena, 2016; Mapfumo and Madhesha, 2014). To determine the level within which effective institutional management or effective water governance contributes towards sustainable management of the water supply system in Norton. Participant 4 indicated that there is public participation as one initiative which contributes towards good water governance, which is demonstrated from the close interaction between the institution and the public through the use of councillors as intermediator players. Participant 2 stated that,

> *"the residents also have a role to play, like every year when we come up with a budget around September, we go to the public to hear their views and ideas regarding plans for the following year. We would say in order for us to supply this and this, we need to charge such an amount and we also offer feedback to the people through the councillors on how the council is performing in the case of a project or something."* (Participant 4).

Regardless, the official further indicated that they still have the final say regarding decisions to be made thus disregarding the importance of public participation and also indicated that corruption and maladministration characterised with lack of transparency and efficiency are still a challenge hindering effective supply of potable water within Norton. Hence, public trust in the water supply institution is eroded and the citizens shun away from actively participating

in the local governance system. The findings are similar to the findings made by Mapfumo and Madhesha, (2014) in Masvingo Municipality which revealed that urban water supply in Masvingo is characterised by poor governance system which has led to poor supply of water within the town. Thus, the management of the Norton Town Council is largely contradictory to both the systems approach and the integrated urban water management approach which emphasises on effective governance as a contributory factor towards potable water management and supply sustainability.

### 4.4.5 Summary of factors affecting demand and supply of potable water in NTC

| | |
|---|---|
| ***Demand characteristics*** | From the above analysis, the factors that were used to explain increasing potable water demand in Norton can be characterised as changes in water use dynamics, population demand, types of residential location, the availability of social institutions, availability of economic opportunities and economic institutions. |
| ***Supply characteristics*** | Obsolete water supply system, financial constraints, poor planning and management, ineffective personnel capacity, lack of stakeholder engagement, lack of political and policy will and lack of administrative independence |

*Table 4.13 Summary of factors affecting demand and supply of potable water in NTC Source: Author, 2020*

### 4.5 Water supply infrastructure needs in Norton

The study established that the gap between demand and supply is widening hence an indication that there is a water supply problem within the town. Respondents were asked to indicate other sources of water considering the unreliability and inefficient of water supply from the Council. The factors that influence the supply were mentioned earlier, however, due to the extending gap, the citizens have resorted to other coping mechanisms to alleviate the water shortages. From the respondents who took part in the study from both the high and low density areas only 39% (figure 4.8) have access to piped water supply from the NTC. These results are clear evidence that the residents have lost trust in the council and hence rely on other alternative potable water sourceswhich are unsustainable and unpotable. Literature surveyed also substantiates the same view highlighting failure by water governing institutions in sustaining potable water supply therefore citizens resort to other coping mechanisms to access water (Nhema and Zinyama, 2016; Combined Harare Residence Association, 2015; Mudzingwa, 2015; Mangizo and Kapungu, 2010). However, these sources most especially boreholes (public) and wells are unsustainable due to lack of constant maintenance and the boreholes end up malfunctioning amidst contaminated water unsafe for consumption.

#### 4.5.1 The physical water supply infrastructure system needs

To determine physical water supply infrastructure system needs within the NTC, respondents were asked to provide the frequency of piped water supply form the NTC and the results are presented in figure 4.10.

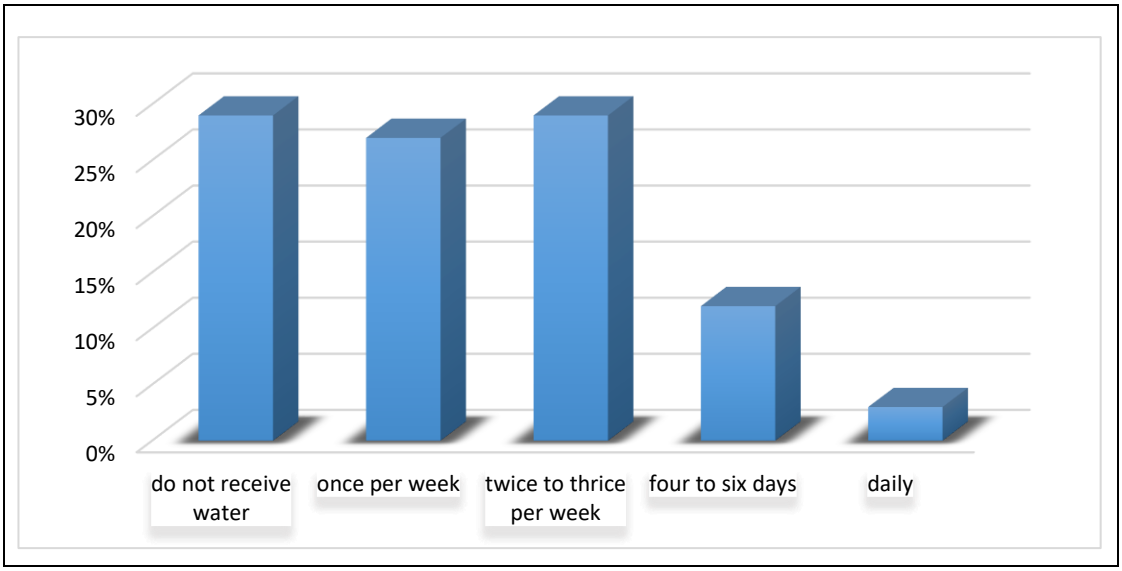


*Figure 4.10: Frequency of piped potable water supply from NTC* Source: *Author, 2020*

Based on the respondents surveyed, 29% indicated that they do not receive water from the municipality entirely, 27% indicated that they receive water at least once a week, 29% receive piped water twice or thrice per week, 12% receives piped water for about 4 to 6 days and lastly 3% indicated daily water supply from the council. The results indicated that piped water from the NTC is not reliable because the majority of participants indicated that they do not receive water daily. The areas which receive water, the supply is limited to a couple of hours per day with other days completely dry. The residents would store water in containers to use when the rationing period occurs. However, due to the severity of the rationing period, some residents resorts to unsafe water sources for domestic uses and sanitation.

The respondents were also asked to indicate their views using the physical infrastructure needs that is from the source, treatment, storage and the distribution system as infrastructure system needs the findings are presented in figure 4.11.

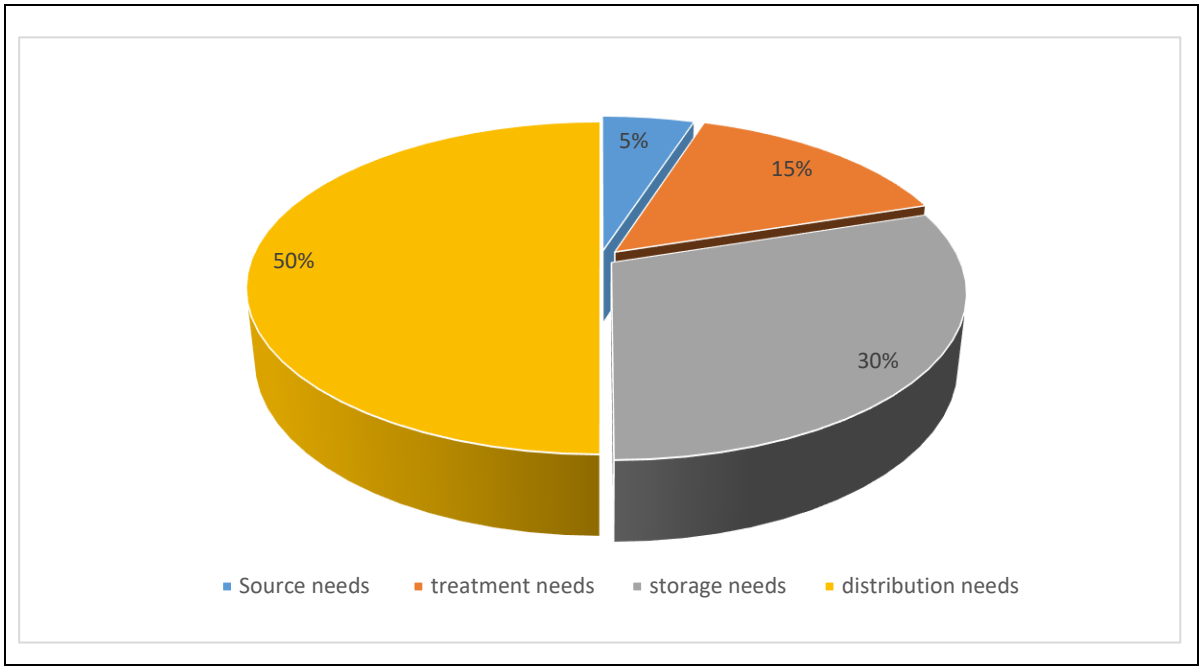


*Figure 4.11: Water supply infrastructure system needs in Norton* Source: *Author, 2020*

The physical water supply infrastructure system within Norton is neglected which results in poor supply hence the respondents *'agree'* that the water infrastructure require massive intervention to restore efficiency and effectiveness of supply. The findings are in line with the Norton Town Council directors indicated that is, "we need 40 million litres storage facilities that is what we require, and we also require rehabilitation of the network". The personnel also indicated that they need a water treatment plant of their own to reduce water supply shortages within the town. From the total respondents who took part in the study to assess the physical

infrastructure needs, the findings of the study indicate that the infrastructure system require *water source needs 5%, water treatment needs 15%, water storage needs 30% and water distribution needs 50%* as shown figure 4.11. The results indicate that the respondents are optimistic that sustainability of water supply can only be achieved when the technical physical potable water supply infrastructure system is re-capacitated to meet with the growing population and the urban expansion.

Literature substantiates that water supply is a system and hence all aspects of the water supply system needs to be met in order to achieve sustainability in urban water supply (Chakunda and Chakaipa 2015; Bahri *et al.,* 2016; GWP, 2013; Makwara and Tavuyango, 2012). The Norton Town Council officials were asked to indicate the water infrastructure system needs within the town. The respondents pointed out that the town is rich in natural water resources viable enough to sustain the growing population demand in Norton. One of the participant signified that,

> "*The water bodies are there, but we don't have the facilities to treat the water hence we rely on the city of Harare*." *(Participant 2)*

Thus, the Norton Council positioned itself as eligible enough to ensuring that water is sufficient to be provided to all residents within the town. Participant 3 further elaborated that the council is only reluctant in ensuring sufficient water to the residents not because of lack of raw water sources but rather due to the incapacity of the council to come up with innovative ideas, strategies and initiatives that are meant to improve reliability of water supply for the town. The participant stated that,

> *"Norton, where we are next to Kariba when it comes to the availability of water in national reservoir, water does not come out all the time." (Participant 3).*

Therefore, this implies that the town has vast water resources essential for the realisation of equitable water supply which explains the low statistics of 5% for source needs in the NTC. However, the planning and management of these water sources is critical towards the realisation of sustainable supply to meet with the increasing urban water demand (Panganayi and Mangizvo, 2017; Kusena, 2016; Qian, 2016; Magume *et al*., 2015; Muzondi, 2014). This can be achieved through a relatively shorter water distribution system as water will be treated and distributed within the town rather than accessing water from external urban water supply areas implying less build infrastructure and less costs for transportation and maintenance. Therefore, the availability of these vast water sources in the town play a significant role in facilitating human development and socio-economic development in Norton.

Adding on, the majority of respondents indicated that the water they receive on their taps is not potable and as such do not meet the requirements of the international water regulatory authorities such as WHO (2010) and UNICEF (2014) and nationally by the Standard Association of Zimbabwe. The respondents also highlighted that the inadequate water supplied by the council is neither suitable for consumption nor for personal hygiene hence the major cause for the outbreak of water borne diseases such as typhoid and diarrhoea within Norton. The respondents' view was in line with the SLB report (2018) which further statistically indicated poor water quality supplied to the consumers for instance, in 2017, the water quality in Norton was recorded as 68.8% and in the next year, the water quality further deteriorated to around 55.3% in 2018. This is clear evidence that the water supply quality parameters are not being met. Some questionnaire respondents cited that the water sometimes has bad odors and others indicated that the water shows brown and rust residues if placed in containers for a day.

Furthermore, the storage facilities are not enough to provide for the growing demand. According to the findings of the research, the demand for water is growing but the potable water storage facilities are not increasing meaning that less water is stored in the reservoir tanks before being distributed. Participant 1 indicated that;

> *"We require our own water treatment plants and it comes with the need for other storage infrastructure because 10 million litres is not enough. We need 40 million litres storage facilities that is what we require and we also require rehabilitation of the network." (Participant)1*

Therefore, the Council needs to prioritise the projects aimed at internally sustaining water supply through initiatives that increase the storage capacity of treated and clean water. The initiative has the potential to ensure uninterrupted supply as enough water will be stored for a couple of days even in the event of a fault in prior stages, sufficient water will still be available.

The distribution system also require intervention as evidenced by a 50% response as shown in figure 4.10. In 2016, 72 pipe bursts were recorded and in the following year, 2017 the number of pipe bursts more than doubled recording a total of 158 water pipe bursts (Norton SLB Report, 2017). The pipe bursts are responsible for high non-revenue water in Norton. Participant 2 indicated that;

> *"The pipes are old and obsolete and as such we are losing more water through burst pipes than what we are distributing to the people. So, the distribution system needs*

> *to be re-capacitated to meet with the growing population demand so that we minimize non-revenue water"* (Participant 2)

This implies that the water infrastructure system is further deteriorating failing to amount to the pressure of demand the infrastructure was designed to serve a lower population but presently, the population demand for water is increasing and yet the water system is not being expanded and maintained to meet with demand.

Moreover, the town also has a poor billing system and the implication for that is that the revenue base of the Council is affected as some residents use unbilled water due to malfunctioning water meters which fail to reflect the actual volume of water consumed. In addition, the issue also raises concerns about the technical capacity of the council staff since they are unable to maintain and fix the convectional water meters. Failure by the Council to provide water services to the new allocated residential areas also hinders the revenue base and disregard the basic human right to water for the citizens who would be at times willing to pay for services if connected to the distribution system.

One council official indicated that the high density require more water supply as compared to the low density since the demand for potable water is high in the high density. However, the findings indicated that the low density receive more water than the high density due to the geographical location of the suburbs and the terrain. Participant 2 further alluded that;

> "*you find out that with the current set up, water reaches the low-density suburbs first with high pressure and when it reaches the low density the pressure will be low …"* Participant 2.

Participant 3 further argued that;

> "*We have high density suburbs which are highly populated and needs more water, low density needs a bit less water but unfortunately if we look at our main trunk form Morton Jeffry Water Works it first passes though the low density areas and finally to the high density areas meaning that the low density areas basically benefit than the high density areas. When it goes to the high density areas the pressure will be very low and the demand for consumption is very high" Participant 3*

This therefore implies that the high density basically suffers from unreliable water supply characterised with less pressure for even fewer hours. Some of the high density locations do not receive water regardless of being connected to the supply system such as Maridale and

Johannesburg in Norton that have been in existence for more than 10 years whereas other suburbs are new and are yet to be connected to the system.

### 4.5.2 Financial capacity

To determine financial needs within the NTC, respondents were asked to provide their views using a five point Likert scale and the findings are presented in form of percentage values.

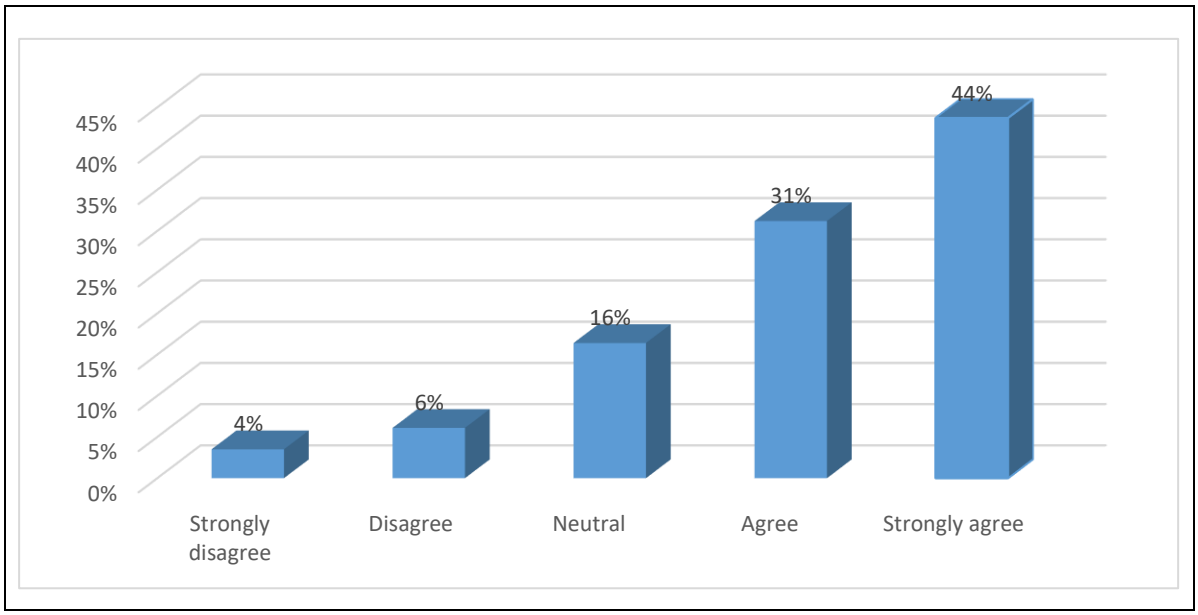


*Figure 4.12 Financial capacity in NTC* Source: *Author, 2020*

From the study findings, 44% strongly agree and 31% agree that the current potable water supply require financial capacity to equip the council with financial resources for upgrading the water reticulation network to meet with the growing urban demand. 4% of the respondents strongly disagreed, 6% disagreeing and 16% of the respondents remained neutral in analysing financial capacity as essentially important in water supply system against infrastructure needs scenario in terms of anticipated urban growth. The findings indicated that the major challenge to the supply system is attributed to lack of financial investments to plan and maintain the infrastructure system. In the early years, the economic situation within the country was stable hence, the Council had enough money to fund the infrastructure however, over time the infrastructure is degraded coupled with non-payment of services. This proved to have a negative impact on water supply. Furthermore, the government no-longer funds local councils thus the Council constantly falls into budget deficit. The major sources of finance for the Council though water service payments have been drastically affected by the current socio-economic crisis and as such user payments have been dropping depriving the Council of a solid

revenue base. The consequence for the lack of infrastructure investments results in obsolete water supply infrastructure system coupled with non-revenue water due to pipe bursts and estimated billing system as most of the meters are non-functional therefore, the Norton Town Council struggles to achieve its water supply targets effectively. The council incur costs of the water but the water will not be billed resulting in financial losses and financial unviability as a result of non-payments by the water service users.

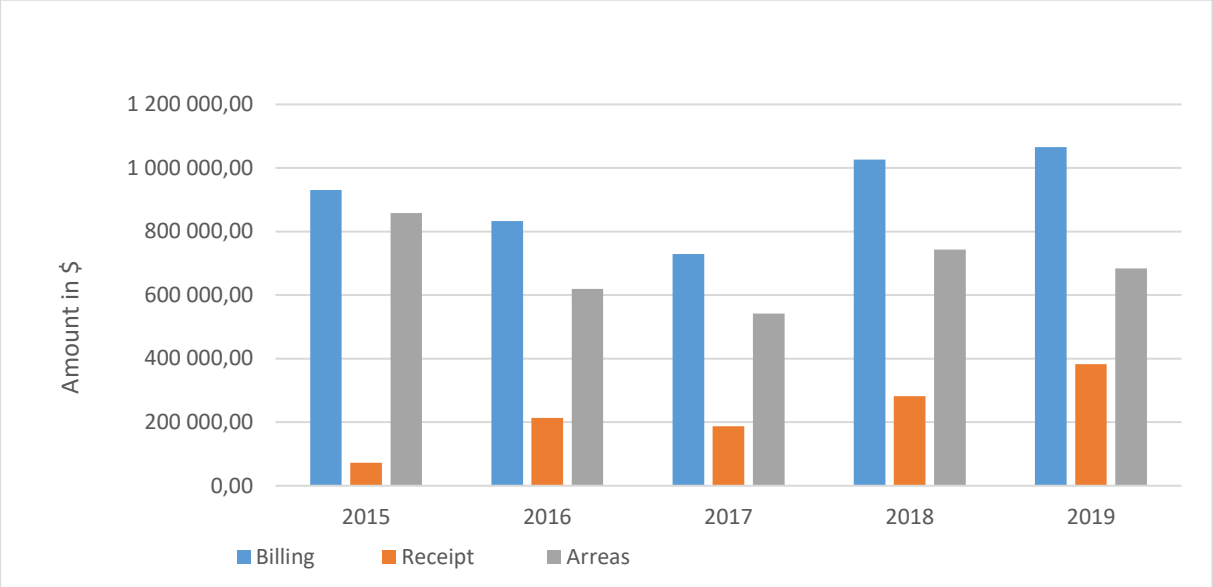


*Figure 4.13: NTC water investments from water billings 2016-2019*
*Source: Author, 2020*

The NTC revenue base from billing for water services is presented in figure 4.13. The findings show unmatched water service billing against the payments. The annual payments from 2015 to 2019 are less than 55% against the water billing structure. The interviewed participants indicated that financial constraints due to non-payments of services by the consumers is a challenge in NTC. Participant 2 said that the water charges are not economical as the tariffs are relatively low as compared to the expenses incurred to supplying potable water in Norton hence resulting in water supply service turmoil. The participant highlighted that;

> *"But regardless, we are now charging $1.50 but still it is sub economic and is not enough to even maintain and repair the infrastructure system in case there is a burst pipe." (Participant 2)*

The water charges are a challenge on their own, as if it is not enough to dilapidate water supply services, the consumers shun away from making regular payments to the council. The council showed that they depend on buying treated water from the city of Harare at around $1.40 per

cubic litre and they include a mark-up for each cubic litre supplied. The findings show that the first 10 cubic litres are charged at $1.50 and the costs gradually increase as the potable water demand also increases reaching a maximum of $1.58per cubic litre. Although the costs for the water is affordable even for the poor as stressed by WHO (2010) the citizens are not playing their part in paying for the water services which is a critical concern for the council. Participant 3 further reiterated that;

> *"It's a culture of not paying if you see of all the commodities that are given in the sub-city, water is very important and if people had a culture of paying they would simply pay the rates but it is a culture that emanated from politics and from people having a negative attitude towards their local authorities." (Participant 3)*

As literature substantiates, the service tariffs are the major sources of finance for the local communities, the N.T.C is being deprived of the appropriate revenue to sustain service provision hence the council struggles to balance the gap between revenue and expenses. Participant 3 said that;

> *"Norton Town Council struggles to pay for the right amount of water. We are supposed to do regular water quality monitoring, regular upgrading of the water reticulation system but we find ourselves being strained financially so we won't be able to provide the water." (Participant 3)*

These findings imply that there is a strong relationship between financial resources and water service delivery. The financial constraints experienced by the council results in the council neglecting vital water supply infrastructure upgrades essential for achieving potable water delivery sustainability. This study likewise confirms lack of payment as affecting service provision within urban municipalities thus concur with literature surveyed (Matabvu, 2016; Nhema and Zinyama, 2016) and yet the service payments constitutes the larger percentage for income generation for the local government hence this further cripples the ability of these institutions to supply.

### 4.5.3 Efficient governance system

The respondents were asked to give their level of agreement on the contribution of governance and institutional requirements towards facilitating sustainable supply of potable water due to anticipated increase in population in the NTC. The results are shown figure 4.14.

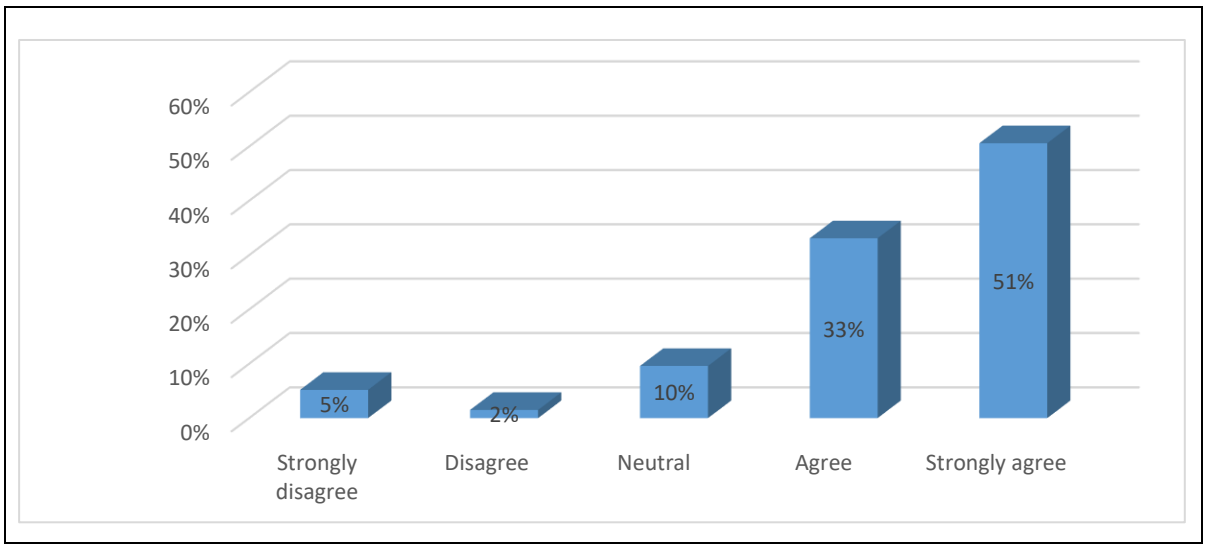


*Figure 4.14: Efficient governance system* Source: *Author, 2020*

The study also showed that 51% of the respondents strongly agree whereas 32% agree that institutional and governance intervention issues has a potential of improving sustainability in water provision by the NTC. The findings portray that inefficient management on the part of the Council has contributed to the poor water supply within the town hence the need to address institutional requirements for efficiency to be established. Eneh and Nnaji (2016) and Mapfumo and Madhesha (2014) supports this view arguing that ineffective governance translates to institutional unaccountability, inefficiency and ineffectiveness resulting in poor service delivery. This assertion implies that adopting and implementing the principles of good governance in NTC results in effective and efficient water supply management which is essential for sustaining water provision. This also implies that the management plays a very critical role in ensuring the revitalisation of the potable water supply system since they are entrusted by both the public and the government to providing services in a sustainable way for improving the living standards of the people and promoting development.

However, the findings of the study show that generally, the citizens have lost trust in the NTC due to issues of corruption and mismanagement of the limited resources available. This implies that there is lack of integrity and transparency due to corruption in the NTC as indicated by participant 2 saying that, "*you cannot run away from corruption.*" Therefore, it can be concluded that the NTC has an active role to play towards implementing internal strategies aimed at sustaining piped potable water supply in Norton. Sustainability of water supply is a complex issue which require intervention from various stakeholders as in-line with the systems

approach and the demand management approach though close interaction with the community and enact water conservation techniques to the households.

### 4.5.4 Responsive regulatory environment

The respondents were asked to give their level of agreement on the contribution of regulations and policies in facilitating sustainable supply of potable water due to anticipated increase in population in the NTC. The results are shown in figure 4.15.

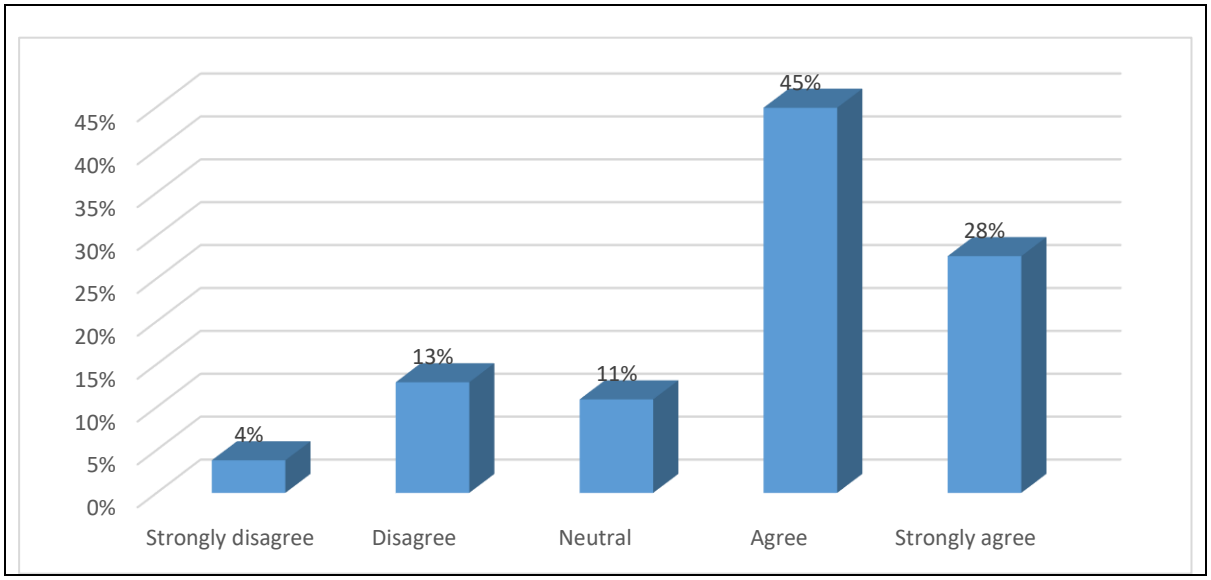


*Figure 4.15 Responsive regulatory environment in NTC* Source: *Author, 2020*

The findings as shown in figure 4.14 show that a larger percentage of the respondents agree and strongly agree that regulatory measures needs to be enforced in the NTC to ensure sustainability of water supply services 45% and 28% respectively. The results are in line with the tenets of the systems approach, that indicates that sustainable water provision in urban areas call for the revitalisation of the entire water supply system inclusive of the regulatory needs. Since water access in regarded as a basic human right, the government is responsible for providing equitable and sustainable supply in local government as in line with literature surveyed (Eneh and Nnaji, 2016; Bahri *et al.*, 2016; Chakunda and Chakaipa 2015; Matsa and Tapfuma 2015; Muzondi, 2014; GWP, 2013; Musingafi, 2013; Machingauta, 2010). The findings point out regulatory issues as a challenge in providing sustainable water within Norton by extension, the government as the responsible stakeholder in service delivery is responsible for worsening infrastructure dilapidation. The government practically interfere in the billing system of the local authorities hindering their revenue base for example through debt cancellations and also the responsible ministry is reluctant towards providing funding to the local authorities. Participant 2 said that;

> *"... another thing is the issue of political interference in the billing system of the Council. ... water charge in Norton was just a dollar and when we proposed for a 50 % increase the councilors refused the 50% is just $0.50 more. Which is still sub-economic and is not enough to even maintain and repair the infrastructure system in case there is a burst pipe."* Participant 2.

This implies that the government is responsible for regulating and implementing frameworks which will ensure that all citizens enjoy the right to potable water as enshrined in the constitution. This can be implemented through providing Norton Town Council with independence to the charge economic tariffs which will help in ensuring water reliability. Thus, the government is also responsible for implementing frameworks that will also coerce urban dwellers to pay for services consequently enough investments will be available towards infrastructure development and also providing a sustainable government formula for funding local authorities meant to rehabilitate the potable water infrastructure supply system.

### 4.5.5 Improved personnel capacity

The respondents were asked to give their level of agreement on the contribution of capacity development needs in facilitating sustainable supply of potable water due to anticipated increase in population in the NTC. The results are shown in figure 4.16.

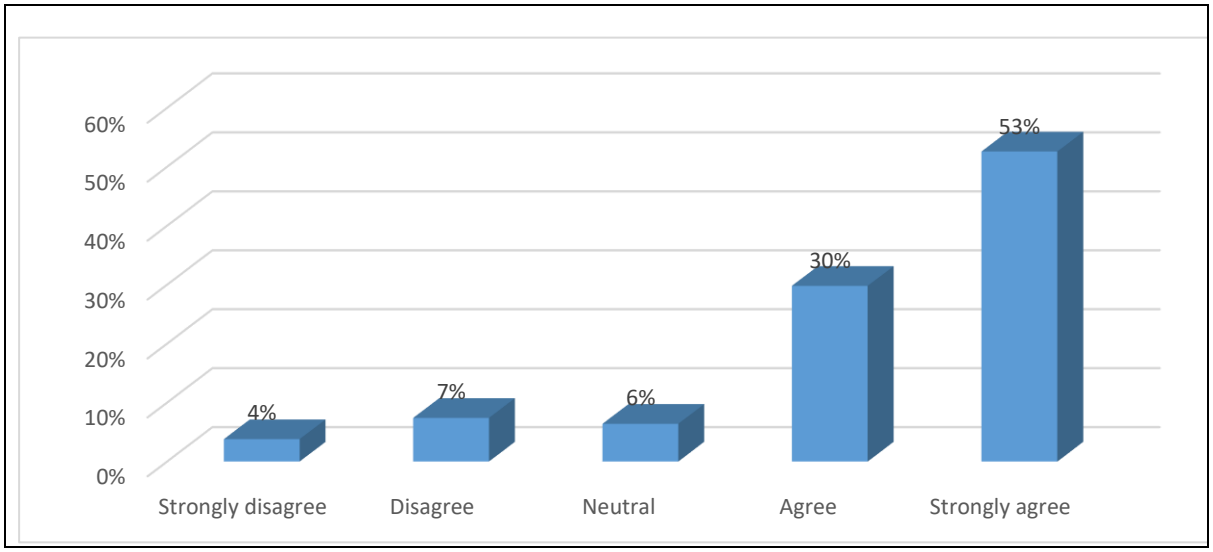


*Figure 4.16 Improved personnel capacity in NTC* Source: *Author, 2020*

The results show that 53% of the respondents strongly agreeing and 30% agree that capacity development is equally important to achieve and nurture strong personnel to effectively and efficiently conduct their duties. Losses in the water supply systems are most prominent due to

personnel ineffectiveness resulting in potable water losses as the employees fail to perform regular maintenance hence faults take longer to be addressed. Literature surveyed also portray gaps in human resources as a hindrance in sustainably managing water supply in urban areas' water sector (Chigonda and Chazireni, 2017; Panganai and Mangizvo, 2017; Eneh and Nnaji, 2016; Muller, 2016). There is however, the need for adequate funding aimed at capacity building that will lead to innovative learning enhancing employee competence and generally improving the capacity of the water sectors as employees will be able to cope with changing demand and new technologies. Due to lack of competent capacity within NTC, most conventional meters are malfunctioning impeding the revenue base of the council. This shows the linkage of these needs as a system with an overall goal of sustaining the water supply sector in the NTC. This can only be possible if there is a strong revenue base for the council to invest in the employees during development capacity programs and workshops for all to encourage employee efficacy in all departments affiliated to the supply of potable piped water in Norton.

### 4.6 Sustainability of water supply system within Norton

The respondents were asked to indicate ways in which the Norton City Council can adopt in implementing effective water supply and sustainability of potable water provision. The variables used to measure sustainability of piped water supply were analysed and the results are presented below.

| | Mean | Std. Deviation |
|---|---|---|
| Address the current water supply system infrastructure | 3.75 | .993 |
| Effective urban planning | 3.72 | .998 |
| Independent water supply system for the town | 3.70 | 1.011 |
| Stakeholder involvement in the planning and management of water supply system | 3.78 | .954 |
| Develop prepaid water supply system | 3.71 | 1.027 |
| Adoption of new technology in the water planning and management | 3.78 | .956 |
| Public participation to address water supply issues | 3.73 | 1.022 |
| Educational campaigns on water conservation techniques | 3.81 | .968 |
| Capacity development of council personnel | 3.73 | 1.025 |
| Effective water billing system and payments by water users | 3.72 | 1.042 |
| Political will | 3.70 | 1.067 |
| Legal and legislative frameworks guiding water supply system | 3.87 | .969 |
| Encouraging the use of other sources of water | 3.85 | .958 |
| Think long term plans for water supply | 3.81 | 1.015 |

*Table 4.14 Ways that encourage sustainability and governance of water supply provision*
*Source: Author, 2020*

Table 4.14 shows that respondents 'agree' that addressing the current water supply system infrastructure, effective urban planning and management of the system, political will and effective billing system on the part of the council and payments by the customers contributes towards water supply sustainability within the town with an average mean of 4 (average standard deviation: 1.001). The statistics shows that the data was suitable for factor analysis and the results are presented in the table below for the reduction of variables and the results are presented in table 4.15

| | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | | .632 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 9206.858 |
| | Df | 91 |
| | Sig. | .000 |

*Table 4.15 KMO and Bartlett's Test*
Source: Author, 2020

The KMO and Bartlett's test results after performing explorative factor analysis and the sampling adequacy was 0.632, which is above the cut-off value of 0.5. Bartlett's test of sphericity was recorded 9206.858 with a highly significant value of.001 indicating that the correlations among the items were sufficient enough to conduct factor analysis. The findings are presented in the table 4.16.

| | Factor | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| Stakeholder involvement in the planning and management of water supply system | .972 | | | |
| Capacity development of council personnel | .966 | | | |
| Encouraging the use of other sources of water | .961 | | | |
| Political will | .839 | | | |
| Address the current water supply system infrastructure | .745 | | | |
| Develop prepaid water supply system | | .979 | | |
| Think long term plans for water supply | | .972 | | |
| Effective water billing system and payments by water users | | .971 | | |
| Effective urban planning | | .749 | | |
| Independent water supply system for the town | | | .956 | |
| Legal and legislative frameworks guiding water supply system | | | .931 | |
| Educational campaigns on water conservation techniques | | | .888 | |
| Adoption of new technology in the water planning and management | | | | .542 |
| Public participation to address water supply issues | | | | .411 |
| Eigenvalues | 5.626 | 2.843 | 2.025 | 1.170 |
| % Variance | 40.188 | 20.308 | 14.467 | 3.354 |
| Cumulative % | 40.188 | 60.496 | 74.963 | 78.317 |

Extraction Method: Principal Axis Factoring. Rotation Method: Varimax with Kaiser Normalization.

*Table 4.16: Rotated Factor Matrix for sustainable water provision factors*
*Source: Author, 2020.*

Table 4.16 presents 4 factors that were retained and had an eigenvalue greater than 1. The first factor has an eigenvalue of 5.626, factor 2 has 2.843, the third factor loading has an eigenvalue of 2.025 and lastly the fourth factor has 2.270. These factors had a cumulative variance of 78%

in explaining sustainability in water provision. Table 4.17 shows extracted factors named and described as the major features that will positively contribute towards sustaining supply in Norton.

| Factor No. | Name of factor | % of variance | Factor description |
|---|---|---|---|
| 1 | Effective water governance | 40.20% | Factor 1 consisted of items such stakeholder involvement in the planning and management of water supply system, capacity development of council personnel, encouraging the use of other sources of water, political will and addressing the current water supply system infrastructure with factor loadings ranging from 0.745 to 0.972. |
| 2 | Effective financial management | 20.30% | Factor 2 comprised of the develop prepaid water supply system, long term plans for water supply, effective water billing system and payments by water users and effective urban planning with factor loadings of 0.749 and 0.979 |
| 3 | Supply management | 14.50% | Factor 3 included items such as the adoption of an independent water supply system for the town, legal and legislative frameworks guiding water supply system and educational campaigns on water conservation techniques with factor loadings ranging from 0.888 and 0.956 |
| 4 | Water planning | 3.40% | Factor 4 consisted of variables such as the adoption of new technology in the water planning and management and public participation to address water supply issues. The factor loadings of the items recorded 0.542 and 0.411respectively. |

*Table 4.17 Factor description for sustainable water provision in NTC*
*Source: Author, 2020*

According to the research findings, effective water governance, effective financial management, supply management and effective water planning contributes towards water supply sustainability within the town. These strategies as indicted provides a balance between all the relevant stakeholders to ensure financial sustainability, political viability, stakeholder engagements and a sustainable institution thus crediting the human right approach towards water access for all. Systems theory in realising the right to water for all. Nevertheless, this is only attainable if the council strategize and implement projects that are demand and supply oriented hence the applicability of water the demand management approach. According to the approach, there should be strategies and

programs in place to use available water effectively prior to increased supply that can best be achieved through the intervention of all aspects related to water supply planning and management and also when there is enough income from revenue collections. Adding on, the Norton Council official stated that the customers are their main source of revenue and as such, efficiency in service payments will ensure effective water supply governance.

### 4.7 Chapter summary

The data analysis, presentation and interpretation related to potable water supply by the Norton Town Council was discussed in this chapter. Both qualitative and quantitative data was presented. The chapter presented demographic characteristics of respondents, demand and supply characteristics, the potable water supply infrastructure needs and the factors to achieve sustainable potable water supply in Norton. These findings were presented in form of tables and graphs derived from descriptive statistics, trend analysis and factor analysis additionally qualitative data collected was presented using thematic analysis.

# CHAPTER 5

# SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

## 5.1 Introduction

The key findings, recommendations and conclusions of the study are presented in this chapter. The study sought to formulate a model for sustainable potable water provision in the Norton Town Council. The study was guided by the following objectives; to characterise the Norton urban population water demand and supply situation. (water demand and supply scenario), secondly to analyse the water supply system against infrastructure needs scenario in terms of anticipated urban growth and lastly to suggest a model for sustainable potable water provision by Norton town council. The study was conducted from 2018 to 2020 with a target population of NTC officials and households in Norton.

Norton Town Council is situated in a small urban area in Norton located in Mashonaland West Province in Zimbabwe. The researcher employed a mixed method approach aided with a survey research design to achieve the research objectives. The researcher distributed 379 questionnaires to households within Norton and conducted structured interviews with four NTC officials. The officials were selected using purposive sampling technique and the questionnaire respondents were selected using stratified random sampling. Qualitative data gathered was analysed using thematic analysis and quantitative data was analysed using descriptive, trend analysis and inferential statistics such as factor analysis through the use of IBM Statistical Package for Social Sciences version 25". Data was presented in form of graphs, tables and pie charts using both IBM SPSS and Microsoft excel.

## 5.2 Summary on the characteristics of Norton urban population water demand and supply situation

The study was set out to establish the characteristics of water demand and supply in Norton. The study established that there is a gap between potable water demand and supply and the supply gap is further widening within the town from 2012 to 2019. Water use dynamics and population demand were the two factors identified to influencing demographic water demand. Under social characteristics influencing potable water demand, types of residential location and availability of social institutions were identified as the major contributing factors to increased demand. Lastly, economic factors influencing potable water demand were also analysed and recorded 2 factor loadings which showed that availability of informal employment

opportunities and economic institutions determine potable water demand. Under the supply characteristics, the study identified that water supply is deteriorating as a result of obsolete water supply infrastructure system, lack of financial resources, poor management, poor planning and maintenance, lack of public engagement and political related constrains. These results were drawn basing on the factor analysis performed by the researcher.

The interviews conducted with the Norton Town Council officials indicated that the Council is failing to meet with the obligation to effectively and sustainably deliver water services within the town. The participants also indicated that demand for potable water is high due to population growth coupled with urban expansion that resulted in the development and establishment of new residential areas that are not covered with the current water supply system. The results also indicate that population increase influences demand in a number of ways. The unsustainable operation for the council according to the interviewees is due to revenue constrains, political interference and weak policies that fail to promote effective water provision within the town. Thus, the findings were essential in coming up with a sustainable model for water provision for the town.

### 5.3 An analysis of the water supply system against infrastructure needs scenario in terms of anticipated population growth for Norton

The study was set out to determine the water supply system in Norton and also the infrastructure needs in relation to population increase. The results of the study indicated that the council is operating with insufficient water supply infrastructure system and also the existing infrastructure is old and dilapidated hence is being overwhelmed by increase in demand. The study results indicate that the current water supply system require infrastructure intervention. The study further revealed that the water supply infrastructure needs in Norton can be broadly categorised into the physical WSS (from the source to the distribution system) with much emphasis placed on the storage and distribution phase, financial capacity, efficient governance system, personnel capacity and responsive regulatory environment. The respondents indicated that the water from the municipality does not meet with potability standards thus an indication that the system require water treatment facilities *(mean=4.0),* the water storage facilities are insufficient to meet with demand hence the respondents also '*agree'* there is need for more storage facilities. In addition, the water distribution system is old hence needs to be maintained and expanded in line with the expansion of the city *(mean= 4.0; SD= 1.026)* and *(mean= 3.79; SD=.973).* In addition, the respondents also *'agree'* that the water supply system require

responsive regulations and personnel capacity to archive effective supply. The study also showed that a large proportion of respondents '*strongly agreeing*' that financial and governance issues also needs to be addressed as they are the major causes of potable water supply challenges. Thus, the findings indicate that the water supply system require an overhaul maintenance and upgrading of the infrastructure coupled with non-physical aspects as they act as hindrance to effective and sustainable water supply within the town.

From the interviews conducted, the findings reveal that the Norton Town Council does not have a water treatment plant and hence they depend on purchasing water from the City of Harare whilst the HCC is failing to supply within Harare itself thus making it practically impossible to outsource. The NTC itself is also to blame for poor water supply due to poor internal policy system and uncoordinated stakeholder engagement. Furthermore, the distribution system is dilapidated and needs to be re-capacitated to meet with the increasing potable water demand. The dilapidated distribution system is evidenced by increase in non-revenue water; new residential areas are not connected to the supply system coupled with malfunctioning water billing meters and water bursts that proves to be a huge loss to the council. The current water supply regulatory frameworks according to the research findings are hindering sustainable potable water provision in Norton as they are fragmented and outdated in meeting with the current water supply needs. The findings also suggest that there is high level of political interference in the administrative duties of the council and lack of political will thus, the government is failing to effectively play its role towards sustainable supply through creating an enabling environment conducive for the drafting and implementation of water related policies. The interviewees emphasised that financial constrains are a major obstacle towards attaining the objectives of the council including water provision since residents do not play their role in paying for services rendered. Resultantly, water services continue to dilapidate under the management of the NTC.

### 5.4 Ways to achieve sustainable potable water provision by Norton town council

The research study sought to determine sustainable ways of providing potable water in Norton Town Council. The results indicated that there are a number of ways within which the Council can adopt and implement sustainable potable water supply. The results show that effective financial management, water planning, supply management and effective water governance can positively impact potable water delivery in Norton.

As indicated earlier in this chapter, potable water demand is growing faster than the capacity of Norton council to supply hence an indication for the need to strategies and prioritise the water supply system. The findings of the research showed that respondents *agree* (*mean 4*) that there is need for an effective urban planning and management of the water supply system, effective billing system, political will and stakeholder engagement towards attaining sustainable supply. These factors had a cumulative variance of 78% in explaining sustainability in water provision. Thus, the findings show the possibility of achieving equitable water supply within Norton if these strategies are implemented.

## 5.3 Conclusions

The conclusions drawn from the study are presented in this section in respect with the research objectives.

### 5.3.1 The demand for potable water and supply situation in Norton Town Council

In conclusion, basing on the findings of the study it is determined that the demand for potable water is increasingly being influenced by population growth. The population increase impacts on the demographic perceptions and the consumption patterns as well as economic and social aspects. Nevertheless, demographic issues are a major concern for increasing potable water demand. On the supply situation, the council fails to provide water efficiently hence the gap between demand and supply is increasing meaning that demand is increasing yet supply is decreasing. The factors indicated to hindering effective supply play a significant role in the deterioration of the water supply system in Norton Town Council. The most significant factor leading to unsustainable supply is the weak water supply infrastructure system, insufficient financial resources, poor planning and management, political constrains and lack of stakeholder engagement.

### 5.3.2 The water supply system against infrastructure needs scenario in terms of anticipated population growth for Norton

The conclusion that can be drawn from the research findings show that the water supply system is dilapidated and hence require a systems dynamic to planning and management for achieving sustainable supply. Factually, it can be concluded that respondents *'agree'* that there is need to re-capacitate the entire water supply system. For this to be achieved, there is need for financial capacity for the council though service payments, grants and donations from various stakeholders. Adding on, there is the need for a positive regulatory environment and a coherent

legislative framework that support the realisation of the human right to water access. The implementation of all these identified concerns require capacity development to translate drafted plans into action combined with effective governance and translating relevant water policies into water supply sustainability.

### 5.3.3 The ways to achieve sustainable potable water provision by Norton Town Council

Conclusively, the findings of the study show that the current potable water supply in Norton is not sustainable hence a number of ways were suggested to meet sustainability of the water supply system. The council can adopt a number of strategies that according to the study includes the adoption of water planning, supply management strategies, effective water governance (policy and capacity development) and effective financial management. Thus, the research is basically a lesson to other small urban areas facing the same challenge of water provision unsustainability thus ensuring that water supply institutions uphold and fulfil their mandate of water provision.

## 5.4 Recommendations

The recommendations drawn from this study are outlined in this section.

### 5.4.1 Characterising Norton urban population water demand and supply situation

The study revealed a gap between demand and supply with regard to potable water provision in Norton Town Council. The pragmatic study revealed that potable water demand is high in high density areas in relation to high population density in the suburbs and also due to varying consumption patterns. The study also revealed that several high density suburbs in Norton do not have access to potable water from the council as compared to the low density areas and hence rely on alternative water sources that are at times contaminated and not suitable for human consumption. A number of factors were identified to be influencing the high demand for potable water and also supply issues that hinder effective water supply for the town as highlighted earlier.

#### 5.4.1.1 Recommendations

The study recommends that the Norton Town Council must strategically plan for urban expansion in close contemplation with the ability of the council to provide bulk services to the newly allocated areas. The NTC should also take appropriate measures to ensure water

availability to all through initiatives such as sinking more boreholes that are periodically serviced and maintained to keep up with the demand for water. The study also recommends that the NTC holistically adopt demand management strategies to ensure effective water uses before increasing supply which can be applied using the demand management approach.

### 5.4.2 The water supply system against infrastructure needs scenario in terms of anticipated population growth for Norton

The study showed that the water supply system in Norton is old and dilapidated as it has over lived its time span and also the population the system was meant to serve during its inception has seriously multiplied thus burdening the supply system ultimately leading to regular service system failure. Due to these issues, the water supply requires an overhaul intervention from the physical supply system itself to the institutional, socio-economic and political needs.

#### 5.4.2.1 Recommendations

The study recommends that the council embarks on implementing the long awaited water treatment plant within Norton that would see the council treating its own water and distributing the water to the Norton residents. In determining equitable supply, the study recommends that the NTC engages all relevant stakeholders utilising the systems dynamic to water supply and effective financial management through formulating strategies that ensures user payments that are economic.

### 5.4.3 Ways to achieve sustainable potable water provision by Norton Town Council

The SDGs to be achieved by 2030 substantiates that access to potable water is essential for development, which led to an inception of an independent goal that deals with access to water. The study thus acknowledges the visions for the 2030 agenda and the findings of the study recognises sustainability in water provision as an essential step towards guaranteeing potable water access to all. Comprehensively dealing with issues of sustainability, the study demonstrates the need for an effective water governance system within the NTC and its relevant stakeholders, effective financial mobilisation and management strategies, supply management and effective water planning techniques.

#### 5.4.3.1 Recommendations

Since Norton is located in a water rich environment, the study recommends the need for innovative ideas that will revamp the potable water supply system in that town. These can only be made possible through user payments. The council must implement strategies that ensure effective user payments for cost recovery and also demand management prior to increasing potable water supply involving scheduling water rationing and water pricing. Furthermore, the study recommends that the government must promulgate relevant policy frameworks that will result in effective supply of water from the local authorities towards the realisation of the right to water for all individuals. Additionally, the study also recommends that the need for incorporating the Norton urban planning (urban expansion) and water supply service so that every individual will have access to water as a human right.

### 5.5 Proposed model for potable water provision in NTC

The initial aim of the study was to recommend a conceptual model for sustainable potable water provision. The recommended model is provided in figure 5.1.

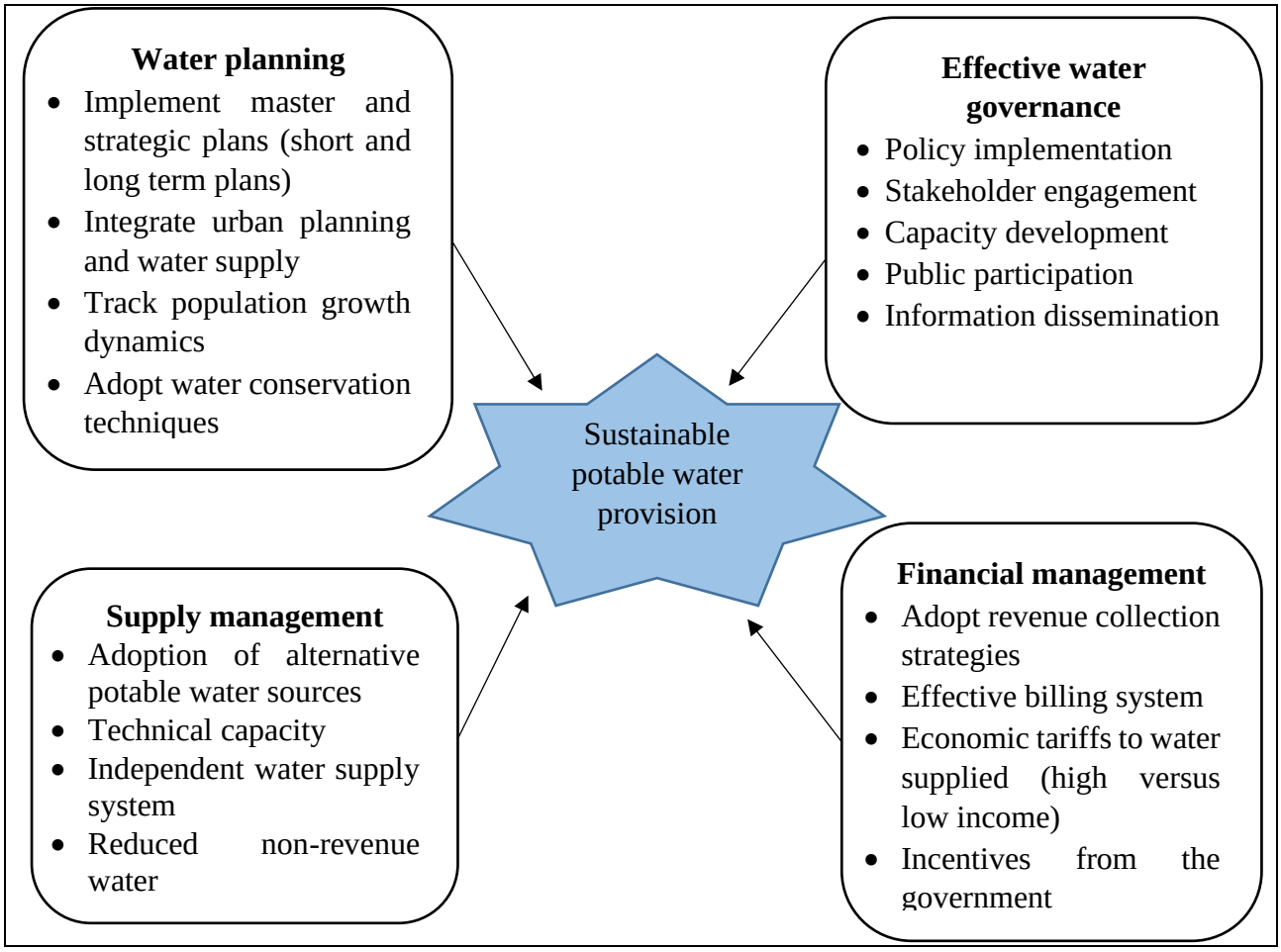


*Figure 5.1 A conceptual model for sustainable potable water provision in Norton.*
*Source: Author, 2020*

The model presented in figure 5.1 summarises the synthesis of findings and recommendations of the study. As shown by the model, sustainability in water supply is presented as interrelated concepts forming an effective and robust system that guarantees potable water access to all within Norton Town Council.

### 5.6 Areas for future research

In relation to the findings, the study further recommends areas of future research as far as the sustainability of potable water provision in small urban areas is concerned considering that there is still insufficient literature in that area of study. A similar research study can be conducted to compare sustainability of water provision on a broader scale that is small and large urban areas. Adding on, there are numerous complexities that obstruct the sustainability of potable water provision thus it is essential to also conduct a similar study from a developed nation perspective. Therefore, undertaking these studies will provide a detailed account on the ways to achieve effective potable water provision for all thus achieving the basic human right realisation a milestone towards achieving the SDGs by 2030.

### 5.7 Chapter summary

The chapter presented a summary of the research findings in line with the study objectives. Conclusions drawn from the study were also presented and the chapter provided recommendations that will ensure sustainability in potable water provision by the NTC. A conceptual model for potable water supply sustainability was also presented. The study also proposed areas for future research.

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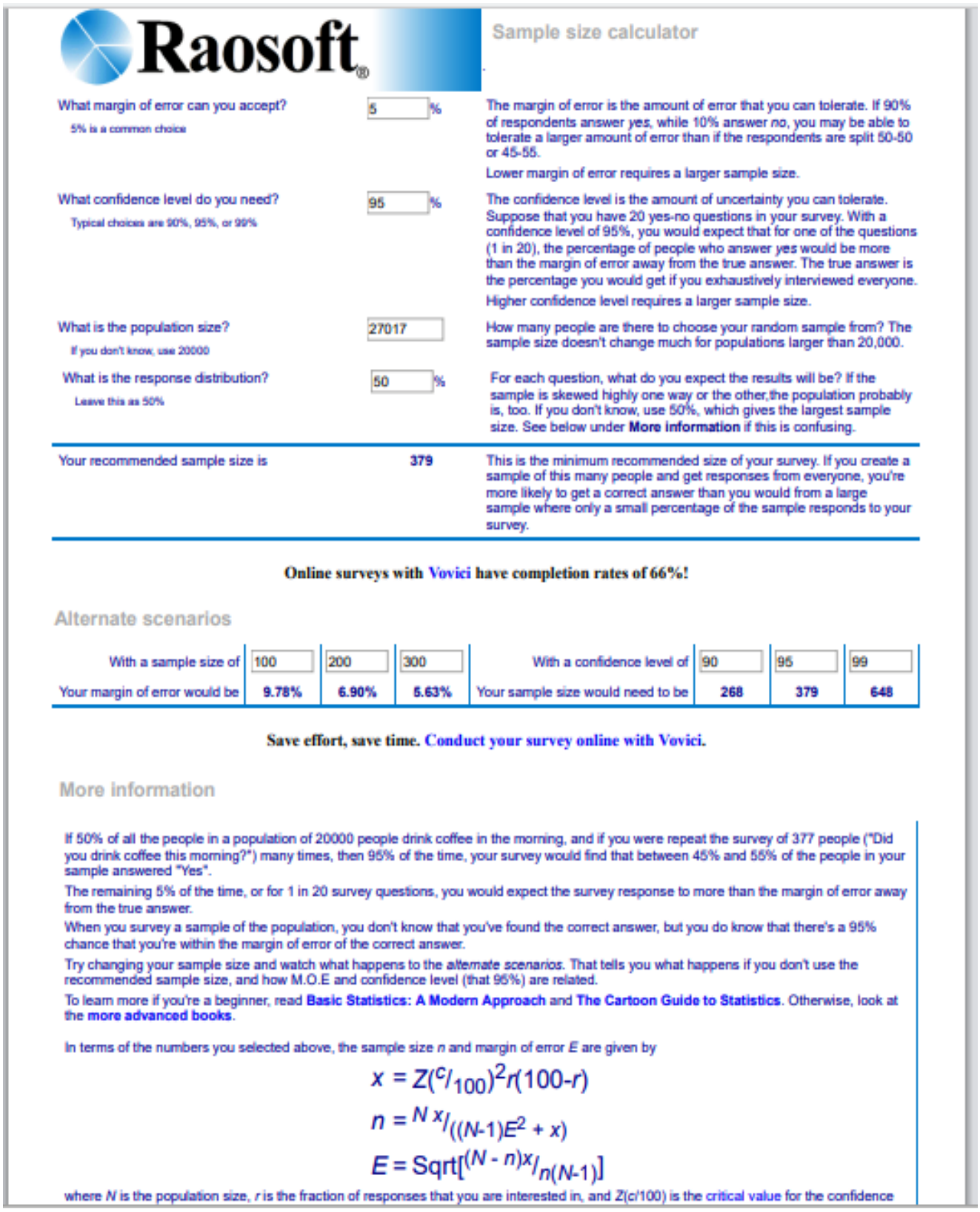
content/uploads/2015/04/Harare_Slum_Upgrading_Profiles.pdf. (Accessed 15 September 2019).

## LIST OF APPENDIX

## APPENDIX 1: RAOSOFT SAMPLE SIZE CALCULATOR



Raosoft®

Sample size calculator

| | | |
|---|---|---|
| What margin of error can you accept? 5% is a common choice | 5 % | The margin of error is the amount of error that you can tolerate. If 90% of respondents answer *yes*, while 10% answer *no*, you may be able to tolerate a larger amount of error than if the respondents are split 50-50 or 45-55. Lower margin of error requires a larger sample size. |
| What confidence level do you need? Typical choices are 90%, 95%, or 99% | 95 % | The confidence level is the amount of uncertainty you can tolerate. Suppose that you have 20 yes-no questions in your survey. With a confidence level of 95%, you would expect that for one of the questions (1 in 20), the percentage of people who answer *yes* would be more than the margin of error away from the true answer. The true answer is the percentage you would get if you exhaustively interviewed everyone. Higher confidence level requires a larger sample size. |
| What is the population size? If you don't know, use 20000 | 27017 | How many people are there to choose your random sample from? The sample size doesn't change much for populations larger than 20,000. |
| What is the response distribution? Leave this as 50% | 50 % | For each question, what do you expect the results will be? If the sample is skewed highly one way or the other,the population probably is, too. If you don't know, use 50%, which gives the largest sample size. See below under **More information** if this is confusing. |
| Your recommended sample size is | **379** | This is the minimum recommended size of your survey. If you create a sample of this many people and get responses from everyone, you're more likely to get a correct answer than you would from a large sample where only a small percentage of the sample responds to your survey. |

**Online surveys with Vovici have completion rates of 66%!**

Alternate scenarios

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| With a sample size of | 100 | 200 | 300 | With a confidence level of | 90 | 95 | 99 |
| Your margin of error would be | **9.78%** | **6.90%** | **5.63%** | Your sample size would need to be | **268** | **379** | **648** |

**Save effort, save time. Conduct your survey online with Vovici.**

More information

If 50% of all the people in a population of 20000 people drink coffee in the morning, and if you were repeat the survey of 377 people ("Did you drink coffee this morning?") many times, then 95% of the time, your survey would find that between 45% and 55% of the people in your sample answered "Yes".

The remaining 5% of the time, or for 1 in 20 survey questions, you would expect the survey response to more than the margin of error away from the true answer.

When you survey a sample of the population, you don't know that you've found the correct answer, but you do know that there's a 95% chance that you're within the margin of error of the correct answer.

Try changing your sample size and watch what happens to the *alternate scenarios*. That tells you what happens if you don't use the recommended sample size, and how M.O.E and confidence level (that 95%) are related.

To learn more if you're a beginner, read **Basic Statistics: A Modern Approach** and **The Cartoon Guide to Statistics**. Otherwise, look at the **more advanced books**.

In terms of the numbers you selected above, the sample size $n$ and margin of error $E$ are given by

$$x = Z(^{c}/_{100})^{2} r(100-r)$$

$$n = {}^{N\,x}/_{((N-1)E^{2} + x)}$$

$$E = \mathrm{Sqrt}[{}^{(N - n)x}/_{n(N-1)}]$$

where $N$ is the population size, $r$ is the fraction of responses that you are interested in, and $Z(c/100)$ is the critical value for the confidence

# APPENDIX 2: QUESTIONNAIRE FOR HOUSEHOLDS

**Household questionnaire**

**Introduction**

My name is Melody Shayamano (student no.18022936) and I am a Public Administration Master's degree student in the school of management sciences at the University of Venda, South Africa. I am undertaking a research study entitled, **"A Model for Sustainable Potable Water Provision in Local Government: A Case Study of Norton Town Council in Zimbabwe** The study is purely for academic purposes and the information obtained will be treated with outmost confidentiality. Your participation is greatly appreciated."

Researcher contact information: Email: melodyshayamano@gmail.com
Phone number: 0777 261 684 or +27 82 936 1078

Name of Participant _____ Date _____ Signature _____

**Instruction**: Please complete the following questions by ticking ✓ or ✗ cross on your response.

**Section A: Respondent information**

1. Gender | 1 | Male | | | 2 | Female | |

2. Age | 1 | 18-25 | | | 2 | 26-35 | | | 3 | 36-45 | | | 4 | 46-55 | | | 5 | 56 + |

3.Highest educational qualification

| 1 | O level and below | | 2 | A Level | | 3 | Certificate or Diploma | | 4 | Degree | | 5 | Post graduate | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

4. Period you have lived in Norton

| 1 | Less than 5yr | | 2 | 5 to <10 yrs | | 3 | 10yrs < 15yrs | | 4 | 15yrs < 20yrs | | 5 | 20yrs + | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

5. Where do you live?

| 1 | High density suburbs | | 2 | Low density suburbs | |
|---|---|---|---|---|---|

**SECTION B: Characteristics of urban population water demand and supply**

6. To what extent do you agree or disagree that the following characterises Norton urban potable water demand.

| Please use the following scale to indicate you most appropriate response to answer the following: | | | | |
|---|---|---|---|---|
| **1= Strongly disagree** | **2= Disagree** | **3= Neutral** | **4= Agree** | **5= Strongly agree** |

| | | | | | | |
|---|---|---|---|---|---|---|
| Demographics | Population increase | 1 | 2 | 3 | 4 | 5 |
| | Changing water consumption | 1 | 2 | 3 | 4 | 5 |
| | Total number of households | 1 | 2 | 3 | 4 | 5 |
| | Family size within each household | 1 | 2 | 3 | 4 | 5 |
| | Total number of family renting per household | 1 | 2 | 3 | 4 | 5 |
| | Gender | 1 | 2 | 3 | 4 | 5 |
| | Household size | 1 | 2 | 3 | 4 | 5 |
| | Spatial distribution of people within the town | 1 | 2 | 3 | 4 | 5 |
| | Residential location of households | 1 | 2 | 3 | 4 | 5 |
| | availability of institutions such as schools and health facilities | 1 | 2 | 3 | 4 | 5 |
| | The town is located in a good environment (preferred by most people) | 1 | 2 | 3 | 4 | 5 |
| | availability of social amenities such as churches | 1 | 2 | 3 | 4 | 5 |
| | Safe place for dwelling as compared to other small town | 1 | 2 | 3 | 4 | 5 |
| Economic | Level of economic development | 1 | 2 | 3 | 4 | 5 |
| | Number of operating institutions | 1 | 2 | 3 | 4 | 5 |
| | Employment opportunities eg fishing | 1 | 2 | 3 | 4 | 5 |
| | Cheaper housing rentals | 1 | 2 | 3 | 4 | 5 |
| | Availability of vacant lands | 1 | 2 | 3 | 4 | 5 |

What other factors are influencing potable water demand in Norton?

.....

.....

7. To what extent do you agree or disagree that the following characterises Norton urban potable water supply.

| Please use the following scale to indicate you most appropriate response to answer the following: | | | | |
|---|---|---|---|---|
| **1= Strongly disagree** | **2= Disagree** | **3= Neutral** | **4= Agree** | **5= Strongly agree** |

| | | | | | | |
|---|---|---|---|---|---|---|
| Water supply system | Poor water quality | 1 | 2 | 3 | 4 | 5 |
| | Insufficient water quantity | 1 | 2 | 3 | 4 | 5 |
| | Inadequate water source | 1 | 2 | 3 | 4 | 5 |
| | Lack of water treatment facilities | 1 | 2 | 3 | 4 | 5 |
| | Insufficient water storage facilities | 1 | 2 | 3 | 4 | 5 |
| | Dilapidated distribution networks | 1 | 2 | 3 | 4 | 5 |
| | Insufficient potable water access | 1 | 2 | 3 | 4 | 5 |
| | Lack of reliability | 1 | 2 | 3 | 4 | 5 |
| | Unsustainability of the water source | 1 | 2 | 3 | 4 | 5 |
| | Non-durability of infrastructure | 1 | 2 | 3 | 4 | 5 |
| Economic | Customers unwillingness to pay for water charges | 1 | 2 | 3 | 4 | 5 |
| | Financial constrains | 1 | 2 | 3 | 4 | 5 |
| | Economic value of water | 1 | 2 | 3 | 4 | 5 |
| | Non-affordability of water | 1 | 2 | 3 | 4 | 5 |
| | Unreliable sources of finance | 1 | 2 | 3 | 4 | 5 |
| | Lack of funding | 1 | 2 | 3 | 4 | 5 |
| | Mismanagement of resources | 1 | 2 | 3 | 4 | 5 |
| | Level of industry performance | 1 | 2 | 3 | 4 | 5 |
| | Income of the consumers | 1 | 2 | 3 | 4 | 5 |
| | Embracing new technology | 1 | 2 | 3 | 4 | 5 |
| Governance/ administrative issues | Lack of expertise knowledge | 1 | 2 | 3 | 4 | 5 |
| | Bureaucracy | 1 | 2 | 3 | 4 | 5 |
| | Corruption | 1 | 2 | 3 | 4 | 5 |
| | Lack of public participation | 1 | 2 | 3 | 4 | 5 |
| | exclusion in planning | 1 | 2 | 3 | 4 | 5 |
| | Social inclusion | 1 | 2 | 3 | 4 | 5 |
| | Lack of transparency | 1 | 2 | 3 | 4 | 5 |
| | Lack of efficiency | 1 | 2 | 3 | 4 | 5 |
| | Ineffective management | 1 | 2 | 3 | 4 | 5 |
| | Inadequate infrastructure maintenance and replacements | 1 | 2 | 3 | 4 | 5 |
| | Lack of stakeholder involvement | 1 | 2 | 3 | 4 | 5 |
| Politics | Political interference | 1 | 2 | 3 | 4 | 5 |
| | Ineffective legislative frameworks | 1 | 2 | 3 | 4 | 5 |
| | Lack of decentralisation | 1 | 2 | 3 | 4 | 5 |
| | Poor policy frameworks | 1 | 2 | 3 | 4 | 5 |
| | Poor governance | 1 | 2 | 3 | 4 | 5 |
| Ecological | Climate change | 1 | 2 | 3 | 4 | 5 |
| | Pollution of the water sources | 1 | 2 | 3 | 4 | 5 |

**SECTION C: Water supply system against infrastructure needs scenario in terms of anticipated growth.**

8. Do you use municipal tap water? | 1 | Yes | | 2 | No | |

9. If no. what other sources do you use.

| | | |
|---|---|---|
| 1 | Borehole | |
| 2 | Well | |
| 3 | Purchase water | |
| 4 | Other | |

Specify .....

10. Who maintains the infrastructure

.....

.....

11. How frequent is the water supply in your area?

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | Do not receive water | | | 2 | Occasionally | |
| 3 | Once per week | | | 4 | Twice to thrice per week | |
| 5 | Four to six days per week | | | 6 | Daily | |

12. Is the water potable?

| | | | | | |
|---|---|---|---|---|---|
| 1 | Yes | | 2 | No | |

13. Does the water system require infrastructure needs intervention?

| | | | | | |
|---|---|---|---|---|---|
| 1 | Yes | | 2 | No | |

14. If yes, what infrastructure mediation needs to be addressed using the following degree scale.

| Please use the following scale to indicate you most appropriate response to answer the following: | | | | | | |
|---|---|---|---|---|---|---|
| **1= Strongly disagree** | **2= Disagree** | | **3= Neutral** | | **4= Agree** | **5= Strongly agree** |
| 1 | Water source | 1 | 2 | 3 | 4 | 5 |
| 2 | Water treatment | 1 | 2 | 3 | 4 | 5 |
| 3 | Storage capacity | 1 | 2 | 3 | 4 | 5 |
| 4 | Distribution system | 1 | 2 | 3 | 4 | 5 |
| 5 | Financial capacity | 1 | 2 | 3 | 4 | 5 |
| 6 | Regulations guiding water | 1 | 2 | 3 | 4 | 5 |
| 7 | Personnel capacity | 1 | 2 | 3 | 4 | 5 |
| 8 | Governance | 1 | 2 | 3 | 4 | 5 |

b. Specify .....

.....

**SECTION D: Model for improved potable water provision**

15. To what extent do you agree or disagree that the following influences sustainability of water supply system in terms of anticipated growth?

| Please use the following scale to indicate you most appropriate response to answer the following: | | | | |
|---|---|---|---|---|
| **1= Strongly disagree** | **2= Disagree** | **3= Neutral** | **4= Agree** | **5= Strongly agree** |

| | | | | | |
|---|---|---|---|---|---|
| Address the current water supply system infrastructure | 1 | 2 | 3 | 4 | 5 |
| Effective urban planning | 1 | 2 | 3 | 4 | 5 |
| Independent water supply system for the town | 1 | 2 | 3 | 4 | 5 |
| Stakeholder involvement in the planning and management of water supply system | 1 | 2 | 3 | 4 | 5 |
| Develop prepaid water supply system | 1 | 2 | 3 | 4 | 5 |
| Adoption of new technology in the water planning and management | 1 | 2 | 3 | 4 | 5 |
| Public participation to address water supply issues | 1 | 2 | 3 | 4 | 5 |
| Educational campaigns on water conservation techniques | 1 | 2 | 3 | 4 | 5 |
| Capacity development of council personnel | 1 | 2 | 3 | 4 | 5 |
| Effective water billing system and payments by water users | 1 | 2 | 3 | 4 | 5 |
| Political will | 1 | 2 | 3 | 4 | 5 |
| Legal and legislative frameworks guiding water supply system | 1 | 2 | 3 | 4 | 5 |

17. What other issues do you think the council should look into in order to sustain potable water provision?

.....
.....
.....

18. What other issues would you like to bring to the attention of the researcher?

.....
.....

**THANK YOU FOR PARTICIPATING.**

# APPENDIX 3: KEY INFORMANT INTERVIEW GUIDE

**KEY RESPONDENT'S INTERVIEW GUIDE**

**Key respondent's interview questions schedule**
Organisation ……

1. In your own opinion, what does potable water mean?
2. What do you understand by the notion, sustainability of potable water provision?
3. What strategies have been used by the council to meet with demand and supply?

**Section B: Potable water demand and supply scenario**

4. In your own opinion, what characteristics influencing water demand and supply?
5. In your view, what are the economic aspects that influence water supply?
6. What governance and regulatory aspects impact the demand and supply situation in urban councils?
7. Explain how these identified characteristics are impacting water provision in Norton town council?
8. In what ways does the government interfere in the duties and responsibilities of the town council?

**Section C: water supply infrastructure needs in relation to population increase**

9. In your own view what are the potable **water infrastructure** needs in Norton Town council?
10. In your own view what are the **human needs** in Norton Town Council?
11. In your own view what are the potable water **management needs** in Norton town?
12. In your own view, in what ways does the council meet with strategic planning in terms of water system infrastructure?

**SECTION D: A sustainable model for water provision.**

13. What features do you think are crucial to comprehensively sustain the water supply system in urban municipalities?
14. Any other comments……

……
……

**THANK YOU FOR PARTICIPATING**

## APPENDIX 4: UHDC PROPOSAL APPROVAL LETTER

# UNIVERSITY OF VENDA

## OFFICE OF THE DEPUTY VICE-CHANCELLOR: ACADEMIC

TO : MR/MS M. SHAYAMANO

SCHOOL OF MANAGEMENT SCIENCES

FROM: PROF. J.E CRAFFORD

DEPUTY VICE-CHANCELLOR: ACADEMIC

DATE : 21 JANUARY 2020

**DECISIONS TAKEN BY UHDC OF 21st JANUARY 2020**

Application for approval of Masters Proposal Report in Management Sciences:
**M. Shayamano (18022936)**

Topic: "A Model for sustainable portable water provision in local government: A Case study of Norton Town Council in Zimbabwe."

| | | |
|---|---|---|
| Supervisor | UNIVEN | Dr. J. Zuwarimwe |
| Co-supervisor | UNIVEN | Mr. T. Silima |

**UHDC approved Masters proposal**

**PROF. J.E CRAFFORD**
**DEPUTY VICE-CHANCELLOR: ACADEMIC**

# APPENDIX 5: RESEARCH ETHICS APPROVAL CERTIFICATE

ETHICS APPROVAL CERTIFICATE

RESEARCH AND INNOVATION
OFFICE OF THE DIRECTOR

NAME OF RESEARCHER/INVESTIGATOR:
**Ms M Shayamano**

STUDENT NO:
**18022936**

PROJECT TITLE: **A model for sustainable portable water provision in local government: A case study of Norton town council in Zimbabwe.**

PROJECT NO: SMS/20/PDN/15/1006

SUPERVISORS/ CO-RESEARCHERS/ CO-INVESTIGATORS

| NAME | INSTITUTION & DEPARTMENT | ROLE |
|---|---|---|
| Dr J Zumarimwe | University of Venda | Supervisor |
| Mr T Silima | University of Venda | Co - Supervisor |
| Ms M Shayamano | University of Venda | Investigator – Student |

Type: **Masters Research**
Risk: **Minimal risk to humans, animals or environment**
Approval Period: **June 2020 – June 2022**

The Research Ethics Social Sciences Committee (RESSC) hereby approves your project as indicated above.

General Conditions
While this ethics approval is subject to all declarations, undertakings and agreements incorporated and signed in the application form, please note the following.

- The project leader (principle investigator) must report in the prescribed format to the REC:
  - Annually (or as otherwise requested) on the progress of the project, and upon completion of the project
  - Within 48hrs in case of any adverse event (or any matter that interrupts sound ethical principles) during the course of the project.
  - Annually a number of projects may be randomly selected for an external audit.
- The approval applies strictly to the protocol as stipulated in the application form. Would any changes to the protocol be deemed necessary during the course of the project. The project leader must apply for approval of these changes at the REC. Would there be deviated from the project protocol without the necessary approval of such changes, the ethics approval is immediately and automatically forfeited.
- The date of approval indicates the first date that the project may be started. Would the project have to continue after the expiry date; a new application must be made to the REC and new approval received before or on the expiry date.
- In the interest of ethical responsibility, the RECs retains the right to:
  - Request access to any information or data at any time during the course or after completion of the project,
  - To ask further questions; Seek additional information; Require further modification or monitor the conduct of your research or the informed consent process.
  - withdraw or postpone approval if:
  - Any unethical principles or practices of the project are revealed or suspected.
  - It becomes apparent that any relevant information was withheld from the REC or that information has been false or misrepresented.
  - The required annual report and reporting of adverse events was not done timely and accurately,
  - New institutional rules, national legislation or international conventions deem it necessary

ISSUED BY:
UNIVERSITY OF VENDA, RESEARCH ETHICS COMMITTEE
Date Considered: June 2020

Name of the RESSC Chairperson of the Committee: Mashau Takalani Samuel

Signature

Director Research and Innovation

Signature: .....

UNIVERSITY OF VENDA
DIRECTOR
RESEARCH AND INNOVATION
2020 -06- 11
Private Bag X5050
Thohoyandou 0950

University of Venda
PRIVATE BAG X5050, THOHOYANDOU, 0950: LIMPOPO PROVINCE: SOUTH AFRICA
TELEPHONE (015) 962 8504/8313 FAX (015) 962 9060
*"A quality driven financially sustainable, rural-based Comprehensive University"*

# APPENDIX 6: REQUEST FOR PERMISSION TO CONDUCT RESEARCH NTC

1334 Lusaka
Highfield
Harare

07 March 2019

Norton Town Council

208 Galloway Road

Norton

Dear Sir/Madam

**RE: REQUEST FOR PERMISSION TO CONDUCT A STUDY IN NORTON.**

My name is Melody Shayamano (18022936). I am a Masters student in the department of public and Development Administration under the School of Management Sciences at the University of Venda, South Africa. As part of the Masters academic curriculum, I am required to undertake a dissertation in fulfilment of my qualification for the Master of Administration. I wish to undertake a study entitled: **A model for sustainable potable water provision in local government: A case study of Norton Town Council in Zimbabwe**

I therefore seek for permission from your office to conduct the research in Norton so as to obtain information in relation to the topic to be investigated. The data gathered will be purely utilized for research and academic purpose.

All necessary ethical considerations will be enhanced to protect the welfare and dignity of the participants.

Yours Sincerely,

Melody Shayamano

+263 777 261 684, +27 82 936 1078

melodyshayamano@gmail.com

## APPENDIX 7: PERMISSION TO CONDUCT RESEARCH IN NTC

**NORTON TOWN COUNCIL**

**ALL COMMUNICATIONS TO BE ADDRESSED TO THE CHIEF EXECUTIVE OFFICER**

**208 Galloway Road**
**P. Bag 904**
**Norton, Zimbabwe**

**Phone: +263 062 2226/7/8**
**Fax: +263 062 2219**
**Email:ceo@nortontc.org.zw**

12 February 2019

**TO WHOM IT MAY CONCERN**

**RE: DATA GATHERING BY M.SHAYAMANO**

This minute serves to confirm that Mr Melody Shayamano is a student at Venda University doing a Master in Public Administration degree program. He has requested for permission to carry out a research in Norton Town Council, which we have granted.

Please kindly offer him the assistance he requires.

Regards,

NORTON TOWN COUNCIL
HUMAN RESOURCES
12 FEB 2019
P. BAG 904, NORTON
TEL: 263622489
Email: jchishakwe@nortontc.org.zw

**J Chishakwe**
**For Town Secretary**

## APPENDIX 8: PROOF READING LETTER

+27 72 594 8848
mawokomayi@gmail.com

**Date: 22/06/2020**

**RE: TO WHOM IT MAY CONCERN**

This letter serves to confirm that I have edited a Master of Administration dissertation entitled:

*A MODEL FOR SUSTAINABLE POTABLE WATER PROVISION IN LOCAL GOVERNMENT: A CASE STUDY OF NORTON TOWN COUNCIL IN ZIMBABWE*

By

**SHAYAMANO MELODY**

Student Number: **18022936**

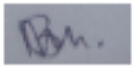
studying at the

**UNIVERSITY OF VENDA**

I carefully read through the dissertation, focusing on grammatical errors and spelling mistakes.

Please do not hesitate to contact me for any queries.

Yours Sincerely,



Ms Mawokomayi

*Betina Mawokomayi, Msc Communication, (University of Fort Hare) B.A. Hons, Lit. & Media Studies (University of Venda), B.A. Media Studies (University of Venda). Language & Writing Consultant (University of Fort Hare).*

**APPENDIX 9: TURNITIN ORIGINALITY REPORT**

A Model For Sustainable Potable Water Provision In Local Government: A Case Study Of Norton Town Council In Zimbabwe

ORIGINALITY REPORT

| 16% | 9% | 4% | 14% |
|---|---|---|---|
| SIMILARITY INDEX | INTERNET SOURCES | PUBLICATIONS | STUDENT PAPERS |

PRIMARY SOURCES

| | | |
|---|---|---|
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| 2 | Submitted to University of Venda<br>Student Paper | 1% |
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| 8 | Submitted to University of Fort Hare<br>Student Paper | <1% |